



## CHEMISTRY

### BOOKS - GRB CHEMISTRY (HINGLISH)

#### CHEMICAL KINETICS

#### STRAIGHT OBJECTIVE TYPE

1.  $x\text{A} + y\text{B} \rightarrow z\text{C}$ . If  $-\frac{d[\text{A}]}{dt} = -\frac{d[\text{B}]}{dt} = 1.5\frac{d[\text{C}]}{dt}$ , then x, y and z are :

A. 1, 1, 1

B. 3, 2, 3

C. 3, 3, 2

D. 2, 2, 3

Answer: C





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2. For the reaction :  $x\text{A} \rightarrow y\text{B}$ ,

$$\log_{10}\left(\frac{-d[\text{A}]}{dt}\right) = \log_{10}\left(\frac{+d[\text{B}]}{dt}\right) + 0.3$$

If the value of  $\log_{10}5 = 0.7$ , the value of  $x:y$  is :

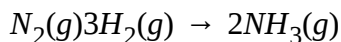
- A. 2 : 1
- B. 1 : 2
- C. 3 : 10
- D. 5 : 2

**Answer: A**



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3. Consider the chemical reaction,



The rate of reaction can be expressed in terms of time derivative of

concentration of  $N_2(g)$ ,  $H_2(g)$  or  $NH_3(g)$  Identify the correct relationship amongst the rate expression :

$$\text{A. Rate} = -\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$$

$$\text{B. Rate} = \frac{d[N_2]}{dt} = 3\frac{d[H_2]}{dt} = 2\frac{d[NH_3]}{dt}$$

$$\text{C. Rate} = \frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$$

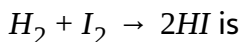
$$\text{D. Rate} = -\frac{d[N_2]}{dt} = \frac{d[H_2]}{dt} = \frac{d[NH_3]}{dt}$$

**Answer: A**



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**4. The difference rate law for the reaction**



$$\text{A. } -\frac{d[H_2]}{dt} = -\frac{d[I_2]}{dt} = -\frac{d[HI]}{dt}$$

$$\text{B. } \frac{d[H_2]}{dt} = \frac{d[I_2]}{dt} = \frac{1}{2} \frac{d[HI]}{dt}$$

$$\text{C. } \frac{1}{2} \frac{d[H_2]}{dt} = \frac{1}{2} \frac{d[I_2]}{dt} = - \frac{d[HI]}{dt}$$

$$\text{D. } -2 \frac{d[H_2]}{dt} = -2 \frac{d[I_2]}{dt} = \frac{d[HI]}{dt}$$

**Answer: D**

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5. For the gaseous phase reaction :  $A(g) \rightarrow \text{products}$ , occurring at constant volume the correct relation between  $\frac{dC_A}{dt}$ ,  $\frac{dn_A}{dt}$  and  $\frac{dP_A}{dt}$  is :

[  $C_A \rightarrow$  Concentration of reactant A,  $n_A \rightarrow$  Moles of reactant A,  $P_A \rightarrow$  Partial pressure of reactant A ]

$$\text{A. } \frac{dC_A}{dt} = \frac{dn_A}{dt} = \frac{dP_A}{dt}$$

$$\text{B. } \frac{dC_A}{dt} = \left( \frac{dP_A}{dt} \right) RT = \frac{1}{V} \frac{dn_A}{dt}$$

$$\text{C. } \frac{dC_A}{dt} = \frac{1}{RT} \frac{dP_A}{dt} = \frac{1}{V} \frac{dn_A}{dt}$$

$$D. \frac{dC_A}{dt} = \frac{1}{V} \frac{dn_A}{dt} = \frac{1}{V} \frac{dP_A}{dt}$$

Answer: C

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6. In the following reaction, how is the rate of appearance of the underlined Product related to the rate of disappearance of the underlined reactant ?



$$A. \frac{d[\text{Br}_2]}{dt} = \frac{5}{3} \frac{d[\text{Br}^\ominus]}{dt}$$

$$B. \frac{d[\text{Br}_2]}{dt} = \frac{d[\text{Br}^\ominus]}{dt}$$

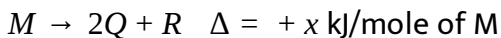
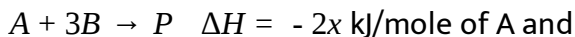
$$C. \frac{d[\text{Br}_2]}{dt} = - \frac{d[\text{Br}^\ominus]}{dt}$$

$$D. \frac{d[\text{Br}_2]}{dt} = - \frac{3}{5} \frac{d[\text{Br}^\ominus]}{dt}$$

**Answer: D**

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7. For a hypothetical reaction,



If these reaction are carried simultaneously in a reactor such that temperature is not changing. If rate of disappearance of B is  $y \text{ M sec}^{-1}$  then rate of formation (in  $\text{M sec}^{-1}$ ) of Q is :

A.  $\frac{2}{3}y$

B.  $\frac{3}{2}y$

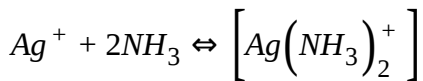
C.  $\frac{4}{3}y$

D.  $\frac{3}{4}y$

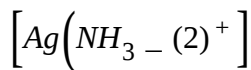
**Answer: C**

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8. For the complex,



$$\left(\frac{dx}{dt}\right) = 2 \times 10^7 L^2 mol^{-1} [Ag^+] [NH_3]^2 - 1 \times 10^{-2} s^{-1}$$



Hence, ratio of rate constants of the forward and backward reaction is :

A.  $2 \times 10^7 L^2 mol^{-2}$

B.  $2 \times 10^9 L^2 mol^{-2}$

C.  $1 \times 10^{-2} L^2 mol^{-2}$

D.  $0.5 \times 10^{-9} L^2 mol^{-2}$

**Answer: B**



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9. In the reaction  $N_2 + 3H_2 \rightarrow 2NH_3$

$\left(\frac{dx}{dt}\right) = 1 \times 10^2 [N_2][H_2]^3$  and at some instant  $\frac{[N_2][H_2]^3}{[NH_3]^2}$  has value

$10^{-5} M^2$  then, at this instant, value of  $\left(\frac{dx}{dt}\right)$  is :

A. 0

B.  $1 \times 10^5$

C.  $1 \times 10^{-5}$

D.  $1 \times 10^{-3}$

**Answer: A**



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10.  $2A \xrightarrow{K} 3B + 4C$

Rate of disappearance of A is  $4 \times 10^{-2} M s^{-1}$ . Find the rate of appearance of B at the same instant.



A.  $9 \times 10^{-2}$

B.  $10^{-2}$

C.  $4.5 \times 10^{-2}$

D.  $6 \times 10^{-2}$

**Answer: D**



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11. If  $I$  is the intensity of an absorbed light and  $c$  is the concentration of  $AB$  for the photochemical process.  $AB + h\nu \rightarrow AB^*$ , the rate of formation of  $AB^*$  is directly proportional to

A.  $C$

B.  $I$

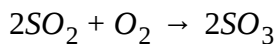
C.  $I^2$

D.  $CI$

**Answer: B**

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**12.** The rate of formation of  $SO_3$  in the reaction



is  $100 \text{ g min}^{-1}$  Hence rate of disappearance of  $O_2$  is

- A.  $50 \text{ g min}^{-1}$
- B.  $40 \text{ g min}^{-1}$
- C.  $200 \text{ g min}^{-1}$
- D.  $20 \text{ g min}^{-1}$

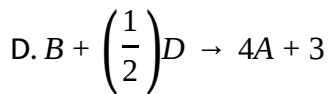
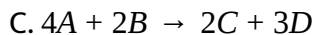
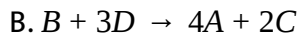
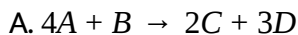
**Answer: D**

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13. The rate of a reaction is expressed in different ways as follows:

$$+\frac{1}{2} \frac{d[C]}{dt} = -\frac{1}{3} \frac{d[D]}{dt} = +\frac{1}{4} \frac{d[A]}{dt} = -\frac{d[B]}{dt}$$

the reaction is



**Answer: B**

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14. If the reaction,  $A + 2B \rightarrow 3C + D$ , which of the following expression does not describe changes in the concentration of various species as a function of time :

A.  $\left\{ \frac{d[C]}{dt} \right\} = - \left\{ \frac{3d[A]}{dt} \right\}$

$$\text{B. } \left\{ \frac{3d[D]}{dt} \right\} = \left\{ \frac{d[C]}{dt} \right\}$$

$$\text{C. } \left\{ \frac{3d[B]}{dr} \right\} = - \left\{ \frac{2d[C]}{dt} \right\}$$

$$\text{D. } \left\{ \frac{2d[B]}{dt} \right\} = - \left\{ \frac{d[A]}{dt} \right\}$$

**Answer: D**

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15. For a reaction  $\frac{1}{2}A \rightarrow 2B$ , rate of disappearance of 'A' is related to the rate of appearance of 'B' by the expression:

$$\text{A. } -\frac{d[A]}{dt} = \frac{1}{4} \frac{d[B]}{dt}$$

$$\text{B. } -\frac{d[A]}{dt} = \frac{d[B]}{dt}$$

$$\text{C. } -\frac{d[A]}{dt} = 4 \frac{d[B]}{dt}$$

$$\text{D. } -\frac{d[A]}{dt} = \frac{1}{2} \frac{d[B]}{dt}$$

**Answer: D**

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16. The rate of disappearance of ammonia is 3.4 gm/litre sec. when it dissociates to form nitrogen and hydrogen. The rate of appearance of nitrogen will be :

- A. 3.4 gm/litre sec
- B. 1.7 gm/litre sec
- C. 0.1 gm/litre sec
- D. 2.8 gm/litre sec

**Answer: D**

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17. For the reaction ,

$2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$ , the rate of disappearance of

$C_2H_6(g)$  :

A. equals the rate of disappearance of  $O_2(g)$ .

B. is seven times the rate of disappearance of  $O_2(g)$ .

C. is twice the rate of appearance of  $CO_2(g)$ .

D. is one-third the rate of appearance of  $H_2O(l)$ .

**Answer: D**

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**18.** Consider a reaction  $3A(g) \rightarrow 4B(g) + C(g)$ , starting with pure A having pressure  $\frac{3}{5}$  atm, the pressure after 10 min. reaches to 1 atm. Calculate the value of rate of disappearance of A at initial instant.

A.  $0.06 \text{ atm min}^{-1}$

B.  $0.6 \text{ mole lit}^{-1} \text{ min}^{-1}$

C.  $\frac{3}{50} \ln \frac{3}{5} \text{ atm min}^{-1}$

D.  $0.36 \text{ atm min}^{-1}$

**Answer: A**



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**19.** For the reaction :  $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$  . If rate of appearance of  $NH_3$  is  $6.8 \times 10^{-3}$  gm/min, then rate of disappearance of  $H_2(g)$  at the same condition will be :

A.  $6.8 \times 10^{-3}$  gm/min

B.  $1.02 \times 10^{-2}$  gm/min

C.  $16 \times 10^{-4}$  gm/min

D.  $1.2 \times 10^{-3}$  gm/min

**Answer: D**



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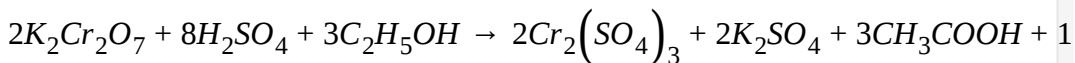
**20.** Which of the following statements regarding rate constant is correct?

- A. Rate constant always depends on concentration of reactant.
- B. Rate constant is temperature dependent.
- C. For instantaneous reaction, rate constant will be very small.
- D. Rate constant will always depend on pressure or volume of the container.

**Answer: B**

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21. The reaction that occurs in a 'breathlyser' , a device used to determine the alcohol level in a person's blood stream, is :



If the rate of deappearance of ethanol is 6.9 gm/min, then the rate of appearance of chromium (III) sulphate is : (Cr=52)

- A. 4.6 gm/min
- B. 10.35 gm/min



C. 39.2 gm/min

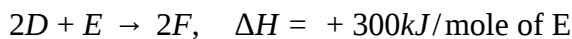
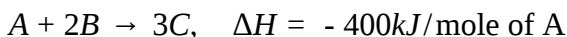
D. 88.2 gm/min

**Answer: C**



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**22.** For two chemical reactions :



occurring in container such that temperature does not change. What should be the rate of formation of 'F' if rate of disappearance of B is  $10^{-3}$  M/sec?

A.  $10^{-3}$  M/sec

B.  $8 \times 10^{-2}$  M/ min

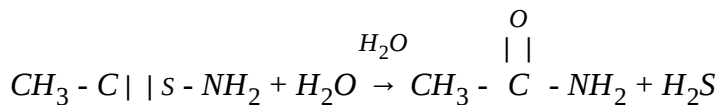
C.  $\frac{4}{3} \times 10^{-3}$  M/ min

D.  $4 \times 10^{-3}$  M/sec

Answer: D

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23. The rate law for hydrolysis of this acetamide,  $CH_3CSNH_2$ , is :



$$\text{Rate} = K [\text{thioacetamide}] [H^+]$$

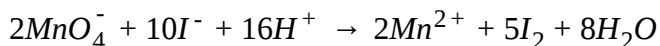
In which of the following solutions, will the rate of hydrolysis of thioacetamide (TA) is least at  $25^\circ C$  ?

- A. 0.1M TA + 0.20M  $HNO_3$
- B. 0.1M TA + 0.20M  $CH_3COOH$
- C. 0.1M TA + 0.20M  $HCOOH$
- D. 0.15M TA + 0.15M  $HCl$

Answer: B

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24. The instantaneous rate of disappearance of the  $MnO_4^-$  ion in the following reaction is  $4.56 \times 10^{-3} Ms^{-1}$ . Then the rate of appearance of  $I_2$  is :



A.  $1.14 \times 10^{-3} Ms^{-1}$

B.  $5.7 \times 10^{-3} Ms^{-1}$

C.  $4.56 \times 10^{-4} Ms^{-1}$

D.  $1.14 \times 10^{-2} Ms^{-1}$

**Answer: D**

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25. For the reaction,  $2NO_2(g) \rightarrow 2NO(g) + O_2(g)$  at a certain temperature, the initial rate of decomposition of  $NO_2$  is  $0.0036 \text{ mol } L^{-1} s^{-1}$ . What is the initial rate of formation of  $O_2(g)$  in  $\text{mol } L^{-1} \cdot s^{-1}$ ?

A. 0.0018

B. 0.0036

C. 0.0054

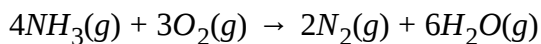
D. 0.0072

**Answer: A**



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**26.** The oxidation of ammonia produces nitrogen and water according to the equation :



If the rate of formation of  $\text{N}_2$  at a certain temperature is  $3.0\text{mol. L}^{-1} \cdot \text{s}^{-1}$ , what is the rate of disappearance of  $\text{O}_2$  ?

A.  $2.0\text{mol.L}^{-1} \cdot \text{s}^{-1}$

B.  $3.0\text{mol.L}^{-1} \cdot \text{s}^{-1}$

C.  $4.5\text{mol.L}^{-1} \cdot \text{s}^{-1}$

D.  $9.0\text{mol}\cdot\text{L}^{-1}\cdot\text{s}^{-1}$

**Answer: C**



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27. For the reaction  $A + B \rightarrow C$ , the rate law is :  $\text{Rate}=k[A]^2$ .

Which change(s) will increase the rate of the reaction?

(P) Increasing the concentration of A

(Q) Increasing the concentration of B

A. P only

B. Q only

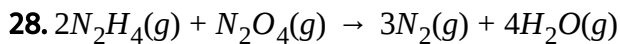
C. Both P and Q

D. Neither P nor Q

**Answer: A**



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If  $N_2H_4(g)$  disappears at a rate of  $0.12 \text{ mol L}^{-1} \text{ min}^{-1}$ , at what rate does  $N_2(g)$  appear?

A.  $0.080 \text{ mol.L}^{-1} \cdot \text{min}^{-1}$

B.  $0.12 \text{ mol.L}^{-1} \cdot \text{min}^{-1}$

C.  $0.18 \text{ mol.L}^{-1} \cdot \text{min}^{-1}$

D.  $0.30 \text{ mol.L}^{-1} \cdot \text{min}^{-1}$

**Answer: C**



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29. For the reaction,  $2A + B \rightarrow C$  which relationship is correct?

A.  $\Delta[A] = \Delta[C]$

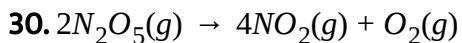
B.  $-\Delta[A] = \Delta[C]$

C.  $-2\Delta[A] = \Delta[C]$

$$D. = \Delta[A] = 2\Delta[C]$$

**Answer: D**

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The rate of disappearance of  $N_2O_5(g)$  at a certain temperature is  $0.016 \text{ mol} \cdot \text{L}^{-1} \cdot \text{min}^{-1}$ . What is the rate of formation of  $NO_2(g)$  (in  $\text{mol} \cdot \text{L}^{-1} \cdot \text{min}^{-1}$ ) at this temperature ?

A. 0.0080

B. 0.016

C. 0.032

D. 0.064

**Answer: C**

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31. The rate of decomposition of hydrogen peroxide is first order in  $H_2O_2$ . At  $[H_2O_2] = 0.150 \text{ M}$ , the decomposition rate was measured to be  $4.83 \times 10^{-6} \text{ M} \cdot \text{s}^{-1}$ . What is the rate constant for the reaction?

A.  $2.15 \times 10^{-4} \text{ s}^{-1}$

B.  $3.22 \times 10^{-5} \text{ s}^{-1}$

C.  $4.83 \times 10^{-6} \text{ s}^{-1}$

D.  $7.25 \times 10^{-7} \text{ s}^{-1}$

**Answer: B**



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32. For the reaction,  $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ , how does the rate of disappearance of  $O_2$  compare to the rate of production of  $CO_2$ ? The rate of disappearance of  $O_2$  is :

A. the same as the rate of production of  $CO_2$



- B.  $\frac{1}{5}$  the rate of production of  $CO_2$ .
- C.  $\frac{3}{5}$  the rate of production of  $CO_2$ .
- D.  $\frac{5}{3}$  the rate of production of  $CO_2$ .

**Answer: D**

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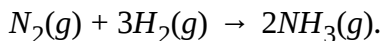
**33. What are the units of rate of reaction ?**

- A.  $\text{mol.L}^{-1}.\text{s}^{-1}$
- B.  $\text{mol.L}^{-1}$
- C.  $\text{mol.L.s}^{-1}$
- D.  $\text{L.mol}^{-1}.\text{s}^{-1}$

**Answer: A**

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34. The commercial production of ammonia is represented by the equation,



If the rate of disappearance of  $H_2(g)$  is  $1.2 \times 10^{-3}$  mol/min, what is the rate of appearance of  $NH_3(g)$ ?

A.  $2.4 \times 10^{-3}$  mol/min

B.  $1.8 \times 10^{-3}$  mol/min

C.  $1.2 \times 10^{-3}$  mol/min

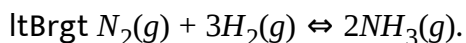
D.  $8.0 \times 10^{-4}$  mol/min

**Answer: D**



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35. A rigid container holds an equal number of moles of  $N_2$  and  $H_2$  gas at a total pressure of 10.0 atm. The gases react according to the equation,



If the total pressure of the gas decreases at a rate of  $0.20\text{atm. s}^{-1}$ , what is the rate of change of the partial pressure of  $N_2$  in the container?

A. Decreases at  $0.40\text{atm.s}^{-1}$

B. Decreases at  $0.30\text{atm.s}^{-1}$

C. Decreases at  $0.20\text{atm.s}^{-1}$

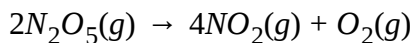
D. Decreases at  $0.10\text{atm.s}^{-1}$

**Answer: D**



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**36.** The gas phase decomposition of dinitrogen pentoxide is represented by this equation,



What is the rate of formation of oxygen gas (in  $\text{mol.L.s}^{-1}$ ) in an experiment where  $0.080$  mol of  $N_2O_5$  is consumed in a  $4.0$  L container every  $0.20$  second?

A. 0.020

B. 0.050

C. 0.10

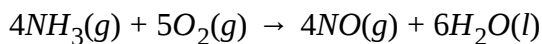
D. 0.20

**Answer: B**



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**37.** Ammonia reacts with oxygen according to the equation :



In an experiment in which the rate of change of nitric oxide is found to be  $1.10\text{M}\cdot\text{min}^{-1}$ , what is the rate of change of oxygen gas?

A.  $-1.38\text{M}\cdot\text{min}^{-1}$

B.  $-0.880\text{M}\cdot\text{min}^{-1}$

C.  $-0.275\text{M}\cdot\text{min}^{-1}$

D.  $-0.220\text{M}\cdot\text{min}^{-1}$

**Answer: A**



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## B. Rate Law

1.  $aA + bB \rightarrow \text{Product}$ ,  $dx/dt = k[A]^a[B]^b$ . If conc. Of A is doubled, rate becomes four times. If conc. Of B is made four times, rate is doubled.

What is the relation between rate of disappearance of A that B?

A.  $\left\{ -\frac{d[A]}{dt} \right\} = \left\{ -\frac{d[B]}{dt} \right\}$

B.  $\left\{ -\frac{d[A]}{dt} \right\} = 4 \left\{ -\frac{d[B]}{dt} \right\}$

C.  $-4 \left\{ \frac{d[A]}{dt} \right\} = \left\{ -\frac{d[B]}{dt} \right\}$

D. None of the above

**Answer: B**



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2. For the reaction,  $2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$  the rate expression can be written in the following ways :

$$\left\{ \frac{d[N_2]}{dt} \right\} = k_1[NO][H_2],$$

$$\left\{ \frac{d(H_2O)}{dt} \right\} = k[NO][H_2],$$

$$\left\{ \frac{d[NO]}{dt} \right\} = k_1'[NO][H_2],$$

$$\left\{ \frac{d[H_2]}{dt} \right\} = k_1''[NO][H_2].$$

The relationship between  $k$ ,  $k_1$ ,  $k_1'$  and  $k_1''$

A.  $k = k_1 = k_1' = k_1''$

B.  $k = 2k_1 = k_1' = k_1''$

C.  $k = 2k_1' = k_1 = k_1''$

D.  $k = k_1 = k_1' = 2k_1''$

**Answer: B**

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3. For a reaction  $pA + qB \rightarrow$  products, the rate law expression is

$r = k[A]^l[B]^m$  then

A.  $(p + l) < (l + m)$

B.  $(p + q) > (l + m)$

C.  $(p+q)$  may or may not be equal to  $(l+m)$

D.  $(p + q) = (l + m)$

**Answer: C**



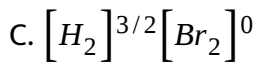
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4. For the reaction  $H_2 + Br_2 \rightarrow 2HBr$  overall order is found to be  $3/2$ . The

rate of reaction can be expressed as:

A.  $[H_2][Br_2]^{1/2}$

B.  $[H_2]^{1/2}[Br_2]$



D. all of these

**Answer: D**



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5. If rate constant is numerically the same for three reaction of first, second and third order respectively, then which of the following is correct?

A. If  $[A]=1$  then  $r_1 = r_2 = r_3$

B. If  $[A]<1$  then  $r_1 > r_2 > r_3$

C. If  $[A]>1$  then  $r_3 > r_2 > r_1$

D. All of the above

**Answer: D**



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6. In acidic medium the rate of reaction between  $(\text{BrO}_3)^-$  and  $\text{Br}^-$  ions is

given by the expression  $-\frac{d(\text{BrO}_3^-)}{dt} = k[\text{BrO}_3^-][\text{Br}^-][\text{H}^+]^2$  it means

- A. rate constant of overall reaction is  $4 \text{ sec}^{-1}$
- B. rate of reaction is independent of the concentration of acid
- C. the changes in pH of the solution will not affect the rate
- D. doubling the concentration of  $\text{H}^+$  ions will increase the reaction rate by 4 times

**Answer: D**



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7. For a reaction  $\text{A} + 2\text{B} \rightarrow \text{C}$ , rate is given by  $R = K[\text{A}][\text{B}]^2$ . The order of reaction is:

- A. 3

B. 6

C. 5

D. 7

**Answer: A**



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8. The rate law for the dimerisation of  $NO_2$  is :

$$-\frac{d[NO_2]}{dt} = k[NO_2]^2$$

which of the following changes will change the value of specific rate constant, k :

A. doubling the total pressure on the system

B. doubling the temperature

C. both (a) and (b)

D. None of the above

**Answer: B**

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9. For the reaction  $3A \rightarrow \text{Products}$  the value of  $k = 1 \times 10^{-3} \text{ L}/(\text{mol}\cdot\text{min})$

the value of  $-\frac{d[A]}{dt}$  in mol/L-sec when  $[A] = 2 \text{ M}$  is :

A.  $6.67 \times 10^{-3}$

B.  $1.2 \times 10^{-2}$

C.  $2 \times 10^{-4}$

D.  $4 \times 10^{-3}$

**Answer: C**

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10. For the non-equilibrium process,

$A + B \rightarrow \text{products}$ , the rate is first-order w.r.t. A and second-order w.r.t. B.

If 1.0 mole each of A and B introduced into a 1.0 L vessel and the initial rate was  $1.0 \times 10^{-2} \text{ mol L}^{-1}\text{s}^{-1}$ , rate when half reactants have been turned into products is :

A.  $1.25 \times 10^{-3} \text{ mol L}^{-1}\text{s}^{-1}$

B.  $1.0 \times 10^{-2} \text{ mol L}^{-1}\text{s}^{-1}$

C.  $2.50 \times 10^{-3} \text{ mol L}^{-1}\text{s}^{-1}$

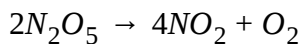
D.  $2.0 \times 10^{-2} \text{ mol L}^{-1}\text{s}^{-1}$

**Answer: A**



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**11.** The rate constant for the reaction



is  $3.0 \times 10^{-5}\text{s}^{-1}$ . If the rate is  $2.40 \times 10^{-5}\text{molL}^{-1}\text{s}^{-1}$ , then the concentration of  $N_2O_5$  (in  $\text{molL}^{-1}$ ) is

A. 1.4

B. 1.2

C. 0.04

D. 0.8

**Answer: D**



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**12.** Consider a reaction  $aG + bH \rightarrow \text{Products}$ . When concentration of both the reactants  $G$  and  $H$  is doubled, the rate increases eight times. However, when the concentration of  $G$  is doubled, keeping the concentration of  $H$  fixed, the rate is doubled. The overall order of reaction is

A. 0

B. 1

C. 2

D. 3

**Answer: D**

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**13.** The rate law for a reaction between the substances A and B is given by

$$\text{Rate} = k[A]^n[B]^m$$

On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be as:

A.  $\frac{1}{2^{m+n}}$

B.  $(m = n)$

C.  $(n - m)$

D.  $2^{(n-m)}$

**Answer: D**

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14. For the reaction system  $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$  volume is suddenly produced to half its value by increasing the pressure on it. If the reaction is of first order with respect to  $O_2$  and second order with respect to  $NO$ . The rate of reaction will

- A. diminish to one-fourth of its initial value
- B. diminish to one-eighth of its initial value
- C. diminish to eight times of its initial value
- D. diminish to four times of its initial value

**Answer: C::D**



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15. The rate equation for the reaction  $2A + B \rightarrow C$  is found to be:  $rate = k[A][B]$ . The correct statement in relation of this reaction is that

- A. unit of k must be  $sec^{-1}$

B.  $t_{1/2}$  is constant

C. rate of formation of C is twice the rate of disappearance of A

D. value of k is independent of initial concentrations of A and B

**Answer: C**



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**16.** A reaction was found to be second order with respect to the concentration of carbon monoxide. If the concentration of carbon monoxide is doubled, with everything else kept the same, the rate of reaction will:

A. remain unchanged

B. be tripled

C. increase by a factor of 4

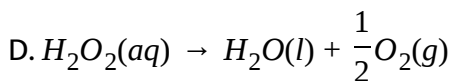
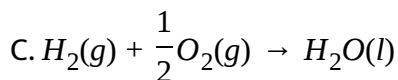
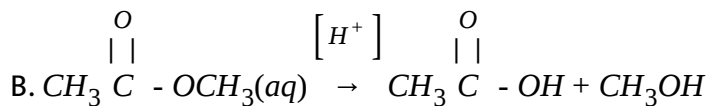
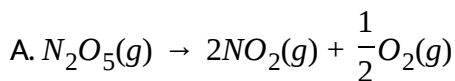
D. be doubled



Answer: C

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17. In which of the following reactions the graph of concentration vs time for reactants and products will be difficult to plot.



Answer: B

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18. For a process  $A + B \rightarrow \text{product}$ , the rate of reaction is second order with respect to A and zero order with respect to B. When 1 mole each of A

and B are taken in 1 litre vessel the initial rate is  $1 \times 10^{-2}$  mol/L-sec. The rate of reaction when 50% of the reactant have been converted to product would be :

A.  $1 \times 10^{-2}$  mol/L-sec

B.  $2.5 \times 10^{-3}$  mol/L-sec

C.  $5 \times 10^{-2}$  mol/L-sec

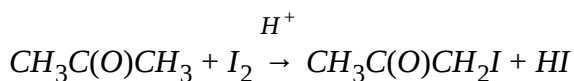
D.  $5 \times 10^{-3}$  mol/L-sec

**Answer: D**



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**19.** Propanone reacts with iodine in acid solution as shown in this equation.



These data were obtained when the reaction was studied.

$[CH_3C(O)CH_3], M$	$[I_2], M$	$[H^+], M$	Relative Rate
0.010	0.010	0.010	1
0.020	0.010	0.010	2
0.020	0.020	0.010	2
0.020	0.010	0.020	4

What is the rate equation for the reaction?

A. Rate =  $k [CH_3C(O)CH_3] [I_2]$

B. Rate =  $k [CH_3C(OH)CH_3]^2$

C. Rate =  $k [CH_3C(O)CH_3] [I_2] [H^+]$

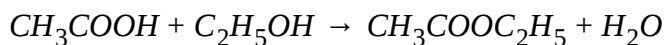
D. Rate =  $k [CH_3C(O)CH_3] [H^+]$

Answer: D



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20. One litre of 2 M acetic acid and one litre of 3 M ethyl alcohol are mixed to form ester according to the given equation



If each solution is diluted by adding equal volume (1 litre) of water, by how many times the initial forward rate is reduced?

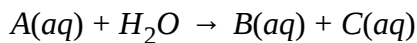
- A. 4 times
- B. 2 times
- C. 0.5 times
- D. 0.25 times

**Answer: C**



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21. A substance 'A' undergoes conversion by an elementary step to 'B' and 'C' in aqueous phase as shown :



If concentration of A(aq) initially and after 6.93 min. is 1 M and  $\frac{1}{4}$  M respectively then calculate rate constant in terms of  $M^{-1}\text{min}^{-1}$ .

- A.  $\frac{1}{5}$

B.  $\frac{1}{10}$

C.  $3.6 \times 10^{-3}$

D.  $1.8 \times 10^{-3}$

**Answer: B**

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22. The rate law for a certain reaction is found to be :  $\text{Rate} = k[A][B]^2$  How will the rate of this reaction compare if the concentration of A is doubled and the concentration of B is halved ? The rate will :

- A. remain the same.
- B. be double the original rate.
- C. be triple the original rate.
- D. be one-half the original rate.

**Answer: D**

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23. The equation and rate law for the gas phase reaction between NO and  $H_2$  are :  $2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$

$$\text{Rate} = k[NO]^2[H_2]$$

What are the units of k if time is in seconds and the concentration is moles per litre?

A.  $L, s. mol^{-1}$

B.  $L^2. mol^{-2}. s^{-1}$

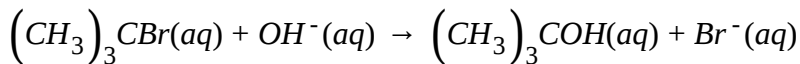
C.  $mol. L^{-1}. s^{-1}$

D.  $mol^2. L^{-2}. s^{-1}$

**Answer: B**

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24. For the reaction :



it is found that halving the concentration of  $\left(\text{CH}_3\right)_3\text{CBr}$  causes the reaction rate to be halved but halving the concentration of  $\text{OH}^-$  has no effect on the rate. What is the rate law?

A.  $\text{Rate} = k \left[ \left(\text{CH}_3\right)_3\text{CBr} \right]^{1/2} \left[ \text{OH}^- \right]$

B.  $\text{Rate} = k \left[ \left(\text{CH}_3\right)_3\text{CBr} \right]^2 \left[ \text{OH}^- \right]$

C.  $k \left[ \left(\text{CH}_3\right)_3\text{CBr} \right]^{1/2}$

D.  $k \left[ \left(\text{CH}_3\right)_3\text{CBr} \right]$

**Answer: D**

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25. A hypothetical reaction has a rate law of :  $\text{Rate} = k[A]^2[B]$ .

Which statement about this reaction is most probably correct?

- A. Doubling the concentration of A will double the rate of the reaction.
- B. Tripling [A] will affect the rate twice as much as tripling [B].
- C. The reaction mechanism involves the formation of  $B_2$  at some stage.
- D. The reaction mechanism involves more than one step.

**Answer: D**



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**26.** Under certain conditions the reaction of CO with  $NO_2$  to give  $CO_2$  and NO results in the rate law,  $\text{rate} = k[CO][NO_2]$ .

What are the units for the rate constant,  $k$ ?

A.  $\text{mol} \cdot \text{L}^{-1} \cdot \text{min}^{-1}$

B.  $\text{mol}^2 \cdot \text{L}^{-2} \cdot \text{min}^{-1}$



C.  $L \cdot mol^{-1} \cdot min^{-1}$

D.  $L^2 \cdot mol^{-2} \cdot min^{-1}$

**Answer: C**

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**27.** Factor that can affect the rate of a chemical reaction between a solid and a solution include all of the following except the :

A. concentration of the reactants in solution

B. volume of the container.

C. size of the solid particles.

D. temperature.

**Answer: C**

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28. Consider the hypothetical reaction :  $A + 2B \rightarrow C$  The rate remains constant when the concentration of A is doubled and the concentration of B is held constant. What are the orders of A and B in this reaction?

A.  $A = 0, B = 1$

B.  $A = 0, B = 2$

C.  $A = 1, B = 2$

D.  $A = 1, B = 0$

**Answer: A**



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29. For the reaction:

$2A + 3B \rightarrow C$ ,  $[A]$  is found to decrease at a rate of  $2.0M \cdot s^{-1}$ . If the rate law is  $rate = k[A]$ , how fast does  $[B]$  decrease under the same conditions?

A.  $0.66M \cdot s^{-1}$

B.  $1.3M \cdot s^{-1}$

C.  $2.0M \cdot s^{-1}$

D.  $3.0M \cdot s^{-1}$

**Answer: D**



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**30.** The reaction  $H_2O_2(aq) + 3I^-(aq) + 2H^+(aq) \rightarrow I_3^-(aq) + 2H_2O(l)$  has a rate law :  $rate = k[H_2O_2][I^-]$ . What is the order of the reaction with respect to  $H^+$ , and what is the overall order of the reaction?

A. 0th order in  $H^+$ , 2nd order overall

B. 1st order in  $H^+$ , 2nd order overall

C. 1st order in  $H^+$ , 3rd order overall

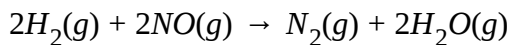
D. 2nd order in  $H^+$ , 6th order overall

**Answer: A**



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31. For the reaction



Rate =  $k[H_2][NO]^2$ . At a given temperature, what is the effect on the reaction rate if the concentration of  $H_2$  is doubled and the concentration of NO is halved?

- A. The reaction rate is halved.
- B. The reaction rate is unchanged.
- C. The reaction rate is doubled.
- D. The reaction rate increases eightfold.

Answer: A



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32.  $A + 2B \rightarrow C$ , the rate equation for this reaction is given as

$$\text{Rate} = k[A][B].$$

If the concentration of A is kept the same but that of B is doubled what will happen to the rate itself?

A. Quadrupled

B. Doubled

C. Halved

D. The same

**Answer: B**



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33. For a rate law of the form,  $\text{Rate} = k[A]^m[B]^n$ , the exponents m and n are obtained from :

A. changes in rate with changing temperature.

B. the concentrations of A and B in a single experiment.

C. the concentrations of A and B in a single experiment.

D. changes in the reaction rates for different concentrations of A and

B.

**Answer: D**

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**34.** The reaction between NO and  $I_2$  is second-order in NO and first-order in  $I_2$ . What change occurs in the rate of the reaction if the concentration of each reactant is tripled?

A. 3-fold increase

B. 6-fold increase

C. 18-fold increase

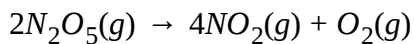
D. 27-fold increase

**Answer: D**



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**35.** This reaction is first order with respect of  $N_2O_5$ .



If the half-life for this reaction is 19.0 minutes, what is the rate constant,  $k$

for  $r = k[N_2O_5]$ ?

A.  $0.0182\text{min}^{-1}$

B.  $0.0263\text{min}^{-1}$

C.  $0.0365\text{min}^{-1}$

D.  $0.0526\text{min}^{-1}$

**Answer: A**



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## C. Integrated Rate Laws

1. The rate constant of reaction,

$2A + B \rightarrow C$  is  $2.57 \times 10^{-5} \text{L mole}^{-1} \text{sec}^{-1}$  after 10 sec.,

$2.65 \times 10^{-5} \text{L mol}^{-1} \text{sec}^{-1}$  after 20 sec., and  $2.55 \times 10^{-5} \text{L mole}^{-1} \text{sec}^{-1}$  after

30 sec. The order of the reaction is :

A. 0

B. 1

C. 2

D. 3

**Answer: C**



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2. In a certain reaction, 10 % of the reactant decomposes in one hour, 20 % in two hours, 30 % in three hours, and so on. The dimension of the



velocity constant (rate constant) are

A.  $\text{hour}^{-1}$

B.  $\text{mole litre}^{-1}\text{sec}^{-1}$

C.  $\text{litre mole}^{-1}\text{sec}^{-1}$

D.  $\text{mole sec}^{-1}$

**Answer: B**



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3. In presence of HCl, sucrose gets hydrolysed into glucose and fructose.

The concentration of sucrose was found to reduce from 0.4 M to 0.2 M in

1 hour and to 0.1 M in total of 2 hours. The order of the reaction is :

A. zero

B. one

C. two

D. none of these

**Answer: B**

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4. In a first order of reaction the reacting substance has half-life period of ten minutes. What fraction of the substance will be left after an hour the reaction has occurred ?

- A.  $\frac{1}{6}$  of initial concentration
- B.  $\frac{1}{64}$  of initial concentration
- C.  $\frac{1}{12}$  of initial concentration
- D.  $\frac{1}{32}$  of initial concentration

**Answer: B**

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5. In the following first order reactions  $(A) \xrightarrow{k_1} \text{product}$ ,  $(B) \xrightarrow{k_2} \text{product}$ , the ratio  $k_1/k_2$  if 90 % of (A) has been reacted in time 't' while 99 % of (B) has been reacted in time 2t is :

A. 1

B. 2

C.  $\frac{1}{2}$

D. none of these

**Answer: A**



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6. Two substances A ( $t_{1/2} = 5 \text{ min}$ ) and B ( $t_{1/2} = 10 \text{ min}$ ) are taken in such a way that initially  $[A] = 4[B]$ . The time after which both the concentrations will be equal is : (Assume that reaction is first order)

A. 5 min

B. 15 min

C. 20 min

D. concentration can never be equal

**Answer: C**

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7. If a 1-order reaction is completed to the extent of 60 % and 20 % in time intervals,  $t_1$  and  $t_2$ , what is the ratio,  $t_1 : t_2$ ?

A. 6.32

B. 5.58

C. 4.11

D. 8.33

**Answer: C**

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8. For a reaction  $A \rightarrow$  products, the concentration of reactant are  $C_0, aC_0, a^2C_0, a^3C_0, \dots$  after time interval  $0, t, 2t, \dots$ . Where 'a' is constant.

Then :

A. reaction is of  $1^{st}$  order and  $K = \left(\frac{1}{1}\right) \ln a$

B. reaction is of  $2^{nd}$  order and  $K = \left(\frac{1}{tC_0}\right) \frac{(1-a)}{a}$

C. reaction is of  $1^{st}$  order and  $K = \frac{1}{t} \ln\left(\frac{1}{a}\right)$

D. reaction is of zero order and  $K = \frac{1}{t} \ln\left(\frac{1}{a}\right)$

**Answer: C**



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9. The rate constant for the reaction  $A \rightarrow B$  is  $2 \times 10^{-4} \text{L mol}^{-1} \text{min}^{-1}$ . The concentration of A at which rate of the reaction is  $\left(\frac{1}{20}\right) \times 10^{-5} \text{M sec}^{-1}$  is

:

A. 0.25 M

B.  $\left(\frac{1}{20}\right)\sqrt{\frac{5}{3}}$  M

C. 0.05 M

D. none of these

**Answer: C**



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10. A drop of solution (volume  $0.05\text{mL}$ ) contains  $3 \times 10^{-6}\text{mole } H^{\oplus}$  ions. If the rate constant of disappearance of  $H^{\oplus}$  ions is  $1 \times 10^7\text{molL}^{-1}\text{s}^{-1}$ , how long would it take for  $H^{\oplus}$  ions in the drop of disappear?

A.  $6 \times 10^{-8}$  sec

B.  $6 \times 10^{-7}$  sec

C.  $6 \times 10^{-9}$  sec

D.  $6 \times 10^{-10}$  sec

**Answer: C**



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11. Which of the following options correctly represents relationship between  $t_{7/8}$  and  $t_{1/2}$  where  $t_{7/8}$  represents time required for concentration to become  $\frac{1}{8}$ th of original for a reaction of order 'n'?

A.  $t_{7/8} = (2n + 1)t_{1/2}$

B.  $t_{7/8} = t_{1/2} [2^{n-1} - 1]$

C.  $t_{7/8} = t_{1/2} [2^{n-1} + 1]$

D.  $t_{7/8} = t_{1/2} [2^{2n-2} + 1 + 2^{n-1}]$

**Answer: D**



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12. Which of the following statements is not correct for a pseudo first order rate constant?

- A. Its value is independent of the reactant present in small amount.
- B. Its value is dependent on the temperature.
- C. Its value will not change if volume is changed.
- D. It is dependent on the concentration of the reactant.

**Answer: C**



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13. Following data is obtained in a chemical reaction occurring with a single reactant. The order of the reaction will be (if

$t_{1/2} = 40\text{min}$ ,  $t_{3/4} = 360\text{min}$ ) :

- A. 9
- B. 8



C. 4

D. 3

**Answer: C**



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14. If for a reaction  $t_{x/y}$  represents time required for  $\frac{x}{y}$ th fraction of reactant to react then identify the correct option for a first order reaction :

Statement-I :  $t_{3/4} = t_{1/2} \times 2$

Statement-II :  $t_{15/16} = t_{1/2} \times 4$

Statement-III :  $t_{7/8} = t_{3/4} \times 2$

Statement-IV :  $t_{15/16} = t_{3/4} \times 3$

A. All statements are correct

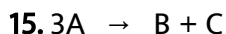
B. Only Statement-I is correct

C. Statement-III and Statement-IV are incorrect

D. Statement-II and Statement-IV are correct

**Answer: C**

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It would be a zero order reaction when :

- A. the rate of reaction is proportional to square of concentration of A
- B. the rate of reaction remains same at any concentration of A
- C. the rate remains unchanged at any concentration of B and C
- D. the rate of reaction doubles if concentration of B is increased to double

**Answer: B**

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16. Which of the following statement is incorrect for a photochemical reaction?

- A. Photochemical reactions are complex reactions.
- B. Overall order of photochemical reactions is always zero.
- C. Only the first step of such reactions follows zero order kinetics.
- D. The rate of such reactions depends on the intensity of radiations absorbed.

**Answer: B**



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17. In a zero order reaction half life is 100 sec. After how much time  $\frac{7}{8}$  fraction of reactant will be reacted?

- A. 300 sec.
- B. 200 sec.

C. 175 sec.

D. 25 sec.

**Answer: C**



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18. Select the correct option for 1st order reaction  $2A \rightarrow \text{product}$  having rate constant of reaction  $1.386 \times 10^{-2} \text{min}^{-1}$ .

A. Time required for 75 % completion of reaction is 100 min.

B. Time required for 99.9 % completion of reaction is 250 min.

C. Rate of decomposition of reactant at concentration 0.1 M is

$$1.386 \times 10^{-3} \text{M} / \text{min}$$

D. Rate of decomposition of reactant at concentration 0.1 M is

$$1.386 \times 10^{-3} \text{M} / \text{sec}.$$

**Answer: B**

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19. For zero order reaction which is true?

- A. The rate constant is dimensionless.
- B. Amount of reactant remain same throughout.
- C.  $t_{1/2} \propto$  initial concentration of reactant.
- D. A plot of concentration of reactant vs time is a straight line with slope equal to K.

**Answer: C**

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20. The reaction :  $A(g) \rightarrow 2B(g)+C(g)$  is first order reaction w.r.t. A, with rate constant  $1.386 \times 10^{-4} \text{sec}^{-1}$ . If initially 0.1 mole/litre of A was taken and the reaction is occurring at constant pressure and temperture then the concentration of A after 5000 sec will be:

A. 0.05mole/litre

B. 0.025mole/litre

C. 0.1 mole/litre

D. none of these

**Answer: B**

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21. For a certain reaction of order  $n$ , the time for half change,  $t_{1/2}$  is given

by  $t_{1/2} = \frac{(2 - \sqrt{2})}{k} \times C_0^{1/2}$  where  $k$  is constant and  $C_0$  is the initial

concentration. What is  $n$ ?

A. 1

B. 2

C. 0

D. 0.5

**Answer: D**



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**22.** Given that for a reaction of order  $n$ , the integrated form of the rate equation is :

$$k = \frac{1}{t(n-1)} \left[ \frac{10}{C^{n-1}} - \frac{1}{C_0^{n-1}} \right] \text{ where } C_0 \text{ and } C \text{ are the values of the reactant}$$

concentration at the start and after time  $t$ . What is the relationship between  $t_{3/4}$  and  $t_{1/2}$  where  $t_{3/4}$  is the time required for  $C$  to become

$$\frac{1}{4}C_0?$$

A.  $t_{3/4} = t_{1/2} [2^{n-1} + 1]$

B.  $t_{3/4} = t_{1/2} [2^{n-1} - 1]$

C.  $t_{3/4} = t_{1/2} [2^{n+1} - 1]$

D.  $t_{3/4} = t_{1/2} [2^{n+1} + 1]$

**Answer: A**

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23. Units of rate constant of first and zero order reactions in terms of molarity  $M$  are respectively:

A.  $\text{sec}^{-1}$ ,  $M \text{ sec}^{-1}$

B.  $\text{sec}^{-1}$ ,  $M$

C.  $M \text{ sec}^{-1}$ ,  $\text{sec}^{-1}$

D.  $M \text{ sec}^{-1}$

**Answer: A**

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24. Select the correct statement out of P, Q and R for zero order reaction.

(P) Quantity of the product formed is directly proportional to time

(Q) Larger the initial concentration of the reactant, greater the half-life period



(R) If 50 % reaction takes place in 100 minutes, 75 % reaction takes place in 150 minutes.

- A. P only
- B. P and Q only
- C. Q and R only
- D. P, Q and R

**Answer: D**



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**25.** A certain zero order reaction has  $k = 0.025\text{Ms}^{-1}$  for the disappearance of A. What will be the concentration of A after 15 seconds if the initial concentration is  $0.50\text{M}$ ?

- A.  $0.50\text{ M}$
- B.  $0.375\text{ M}$
- C.  $0.125\text{ M}$

D. 0.060 M

**Answer: C**

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**26.** Half life in a first order and zero order reaction are same then ratio of initial rates in 1st and zero order is : (Given initial concentration is same)

A. 0.693 : 1

B. 1.386 : 1

C. 0.693 : 2

D. 1 : 0.693

**Answer: B**

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27. A reaction of first-order completed 90 % in 90 minutes, hence, it is completed 50 % in approximately :

- A. 50 min
- B. 54 min
- C. 27 min
- D. 62 min

**Answer: C**



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28. Half life period of a first order reaction is 10 minutes. Starting with 10 M, rate after 20 minutes is

A.  $0.0693 \text{ mol L}^{-1} \text{ min}^{-1}$

B.  $0.0693 \times 2.0 \text{ mol L}^{-1} \text{ min}^{-1}$

C.  $0.0693 \times 5 \text{ mol L}^{-1} \text{ min}^{-1}$

D.  $0.0693 \times 10 \text{ mol L}^{-1} \text{ min}^{-1}$

**Answer: B**



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29. For the first-order reaction  $T_{av}$  (average life),  $T_{50}$  and  $T_{75}$  in the increasing order are :

A.  $T_{50} < T_{av} < T_{75}$

B.  $T_{50} < T_{75} < T_{av}$

C.  $T_{av} < T_{50} < T_{75}$

D.  $T_{av} = T_{50} < T_{75}$

**Answer: A**



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30. For the following reaction  $A(g) + B(g) \rightarrow 2C(g) + D(g)$ , the law is given as  $R = [A]^{1/3} \cdot [B]^{2/3}$ . If initially concentration of A and B are unity then total molar concentration of all gases at  $t=600$  sec. will be : [Given :  $K = 2.31 \times 10^{-3} \text{sec}^{-1}$ ]

- A. 1 mole/litre
- B. 1.25 mole/litre
- C. 3.5 mole/litre
- D. 2.75 mole/litre

**Answer: D**

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31. which is not true for a second order reaction?

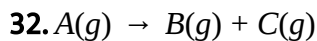
- A. It can have rate constant  $1 \times 10^{-3} \text{L mol}^{-1} \text{s}^{-1}$
- B. Its half-life is inversely proportional to its initial concentration

C. Time to complete 75 % reaction is twice of half-life

$$D. T_{50} = \frac{1}{K \times \text{initial conc.}}$$

**Answer: C**

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$$-\frac{d[A]}{dt} = k[A]$$

At the start, pressure is 100 mm and after 10 min, pressure is 120 mm.

Hence, rate constant ( $\text{min}^{-1}$ ) is :

A.  $\frac{2.303}{10} \log \frac{120}{100}$

B.  $\frac{2.303}{10} \log \frac{100}{20}$

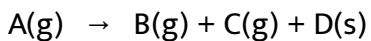
C.  $\frac{2.303}{10} \log \frac{100}{80}$

D.  $\frac{2.303}{10} \log \frac{100}{120}$

**Answer: C**

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33. For the 1st order reaction :



taking place at constant pressure and temperature condition. Initially volume of container containing only A was found to be 10 L and after 0.693 hrs it was 17.5 L. The rate constant for the reaction is :

A.  $\frac{1}{0.693} \ln \frac{3}{2} \text{hr}^{-1}$

B.  $2 \text{hr}^{-1}$

C.  $\frac{1}{0.693} \ln \frac{4}{3} \text{hr}^{-1}$

D.  $1 \text{hr}^{-1}$

**Answer: B**

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34. Which of the following statements is correct for a possible order reaction?

- A. The rate of a reaction decreases with passage of time as the concentration of reactants decreases.
- B. The rate of reaction is same at any time during the reaction.
- C. The rate rate of a reaction is independent of temperature change.
- D. The rate of a reaction decreases with increase in concentration of reactant(s).

**Answer: A**



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35. In a reaction involving one single reactant, the fraction of the reactant

consumed may be defined as  $f = \left(1 - \frac{C}{C_0}\right)$  where  $C_0$  and  $C$  are the



concentration of the reactant at the start and after time,  $t$ . For a first order reaction.

A.  $\frac{df}{dt} = k(1 - f)$

B.  $-\frac{df}{dt} = kf$

C.  $-\frac{df}{dt} = k(1 - f)$

D.  $\frac{df}{dt} = kf$

**Answer: A**



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**36.** For an acid catalysed hydrolysis of an ester which of the following options regarding initial rate of reaction is correct?

A. There will be no effect of concentration of  $[H^+]$  on rate of reaction.

- B. Rate of reaction will be same if 0.05 M HCl is taken or 0.05M  $H_2SO_4$  is taken.
- C. Rate of reaction will be faster when 1 M HCl is taken as compared to when 1 M  $CH_3COOH$  is taken.
- D. The reaction proceeds following third order kinetics.

**Answer: C**

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**37.** For the reaction :  $A \rightarrow \text{Product}$ , the order of reaction is equal to :

A. 
$$\frac{\ln(r_0)_1 + \ln(r_0)_2}{\ln[A_0]_1 + \ln[A_0]_2}$$

B. 
$$1 - \frac{\ln(t_{1/2})_1 - \ln(t_{1/2})_2}{\ln[A_0]_1 - \ln[A_0]_2}$$

C. 
$$\frac{\ln(t_{1/2})_1 - \ln(t_{1/2})_2}{\ln[A_0]_1 - \ln[A_0]_2}$$

$$D. 1 + \frac{\ln(t_{1/2})_1 - \ln(t_{1/2})_2}{\ln[A_0]_1 - \ln[A_0]_2}$$

**Answer: B**

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**38.** A reaction :  $A + B \rightarrow C$  follows the rate law as shown :  $R = 10^{-2} [A][B]$  M/sec. Calculate time required for concentration of [B] to reduce to one fourth of its original value if initially A and B are taken at 3 M and 3.2 M respectively.

A.  $\left(\ln \frac{5}{4}\right) \times \frac{1}{2 \times 10^{-3}} \text{sec}$

B.  $(\ln 5) \times \frac{1}{2} \text{sec}$

C.  $\ln 4 \times \frac{1}{2 \times 10^{-3}} \text{sec}$

D.  $\ln 5 \times \frac{1}{2 \times 10^{-2}} \text{sec}$

**Answer: A**

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39. The half life period of a first order chemical reaction is 16.93 minutes.

Time required for the completion of 99 % of the chemical reaction will be

( $\log 2 = 0.301$ ):

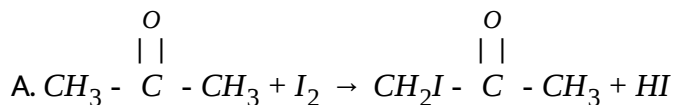
- A. 23.03 minutes
- B. 112.49 minutes
- C. 460.6 minutes
- D. 230.3 minutes

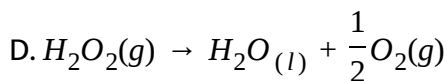
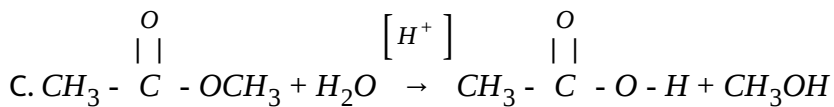
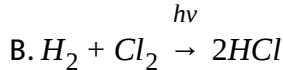
**Answer: B**



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40. Which of the following reactions is pseudo first order reaction?





**Answer: C**

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**41.** Which of the following options regarding characteristics of zero order reaction is correct?

(P) Time for 50 % dissociation will increase as initial concentration increase.

(Q) In same time interval same % of reactant gets consumed.

(R) The graph of log of concentration of reactant vs. time will be linear.

(S) Average rate between two time interval and instantaneous rate at the two intervals will be same as long as reaction is occurring at the two instants.

A. Only P is correct

B. Q and R are the only incorrect statements

C. Only R is incorrect

D. Only S is correct

**Answer: B**

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**42.** For a first order reaction, the concentration decreases to 30 % of its initial value in 5.0 min. What is the rate constant?

A.  $0.46^{-1}$

B.  $0.24\text{min}^{-1}$

C.  $0.14\text{min}^{-1}$

D.  $0.060\text{min}^{-1}$

**Answer: B**

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43. For a gaseous reaction :  $2A(g) \rightarrow B(g)+2C(g)$ , the pressure changes from 10 atm to 15 atm in 10 min. Order of the reaction may be :

A. 1

B. 1.2

C. 1.5

D. 0.75

**Answer: D**

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44. The inversion of cane sugar proceeds with half life of 50 minutes  $\text{pH} = 5$  for any concentration of sugar. However if  $\text{pH} = 6$ , the half life changed to 500 minutes. The law expression of sugar inversion can be written as:

$$A. r = K[\text{sugar}]^2 [H^+]^0$$

$$B. r = K[\text{sugar}]^1 [H^+]^0$$

$$C. r = K[\text{sugar}]^1 [H^+]^1$$

$$D. r = K[\text{sugar}]^0 [H^+]^0$$

**Answer: C**

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45. The reaction  $A \xrightarrow{k} \text{Products}$ , is zero order while the reaction  $B \xrightarrow{k} \text{Product}$ , is 1st order. For what initial concentration of A the half lives of the two reactions are equal?

A. 2 M

B.  $\ln 2$  M

C.  $2 \log 2$  M

D.  $2 \ln 2$  M



**Answer: D**

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46. For the reaction  $A + 2B \rightarrow$  products (started with concentration taken in stoichiometric proportion), the experimentally determined rate law is :

$$-\frac{d[A]}{dt} = k\sqrt{[A]}\sqrt{[B]}$$

The half life time of the reaction would be :

A.  $\frac{0.693}{k}$

B.  $\frac{0.693}{1/k}$

C.  $\frac{0.693}{\sqrt{2}k}$

D. not defined

**Answer: C**

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47. For a reaction  $2A + B \rightarrow \text{product}$ , rate law is  $-\frac{d[A]}{dt} = k[A]$ . At a time when  $t = \frac{1}{k}$ , concentration of the reactant is " ( $C_0 = \text{initial concentration}$ )

A.  $\frac{C_0}{e}$

B.  $C_0 e$

C.  $\frac{C_0}{e^2}$

D.  $\frac{1}{C_0}$

**Answer: C**

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48. Concentration of the reactant in first-order is reduced to  $\frac{1}{e^2}$  after :

(Natural life =  $\frac{1}{k}$ )

A. one natural life-time

B. two natural life-time

C. three natural life-time

D. four natural life-time

**Answer: B**

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**49.** In a I order reaction  $A \rightarrow$  products, the concentration of the reactant decrease to 6.25 % of its initial value in 80 minutes. What is (i) the rate constant and (ii) the rate of the reaction, 100 minutes after the start, if the initial concentration is 0.2mole/litre ?

A.  $2.17 \times 10^{-2} \text{min}^{-1}$ ,  $3.47 \times 10^{-4} \text{mol.litre}^{-1} \text{min}^{-1}$ .

B.  $3.465 \times 10^{-2} \text{min}^{-1}$ ,  $2.166 \times 10^{-4} \text{mol.litre}^{-1} \text{min}^{-1}$ .

C.  $3.465 \times 10^{-3} \text{min}^{-1}$ ,  $2.17 \times 10^{-3} \text{mol.litre}^{-1} \text{min}^{-1}$ .

D.  $2.166 \times 10^{-3} \text{min}^{-1}$ ,  $2.667 \times 10^{-4} \text{mol.litre}^{-1} \text{min}^{-1}$ .

**Answer: B**

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50. Under the same reaction conditions, initial concentration of  $1.386 \text{ mol dm}^{-3}$  of a substance becomes half in 40 seconds and 20 seconds through first order and zero order kinetics, respectively. Ratio

$\left(\frac{k_1}{k_0}\right)$  of the rate constant for first order ( $k_1$ ) and zero order ( $k_0$ ) of the reaction is :

A.  $0.5 \text{ mol}^{-1} \text{ dm}^{-3}$

B.  $1.0 \text{ mol}^{-1} \text{ dm}^{-3}$

C.  $1.5 \text{ mol}^{-1} \text{ dm}^{-3}$

D.  $2.0 \text{ mol}^{-1} \text{ dm}^{-3}$

**Answer: A**



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51. In a first order reaction, the concentration of the reactant decreases from  $800\text{mol dm}^{-3}$  to  $50\text{mol dm}^{-3}$  in  $2 \times 10^4\text{s}$ . The rate constant of the reaction (in  $\text{s}^{-1}$ ) is

A.  $3.45 \times 10^{-5}$

B.  $1.38 \times 10^{-4}$

C.  $1.00 \times 10^{-4}$

D.  $5.00 \times 10^{-5}$

**Answer: B**



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52. A reaction is catalysed by  $H^+$  ion, and in the rate law the dependence of rate is of first order with respect to the concentration of  $H^+$  ions, in presence of HA rate constant is  $2 \times 10^{-3}\text{min}^{-1}$  and in presence of HB rate constant is  $1 \times 10^{-10}\text{min}^{-1}$ . HA and HB have relative strength as :

A. 0.5

B. 0.002

C. 0.001

D. 2

**Answer: D**



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53. For the first-order reaction  $(C = C_0 e^{-k_1 t})$  and  $T_{av} = k_1^{-1}$ . After two average lives concentration of the reactant is reduced to :

A. 25 %

B. 75 %

C.  $\frac{100}{e}$  %

D.  $\frac{100}{e^2}$  %

**Answer: D**



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54. Number of natural life times ( $T_{av}$ ) required for a first-order reaction to achieve 99.9 % level of completion is :

A. 2.3

B. 6.9

C. 9.2

D. 0.105

**Answer: B**



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55. For a zero order reaction and a 1st order reaction half life are in ratio of 4:1. Calculate ratio of time taken to complete 87.5 % reaction for zero order : first order reaction respectively.

A. 7:3

B. 3:7

C. 4:1

D. 5:3

**Answer: A**



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**56.** A first order reaction has a rate constant of  $0.0541\text{s}^{-1}$  at  $25^\circ\text{C}$ . What is the half-life for this reaction?

A. 18.5s

B. 12.8s

C. 0.0781s

D. 0.0375s

**Answer: B**



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57. For a first order chemical reaction :  $A \rightarrow P$ . The correct statement(s) is/are :

A. The extent of reaction completed at any time 't' is dependent on initial concentration of the reactant.

B. The reaction must be an elementary reaction.

C. The time required for 99 % completion of reaction is  $\left[ \frac{2t_{1/2}}{\log_{10} 2} \right]$

D. Concentration of product increases linearly with time.

**Answer: C**

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58. Which does not change with time for a first-order reaction?

- A. The amount of reactant that disappears in each half-time
- B. The concentration of the reactant
- C. The length of each half-life
- D. The rate of the reaction

**Answer: C**

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**59.** At a given temperature, a first-order reaction has a rate constant of  $3.3 \times 10^{-3} \text{s}^{-1}$ . How much time is required for the reaction to be 75 % complete?

- A. 100 s
- B. 210 s
- C. 420 s
- D. 630 s

**Answer: C**

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**60.** Which statement about second order reactions is correct?

- A. Second order reactions require different reactants.
- B. Second order reactions are faster than first order reactions.
- C. Second order reactions are unaffected by changes in temperature.
- D. The half-life of a second order reaction depends on the initial reactant concentration.

**Answer: D**

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**61.** For the reaction  $A \rightarrow B$  that is first-order in A, The rate constant is  $2.08 \times 10^{-2} \text{s}^{-1}$ . How long would it take for [A] to change from 0.100M to

0.0450M ?

A. 0.0166s

B. 16.7s

C. 38.4s

D. 107 s

**Answer: C**



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**62.** A substance, X, undergoes a first order reaction  $X \rightarrow Y$  with a half life of 20 minutes. If the initial concentration of X is 2.0 M, what will its concentration be after 40 minutes?

A. 0.25 M

B. 0.50 M

C. 1.0 M

D. 1.4 M

**Answer: B**

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**63.** For reaction,  $A \rightarrow B$ , the rate law is  $\text{rate} = k[A]$ . If the reaction is 40.0 % complete after 50.0 minutes, what is the value of the rate constant,  $k$ ?

A.  $8.00 \times 10^{-3} \text{min}^{-1}$

B.  $1.02 \times 10^{-2} \text{min}^{-1}$

C.  $1.39 \times 10^{-2} \text{min}^{-1}$

D.  $1.83 \times 10^{-2} \text{min}^{-1}$

**Answer: B**

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64. What is the half life of the irreversible first order reaction,  $A \rightarrow B$ , if

75 % of A is converted to B in 60 minutes?

A. 30 minutes

B. 45 minutes

C. 60 minutes

D. 80 minutes

**Answer: A**



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65. The first-order disappearance of a substance has a half-life of 34.0 s.

How long does it take for the concentration of that substance to fall to

12.5 % of its initial value?

A. 11 s

B. 68 s

C. 102 s

D. 272 s

**Answer: C**

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**66.** The rate of decomposition of a certain compound in solution is first order. If the concentration of the compound is halved, what happens to the reaction's half-life?

A. It doubles

B. It decreases to  $\frac{1}{2}$  of the original value

C. It decreases to  $\frac{1}{4}$  of the original value

D. It remains the same

**Answer: D**

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67. Which change will decrease the rate of the reaction between  $I_2(s)$  and  $H_2(g)$ ?

- A. Increasing the partial pressure of  $H_2(g)$
- B. Adding the  $I_2(s)$  as one piece rather than as several small lones
- C. Heating the reaction mixture
- D. Adding a catalyst for the reaction

**Answer: B**



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68. What is the first-order rate constant for the reaction that is 36.5 % complete in 0.0200 seconds?

- A.  $50.4s^{-1}$
- B.  $27.7s^{-1}$



C.  $22.7\text{s}^{-1}$

D.  $9.86\text{s}^{-1}$

**Answer: C**

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**69.** The half-life of a first-order reaction is 1.5 hours. How much time is needed for 94 % of the reactant to change to product?

A. 0.13 hours

B. 6.1 hours

C. 2.3 hours

D. 36 hours

**Answer: B**

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70. What are the units for the rate constant of a zero-order reaction?

A. time

B. time<sup>-1</sup>

C. M.time

D. M.time<sup>-1</sup>

**Answer: D**



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71. For a first order reaction  $A \rightarrow B$ , find  $\left[ \frac{t_{7/8}}{t_{1/2}} \right]$ .

A. 3

B. 4

C. 2

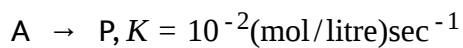
D. 6

**Answer: A**



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**72.** For the zero order reaction :



If initial concentration of A is 0.3 M, then find concentration of A left after 10 sec.

A. 0 M

B. 0.2 M

C. 0.1 M

D. 0.15 M

**Answer: B**



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73. Which is constant for different reactant concentrations in a first-order reaction?

- A. The time required for the concentration of reactants to drop below 0.001 M.
- B. The time required for one-half of reactants to disappear.
- C. The rate of disappearance of reactants in  $\text{mol.L}^{-1} \cdot \text{time}^{-1}$ .
- D. The rate of formation of products in  $\text{mol.L}^{-1} \cdot \text{time}^{-1}$ .

**Answer: B**

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## D. Methods to Determine the Rate Law

1.  $A + B \rightarrow \text{Product}$ ,  $\frac{dx}{dt} = k[A]^a[B]^b$  If  $\left(\frac{dx}{dt}\right) = k$ , then order of reaction is :

A. 4

B. 2

C. 1

D. 0

**Answer: D**

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2. For the reaction  $2A + 3B \rightarrow \text{product}$ , A is in excess and on changing the concentration of B from 0.1 M to 0.4 M, rate becomes doubled. Thus, rate law is :

A.  $\frac{dx}{dt} = k[A]^2[B]^2$

B.  $\frac{dx}{dt} = k[A][B]$

C.  $\frac{dx}{dt} = k[A]^0[B]^2$

D.  $\frac{dx}{dt} = k[B]^{1/2}$

**Answer: D**

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3. For the reaction  $A \rightarrow B$  which is first order in A, which of the following change, as the concentration of A changes?

(P) Rate

(Q) Rate constant

(R) Half-life

A. P only

B. R only

C. Q and R only

D. P, Q and R

**Answer: A**

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4. For a given reaction,

$A \rightarrow \text{Product}$ , rate is  $1 \times 10^{-4} \text{Ms}^{-1}$

when  $[A] = 0.01 \text{ M}$  and rate is  $1.41 \times 10^{-4} \text{M s}^{-1}$

when  $[A] = 0.02 \text{ M}$ . Hence, rate law is :

A.  $-\frac{d[A]}{dt} = k[A]^2$

B.  $-\frac{d[A]}{dt} = k[A]$

C.  $-\frac{d[A]}{dt} = \frac{k}{4}[A]$

D.  $-\frac{d[A]}{dt} = k[A]^{1/2}$

**Answer: D**



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5. For an elementary reaction :  $A + 2B \rightarrow C$  when  $1 \text{ M}$  A was taken with  $10^{-4} \text{ M}$  B, time taken for B to reduce to half was found to be 10 seconds.

Calculate  $t_{1/2}$  when  $1 \text{ M}$  A is reacted with  $10^{-5} \text{ M}$  B.

[ $t_{1/2}$ =time for B to reduce to 50% of original]

A. 10 seconds

B. 1 seconds

C. 100 seconds

D. 20 seconds

**Answer: C**

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6. Saponification of ethyl acetate ( $CH_3COOC_2H_5$ ) by NaOH (Saponification of ethyl acetate by NaOH is second order reaction) is studied by titration of the reaction mixture initially having 1:1 molar ratio of the reactants. If 10 mL of 1 N HCl is required by 2 mL of the solution at the start and 8 mL of 1 N HCl is required by another 5 mL after 10 minutes, then rate constant is :

A.  $k = \frac{2.303}{10} \log \frac{10}{8}$

B.  $k = \frac{2.303}{10} \log \frac{10}{2}$



$$C. k = \frac{1}{10} \left[ \frac{1}{8} - \frac{1}{10} \right]$$

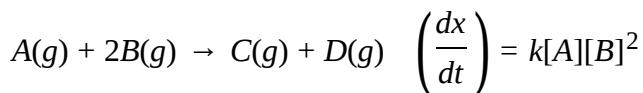
$$D. k = \frac{1}{10} \left[ \frac{1}{2} - \frac{1}{10} \right]$$

**Answer: C**



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7. For the reaction,



Initial pressure of A and B are respectively 0.60 and 0.80 atm. At a time when pressure of C is 0.20 atm rate of the reaction, relative to the initial value is :

A.  $\frac{1}{6}$

B.  $\frac{1}{48}$

C.  $\frac{1}{4}$

D.  $\frac{1}{24}$

**Answer: A**



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8. If  $\left(\frac{dx}{dt}\right) = k[H^+]^n$  and rate becomes 100 times when pH change from 2 to 1. Hence, order is :

A. 1

B. 2

C. 3

D. 0

**Answer: B**



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9. Consider the following reaction,  $Zn + 2H^+ \rightarrow Zn^{2+} + H_2$

Half-life period is independent of concentration of Zn at constant pH. At

constant Zn concentration, half-life is 10 minutes at pH = 2 and half-life is 100 minutes at pH = 3. Hence, rate law is :

A.  $k[\text{Zn}][\text{H}^+]$

B.  $k[\text{Zn}][\text{H}^+]^2$

C.  $k[\text{Zn}]^0[\text{H}^+]$

D.  $k[\text{Zn}]^0[\text{H}^+]^2$

**Answer: A**



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**10.** For a gaseous reaction :  $2\text{A}(\text{g}) \rightarrow 3\text{B}(\text{g}) + 4\text{C}(\text{g})$ , occurring in a rigid vessel, if initially pressure is 3 atm and after 10 minutes and 20 minutes the pressure is 6.75 atm and 10.5 respectively, then what will be the order of reaction?

A. 0

B. 1

C. 2

D.  $\frac{1}{2}$

**Answer: A**



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11. For the reaction :  $A \rightarrow \text{Products}$ , the time for 75 % completion of reaction is 5 times for 50 % completion of reaction. The order of reaction is :

A. 0

B. -1

C. 2

D. 3

**Answer: D**



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12. For a reaction :  $A(g) \rightarrow nB(g)$ , the rate constant is  $6.93 \times 10^{-4} s^{-1}$ . The reaction is performed at constant volume and temperature, starting with only pure 'A'. If after 1000 seconds, the pressure of system becomes 3 times of its initial pressure, then the value of 'n' is :

A. 2

B. 3

C. 4

D. 5

**Answer: D**



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13. What is the order of a reaction if the rate constant has the units  $L \cdot mol^{-1} \cdot s^{-1}$ ?

A. zero

B. First

C. Second

D. Third

**Answer: C**

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**14.** The time elapsed between 33 % and 67 % completion of a first order reaction is 30 minutes. What is the time needed for 25 % completion?

A. 150.5 minutes

B. 12.5 minutes

C. 180.5 minutes

D. 165.5 minutes

**Answer: B**

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15. A reaction  $2A + B \xrightarrow{k} C + D$  is first order with respect to A and 2nd order with respect to B. Initial conc. (t = 0) of A is  $C_0$  while that of B is  $2C_0$ . If at t = 30 minutes the conc. Of C is  $\frac{C_0}{4}$  then rate expression at t = 30 minutes is :

A.  $R = 7C_0^3 \frac{k}{16}$

B.  $R = 27C_0^3 \frac{k}{32}$

C.  $R = 247C_0^3 \frac{k}{64}$

D.  $R = 49C_0^3 \frac{k}{32}$

**Answer: D**



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16. The reaction :  $A(aq) \rightarrow \text{Products}$ , occur 0.01 % in 20 milliseconds when the initial concentration of 'A' was 0.4 M and 80 milliseconds when the initial concentration of 'A' was 0.2 M. The order of reaction is :

A. 0

B. 1

C. 2

D. 3

**Answer: D**



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17. Two I-order reaction have half-lives in the ratio 3:2. Calculate the ratio of time intervals  $t_1, t_2$ . Where  $t_1$  is the time period for 25 % completion of the first reaction and  $t_2$ , for 75 % completion of the second reaction.

A. 0.311 : 1

B. 0.420 : 1

C. 0.273 : 1

D. 0.199 : 1



**Answer: A**

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**18.** If the fermentation of sugar in an enzymatic solution that is 0.12 M, the concentration of the sugar is reduced to 0.06 M in 10 h and to 0.03 M in 20 h. What is the order of the reaction?

A. 1

B. 2

C. 3

D. 0

**Answer: A**

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19. In an acid catalysed hydrolysis of an organic compound A, the half-life of A changes from 100 min (when carried out in a buffer solution of pH=3) to 1 min (when carried out in a buffer solution of pH=4). Both the half-lives are independent of the concentration of the organic compound. If the rate law is represented as  $R = k[H^+]^a[A]^b$  then the values of a and b will be :

A.  $a = 1, b = 1$

B.  $a = -1, b = 2$

C.  $a = 2, b = 1$

D.  $a = -2, b = 1$

**Answer: D**



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20. For reaction  $A + B \rightarrow \text{products}$ , the rate of the reaction was doubled when the concentration of A was doubled. The rate was also doubled

when the concentration of both A and B were doubled. Then, order of the reaction with respect to A and B are :

A. 1,1

B. 2,0

C. 1,0

D. 0,1

**Answer: C**



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21. when the concentration of a particular reactant is tripled, the initial rate of the reaction increases by a factor of nine, what is the order of the reaction with respect to this reactant?

A. Zero

B. One

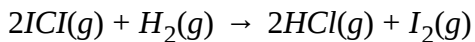
C. Two

D. Three

**Answer: C**

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**22.** Consider the reaction,



At a certain temperature the rate constant is found to be  $1.63 \times 10^{-6} \text{ L/mol} \cdot \text{s}^{-1}$ . What is the overall order of the reaction?

A. Zero

B. First

C. Second

D. Third

**Answer: C**

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23. For a reaction  $A + B \rightarrow \text{product}$ , the rate of the reaction was doubled when the concentration of A alone was reduced to half. Half life of reaction is doubled when concentration of B is reduced to half keeping concentration of A constant. Then order of reaction with respect to A and B are :

A. 2,2

B. 2,3

C.  $\frac{1}{2}, \frac{1}{2}$

D. -1, 2

**Answer: D**



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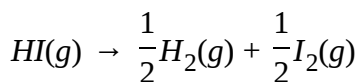
24. If the half-life of a reaction increases as the initial concentration of substance increases, the order of the reaction is :

- A. zero
- B. First
- C. second
- D. third

**Answer: A**

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25. The dissociation of HI molecules as shown below, occurs at a temperature of 639 K. The rate constant  $k = 3.02 \times 10^{-5} M^{-1} s^{-1}$



What is order of reaction?

- A. 0
- B. 1
- C. 2
- D. can not be predicted

**Answer: C**

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26. For acid catalysed hydrolysis of ester, rate law obtained is rate =  $k[\text{ester}][H^+]$

where  $k = 0.01M^{-1}hr^{-1}$ . What is the half-life of this reaction, if the initial concentrations are 0.02 M for the ester and 0.05 M for the catalyzing acid?

- A. 1429 hours
- B. 5000 hours
- C. 1386 hours
- D. 2 hours

**Answer: C**

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27. The acid catalysed hydrolysis of an organic compound A at  $30^{\circ}\text{C}$  has a time for half change of 100 min, when carried out in a buffer solution at  $\text{pH}=5$ , and 10 min. when carried out at  $\text{pH}=4$ . Both times of half change are independent of the initial concentration of A. If the rate constant K is given by  $\frac{-d[A]}{dt} = K[A]^a[H^+]^b$  what are the values of a and b?

A.  $a = 1, b = 1$

B.  $a = 2, b = 1$

C.  $a = 0, b = 1$

D.  $a = 1, b = 0$

**Answer: A**



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28. The half life period for catalytic decomposition of  $\text{AB}_3$  at 50 mm is found to be 4 hrs and at 100 mm it in 2 hrs. The order of reaction is :



A. 2

B. 1

C. 2

D. 0

**Answer: C**



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## E. Methods to Monitor the Progress of Reaction

1. Consider the reaction  $2A(g) \rightarrow 3B(g) + C(g)$ . Starting with pure A initially, the total pressure doubled in 3 hrs. The order of the reaction might possibly be :

A. zero

B. First

C. second

D. unpredictable from this data

**Answer: A**

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2. Formation of  $NO_2F$  from  $NO_2$  and  $F_2$  as per the reaction  $2NO_2(g) + F_2(g) \rightarrow 2NO_2F(g)$  is a second order reaction, first order with respect to  $NO_2$  and first order with respect to  $F_2$ . If  $NO_2$  and  $F_2$  are present in a closed vessel in ratio 2:1 maintained at a constant temperature with an initial total pressure of 3 atm, what will be the total pressure in the vessel after the reaction is complete?

A. 1 atm

B. 2 atm

C. 2.5 atm

D. 3 atm

**Answer: B**



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3. In gaseous state reaction,  $A_2(g) \rightarrow B(g) + \left(\frac{1}{2}\right)C(g)$ . The increase in pressure from 100 mm to 120 mm is noticed in 5 minutes. The rate of disappearance of  $A_2$  in  $\text{mm min}^{-1}$  is :

A. 4

B. 8

C. 16

D. 2

**Answer: B**



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4. The decomposition of a gaseous substance (A) to yield gaseous products (B), (C) follows First order kinetics. If initially only (A) is present

and 10 minutes after the start of the reaction the pressure of (A) is 200 mm Hg and that of overall mixture is 300 mm Hg, then rate constant for

$2A \rightarrow B + 3C$  is :

A.  $\left(\frac{1}{600}\right) \ln 1.25 \text{sec}^{-1}$

B.  $\left(\frac{2.303}{10}\right) \log 1.5 \text{min}^{-1}$

C.  $\left(\frac{1}{10}\right) \ln 1.25 \text{sec}^{-1}$

D. none of these

**Answer: A**



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5. In the reaction  $\text{NH}_4\text{NO}_2(\text{aq}) \rightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$  the volume of  $\text{N}_2$  after 20 min and after a long time is 40 ml and 70 ml respectively. The value of rate constant is :

A.  $\left(\frac{1}{20}\right) \ln \left(\frac{7}{4}\right) \text{min}^{-1}$

B.  $\left(\frac{2.303}{1200}\right) \log\left(\frac{7}{3}\right) \text{sec}^{-1}$

C.  $\left(\frac{1}{20}\right) \log\left(\frac{7}{3}\right) \text{min}^{-1}$

D.  $\left(\frac{2.303}{10}\right) \log\left(\frac{11}{7}\right) \text{min}^{-1}$

**Answer: B**



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6. At 1800 K, ethane gas decomposes to ethene and hydrogen. Rate constant for the reaction is  $10^{-3} \text{PA}^{-1} \text{sec}^{-1}$ . IF initial pressure of ethane is  $3 \times 10^5 \text{ PA}$ , how many sec would it take for the pressure to reach  $5 \times 10^5 \text{ PA}$

A. 1800.2 sec

B.  $3.33 \times 10^{-2} \text{ sec}$

C.  $6.66 \times 10^{-3} \text{ sec}$

D. 1000.4 sec

**Answer: C**

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7. For a first order reaction, half life is found to be 138.6 min, what will be the rate of disappearance after 1 half life if initial concentration of reactant is 3M?

A.  $7.5 \times 10^{-3} \text{M min}^{-1}$

B.  $\frac{3}{2} \text{M sec}^{-1}$

C.  $5 \times 10^{-3} \text{M min}^{-1}$

D.  $15 \times 10^{-3} \text{M min}^{-1}$

**Answer: A**

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8. For a reaction :  $2A(g) \rightarrow B(g) + 3C(g)$ , rate constant of disappearance of A is  $10^{-3} M \text{ sec}^{-1}$ . If initially 2 M of A is taken then what will be concentration of C after 5 minutes?

A.  $0.3M$

B.  $0.9M$

C.  $0.45M$

D.  $1.5 \times 10^{-2}M$

**Answer: C**



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9. Given  $X \rightarrow \text{product}$  (1st order reaction)

conc.(mol/lit)    0.01    0.0025

time(min)        0        40

Initial rate of reaction (in mol/l/min)

A.  $3.43 \times 10^{-4}$

B.  $1.73 \times 10^{-4}$

C.  $3.43 \times 10^{-5}$

D.  $1.73 \times 10^{-4}$

**Answer: A**



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**10.** A bacterial growth follows first order kinetics and it is observed that increase in bacteria is by 10 % in 10 min. How long will it take to increase bacteria concentration to double of original?

A. 10 min

B. 50 min

C. 72.9 min

D. 32 min

**Answer: C**





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11. In a particular case of bacterial growth following second order kinetics, concentraion of bacteria increases to 4 times initial concentration of 1 M in 24 minutes. What will be the generation time of the bacterial growth, if initial concentration is 2 M.

A. 24 min

B. 16 min

C. 8 min

D. 12 min

**Answer: C**



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12. Acid catalysed hydrolysis of ester is first-order reactioin and rate constant is given by

$$k = (2.303)(t) \log \frac{V_{\infty} - V_0}{V_{\infty} - V_t}$$

where  $V_0$ ,  $V_t$  and  $V_{\infty}$  are the volume of standard NaOH required to neutralized acid present at a given time, if ester is 50 % hydrolysed then :

A.  $V_{\infty} = V_t$

B.  $V = (V_t - V_0)$

C.  $V_{\infty} = 2V_t - V_0$

D.  $V_{\infty} = 2V_t + V_0$

**Answer: C**

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13. If no catalyst ( $H^+$ ) is present in acid hydrolysis of ester (in above question) then constant K is :

A.  $\frac{2.303}{t} \log \frac{V_0}{V_t - V_{\infty}}$

B.  $\frac{2.303}{t} \log \frac{V_{\infty}}{V_{\infty} - V_t}$

$$C. \frac{2.303}{t} \log \frac{V_0}{V_t}$$

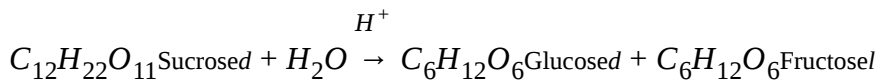
$$D. \frac{2.303}{t} \log \frac{V_\infty}{V_t - V_\infty}$$

**Answer: B**



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**14.** Inversion of sucrose ( $C_{12}H_{22}O_{11}$ ) is first-order reaction and is studied by measuring angle of rotation at different instants of time



If  $(r_\infty - r_0) = a$  and  $(r_\infty - r_t) = (a - x)$  (where  $r_0$ ,  $r_t$  and  $r_\infty$ ) are the angle of rotation at the start, at the time  $t$  and at the end of the reaction respectively, then there is 50 % inversion when :

A.  $r_0 = 2r_t - r_\infty$

B.  $r_0 - r_t = r_\infty$

C.  $r_0 = r_t - 2r_\infty$

D.  $r_0 = r_t + r_\infty$

**Answer: A**

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15. In the above question, solution is optically inactive when :

A.  $r_t = a$

B.  $r_t = 0$

C.  $r_t = x$

D.  $r_t = (a + x)$

**Answer: B**

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16. The gaseous decomposition reaction,



is observed to be first order over the excess of liquid water at 25 °C. If is

found that after 10 minutes the total pressure of system is 188 torr. The rate constant of the reaction (in  $hr^{-1}$ ) is: [Given: vapour pressure of  $H_2O$  at  $25^\circ C$  is 28 →  $\ln 2=0.7, \ln 3=1.1, \ln 10=2.3$ ]

A. 0.02

B. 1.2

C. 0.2

D. none of these

**Answer: B**



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17. In a first order reaction, the concentration of the reactant, decreases from 0.8 M to 0.4 M in 15 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M is :

A. 30 minutes

B. 15 minutes

C. 7.5 minutes

D. 60 minutes

**Answer: A**



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**18.** In the first order decomposition of A:



Concentration of A decrease from initial concentration 0.8 M to 0.2 M in 13.86 min. then rate of appearance of B (in M/sec.) at 13.86 sec. is :

A. 0.1

B. 0.01

C.  $2.6 \times 10^{-3}$

D.  $6.67 \times 10^{-4}$

**Answer: C**



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19. The rate constant for an isomerisation reaction is  $2.079 \times 10^{-5} \text{sec}^{-1}$ . If initial concentration of reactant is  $\sqrt{2}$  M, then calculate rate of reaction after  $\frac{10^5}{6}$  sec. [ $\ln 2 = 0.693$ ]

- A. 1 M/sec
- B.  $2.079 \times 10^{-5} \text{M/sec}$
- C.  $10^5 \text{M/sec}$
- D.  $0.693 \times 10^{-5} \text{M/sec}$

**Answer: B**

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20. The formation of oxide layer on metals follows first order kinetics and completely stops when the oxide thickness becomes 10 nm. If one hour

after exposure of oxygen to metal surface the thickness is 7.5 nm, then what would be the thickness 120 minute after the exposure?

- A. 10 nm
- B. 5.25 nm
- C. 8.475 nm
- D. 9.375 nm

**Answer: D**

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21. For a zero order reaction :  $A \rightarrow 2B$ , initial rate of a reaction is  $10^{-1} \text{M min}^{-1}$ . If concentration of 'A' is 0.1 after 120 sec then what would be concentration of B after 60 sec.

- A. 0.2 M
- B. 0.1 M
- C. 0.05 M



D. 0.15 M

**Answer: A**

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22. For a first order decomposition of  $N_2O_5(g)$  to give  $NO_2(g)$  and  $O_2(g)$ , what will be the rate constant if at initial instant, after 10 minutes and after a very long time, total pressure is 200 mm of Hg, 325 mm of Hg and 450 mm of Hg?

A.  $0.693 \text{ min}^{-1}$

B.  $6.93 \text{ min}^{-1}$

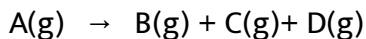
C.  $6.93 \times 10^{-2} \text{ min}^{-1}$

D.  $\frac{6.93}{2} \times 10^{-2} \text{ min}^{-1}$

**Answer: C**

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23. For a first order reaction :



Occurring at 1 bar pressure and 300 K if initial volume of the container containing only A is  $V_0$  and after 10 minutes it is  $V_{10}$  then average life of A will be (in minutes) :

A.  $0.1 \ln \frac{2V_0}{3V_0 - V_{10}}$

B.  $\frac{10}{\ln \frac{2V_0}{3V_0 - V_{10}}}$

C.  $0.1 \ln \frac{V_0}{V_0 - V_{10}}$

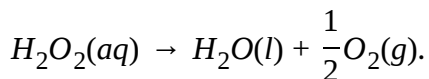
D.  $\frac{10}{\ln \frac{V_0}{V_0 - V_{10}}}$

**Answer: B**



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24. For the first order reaction :



the half life of reaction is 30 min. If the volume of  $O_2(g)$  collected at a certain pressure and temperature is 100 ml after a long time from the start of reaction, then what was the volume of  $O_2(g)$  collected at the same pressure and temperature, after 60 min from the start of reaction?

- A. 25 ml
- B. 75 ml
- C. 50 ml
- D. 12.5 ml

**Answer: B**

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**25.** For the reaction :  $2A(g) \rightarrow 3B(g) + C(l)$ , the rate law is :

$$r = -\frac{1}{2} \cdot \frac{dP_A}{dt} = K \cdot P_A$$

The reaction is performed at constant volume and temperature, starting with only pure  $A(g)$ . If  $P_T$  and  $P_\infty$  are the total pressure of system at

$t = (\infty)$ , and  $P_0$  is the vapour pressure of C(l), then the rate constant of reaction may be expressed as :

$$\text{A. } k = \frac{1}{T_{\min}} \cdot \ln \frac{P_{\infty}}{P_{\infty} - P_T}$$

$$\text{B. } k = \frac{1}{2T_{\min}} \cdot \ln \frac{P_{\infty}}{P_{\infty} - P_T}$$

$$\text{C. } k = \frac{1}{2T_{\min}} \cdot \ln \frac{P_{\infty} - P_0}{3(P_{\infty} - P_T)}$$

$$\text{D. } k = \frac{1}{2T_{\min}} \cdot \ln \frac{P_{\infty} - P_0}{P_{\infty} - P_T}$$

**Answer: C**



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**26.** A substance 'A' decomposes in solution following the first order kinetics. Flask I contains 1 L of 1 M solution of A and flask II contains 100 ml of 0.6 M solution. After 8 hr, the conc. of A in flask 1 becomes 0.25 M. What will be time for conc. of A in flask II to become 0.3 M?

A. 0.4hr

B. 2.4hr

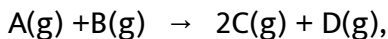
C. 4.0hr

D. unpredictable as rate constant is not given

**Answer: C**

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**27.** For the following reaction :



the rate law is given as rate of disappearance  $A = k[A]^{2/3}[B]^{1/3}$ . If initial concentration of A and B are 2M each and no C and D were present initially, then the time at which total concentration (sum of concentration A, B, C, and D) will become 5.5 M, is :

(Given :  $k = 1.386 \times 10^{-1} \text{ min}^{-1}$ )

A. 5 min

B. 10 sec

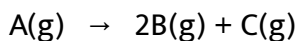
C. 600 sec

D.  $\frac{1}{2}$  min

**Answer: C**

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**28.** Consider a first order gas phase reaction,



The initial pressure taking only A in a rigid vessel was found to be P atm.

After a lapse of 10 minutes, the pressure of the system increases by x units and became  $P_{10}$  atm. The rate constant for the reaction is given by :

A.  $k = \frac{2.303}{10} \log \frac{P}{P+x} \text{ min}^{-1}$

B.  $k = \frac{2.303}{10} \log \frac{P}{P - \frac{x}{2}} \text{ min}^{-1}$

C.  $k = 2.303 \times 6 \log \frac{P}{P_{10} - (P)} \text{ hr}^{-1}$

D.  $k = 2.303 \times 6 \log \frac{2P}{3P - P_{10}} \text{ hr}^{-1}$

**Answer: B**

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29. Decomposition of reaction  $3A(g) \rightarrow 2B(g) + 2C(s)$  follows first order kinetics. Starting with pure A(at 6 atm), the pressure developed after 20 minutes and after a long time are 5.05 atm and 4.05 atm, respectively. Identify the correct statement.

- A. Time for 75 % completion is slightly more than 40 minute.
- B. Time for 87.5 % completion is slightly less than 60 minute.
- C. Time for 93.75 % completion is exactly 80 minute.
- D. Time for 90 % completion is more than 80 minute.

**Answer: C**

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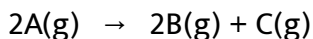
30. AT 373 K, a gaseous reaction  $A \rightarrow 2B + C$  is found to be of first order. Starting with pure A, the total pressure at the end of 10 min. was 176 mm and after a long time when A was completely dissociated, it was 270 mm. The pressure of A at the end of 10 minutes was :

- A. 94 mm
- B. 47 mm
- C. 43 mm
- D. 90 mm

**Answer: B**

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31. Consider the following first order reaction,



Starting with pure A having pressure 2 atm initially, the total pressure is 3 atm after 2 hrs. Then total pressure after 4 hrs will be :



A. 4 atm

B. 1.5 atm

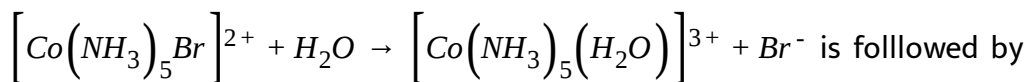
C. 5 atm

D. 3.5 atm

**Answer: D**

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32. The reaction,



is followed by measuring a property of the solution known as the optical density of which may be taken to be linearly related to the concentration of the reactant. The values of optical density are 0.80, 0.35 and 0.20 at the end of 20 minutes, 40 minutes and infinite time after the start of the reaction which is first order. Calculate the rate constant.

A.  $6.93 \times 10^{-3} \text{ min}^{-1}$

B.  $3.51 \times 10^{-2} \text{ min}^{-1}$

C.  $6.93 \times 10^{-2} \text{ min}^{-1}$

D.  $3.51 \times 10^{-3} \text{ min}^{-1}$

Answer: C

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33. For the reaction:  $N_2O_4(g) \rightarrow 2NO_2(g)$  the number of moles of  $N_2O_4(g)$  with time given as :

Time, min	0	5	10
Moles $N_2O_4(g)$	0.200	0.170	0.140

What is the number of moles of  $NO_2(g)$  at  $t = 10 \text{ min}$ ? (Assume moles of  $NO_2(g) = 0$  at  $t = 0$ )

A. 0.280

B. 0.120

C. 0.110

D. 0.060

**Answer: B**

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**34.** A compound decomposes with a first-order rate constant of  $0.00854\text{s}^{-1}$ . Calculate the concentration after 5.0 minutes for an initial concentration of 1.2 M.

A. 0.010 M

B. 0.093 M

C. 0.92 M

D. 1.1 M

**Answer: B**

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35. A first-order reaction has a rate constant of  $k = 0.320 \text{ min}^{-1}$ . For an initial reactant concentration of  $1.22 \text{ M}$ , how long does it take for its concentration to fall to  $0.150 \text{ M}$ ?

- A. 0.671 min
- B. 2.60 min
- C. 6.55 min
- D. 25.4 min

**Answer: C**



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36. The reaction  $\text{CH}_3\text{NC} \rightarrow \text{CH}_3\text{CN}$  is first order. Which reaction characteristic changes as the reaction proceeds?

- A. The half life
- B. The rate constant

C. The rate law

D. The reaction rate

**Answer: D**

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**37.** A substance X decomposes in a second-order reaction. A solution that is initially 1.00 M in X requires 0.50 h for its concentration to decrease to 0.50M. How much time will it take for a solution of X to decrease in concentration from 1.00 M to 0.25 M?

A. 0.50 h

B. 1.0 h

C. 1.5 h

D. 2.0 h

**Answer: C**

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38. In a first order reaction, the concentration of the reactant, decreases from 0.8 M to 0.4 M in 15 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M is :

A.  $\frac{\ln 2}{1200}$

B.  $\frac{\ln 2}{600}$

C.  $\frac{\ln 2}{120}$

D.  $\frac{\ln 2}{60}$

**Answer: A**

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39. For a first order reaction  $A \rightarrow B$ , A is optically active and B is optically inactive, and following experimental data were observed :

Time	0	60 min	$\infty$
Optical Rotation	$82^\circ$	$22^\circ$	$2^\circ$

If some impurity, find optical rotation after 2 hours :

- A.  $7^\circ$
- B.  $12^\circ$
- C.  $22^\circ$
- D.  $42^\circ$

**Answer: A**



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**40.** The reaction  $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$  follows first order kinetics. The pressure of a vessel containing only  $N_2O_5$  was found to increase from 50 mm Hg to 87.5 mm Hg in 30 min. The pressure exerted by the gases after 60 min. will be (Assume temperature remains constant):

- A. 106.25 mm Hg

B. 116.25 mm Hg

C. 125 mm Hg

D. 150 mm Hg

**Answer: A**



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**41.** For the reaction :  $A(g) \rightarrow B(g) + C(g)$  Concentration of 'A' varies with time (in sec) as :

$$[A]_T = [10 - 0.2T^2]M$$

The time at which rate of formation of 'B' is 1 M/sec.

A. 2 sec

B. 3 sec.

C. 4 sec.

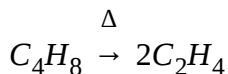
D. 2.5 sec.



**Answer: D**

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**42.** Ethylene is produced by cyclobutane...according to the reaction :



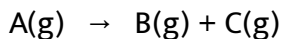
The rate constant is  $2.48 \times 10^{-4} \text{sec}^{-1}$ . In what time will the molar ratio of the ethylene to cyclobutane in reaction mixture attain the value 1?

- A. 27.25 minute
- B. 28.25 minute
- C. 25 minute
- D. 20 minute

**Answer: A**

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43. Consider a first order gas phase decomposition reaction given below :



The initial pressure of the system before decomposition of A was  $P_i$ . After lapse of time 't', total pressure of the system increased by x units and became ' $p_t$ '. The rate constant k for the reaction is given as :

$$A. k = \frac{2.303}{t} \log \frac{P_i}{2P_i - x}$$

$$B. k = \frac{2.303}{t} \log \frac{P_i}{2P_i - P_t}$$

$$C. k = \frac{2.303}{t} \log \frac{P_i}{2P_i + P_t}$$

$$D. k = \frac{2.303}{t} \log \frac{P_i}{P_i + x}$$

**Answer: B**



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F. Effect of Temperature and Catalyst

1. Rate of which reaction increase with temperature:

- A. of any
- B. of exothermic reactions
- C. of endothermic reaction
- D. of none

**Answer: A**



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2. For a zero order reaction. Which of the following statement is false:

- A. The rate is independent of the temperature of the reaction
- B. The rate is independent of the concentration of the reactants
- C. The half life depends upon the concentration of the reactants
- D. The rate constant has the unit  $\text{mole L}^{-1}\text{sec}^{-1}$

**Answer: A**



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3. A large increase in the rate of a reaction for a rise in temperature is due to :

- A. increase in the number of collisions
- B. the increase in the number of activated molecules
- C. the shortening of mean free path
- D. the lowering of activation energy

**Answer: B**



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4. The first order rate constant  $k$  is related to temperature as  $\log$

$k = 15.0 - \left(10^6/T\right)$ . Which of the following pair of value is correct?

A.  $A = 10^{15}$  and  $E = 1.9 \times 10^4 \text{KJ}$

B.  $A = 10^{-15}$  and  $E = 40 \text{KJ}$

C.  $A = 10^{15}$  and  $E = 40 \text{KJ}$

D.  $A = 10^{-15}$  and  $E = 1.9 \times 10^4 \text{KJ}$

**Answer: A**

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5. The decomposition of  $N_2O$  into  $N_2$  and  $O_2$  in presence of gaseous argon follows second order kinetics with  $k = \left(5.0 \times 10^{11} \text{L mol}^{-1} \text{s}^{-1}\right) e^{\frac{-41570 \text{K}}{T}}$  (K stands for Kelvin units). The energy of activation of the reaction is :

A.  $5.0 \times 10^{11} \text{J}$

B. 41570 J

C. 5000 J

D. 345612.98 J

**Answer: D**

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6. How much faster would a reaction proceed at  $25^{\circ}\text{C}$  than at  $0^{\circ}\text{C}$  if the activation energy is  $65\text{ kJ}$ ?

A. 2 times

B. 5 times

C. 11 times

D. 16 times

**Answer: C**

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7. The rate constant, the activation energy and the frequency factor of a chemical reaction at  $25^{\circ}\text{C}$  are  $3.0 \times 10^{-4}\text{s}^{-1}$ ,  $104.4\text{KJ mol}^{-1}$  and

$6.0 \times 10^{14} \text{s}^{-1}$  respectively.

The value of the rate constant as  $T \rightarrow \infty$  is :

A.  $2.0 \times 10^{18} \text{s}^{-1}$

B.  $6.0 \times 10^{14} \text{s}^{-1}$

C. infinite

D.  $3.6 \times 10^{30} \text{s}^{-1}$

**Answer: B**



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8. For a given reaction, energy of activation for forward reaction ( $E_{af}$  is  $80 \text{ kJ mol}^{-1}$ .  $\Delta H = -40 \text{ kJ mol}^{-1}$  for the reaction. A catalyst lowers  $E_{af}$  to  $20 \text{ kJ mol}^{-1}$ . The ratio of energy of activation for reverse reaction before and after addition of catalyst is :

A. 1.0

B. 0.5

C. 1.2

D. 2.0

**Answer: D**

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9. Which of the following statement is correct regarding enthalpy of reaction?

A. It does not depend on physical state of reactant or products.

B. It always increases with increase in temperature.

C. It is equal to ratio of activation energy of forward reaction to activation energy of backward reaction.

D. It does not depend on presence of catalyst.

**Answer: D**

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10. For a reaction  $X \rightarrow Y$ , heat of reaction is  $+ a$  kJ, potential energy of reactant  $X$  is  $+ b$  kJ and energy of activation is  $+ c$  kJ. The energy of product  $Y$  in kJ is :

- A.  $(a+b)$
- B.  $(b-a)$
- C.  $(b+c)$
- D.  $(b+c)-a$

**Answer: A**

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11. Consider the following reactions at 300 K.

$A \rightarrow B$  (uncatalysed reaction)

catalyst

$A \rightarrow B$  (catalyst reaction)

The activation energy is lowered by  $8.314\text{KJ mol}^{-1}$  for the catalysed

reaction. How many times the rate of this catalysed reaction greater than that of uncatalysed reaction?(Given  $e^{3.33} = 20$ )

- A. 15 times
- B. 38 times
- C. 22 times
- D. 28 times

**Answer: D**



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12. If it known that out every 5 collisions, 1 has appropriate orientation and activation energy is 4 Kcal then % of effective collisions at 1000 K as per collisions theory will be :

- A. 20
- B.  $0.2e^{-2}$
- C.  $100e^{-2}$

D.  $20e^{-2}$

**Answer: D**



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13. For a simple reaction  $A \rightarrow B$  it is observed that % of activated molecules at a temperature of 400 K is equal to  $\frac{100}{e^{10}}$  %. Activation energy of the reaction is given by :

A. 33.256 kJ

B. 3.3256 J

C. 33.256 J

D. 3.3256 kJ

**Answer: A**



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14. Identify the statement which is correct from the following

- A. Rate of reaction increases substantially with increases in temperature since frequency of collision increases.
- B. Rate of reaction decreases on increasing temperature if the reaction is exothermic.
- C. Rate of reaction remains unchanged if temperature changes for reactions having no activation energy.
- D. Rate of reactions decreases on decreasing temperature only if the reaction is endothermic

**Answer: C**



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15. The rate of a catalysed reaction at  $27^{\circ}\text{C}$  is  $e^2$  times the rate of uncatalysed reaction at  $727^{\circ}\text{C}$ . If the catalyst decreased the activation

energy by 6 Kcal/mol, the activation energy of uncatalysed reaction is

(consider the same value of pre-exponential factors in both cases):

A.  $\frac{48}{7}$  Kcal/mol

B.  $\frac{6}{7}$  Kcal/mol

C.  $\frac{90}{7}$  Kcal/mol

D. 6 Kcal/mol

**Answer: A**



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**16.** The desorption of gas molecules from the adsorbent surface obeys Arrhenius equations. The average adsorbed at Pt-surface at 400 K is :

[Given : Pre-exponential factor,  $A = 1.25 \times 10^8 \text{ s}^{-1}$ , Activation energy of desorption = 16 Kcal,  $e^{20} = 5 \times 10^8$ ]

A. 0.25 sec

B. 4 sec

C. 8 sec

D. 0.125 sec

**Answer: B**



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17. Temperature coefficient of a reaction at 300 K is 2. Neglected variation of temperature coefficient with temperature, calculated rate of disappearance of a reactant at a concentration of 2M at 360 K if its rate constant at 300 K is  $10^{-3}\text{sec}^{-1}$ .

A.  $4 \times 10^{-3}\text{Msec}^{-1}$

B.  $1.28 \times 10^{-1}\text{Msec}^{-1}$

C.  $6.4 \times 10^{-2}\text{Msec}^{-1}$

D.  $2 \times 10^{-3}\text{Msec}^{-1}$

**Answer: B**



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18. Reaction -1:  $A \rightarrow C$   $k_1 = 10^{10}e^{-500/T}$

Reactions -2:  $B \rightarrow D$   $k_2 = 10^{12}e^{-1000/T}$

Select the correct options about above first order reactions :

A.  $E_{a_1} > E_{a_2}$

B.  $k_1 = k_2$  if  $T > 100^\circ C$

C.  $\text{rate}_1 = \text{rate}_2$  if  $T > 10^{10}.^\circ C$

D. Percentage of effective collision at temperature 'T' for  
reaction<sub>1</sub> > reaction<sub>2</sub>

**Answer: D**



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19. The role of catalyst is to change:

- A. Gibbs energy of reaction
- B. enthalpy of reaction
- C. activation energy of reaction.
- D. equilibrium constant.

**Answer: C**

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**20.** A first order reaction is catalysed by a catalyst which decreases activation energy by 420 kcal. If half life of reaction in absence of catalysed at 300 K is 20 sec., then what would be half in the catalysed reaction at 300 K ? [ $\ln 2 = 0.7$ ]

- A. 20 sec
- B. 10 sec
- C. 5 sec
- D. 15 sec



**Answer: B**

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21. For two reactions: R-I and R-II the rate constants at 300 K and 320 K are  $0.1 \text{ sec}^{-1}$  and  $0.3 \text{ sec}^{-1}$  respectively (for R-I) and  $0.2 \text{ sec}^{-1}$  and  $0.8 \text{ sec}^{-1}$  (for R-II). Which of the options regarding activation energy is correct ?

A. Activation energies of for both the reactions is same.

B. Activation energy of first reaction is more.

C. Activations energy for second reactions is more.

D. Activations energy for second reactions is  $\frac{4}{3}$  times as that of first reactions.

**Answer: C**

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22. For a first order reaction rate is given by ,  $R=K[\text{Reactant}]$  where  $K = a. e^{-E_a/RT}$ . Under what conditions will the rate of the reaction be smallest?

- A. Low concentration of reactant, high temperature and low activation energy.
- B. High concentration of reactant, low temperature and low activation energy.
- C. Low concentration of reactants, low temperature and high activation energy.
- D. High concentration of reactant, low temperature and high activation energy.

**Answer: C**



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23. The energies of activation forward and reverse reaction for  $A_2 + B_2 \rightarrow 2AB$  are  $180 \text{ kJ mol}^{-1}$  and  $200 \text{ kJ mol}^{-1}$  respectively. The pressure of a catalyst lowers the activation energy of both (forward and reverse) reactions by  $100 \text{ kJ mol}^{-1}$ . The magnitude of enthalpy change of the reaction ( $A_2 + B_2 \rightarrow 2AB$ ) in the presence of catalyst will be (in  $\text{KJ mol}^{-1}$ ):

A. 280

B. 20

C. 300

D. -20

**Answer: D**



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24. For an elementary reaction the variation of rate constant ( $k$ ) with temperature is given by the following equation

$$\log_{10}k = 5.4 - \frac{100}{T}$$

Where, T is temperature on Kelvin scale and k is in terms of  $\text{sec}^{-1}$

Identify the incorrect options.

A. There is no finite temperature at which rate constant can be

$$4 \times 10^6 \text{sec}^{-1}$$

B. Fraction of activated for the reactions will be any temperature

C. Activation energy for the reaction will be approx 460.6 cal.

D. Rate of reaction will vary linearly with concentration of reactant.

**Answer: B**



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25. If it is known that 1 out of every 4 collisions has appropriate orientation and activation energy is 2 Kcal, then % of effective collisions at 500 K as per collision theory will be :

A.  $25e^{-2}$

B.  $e^2$

C.  $e^{-2}$

D.  $0.25e^{-2}$

**Answer: A**



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26. In the respect of the equation  $k = Ae^{-E_a/RT}$  is chemical kinetics, which one of the following statement is correct ?

A.  $k$  is equilibrium constant

B.  $A$  is adsorption factor

C.  $E_a$  is energy of activation

D.  $R$  is Rydberg constant

**Answer: C**



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27. The variation of rate constant with temperature follows the equations  $\ln k = 30 - \frac{40}{T} + 20T^2 - 30\ln T$  based on this information, identify the most appropriate option.

A.  $E_A$  at 300 K is approximately equal to  $1.08 \times 10^9 R$ .

B.  $E_A$  will remain constant at all temperature

C. There is some temperature greater than 50 K where  $E_A$  will become negative

D. Rate constant will follow Arrhenius equations.

**Answer: A**



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28. For a certain gaseous reaction a  $10^\circ C$  rise of temp, from  $25^\circ C$  to  $35^\circ C$  doubles the rate of reaction. What is the value of activation energy?

- A.  $\frac{10}{2.303R \times 298 \times 308}$
- B.  $\frac{2.303 \times 10}{298 \times 308R}$
- C.  $\frac{0.693 \times 10}{290 \times 308}$
- D.  $\frac{0.693R \times 298 \times 308}{10}$

**Answer: D**

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**29.** Following are the values of  $E_a$  and  $\Delta H$  for three reactions carried out at the same temperature :

I:  $E_a = 20\text{kJmol}^{-1}$ ,  $\Delta H = -60\text{kJmol}^{-1}$

II :  $E_a = 10\text{kJmol}^{-1}$ ,  $\Delta H = -20\text{kJmol}^{-1}$

III:  $E_a = 40\text{kJmol}^{-1}$ ,  $\Delta H = +15\text{kJmol}^{-1}$

If all the three reaction have same frequency factor then fastest and slowest reactions are :

- |    |         |         |
|----|---------|---------|
|    | Fastest | Slowest |
| A. | I       | II      |

- Fastest      Slowest
- B.    *II*          *III*
- Fastest      Slowest
- C.    *I*            *III*
- D. can't be predicted

**Answer: B**

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30. Milk turns sour at  $40^\circ\text{C}$  three times faster than at  $0^\circ\text{C}$ . Hence,  $E_a$  in calories of process of turning of milk sour is

A.  $\frac{2.303 \times 2 \times 313 \times 273}{40} \log 3$

B.  $\frac{2.303 \times 2 \times 313 \times 273}{40} \log \left( \frac{1}{3} \right)$

C.  $\frac{2.303 \times 2 \times 40}{273 \times 313} \log 3$

D. none of these

**Answer: A**

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31. Two reaction  $A \rightarrow$  products and  $B \rightarrow$  products have rate constant  $k_a$  and  $k_b$  at temperature T and activation energies  $E_a$  and  $E_b$  respectively. If  $k_a > k_b$  and  $E_a < E_b$  and assuming that a for both the reactions is same then :

- A. At higher temperature  $k_a$  will be greater than  $k_b$
- B. at lower temperature  $k_a$  and  $k_b$  will differ more and  $k_a > k_b$
- C. as temperature rises  $k_a$  and  $k_b$  will be close to each other in magnitude
- D. all of the above

**Answer: C**



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32. At room temperature, the reaction between NO and  $O_2$  to give  $NO_2$  is fast, while that between CO and  $O_2$  is slow. It is due to:

- A. CO is smaller in size than that of NO
- B. CO is poisonous
- C. the activation energy for the reaction,  $2NO + O_2 \rightarrow 2NO_2$  is less than  $2CO + O_2 \rightarrow 2CO_2$
- D. none of the above

**Answer: C**

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**33.** Consider an endothermic reaction  $X \rightarrow Y$  with the activation energies  $E_b$  and  $E_f$  for the backward and forward reaction, respectively. In general

- A.  $E_b < E_f$
- B.  $E_b = E_f$
- C.  $E_b > E_f$
- D. none of these

**Answer: A**

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**34.** For a first order reaction  $A \rightarrow P$ , the temperature (T) dependent rate constant ( $K$ ) was found to follow the equation  $\log k = - (2000) \frac{1}{T} + 6.0$ . The pre-exponential factor  $A$  and the activation energy  $E_a$ , respectively, are :

- A.  $1.0 \times 10^6 s^{-1}$  and  $9.2 kJmol^{-1}$
- B.  $6.0 s^{-1}$  and  $16.6 kJmol^{-1}$
- C.  $1.0 \times 10^6 s^{-1}$  and  $16.6 kJmol^{-1}$
- D.  $1.0 \times 10^6 s^{-1}$  and  $38.3 kJmol^{-1}$

**Answer: D**

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35. 75% of a first order reaction occurs in 30 min at  $27^{\circ}\text{C}$  . 87.5% of the same reaction occurs in 30min at  $57^{\circ}\text{C}$  . The activation energy of reaction is:

[ $\ln 2=0.7$ ,  $\ln 3=1.1$ ]

- A.  $2.64\text{kJ/mol}$
- B.  $2.64\text{ Kcal/mol}$
- C.  $10.97\text{ Kcal//mol}$
- D. zero

**Answer: B**

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36. A catalyst increases the rate of reaction by :

- A. decreasing the free energy change for reaction.
- B. decreasing the enthalpy change of reaction.

C. decreasing the activation energy for reaction.

D. all of the above

**Answer: C**



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**37.** The decomposition of a drug in human was found to be a first order process. The activation energy for the decomposition is  $(3100R \times \ln 2)$  and pre-exponential factor  $A = 4096 \text{hr}^{-1}$ . How long will it take the concentration of the drug in the blood to fall to half of its initial value at 310K?

(Given:  $\ln 2 = 0.7$ )

A. 10.5hr

B. 0.175 min

C. 10.5 min

D. 0.175 sec

**Answer: C**



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**38.** An exothermic reaction  $A \rightarrow B$  has an activation energy of  $17\text{kJ}$  per mole of  $A$ . The heat of the reaction is  $40\text{kJ}$ . Calculate the activation energy for the reverse reaction  $B \rightarrow A$ .

A.  $75\text{ KJ/mole}$

B.  $67\text{ KJ/mole}$

C.  $57\text{ KJ/mole}$

D.  $17\text{ KJ/mole}$

**Answer: C**



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39. For a gas reaction  $A \rightarrow P$  at T (K) the rate is given by :

$$\text{Rate} = k' p_A^2 \text{ atm/hr}$$

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40. Which of the following is incorrect regarding catalysis?

- A. Change in catalyst of reaction may change the reaction product.
- B. Catalyst changes the pathway of reaction.
- C. In case of negative catalysis, each step of mechanism occur at higher threshold energy than uncatalysed reaction.
- D. Enzyme catalysis is homogeneous catalysis.

**Answer: C**

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41. The temperature coefficient of a reaction is 2. Calculate rate of disappearance at a temperature of 450 K if rate constant at 400 K is  $4 \times 10^{-2} M^{-1} \text{sec}^{-1}$ , when concentration of reaction is 2 moles per litre.

A.  $1.28 M \text{sec}^{-1}$

B.  $5.12 M \text{sec}^{-1}$

C.  $2.56 M \text{sec}^{-1}$

D.  $8 \times 10^{-2} M \text{sec}^{-1}$

**Answer: B**



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42. A catalyst decreases activation energy by 15 Kcal and it is observed that rate of reaction in absence of catalyst at 400K is same as rate of reaction in presence of catalyst at 300 K. The activation energy in absence of catalyst will be :



A. 30 Kcal

B. 20 Kcal

C. 60 Kcal

D. 15 Kcal

**Answer: C**

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**43.** Activation energy of a chemical reaction can be determined by  $\Delta H^\ddagger$ ...

A. determining the rate constant at standard temperature.

B. determining the rate constants at two temperatures.

C. determining probability of collision.

D. using catalyst.

**Answer: B**

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44.  $(A \rightarrow B, k_A = 10^{15}e^{-2000/T}, ), (C \rightarrow D, k_C = 10^{14}e^{-1000/T})$

Temperature T K at which  $(k_A = k_C)$  is :

- A. 1000 K
- B. 2000 K
- C. (2000/1000) K
- D. (1000/2.303)K

**Answer: D**



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45. The rate of a reaction gets doubled when the temperature change from  $7^\circ C$  to  $17^\circ C$ . By what factor will it change for the the temperature change from  $17^\circ C$  to  $27^\circ C$  ?

- A. 1.81

B. 1.71

C. 1.91

D. 1.76

**Answer: C**



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**46.** Which of the following statements is correct ?

- A. The rate of reaction generally decreases with passage of time as the concentration of reactants decreases in zero order reaction.
- B. The rate of reaction remains same throughout the reaction in a first order reaction.
- C. The rate of reaction increases with passage of time as the concentration of reactants decreases in a negative order reaction.
- D. The rate of reaction is independent of temperature change.

**Answer: C**



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47. Which of the following statement is/are correct with respect to Arrhenius equation ?

- A. Rate constant linearly increases with increasing temperature and exponentially decreases with increasing activation energy.
- B. Rate constant exponentially increasing temperature and increasing activation energy.
- C. Rate constant increases exponentially with increasing temperature and decreases exponentially with increasing activation energy.
- D. Rate constant is unaffected by change in either temperature or activation energy.

**Answer: C**





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48. In the presence of a catalyst, the heat evolved or absorbed during the reaction:

- A. increases
- B. decreases
- C. remains unchanged
- D. may increase or decrease

Answer: C



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49. In gaseous reactions important for the understanding of the upper atmosphere  $H_2O$  and  $O$  react bimolecularly to form two OH radicals .  $\Delta H$  for this reaction is  $72kJmol^{-1}$  at 500 K and  $E_a$  is  $77 kJ mol^{-1}$  then  $E_a$

for the bimolecular recombination of two OH radicals to form  $H_2O \rightarrow O$

is:

A.  $3kJmol^{-1}$

B.  $4kJmol^{-1}$

C.  $5kJmol^{-1}$

D.  $7kJmol^{-1}$

**Answer: C**



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50. Consider the Arrhenius equation given below and mark the correct option.

$$k = Ae^{-\frac{E_a}{RT}}$$

A. Rate constant increases exponentially with increasing activation energy and decreasing temperature

- B. Rate constant decreases exponentially with increasing activation energy and decreasing temperature
- C. Rate constant increases exponentially with increasing activation energy and decreasing temperature
- D. Rate constant increases exponentially with increasing activation energy and increasing temperature

**Answer: D**



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51. An iron catalyst is used in the Haber process in which process  $N_2$  and  $H_2$  react to produce  $NH_3$  What is the role of this catalyst ?

- A. It provides a pathway with a lower activation energy
- B. It increases the equilibrium constant of the reaction
- C. It raises the kinetic energies of the reactants

D. It interacts with the  $NH_3$

**Answer: C**

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52. Catalyst in a chemical reaction :

- A. increases the activation energy
- B. does not change activation energy
- C. does not change  $\Delta H$
- D. none of the above

**Answer: B**

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53. All of the following are expected to affect the rate of an irreversible chemical reactions except :

- A. adding a catalyst
- B. removing some products
- C. increasing the temperature
- D. decreasing the reactant concentration

**Answer: D**



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54. A catalyst speeds up a chemical reaction by :

- A. shifting the equilibrium.
- B. increasing the activation energy.
- C. decreasing the reaction enthalpy.
- D. providing an alternative enthalpy.

**Answer: A**



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**55.** The activation energy of a reaction can be determined by measuring the reaction rate at different:

- A. temperature
- B. catalyst concentrations
- C. reactant concentrations
- D. times on the reaction curve.

**Answer: D**



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**56.** Most reactions occur more rapidly at high temperatures than at low temperature. This is consistent with an increase in which property at

higher temperatures?

(P) Activation energy

(Q) Collision energy

(R) Rate constant

A. P only

B. Q only

C. P and Q only

D. Q and R only

**Answer: C**



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57. Two unimolecular reactions, I and II have the same rate constant at  $25^\circ\text{C}$  but  $E_a$  for reaction I is larger than  $E_a$  for reaction II. Which statement about these two reaction is correct?

A.  $k_{\text{reaction I}}$  is the same as  $k_{\text{reaction II}}$  at all temperatures.

B.  $k_{\text{reaction I}}$  is larger than  $k_{\text{reaction II}}$  at lower temperatures but smaller at higher temperatures.

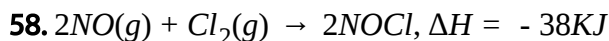
C.  $k_{\text{reaction I}}$  is smaller than  $k_{\text{reaction II}}$  at lower temperatures but larger at higher temperatures.

D.  $k_{\text{reaction I}}$  is larger than  $k_{\text{reaction II}}$  at temperatures both lower and higher than  $25^{\circ}\text{C}$ .

**Answer: D**



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If the activation energy for the forward reaction is 62 KJ , what is the activation energy for the reverse reaction?

A. 24 KJ

B. 38 KJ

C. 62 KJ

D. 100 KJ

**Answer: D**

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59. A catalyst affects the rate of a chemical reaction by:

- A. increasing the average kinetic energy of the reactants.
- B. increasing the number of collisions between the reactants.
- C. decreasing the energy difference between the reactants and products.
- D. providing an alternative reaction pathway with a lower activation energy.

**Answer: D**

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60. Which of these factors affect the value of the rate constant for a reaction?

(P) Temperature

(Q) Reactant concentration

(R) Use of catalyst

A. P only

B. Q only

C. P and Q only

D. P,Q and R

**Answer: C**



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61. Which of the correct exponential form of the Arrhenius equations?

A.  $E_a = Ae^{-k/RT}$

B.  $E_a = Ae^{-k/RT}$

C.  $k = Ae^{-RT/E_a}$

D.  $k = Ae^{-E_a/RT}$

**Answer: D**

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**62.** The chemical in a lightsticks give off light as they react. When the lightsticks is placed in warm water the glow increases . This is because the :

- A. activation energy for the process is lowered.
- B. average kinetic energy of the reactants increases.
- C. higher temperature catalyzes the reaction.
- D. higher temperature changes the wavelength of light emitted.

**Answer: B**



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63. The rate of the reaction of chlorine gas with a liquid hydrocarbon can be increased by all of the changes excepts one. Which change will be ineffective?

- A. Use UV light to dissociate the  $Cl_2$ .
- B. increase temperature at constant pressure.
- C. Divided the liquid into small droplets
- D. Double the pressure by adding He gas.

**Answer: D**



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64. The effect of temperature on the rates of chemical reactions is primarily a result of the:



- A. size of the colliding molecules.
- B. orientation fo the colliding molecules.
- C. enthalpies of the reactants and products.
- D. kinetic energies of the colliding molecules.

**Answer: D**

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**65.** The value of the rate constant for a gas phase reaccation can be changed by increasing the :

- A. amount of product.
- B. pressure of the reactant.
- C. temperature of the reaction vessel.
- D. Times on the reaction curve.

**Answer: C**

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66. The rate of a reaction at  $100^{\circ}\text{C}$  is four times the rate at  $50^{\circ}\text{C}$ . What is its activation energy?

A.  $1152\text{ KJ. mol}^{-1}$

B.  $80.1\text{ KJ. mol}^{-1}$

C.  $54.0\text{ KJ. mol}^{-1}$

D.  $27.8\text{ KJ. mol}^{-1}$

**Answer: D**

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67. A reaction is endothermic with  $\Delta H = 100\text{ KJ/mol}$ . If the activation enthalpy of the forward reaction is  $140\text{ KJ/mol}$ , what is the activation enthalpy of the reverse reaction?

A. 40 KJ/mol

B. 100 KJ/mol

C. 140 KJ/mol

D. 240 KJ/mol

**Answer: A**



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**68.** Change in which factors affect both the rate and the rate constant of a first order reaction?

(P) Temperature

(Q) Concentration

A. P only

B. Q only

C. Both P and Q

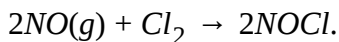
D. Neither P nor Q

**Answer: A**



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**69.** Consider the reaction,



Which of the following is/are required for a successful reaction between NO and  $\text{Cl}_2$  molecules?

(P) Proper orientation

(Q) NO/ $\text{Cl}_2$  Ratio of 2 to 1

(R) Sufficient collision energy

A. Q only

B. P and R only

C. Q and R only

D. P, Q and R

**Answer: B**



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70. When sucrose,  $C_{12}H_{22}O_{11}$ , is dissolved in  $H_2O$  in the presence of an acid catalyst it reacts according to the equation  $C_{12}H_{22}O_{11} \rightarrow 2C_6H_{12}O_6$  with a rate law of  $\text{Rate} = k[C_{12}H_{22}O_{11}]$ . If 3.00 g of sucrose decreases to 2.70 g in 2.50 hours in the presence of a certain concentration of an acid catalyst, what is the half-life for this reaction under these same condition?

- A. 12.5 hours
- B. 16.4 hours
- C. 23.7 hours
- D. 37.9 hours

**Answer: B**

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71. Which accounts for the increase in the rate of a reaction when a catalyst is added to a chemical system?

- A. decrease in the enthalpy change between the reactant and products
- B. An increase in the potential energy of the reactants
- C. A decrease in the potential energy of the activated complex
- D. A decrease in the entropy of the activated complex

**Answer: C**



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72. A reaction has a rate constant  $k = 8.54 \times 10^{-4} \text{Ms}^{-1}$  at  $45^\circ \text{C}$  and an activation energy,  $E_a = 90.8 \text{KJ}$ . What is the value of  $k$  at  $25^\circ \text{C}$ ?

- A.  $4.46 \times 10^{-5} \text{M}^{-1} \text{s}^{-1}$
- B.  $8.54 \times 10^{-5} \text{M}^{-1} \text{s}^{-1}$

C.  $4.46 \times 10^{-4} M^{-1} s^{-1}$

D.  $8.54 \times 10^{-4} M^{-1} s^{-1}$

**Answer: B**



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In a suitable reaction vessel. Pieces of graphite are mixed with carbon dioxide gas at 1.00 atm and 1000 K . Which of the following changes will result in an increase in reaction rate?

- A. Decrease in size of the graphite pieces
- B. Decrease in temperature
- C. Decrease in partial pressure of CO(g)
- D. Decrease in partial pressure of  $CO_2(g)$

**Answer: A**



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74. Which statement about the behavior of a catalyst is correct?

- A. A catalyst reacts with the product and shifts the equilibrium to the right speeding up the reaction.
- B. A catalyst lowers the activation energy of the original reaction pathway.
- C. A catalyst provides additional energy to a reactant so it can achieve the necessary activation energy.
- D. A catalyst provides an alternative reaction pathway with a lower activation energy.

**Answer: D**





75. Which of the following are reasons why reaction rates increase at temperature increases?

(P) Collisions are more frequent between molecules at higher temperatures.

(Q) A greater fraction of collisions have sufficient energy to exceed  $E_a$  at higher temperatures.

(R) Reactant concentrations are higher at higher temperatures.

A. P only

B. Q only

C. P and Q only

D. P, Q and R

**Answer: C**



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76. What is the effect of adding a catalyst on the rate of a reversible reaction in the forwards and the reverse direction?

- A. It has no effect on the rate in either direction
- B. Both rates increase by the same factor.
- C. The rate in the forward direction increases by a greater factor than the rate in the reverse direction
- D. The rate in the reverse direction increases by a greater factor than the rate in the forward direction.

**Answer: B**



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77. For a reversible exothermic reaction, which is the effect of increasing temperature on the equilibrium constant ( $k_{eq}$ ) and on the forward rate constant ( $k_f$ )?

- A.  $K_{eq}$  and  $k_f$  both increase
- B.  $K_{eq}$  and  $k_f$  both Decrease
- C.  $K_{eq}$  increase and  $k_f$  decrease
- D.  $K_{eq}$  decrease and  $K_f$  increases

**Answer: D**

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**78.** Select the incorrect statement.

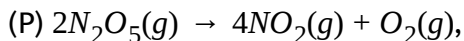
- A. Rate of exothermic reactions (irreversible ) increasee with increase in temperature.
- B. Rate of endothermic reactins (irreversible 0 increases with increases in temperature
- C. For  $N_2 + 3H_2 \rightleftharpoons 2NH_3$  , If rate of formation of  $NH_3$  is  $0.001 \text{ Kg hr}^{-1}$  , then rate of consumption of  $H_2$  is  $0.0015 \text{ kg/hr}$

D. In Arrhenius equation  $K = Ae^{-Ea/RT}$  if  $T \rightarrow \infty \Rightarrow K = A$

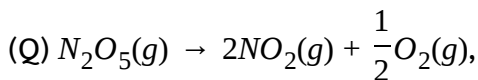
**Answer: C**

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79. We can represent the decomposition of  $N_2O_5(g)$  at a fixed temperature by the following two chemical equations:



Activation energy  $E_a$



Activation energy  $E'_a$  then:

A.  $E_a = E'_a$

B.  $E_a > E'_a$

C.  $E_a < E'_a$

D.  $E_a = 2E'_a$

**Answer: A**



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80. For the equilibrium,



If the ratio of the activation energies of the forward ( $E_f$ ) and reverse ( $E_b$ ) reactions is  $\frac{2}{3}$  then:

A.  $E_f = 60 \text{ KJ/mol}, E_b = 100 \text{ KJ/mol}$

B.  $E_f = 30 \text{ KJ/mol}, E_b = 70 \text{ KJ/mol}$

C.  $E_f = 80 \text{ KJ/mol}, E_b = 120 \text{ KJ/mol}$

D.  $E_f = 70 \text{ KJ/mol}, E_b = 30 \text{ KJ/mol}$

Answer: C



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81. A reaction takes place in three steps with activation energy  $E_{a_1} = 180 \text{ KJ/mol}$ ,  $E_{a_2} = 80 \text{ KJ/mol}$ ,  $E_{a_3} = 50 \text{ KJ/mol}$  respectively overall rate constant

of the reaction is  $k = \left[ \frac{k_1 k_2}{k_3} \right]^{2/3}$  the overall activation energy of reaction will be (Here  $k_1, k_2$  and  $k_3$  are rate constant of first, second and third step respectively):

- A. 140 KJ/mol
- B. 150 KJ/mol
- C. 43.44 KJ/mol
- D. 100 KJ/mol

**Answer: A**



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82. A catalyst decreases  $E_a$  from  $100\text{KJmol}^{-1}$  to  $80\text{KJmol}^{-1}$  At what temperature the rate of reaction in the absence of catalyst at  $500\text{K}$  will be equal to rate reaction in the presence of catalyst?

- A. 400 K

B. 200 K

C.  $\log_{10}A$

D. none of these

**Answer: A**



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83. In Arrhenius equation  $K = Ae^{-E_a/RT}$ , as  $\lim_{T \rightarrow \infty} \log_{10} K$  equals to:

A.  $\ln A$

B. A

C.  $\log_{10}A$

D. none of these

**Answer: C**



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84. The rates of which reactions are increased when the temperature is raised?

(P) endothermic reactions

(Q) exothermic reactions

A. P only

B. Q only

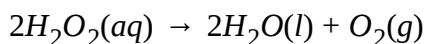
C. Both P and Q

D. Neither P nor Q

**Answer: C**

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85. This exothermic reaction is catalyzed by  $MnO_2(s)$ .



Which of the following will increase the rate of this reaction?



(P) Raising the temperature

(Q) Increasing the surface area of  $MnO_2(s)$

A. P only

B. Q only

C. Both P and Q

D. Neither P nor Q

**Answer: C**



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**86.** The rate of a reaction at  $75^\circ\text{C}$  is 30.0 times that at  $25^\circ\text{C}$ . What is its activation energy?

A.  $58.6\text{ kJ}\cdot\text{mol}^{-1}$

B.  $25.5\text{ kJ}\cdot\text{mol}^{-1}$

C.  $7.05\text{ kJ}\cdot\text{mol}^{-1}$

D.  $1.51 \text{ KJ} \cdot \text{mol}^{-1}$

**Answer: A**



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87. The reaction  $A + B \rightarrow AB$  has an enthalpy of reaction of  $-85.0 \text{ KJ} \cdot \text{mol}^{-1}$ . If the activation enthalpy for the forward reaction is  $120.0 \text{ KJ} \cdot \text{mol}^{-1}$ , What is the activation energy for the reverse reaction  $AB \rightarrow A + B$ ?

A.  $35.0 \text{ KJ} \cdot \text{mol}^{-1}$

B.  $85.0 \text{ KJ} \cdot \text{mol}^{-1}$

C.  $12.0 \text{ KJ} \cdot \text{mol}^{-1}$

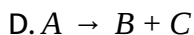
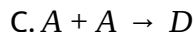
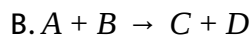
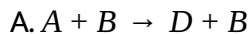
D.  $205.0 \text{ KJ} \cdot \text{mol}^{-1}$

**Answer: D**



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88. Which equation indicates the presence of a catalyst in the reaction?



**Answer: A**



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89. When the temperature of a reaction is raised from 300 K to 310 K, the reaction rate doubles. Determine the activation energy,  $E_a$  associated with the reaction.

A.  $6.45 \text{ KJ mol}^{-1}$

B.  $23.3 \text{ KJ mol}^{-1}$

C.  $53.58 \text{ KJ mol}^{-1}$

D.  $178 \text{ KJ mol}^{-1}$

**Answer: C**

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**90.** A particular reaction rate increases by a factor of five when the temperature is increased from  $5^\circ$  to  $27^\circ$  C. What is the activation energy of the reaction?

A.  $6.10 \text{ KJ .mol}^{-1}$

B.  $18.9 \text{ KJ .mol}^{-1}$

C.  $50.7 \text{ KJ .mol}^{-1}$

D.  $157 \text{ KJ .mol}^{-1}$

**Answer: C**

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91. Rate of disappearance of the reactant A at two different temperature

is given by  $A \rightarrow B$

$$\frac{-d[A]}{dt} = 2 \times 10^{-2} \text{sec}^{-1}[A] - 4 \times 10^{-3} \text{sec}^{-1}[B] \text{ at } 300\text{K}$$

$$\frac{-d[A]}{dt} = 4 \times 10^{-2} \text{sec}^{-1}[A] - 16 \times 10^{-4} \text{sec}^{-1}[B] \text{ at } 400\text{K}$$
 heat of reaction in

the given temperature range, when equilibrium is set up is :

A.  $\frac{2.303 \times 2 \times 300 \times 400}{100} \log 50$  Cal

B.  $\frac{2.303 \times 2 \times 300 \times 400}{100} \log 250$  Cal

C.  $\frac{2.303 \times 2 \times 300 \times 400}{100} \log 5$  Cal

D. none of these

**Answer: C**



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92. When 100 mL of 1.0 M HCl is added to a 2.0 g pieces of  $\text{CaCO}_3$ ,  $\text{CO}_2$  is produced at a certain rate. Which of the changes below will not increase the rate of this reaction/

- A. Adding 100 mL of 2.0 M HCl in place of 100 mL of 1.0 M HCl
- B. Heating the 100 mL of 1.0 M HCl before adding it to the  $\text{CaCO}_3$
- C. Adding 100 mL of 1.0 M HCl to 2.0 g of powdered  $\text{CaCO}_3$
- D. Adding 150 mL of 1.0 M HCl in place of 100 mL of 1.0 M HCl

**Answer: D**

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## Mechanism of Reactions

1. For the reaction  $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$  the experimental data suggest that  $r = k[\text{H}_2][\text{Br}_2]^{1/2}$ . The molecularity and order of the reaction are respectively:

A.  $2, \frac{3}{2}$

B.  $\frac{3}{2}, \frac{3}{2}$

C. not defined,  $\frac{3}{2}$

D.  $1, \frac{1}{2}$

**Answer: C**

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2. For the reaction  $NO_2 + CO \rightarrow CO_2 + NO$  the experimental rate expression is  $\frac{dc}{dt} = k[NO_2]^2$  the number of molecules of CO involved in the slowest step will be:

A. 0

B. 1

C. 2

D. 3

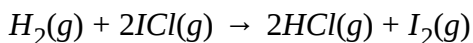
**Answer: A**

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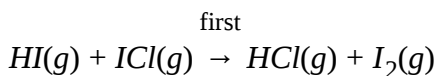
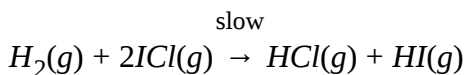
3. The reaction of hydrogen, and iodine monochloride is represented by the equation:

$H_2(g) + 2ICl(g) \rightarrow I_2(g) + 2HCl(g)$  This reaction is first-order in  $H_2(g)$  and also first-order in  $ICl(g)$ . Which of these proposed mechanisms can be consistent with the given information about this reaction?

Mechanism I:



Mechanism II:



A. I only

B. II only

C. Both I and II

D. Neither I nor II

**Answer: B**



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4. The reaction,  $X + 2Y + Z \rightarrow N$  occurs by the following mechanism:

(P)  $X + Y \rightleftharpoons M$  (rapid equilibrium)

(Q)  $M + Z \rightarrow P$  (slow)

(R)  $O + Y + P \rightarrow N$  (very fast)

What is the rate law for this reaction?

A. Rate  $=k[Z]$

B. Rate  $=k[X][Y]^2[Z]$

C. Rate  $=k [N]$

D. Rate  $=k[X][Y][Z]$

**Answer: D**



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5. In the Lindemann theory of unimolecular reaction, it is shown that the

apparent rate constant for such a reaction is  $k_{\text{app}} = \frac{k_1 C}{1 + \alpha C}$  where C is

the concentration of the reactant  $k_1$  and  $\alpha$  are constants. Calculate the

value of C for which  $k_{app}$  has  $90^\circ$  of its limited value at C tending to infinitely large value, given  $\alpha = 9 \times 10^5$ .

A.  $10^{-6}$  mole/litre

B.  $10^{-4}$  mole/litre

C.  $10^{-5}$  mole/litre

D.  $5 \times 10^{-5}$  mole/litre

**Answer: C**



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**6.** Trimolecular reactions are uncommon because

A. the probability for three molecules colliding at an instant is very low.

B. the probability of three molecules colliding at an instant is high

C. the probability of three molecules colliding at an instant is zero

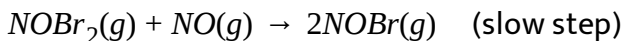
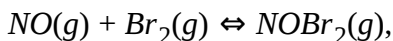
D. the probability of many molecules colliding at an instant is high.

**Answer: A**



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7. The following mechanism has been proposed for the reaction of NO with  $Br_2$  to form NOBr.



If the second step is the rate determining step, the order of the reaction with respect to NO(g) is:

A. 1

B. 0

C. 3

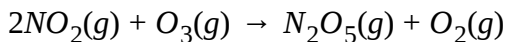
D. 2

**Answer: D**

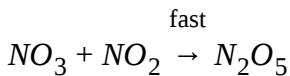
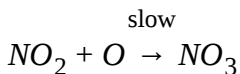
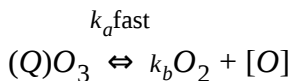
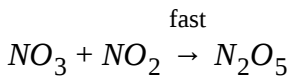
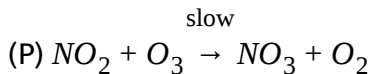


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8. The reaction of  $\text{NO}_2(g)$  and  $\text{O}_3(g)$  is first-order in  $\text{NO}_2$  and  $\text{O}_3(g)$



The reaction can take place by mechanism:



Select the correct mechanism.

A. P only

B. Q only

C. Both P and Q

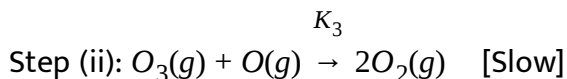
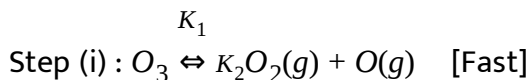
D. none of these

**Answer: C**



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9. Decomposition of ozone follows the given mechanism . From the mechanism select the option which is not correct.



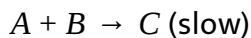
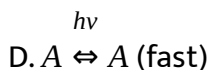
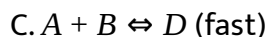
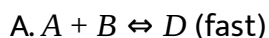
- A. Overall rate will be dependent on rate of (ii) step
- B. order of the reaction is equal to 2.
- C. Molecularity of step (ii) will be 2.
- D. Rate of formation of ozone will decrease with increase in concentration of oxygen gas.

**Answer: B**



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10. The rate of reaction of  $A + B \rightarrow C$  is found to be same when the reaction is carried out at  $300^\circ\text{C}$  or  $200^\circ\text{C}$ . Which of the following mechanism will become improbable?



**Answer: B**



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11. For a photochemical dimerisation of a substance a, the following rate law is obtained.

$$\frac{d[A_2]}{dt} = \frac{k_1 k_3 I [A]}{k_2 + k_4 [A]}$$

If it is known as obeying zero order kinetics then what will be the value of rate of appearance of the dimer?

A. I

B.  $k_1 k_3 I$

C.  $\frac{k_1 k_3 I}{k_4}$

D.  $\frac{k_1 k_3}{k_4}$

**Answer: C**



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12. For a two step reaction,



(Where , R is a reactive intermediate whose concentration is maintained at some low steady state throughout the reaction).If the concentration of C is very high then the order of reaction for formation of "P" is :

A. 2

B. 0

C. 1

D.  $\frac{1}{2}$

**Answer: C**



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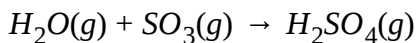
**13.** Read the following industrial methods for the preparation of  $H_2SO_4$  and answer the question at the end.

Professor Molina of the Massachusetts Institute of Technology won the 1995 Noble prize in Chemistry for his work on atmospheric chemistry . One reaction that he studied in detail is the acid rain reaction which produces  $H_2SO_4$  in the atmosphere. He proposed two possible

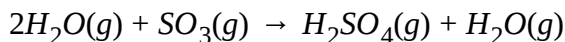


stoichiometric reactions:

Proposal A:

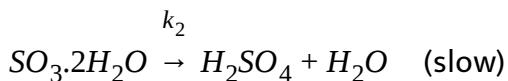
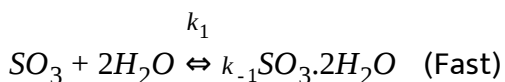


Proposal B:



Using the simple collision theory, what reaction orders would be expected for proposal B?

Proposal B is thought to proceed by the following two-step process:



( $SO_3 \cdot 2H_2O$  is a complex which is stabilized by hydrogen bonds and

$$k_2 \ll k_1 \text{ or } k_{-1})$$

A.  $k[H_2O][SO_3]$

B.  $k[H_2O]^2[SO_3]$

C.  $k[SO_3]$

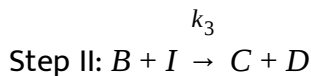
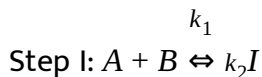
D.  $k[H_2O]$

**Answer: B**



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14. The mechanism of the reaction  $A + 2B \rightarrow C + D$  is:



In the first step is a fast equilibrium, then the incorrect statement is :

- A. Order of reaction with respect to A is 1.
- B. Order of reaction with respect to B is 2.
- C. Overall rate of reaction is,  $r = K_3 \cdot [A][B]^2$
- D. Rates of forward and backward reaction of step I is much greater than the rate of reaction of step II.

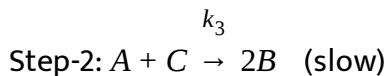
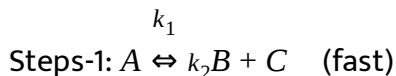
**Answer: C**



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15. Decomposition of A to give B follows a two step mechanism as shown.

From the mechanism identify the option which is incorrect.



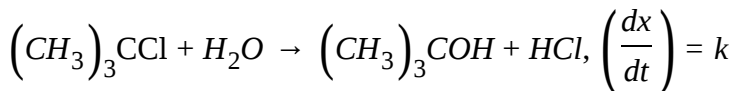
- A. Overall rate constant of the reaction will be  $k_3$ .
- B. Rate of reaction will be dependent on concentration of B.
- C. Rate of reaction will be dependent on concentration of A.
- D. Overall activation energy will involve activation energy of forward and backward reaction of first and that of second step.

**Answer: A**

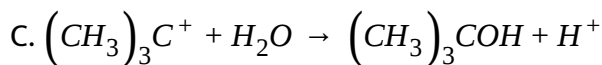
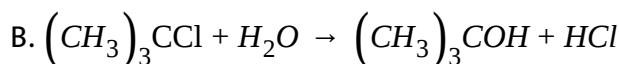
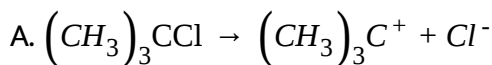


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16. For the following reaction:



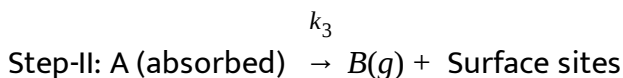
$\left[(CH_3)_3CCl\right]$  hence, rate determining step can be:



Answer: A

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17. The mechanism of reaction  $A(g) \xrightarrow{pt(s)} B(g)$  is :



The rate law of this reaction is  $r = \frac{k_1 k_3 [A]}{k_2 + k_1 [A]}$  (for fixed number of surface sites.)

The only incorrect information regarding the reaction is :

- A. Step-I may be a fast equilibrium and Step-II, RDS.
- B. At very low concentration of 'A' , the reaction is first order w.r.t. 'A'.
- C. At very high concentration of 'A' , the rate becomes independent from of 'A' but depends on the surface sites.
- D. At very high concentration of 'A' , the rate depends on the concentration of 'A' as well as on surface sites.

**Answer: D**



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**18.** A reaction involving two different reactants can never be:

- A. unimolecular reaction

B. first order reaction

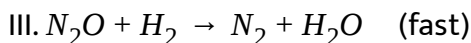
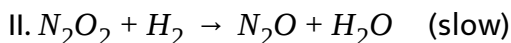
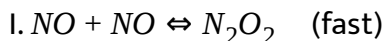
C. second order reaction

D. bimolecular reaction

**Answer: A**

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19. The reaction,  $2NO + 2H_2 \rightarrow N_2 + 2H_2O$  has been assigned to follow the following mechanism :



The rate constant of step II is  $1.2 \times 10^{-4} \text{ mole}^{-1} \text{ L min}^{-1}$  while equilibrium constant of step I is  $1.4 \times 10^{-2}$ . What is the rate of reaction when concentration of  $NO$  and  $H_2$  each is  $0.5 \text{ mole L}^{-1}$  ?

A.  $2.1 \times 10^{-7} \text{ mol L}^{-1} \text{ min}^{-1}$

B.  $3.2 \times 10^{-6} \text{ mol L}^{-1} \text{ min}^{-1}$

C.  $3.5 \times 10^{-4} \text{ mol L}^{-1} \text{ min}^{-1}$

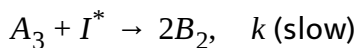
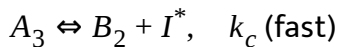
D. None of above

**Answer: A**

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20. For the reaction  $2A_3 \rightleftharpoons 3B_2$

Mechanism



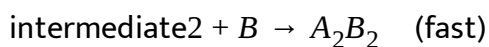
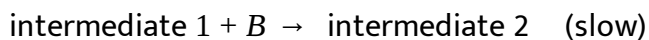
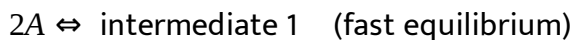
For the net reaction, correct statement is :

- A. order is one but molecularity 2
- B. order is 2 but molecularity 1
- C. both order and molecularity is not defined
- D. order is one but molecularity is not defined

**Answer: D**

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21. What is the rate law for the hypothetical reaction with the mechanism shown?



A.  $\text{Rate} = k[A]^2$

B.  $\text{Rate} = [B]^2$

C.  $\text{Rate} = k[A][B]$

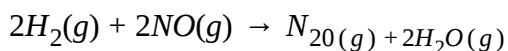
D.  $\text{Rate} = k[A]^2[B]$

**Answer: D**



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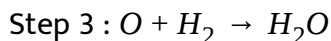
22. For the reaction,





$$\text{Rate} = k[H_2][NO]^2.$$

This mechanism has been proposed:



Which statement about this rate law and mechanism is correct?

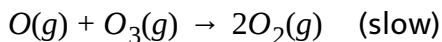
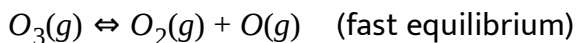
- A. The mechanism is consistent with the rate law if step 1 is the rate determining step.
- B. This mechanism is consistent with the rate law if step 2 is the rate determining step.
- C. The mechanism is consistent with the rate law if step 3 is the rate determining step.
- D. This mechanism can not be consistent with the rate law, regardless of which step is rate-determining.

**Answer: B**



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23. A possible mechanism for the conversion for ozone to oxygen in the upper atmosphere is



Which rate law is consistent with this mechanism?

A. Rate =  $k[O_3]$

B. Rate =  $k[O_3]^2$

C. Rate =  $k[O_3][O]$

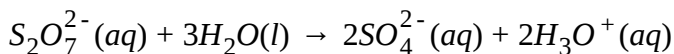
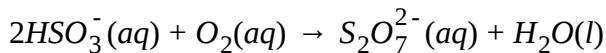
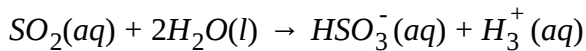
D. Rate =  $k[O_3]^2[O_2]^{-1}$

**Answer: D**



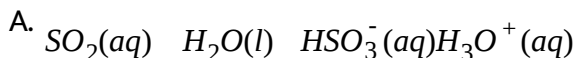
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24. The oxidation of  $SO_2$  to  $H_2SO_4$  in acid rain is thought to occur by the following mechanism.

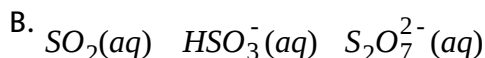


Which species in this mechanism can be given the following designation?

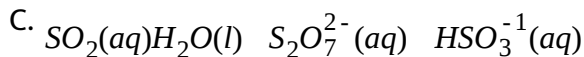
Reactant    catalyst    Intermediate



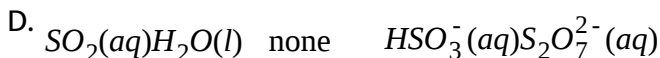
Reactant    catalyst    Intermediate



Reactant                    catalyst                    Intermediate



Reactant                    catalyst    Intermediate



**Answer: D**

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**25.** Ozone in the earth's atmosphere decomposes according to the equation:  $2\text{O}_3(\text{g}) \rightarrow 3\text{O}_2(\text{g})$  This reaction is thought to occur via the two-step mechanism:

Step 1:  $\text{O}_3(\text{g}) \rightleftharpoons \text{O}_2(\text{g}) + \text{O}(\text{g})$  Fast, reversible

Step 2:  $O_3(g) + O(g) \rightarrow 2O_2(g)$  slow

What rate law is consistent with this mechanism?

A.  $-\frac{\Delta[O_3]}{\Delta t} = k[O_3]$

B.  $-\frac{\Delta[O_3]}{\Delta t} = k[O_3]^2$

C.  $-\frac{\Delta[O_3]}{\Delta t} = \frac{k[O_3]^2}{[O_2]}$

D.  $-\frac{\Delta[O_3]}{\Delta t} = \frac{k[O_3]^2}{[O_2]^3}$

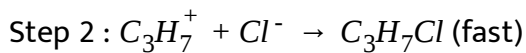
**Answer: C**



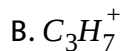
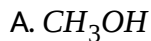
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**26.** The reaction  $C_3H_7I + Cl^- \rightarrow C_3H_7O + I^-$  is thought to occur in the polar solvent  $CH_3OH$  by the mechanism:

Step 1:  $C_3H_7I \rightarrow C_3H_7^+ + I^-$  (slow)



Which species is an intermediate in this reaction?



**Answer: B**



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27. Which statement is true about a reactant that appears in the balanced equations for a reaction but does not appear in the rate equation ?

A. It is an inhibitor

B. It is not part of the reaction

C. Its concentration is too low to be important.

D. It takes part in the reaction after the rate-determining step.

**Answer: D**

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**28.** The hypothetical reaction  $2A + B \rightarrow C + D$  is catalyzed by E as indicated in the possible mechanism below. Itbr. Step 1:  $A + E \rightleftharpoons AE$   
(fast)

Step 2:  $AE + A \rightarrow A_2 + E$  (slow)

Step 3:  $A_2 + B \rightarrow C + D$  (fast)

Which rate law best agrees with this mechanism?

A. Rate =  $k[A][B]$

B. Rate= $k[A][E]$

C. Rate =  $k[A]^2[E]$

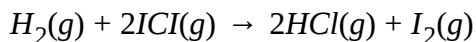
D. Rate =  $k[A]^2[B]$

**Answer: C**

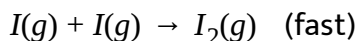
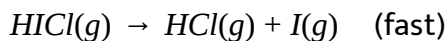


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29. For the reaction.



one proposed mechanism is



Intermediates in this reaction include which of the following?

- A. HCl only
- B. I only
- C. HCl and H only
- D. HCl, H and I

Answer: D



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30. Which elementary reaction characteristic(s) change(s) significantly for a  $10^\circ\text{C}$  temperature increase for a reaction carried out near room temperature?

(P) Fraction of molecules with required  $E_a$

(Q) Fraction of molecules with correct orientation

A. P only

B. Q only

C. Both P and Q

D. Neither P nor Q

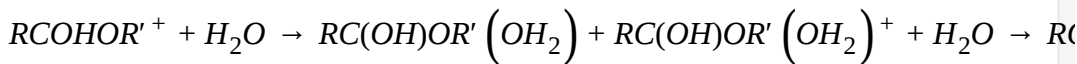
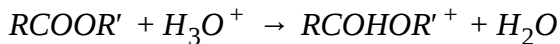
**Answer: A**



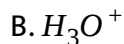
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31. One proposed mechanism for the hydrolysis of an ester is shown below.





Which species is considered an intermediate?



**Answer: A**



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**32.** In the rate-limiting approximation for a two-step reaction, the overall rate of the reaction is always equal to the rate of the ..... Step in the reaction mechanism.

A. first

B. second

C. fastest

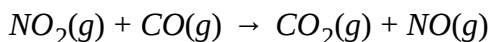
D. slowest

**Answer: D**



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**33.** The reaction of nitrogen dioxide with carbon monoxide



has been studied and the following mechanism mechanism has been proposed:



What rate law corresponding to this mechanism?

A. Rate =  $k[\text{NO}_2]$

B. Rate =  $k[\text{NO}_2][\text{CO}]$

C. Rate =  $k[\text{NO}_2]^2$

$$\text{D. Rate} = k[\text{NO}_2]^2[\text{CO}]$$

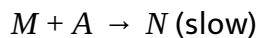
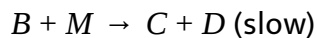
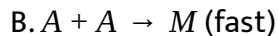
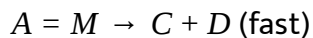
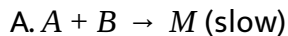
Answer: C

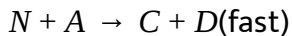
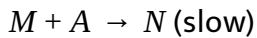
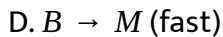


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34. For the reaction,  $2A + B \rightarrow C + D$ , the rate law is  $\text{rate} = k[\text{B}]$ .

Which of the following mechanism would be consistent with this information?



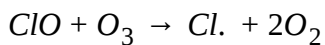
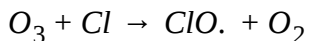


**Answer: C**



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**35.** Consider the proposed mechanism for the destruction of ozone in the stratosphere:



Which of the statements about this mechanism is correct?

A. Cl. Is a catalyst

B.  $O_2$  is in intermediate.

C. Equal amounts of Cl. and ClO. Are present.

D. The number of moles of  $O_2$  produced equals the number of moles of  $O_3$  consumed.

**Answer: A**



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**36.** Which of the following Statement is true?

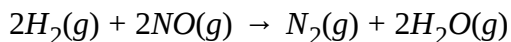
- A. Order of each reactions can be defined and have a fixed definite value
- B. Rate constant for every reaction can be defined and have fixed definite value
- C. It may or may not be possible to define rate constant for a reaction
- D. Molecularity of a complex reaction is equal to order of a complex reaction

**Answer: C**

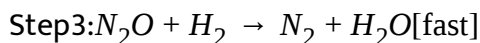
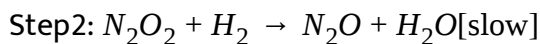
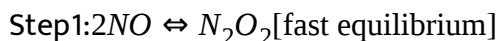


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37. consider the reaction .



The rate law of this reaction will be ,if mechanism of reaction is



A.  $r = k[H_2][NO]$

B.  $r = k[H_2]^2[NO]^2$

C.  $r = k[H_2][NO]^2$

D.  $r = k[H_2]^2[NO]$

**Answer: C**



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**38.** Select the correct Statement .

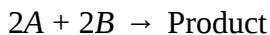
- A. On addition of reactant at equilibrium, equilibrium of atomisation will always be negative.
- B. Enthalpy of atomisation will always be negative.
- C. molecularity of individual step in a complex reaction mechanism can be defined .
- D. One equivalent of a strong acid on reaction with excess of strong base will produce 9gm water

**Answer: C**

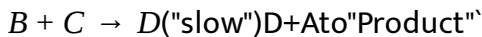
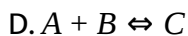
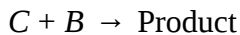
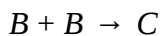
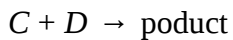
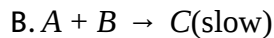
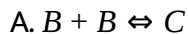


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**39.** For the reaction,



the rate law is  $\text{Rate} = k[A][B]^2$ . which mechanism is constant with this information ?



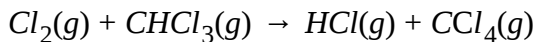
**Answer: D**



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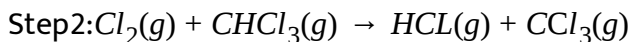
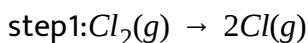
40. Consider this gas phase reaction ,



The reaction is found experimentally to follow this rate law.

$$\text{Rate} = k[\text{CHCl}_3][\text{Cl}_2]^{1/2}$$

Based on this information , what conclusions can be drawn about this proposed mechanism?



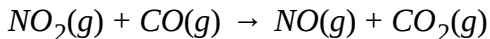
- A. Step 1 is the rate -determining step.
- B. Step2 is the rate-determining Step.
- C. Step3: is the rate -determining Step.
- D. The rate-determining Step cannot be identified.

**Answer: B**



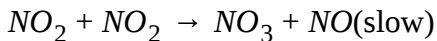
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41. For the reaction ,

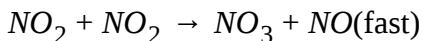


At temperatures below 500K , the rate law is  $\text{rate} = k[\text{NO}_2]^2$  which mechanism is consistent with this information?

Mechanism1:



Mchanism2:



A. 1only

B. 2 only

C. Either1or2

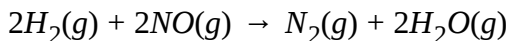
D. Neither1 nor2

**Answer: A**



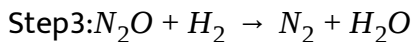
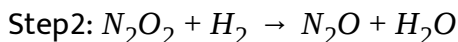
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42. Consider this reaction,



The rate law for this reaction is  $\text{rate} = k[H_2][NO]^2$ .

Under what conditions could these Steps represent the mechanism?



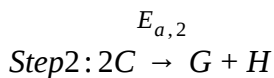
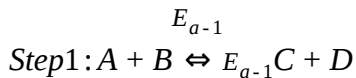
- A. These Steps cannot be the mechanism under any circumstances.
- B. These steps could be the mechanism if Step 1 is the slow step.
- C. These step could be the mechanism if Setp2 is the slow step.
- D. These Steps could be the mechanism if Step 3 is the slow step.

**Answer: C**



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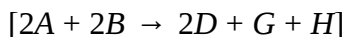
43. For the mechanism



Step 2 is rate-determining. Given the activation energies

$E_{a,1} = 120 \text{ kJ/mol}$ ,  $E_{a,-1} = 96 \text{ kJ/mol}$  and  $E_{a,2} = 196 \text{ kJ/mol}$ . Find  $E_a$  for the

overall reaction.



A. 154

B. 244

C. 354

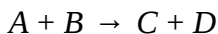
D. none of these

**Answer: B**



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44. For any reaction ,



Rate law obtained is  $\text{Rate} = k[A][B]$

Select the correct option(s).

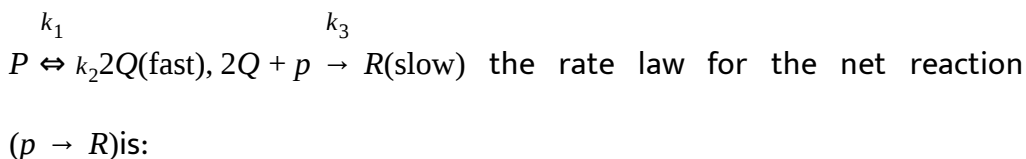
- A. Reaction must be elementary
- B. Reaction must be complex
- C. Reaction may be elementary or complex
- D. Reaction can not be complex

**Answer: C**



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45. The reaction mechanism for the reaction  $P \rightarrow R$  is as follows:



A.  $k_1[P][Q]$

B.  $k_1k_2[P]$

C.  $\frac{k_1k_3[P]^2}{k_2}$

D.  $K_1k_2[P][R]$

**Answer: C**

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## complicatio in first order reactions

1. For a reaction, net rate is  $\left(\frac{dx}{dt}\right) = k[A]^2 - k'[C][B]^2$  then ,Select the correct Statement:

A.  $-\frac{d[A]}{dt} = \frac{d[b]}{dt} = \frac{d[C]}{dt}$  is the relation among

B.  $2A \rightleftharpoons 2B + C$  is the required reaction

C. Both are correct

D. none is correct

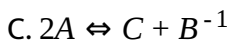
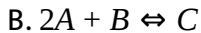
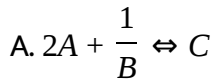
**Answer: B**



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2. For a reaction of reversible nature , net rate is

$\left(\frac{dx}{dt}\right) = k_1[A]^2[B]^1 - k_2[C]$ , hence , given reaction is:



D. none of these

**Answer: B**



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3. At a given temperature,  $k_1 = k_2$  for the reaction,



If  $\left[ \frac{dx}{dt} \right] = k_1[A][B] - k_2[C][D]$  in which set of the concentration, the reaction ceases?

A.  $\begin{matrix} ([A]) & ([B]) & ([C]) & ([D]) \\ (0.1M) & (0.2M) & (0.3M) & (0.4M) \end{matrix}$

B.  $0.4M \quad 0.25M \quad 0.2M \quad 0.5M$

C.  $0.2M \quad 0.2M \quad 0.3M \quad 0.2M$

D.  $0.2M \quad 0.2M \quad 0.4M \quad 0.2M$

**Answer: B**

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4. The rate constant for two parallel reactions were found to be  $1.0 \times 10^{-2} \text{ dm}^3 \text{ mol}^{-1}$  and  $3.0 \times 10^{-2} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ . If the corresponding energies of activation of the corresponding energies of activation of the



parallel reaction are  $60.0 \text{ KJ mol}^{-1}$  and  $70.0 \text{ KJ mol}^{-1}$  respectively, what is the apparent overall energy of activation ?

A.  $130.0 \text{ KJ mol}^{-1}$

B.  $67.5 \text{ KJ mol}^{-1}$

C.  $100.0 \text{ KJ mol}^{-1}$

D.  $65.0 \text{ KJ mol}^{-1}$

**Answer: B**



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5. Consider a reversible reaction, which Statement about this reaction is correct?

(P) The reaction will never reach equilibrium

(Q) If  $\left(\frac{k_1}{k_2}\right) = 2$  then at  $t = \infty$ ,  $[A] = \frac{2a}{3}$  if initially only A was present and at

$t = 0, [A] = a.$

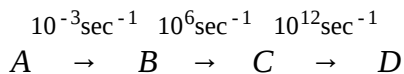
(R) At any instant ,If  $[A] = \frac{a}{5}$  then  $[B] = \frac{2a}{5}$ , if  $\left( \frac{k_1}{k_2} = 2. \right.$

- A. Only P
- B. P and Q
- C. P,Q,R
- D. Q and R

**Answer: A**

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6. A substance undergoes sequential decay to give B, C and D as shown:



Calculate the ratio of moles of 'A' to moles of 'C' assuming steady State is obtained.

- A. 0

B.  $10^9$

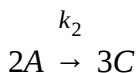
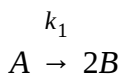
C.  $10^{15}$

D.  $10^3$

**Answer: C**

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7. Study the parallel first order reaction:



At any time ( $t \neq 0$ ) the products contain 40% B and 60% C, by moles .If

the overall rate constant for the reaction of A is  $0.09 \text{ min}^{-1}$  ,then value of

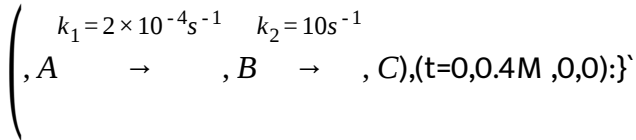
$K_1$  is :

A.  $0.036 \text{ min}^{-1}$

B.  $0.03 \text{ min}^{-1}$

C.  $0.054 \text{ min}^{-1}$

D. 0.06 min

**Answer: B**[View Text Solution](#)**8. For the sequential first order reactions:**

the time after which the concentration of C becomes 0.3 M is:

A.  $\frac{\ln 2}{k_1}$

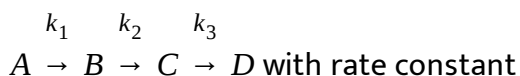
B.  $\frac{\ln 4}{k_1}$

C.  $\frac{\ln 2}{k_2}$

D.  $\frac{\ln 4}{k_2}$

**Answer: B**[View Text Solution](#)

9. A substance undergoes a series of chemical reaction as shown



$k_1 = \frac{\ln 2}{2000} \text{sec}^{-1}$ ,  $k_2 = \frac{\ln 2}{10} \text{sec}^{-1}$ ,  $k_3 = 20 \ln 2 \text{sec}^{-1}$  What will be the value of

$\frac{[A]}{[C]}$  once steady state is obtained?

{[ ] represents concentration}

A. 40000

B. 20000

C. 200

D. 400

**Answer: A**



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10. The reaction  $Cis - X \rightleftharpoons trans - X$  1st order in both directions .At  $25^\circ C$  , the equilibrium constant is 0.10 and the constant  $k_f = 3 \times 10^{-4} \text{sec}^{-1}$  In an

experiment starting with the cis form , How long will it take for half of the equilibrium amount of the trans to be formed?

A. 150 sec.

B. 200sec.

C. 240 sec.

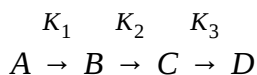
D. 210sec.

**Answer: D**



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11. For a substance undergoes sequential first order reaction calculate ratio calculate ratio of number of atoms of B to C when steady state is obtained.



where  $K_1 = \frac{\ln 2}{10}$ ,  $K_2 = 10 \ln 2$ ,  $K_3 = 10^4 \ln 2$

A. 10

B.  $10^3$

C.  $10^{-3}$

D.  $10^4$

**Answer: B**



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12. For the reversible reaction :  $A \rightleftharpoons B$ ,  $k_1 = 0.02 \text{ min}^{-1}$  and  $k_2 = 0.03 \text{ min}^{-1}$ . The reaction is started with A only. If the half life of such reaction is defined as the time in which half of the equilibrium amount of B is formed, then, what is the half life of reaction ?

A. 34.65 min

B. 23.10 min

C. 13.86 min

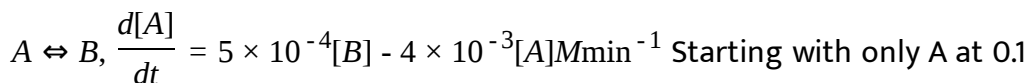
D. Infinite

**Answer: C**



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**13.** For a reaction ,



M concentration calculate concentration of B after time  $t=9200\text{sec}$ .

[Given:  $\ln 2=0.69$ ]

A.  $\frac{0.8}{9}M$

B.  $\frac{0.4}{9}M$

C.  $\frac{0.1}{9}M$

D.  $\frac{0.2}{9}M$

**Answer: B**



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14. Conversion of 'E' isomer of sorivudine to Z isomer of of sorivudine flow revesible first order kinetics with equilibrium constant equal to 10. Starting with 0.1M of 'E' isomer only, calculate concentration of 'E' isomer 60 sec after the start if rate constant of forward reaction is  $0.063 \text{ min}^{-1}$

- A. 0.08M
- B. 0.15M
- C. 0.04M
- D. 0.094M

**Answer: D**



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15. A reaction takes place in 3 steps, the rate constant are  $K_1, K_2, K_3$  and energies of activation are 40, 30 and 20 KJ reaspectively. If overall rate constant  $K = \frac{K_1, K_3}{K_2}$ , the overall energy of activation is:

A. 10

B. 15

C. 30

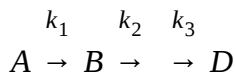
D. 60

**Answer: C**



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**16.** In the given sequence of first order reaction,



What is the ratio of numbers of atoms of A to the number of atoms of B after long time interval starting with pure A, where  $k_1$  where  $K_1$

$$k_1 = \frac{\ln 2}{20 \times 60}, k_2 = \frac{\ln 2}{30} ?$$

A.  $\frac{2}{3}$

B. 10

C. 20

**Answer: D**

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**17.** For the reversible reaction

the initial concentrations of A and B are  $a$  and  $b$ , and the equilibrium concentrations are  $(a - x)$  and  $(b + x)$  respectively. The value of  $x$  is:

A.  $\frac{K_1 a + K_2 b}{K_1 + K_2}$

B.  $\frac{K_1 a - K_2 b}{K_1 + K_2}$

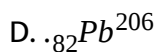
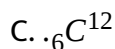
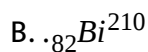
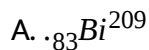
C.  $\frac{K_1 + K_2}{K_1 a + K_2 b}$

D.  $\frac{K_1 + K_2}{K_1 a - K_2 b}$

**Answer: B**

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1. Which of the following isotopes will shows radioactive disintegration?



**Answer: B**



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2. If proton/neutron ratio of an isotope is less than one then which of the following emission will be shown by the isotope

A.  $\beta$  - particle

B. positron emission

C. Kelectron capture

D. Either b and C

**Answer: A**



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3. A radioactive substance has 0.1gm at a particular instant and has an average life of 1 day. The mass of the substance which always during the 4th day is given by:

A. 6.25mg

B. 12.5mg

C. 3.15mg

D. 1.25mg

**Answer: C**



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4. The half-life of a radioisotope is four hours. If the initial mass of the isotope was 200g. The mass remaining after 24hours undecayed is:

A. 1.042g

B. 2.084g

C. 3.125g

D. 4.167g

**Answer: C**



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5. A radioactive element gets spilled over the floor of a room. Its half life period is 30 days. If its initial activity is ten times the permissible value, after how many days will it be safe to enter the room?

A. 10 days

B. 100 days

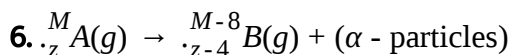
C. 1000 days

D. 300 days

**Answer: B**



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( $\alpha$  - particles are helium nuclei, so will form helium gas by trapping electrons)

The radioactive disintegration follows first-order kinetics. Starting with 1 mol of A in a 11-litre closed flask at  $27^\circ \text{C}$  pressure developed after two half-lives is approximately:

A. 25 atm

B. 12 atm

C. 61.5 atm

D. 40 atm

**Answer: C**



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7. A G.M. counter is used to study the radioactive process of first-order. In absence of radioactive substance A, it counts 3 disintegration per second (dps). When A is placed in the G.M. counter, it records 23 dps at the start and 13 dps after next 10 minutes and A has half-life period  $y$  minutes.  $x$  and  $y$  are:

- A. 8 dps, 10min
- B. 5dps, 10min
- C. 5dps, 20min
- D. 5dps, 5min

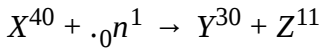
**Answer: A**



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8. What will be the energy change in the following nuclear reaction,



if binding energy per nucleon of X,Y and Z is 9, 7 and 6 MeV respectively.

- A. Energy released 84 MeV
- B. Energy absorbed 84 MeV
- C. Energy released 4 MeV
- D. Energy absorbed 4 MeV

**Answer: B**



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9. Two radioactive nuclides A and B have half-lives 50 min and 10 min respectively . A fresh sample contains the nuclides of B to be eight times that of A. How much time should elapse so that the number of nuclides of A becomes double of B ?

A. 30

B. 40

C. 50

D. 100

**Answer: C**



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**10.** A periodic table has 18 groups numbered from 1 to 18. What will be the group number of the final daughter nucleus formed, if  ${}_{63}\text{Eu}^{150}$  shows sequential decay emitting  $1\alpha$  and  $1\beta$  particles.

A. 3

B. 2

C. 4

D. 5

**Answer: A**



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11. A sample of a radioactive element that contains  $1.0 \times 10^3$  nuclei decays to  $6.2 \times 10^1$  nuclei in 10 minutes. What is its specific decay constant?

A.  $6.2 \times 10^{-1} \text{ min}^{-1}$

B.  $1.2 \times 10^{-1} \text{ min}^{-1}$

C.  $0.28 \times 10^{-1} \text{ min}^{-1}$

D.  $0.062 \times 10^{-1} \text{ min}^{-1}$

Answer: C



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12. Two radioactive materials A and B have disintegration constants  $10\lambda$  and  $2\lambda$  respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of A and B will be  $\frac{1}{e}$  after a time of :

A.  $\frac{1}{10\lambda}$

B.  $\frac{1}{11\lambda}$

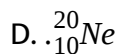
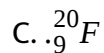
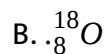
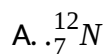
C.  $\frac{11}{10\lambda}$

D.  $\frac{1}{8\lambda}$

**Answer: D**

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13. Which species is most likely to lose a position ( $\beta^+$ )?



**Answer: A**

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14. Which type of radioactive decay produces a daughter nucleus with a higher atomic number?

A.  $\alpha$

B.  $\beta^-$

C.  $\gamma$

D.  $\beta^+$

**Answer: B**



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15. The rate constant for the radioactive decay of  $C-11$  is  $0.0341 \text{ min}^{-1}$ . How long will it take for a sample of C-11 to decrease to  $\frac{1}{4}$  of its original activity?

A. 20.3min

B. 29.3min

C. 40.6min

D. 58.6min

**Answer: C**



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16. What mode of radioactive decay is most likely for the isotope  ${}_{11}^{20}\text{Na}$ ?

A. Alpha

B. Beta

C. Gamma

D. Electron capture

**Answer: D**



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17. Which nucleus is not radioactive?

A. K-38

B. K-39

C. K-42

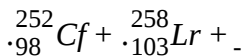
D. K-43

**Answer: B**



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18. The element Lawrencium was first synthesized by the reaction



What products are needed to balance this equation?

A.  $\frac{4}{2}\alpha + \frac{1}{0}n$

B.  $5\text{}_{-1}^{\circ}e$

C.  $5\text{}_{1}^{\circ}e$

D.  $5 \frac{0}{1} n$

**Answer: D**



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19. The isotope  $^{14}\text{C}$  undergoes radioactive decay slowly. Which mode of decay is most likely?

- A. Alpha emission
- B. Beta emission
- C. Positron emission
- D. Electron capture

**Answer: B**



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20. A sample containing a radioactive isotope produces 2000 counts per minutes in a Gieger counter. After 120 hours, the sample produces 250 counts per minutes. What is the half-life of the isotope?

A. 15h

B. 30h

C. 40h

D. 60h

**Answer: C**



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21. The half-life of iodine-131 is 8.02 days. How long will it take for 80% of the sample to decay?

A. 2.6 days

B. 12 days

C. 19days

D. 32days

**Answer: C**



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22. An elements A undergoes successive radioactive decay following sequences  $\beta^{-}, \beta^{-}, X, \beta^{-}, Y$  to form product B.

- A. If X and Y both are  $\alpha$  particles, then A and B are isotopes
- B. If X and Y are positrons then A and B are isobars
- C. If X and Y both are  $\beta^{-}$  particles then A and B are isobars
- D. If X is  $\alpha$  - particle and Y is  $\beta^{-}$  - particle then A and B are isodiaphers

**Answer: D**



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23. During a decay of 952gm  ${}_{92}\text{U}^{238}$  to  ${}_{82}\text{Pb}^{206}$ , total  $18 \times 10^{24}$  alpha-particle are emitted, number of half lives completed in this decay are:

A. 5

B. 4

C. 3

D. 6

**Answer: B**



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24. A, B, C and D elements form compounds AC,  $A_2D$  and BD. If AC and  $A_2D$  are radioactive and BD is not radioactive compound, then which among the following pair of compounds may not be radioactive:

A.  $A_2$  and  $BD$

B.  $BD$  and  $B_2C$

C.  $AD$  and  $C_2D$

D.  $B$ ,  $C$  and  $AD$

**Answer: B**



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25. A radioactive nuclide is produced at a constant rate  $\alpha$  - per second/ It's decay constant is  $\lambda \text{sec}^{-1}$ . If  $N_0$  be the number of nuclei at time  $t = 0$ , then maximum number of nuclei at any instant possible are:

A.  $\frac{\alpha}{\lambda}$

B.  $N_0 - \frac{\alpha}{\lambda}$

C.  $\frac{\lambda}{\alpha}$

D.  $\alpha + \lambda N_0$

**Answer: A**



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26. Strontium is chemically similar to calcium and can replace calcium in bones. The radiation from  $Sr^{90}$  can damage bone marrow where blood cells are produced, and lead to serious health problems. The time taken for 99.99% of a sample of  $Sr^{90}$  is  $\lambda$  for  $Sr^{90} = 0.23\text{yr}^{-1}$ :

- A. 10yr
- B. 200yr
- C. 40yr
- D. 400yr

**Answer: C**



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27. If the amount of radioactive substance is increased three times and simultaneously temperature also increases thrice, the number of atoms disintegrating per unit time would be:

A.  $\frac{1}{3}$ rd of original atoms

B. constant

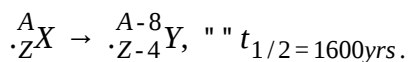
C. triple

D. 9 times

**Answer: C**

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**28.** For the nuclear reaction,



If initial activity was  $10^7$  dps, how many  $\alpha$  - particles will be emitted per second after 4800yrs?

A.  $1.25 \times 10^6 \text{ s}^{-1}$

B.  $2.5 \times 10^6 \text{ s}^{-1}$

C.  $1.25 \times 10^7 \text{ s}^{-1}$

D.  $5 \times 10^7 \text{ s}^{-1}$

**Answer: B**



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29. Magnesium ( $Z=12$ ) has isotopes that range from  $Mg - 20$ , to  $Mg - 31$ , Only  $Mg - 24$ ,  $Mg - 25$ , and  $Mg - 26$  are not radioactive. What mode of radioactive decay would convert. What mode of radioactive decay would convert  $Mg - 20$ ,  $Mg - 21$ ,  $Mg - 22$ , and  $Mg - 23$  into stable isotopes most quickly?

- A. Electron emission
- B. Alpha particle emission
- C. Gamma emission
- D. Positron emission

**Answer: D**



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30. The radioisotope, N-13, has a half-life of 10.0 minutes. What is the rate constant for the radioactive decay of N-13?

A.  $0.0310 \text{ min}^{-1}$

B.  $0.0693 \text{ min}^{-1}$

C.  $0.100 \text{ min}^{-1}$

D.  $6.93 \text{ min}^{-1}$

**Answer: B**



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31. Gadolinium-153, which is used to detect osteoporosis, has a half-life of 242 days. Which value is closest to the percentage of the  $Gd - 153$  left in a patient's system after 2 years (730 days)?

A. 0.33

B. 0.225



C. 0.125

D. 0.0625

**Answer: C**



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**32.** The radioisotope, N-13, has a half-life of 10.0 minutes and is used to image organs in the body. If an injected sample has an activity of 40 microcuries ( $40, \mu\text{Ci}$ ), what is its activity after 25 minutes in the body?

A.  $0.75\mu\text{Ci}$

B.  $3.5\mu\text{Ci}$

C.  $7.1\mu\text{Ci}$

D.  $12\mu\text{Ci}$

**Answer: C**



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33. A radioactive mixture containing a short lived species A and short lived species B. both emitting  $\alpha$  - particles at a given instant, emit at rate 10,000  $\alpha$  - particles per minute. 10 minutes later, it emits at the rate of 7000 particles per minute. If half lives of the species are 10 minutes and 100 hours respectively, then the ratio of activities of A : B in the initial mixture was:

A. 3:7

B. 4:6

C. 6:4

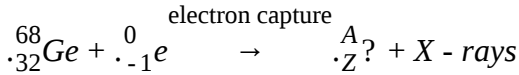
D. 10:4

**Answer: C**



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34. In the decay



A.  $A = 67, Z = 33$

B.  $A = 68, Z = 33$

C.  $A = 67, Z = 31$

D.  $A = 68, Z = 31$

**Answer: D**



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35. The radioisotope  ${}_{15}^{32}\text{P}$  is used in biochemical studies. A sample of this isotope has an activity 1000 times the detectable limits. How long could an experiment be run with the sample before the radioactivity could no longer be detected ( $t_{1/2} = 14.2\text{days}$ )?

A. 28days

B. 102days

C. 142days

D. 50days

**Answer: C**



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**36.** The half-life of tritium is 12.3yrs. If 48.0 mg of tritium is released from a nuclear power plant during the course of an accident, calculate the mass (in mg) of the nuclide that will remain after 5.0yrs.

A. 36.2

B. 32

C. 24

D. 16

**Answer: A**



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37. Carbon-14 radioactively decays via the emission of a beta particle.

Which of the following is the product of this decay?

A. Beryllium-10

B. Boron-14

C. Carbon-13

D. Nitrogen-14

**Answer: D**



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38. 80% of the radioactive nuclei are left undecayed in one day then % of nuclei left undecayed after two days will be:

A. 40%

B. 60%

C. 64%

D. 46

**Answer: C**



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**39.** If half lives of a radioactive element, undergoing parallel path  $\alpha$  - decay and  $\alpha$  - decay are 4 years and 12 years respectively, then percentage of element that remains after 12 years will be:

A. 0.5

B. 0.125

C. 0.0625

D. 0.25

**Answer: C**

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40. A sample of rock from moon contains atoms of uranium and lead in the ration 1:3. Then age of rock will be ( $t_{1/2}$ for uranium =  $4 \times 10^{10}$ years):

A.  $4 \times 10^2$ years

B.  $1.2 \times 10^{10}$ years

C.  $8 \times 10^{10}$ years

D.  $2 \times 10^9$ years

**Answer: C**

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41. If 50second are required to decay 2//3rd fraction of a radionactive sample, what fraction will be left after 25sec?

A.  $\frac{1}{2}$

B.  $\frac{1}{\sqrt{3}}$

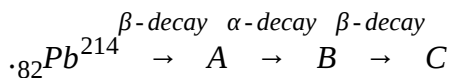
C.  $\frac{1}{3}$

D.  $\sqrt{\frac{2}{3}}$

**Answer: B**

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**42.** Predict the final product © in following nuclear decay process:



A.  ${}_{82}\text{Pb}^{210}$

B.  ${}_{82}\text{Pb}^{212}$

C.  ${}_{78}\text{Pb}^{210}$

D.  ${}_{78}\text{Pb}^{210}$

**Answer: A**

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43. The activity of a radioactive sample initially is 3200 dps and after 8 hours activity is 100 dps. What will be the activity after 4.8 hr from start in dps?

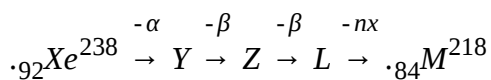
- A. 150
- B. 200
- C. 300
- D. 400

**Answer: D**



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44. In the sequences of the following



the value of n will be

A. 5

B. 4

C. 3

D. 6

**Answer: B**

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45.  ${}_{13}^{27}\text{Al}$  is a stable isotope.  ${}_{13}^{29}\text{Al}$  is expected disintegrate by:

A.  $\alpha$  emission

B.  $\beta$  "emission"

C. Positron emission

D. proton emission

**Answer: B**

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46. Loss of a  $\beta$  - particle is equivalent to:

- A. increase of one proton only
- B. decrease of one neutron only
- C. both A and B
- D. None of the above

Answer: C



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47. Two radioactive material  $A_1$  and  $A_2$  and decay constant of  $10\lambda_0$  and  $\lambda_0$

. If initially they have same number of nuclei, then after time  $\frac{1}{9\lambda_0}$  the ratio of number of their undercayed nuclei will be:

- A.  $\frac{1}{e}$
- B.  $\frac{1}{e^2}$

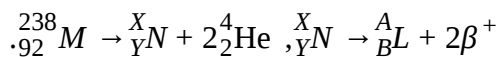
C.  $\frac{1}{e^3}$

D.  $\frac{\sqrt{3}}{1}$

**Answer: A**

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**48.** Consider the following nuclear reactions :



The number of neutrons in the element L is :

A. 142

B. 144

C. 140

D. 146

**Answer: b**

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49. Helium nuclei combines to form an oxygen nucleus. The energy released per nucleon of oxygen nucleus is [if  $m_O = 15.834a\mu$  and  $m_{He} = 4.0026a\mu$ ]:

A.  $10.24MeV$

B.  $0MeV$

C.  $5.24MeV$

D.  $4MeV$

**Answer: a**



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50. Read the following :

(i) The half - life period of a radioactive element X is same as the mean-life time of another radioactive element Y. Initially both of them have the same number of atoms. Then Y will decay at a faster rate than X.

- (ii) The electron emitted in beta radiation originates from decay of a neutron in a nucleus.
- (iii) The half-life of  $^{215}\text{At}$  is 100 ms. The time taken for the radioactivity of a sample of  $^{215}\text{At}$  to decay to  $1/16\text{th}$  of its initial value is 400 ms.
- (iv) The volume ( $V$ ) and mass ( $m$ ) of a nucleus are related as  $V \propto m$ .
- (v) Given a sample of Radium-226 having half-life of 4 days. The probability, a nucleus disintegrates within 2 half lives is  $3/4$ .

Select the correct code for above.

A. T T T T T

B. T F T T F

C. F T F T F

D. F T T T F

**Answer: a**



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51. Which of the following processes represents a gamma-decay only.

$$A. \cdot^A X_Z + \gamma \rightarrow \cdot^A X_{Z-1} + a + b$$

$$B. \cdot^A X_Z + \cdot^1 n_0 \rightarrow \cdot^{A-3} X_{Z-2} + C$$

$$C. \cdot^A X_Z \rightarrow \cdot^A X_Z + f$$

$$D. \cdot^A X_Z + e_{-1} \rightarrow \cdot^A X_{Z-1} + g$$

**Answer: c**

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**52.** Let  $F_{pp}$ ,  $F_{pn}$  and  $F_{nn}$  denote the magnitude of net force by a proton on a proton, by a proton on a neutron and by a neutron on a neutron respectively. Neglect gravitational force. When the separation is 1 fm :

$$A. F_{pp} > F_{pn} > F_{nn}$$

$$B. F_{pp} = F_{pn} = F_{nn}$$

$$C. F_{pp} > F_{pn} > F_{nn}$$

$$D. F_{pp} < F_{pn} = F_{nn}$$

**Answer: d**

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**53.** The half-life of  $Tc^{99}$  is 6.0 hr. The delivery of a sample of  $Tc^{99}$  from the reactor to the nuclear medicine lab of a certain hospital takes 3.0 hr. What is the minimum amount of  $Tc^{99}$  that must be shipped in order for the lab to receive 10.0 mg?

- A. 20.0 mg
- B. 15.0 mg
- C. 14.1 mg
- D. 12.5 mg

**Answer: b**

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54. A sample contains 0.1 gram-atom of radioactive isotope  ${}^A_Z(t_{1/2} = 5\text{days})$  How many number of atoms will decay during eleventh day? [ $N_A = \text{Avogadro's number}$ ]

A.  $0.1 \left( -e^{-\frac{0.693 \times 11}{5}} + e^{-\frac{0.693 \times 10}{5}} \right)$

B.  $0.1 \left( -e^{\frac{0.693 \times 11}{5}} + e^{\frac{0.693 \times 10}{5}} \right)$

C.  $0.1 \left( -e^{-\frac{0.693 \times 11}{5}} + e^{-\frac{0.693 \times 10}{5}} \right) N_A$

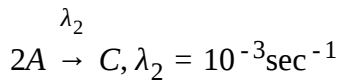
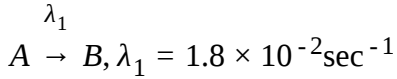
D.  $0.1 \left( -e^{\frac{0.693 \times 11}{5}} + e^{\frac{0.693 \times 10}{5}} \right) N_A$

**Answer: c**



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55. The average (mean) life at a radio nuclide which decays by parallel path is :



- A. 52.63 sec
- B. 500 sec
- C. 50 sec
- D. none of these

**Answer: c**



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56. A sample of  $^{14}\text{CO}_2$  was to be mixed with ordinary  $\text{CO}_2$  for a biological tracer experiment. In order that  $10\text{cm}^3$  of diluted gas should have  $10^4$  dis/min, what activity (in  $\mu\text{Ci}$ ) of radioactive carbon is needed to prepare 60L of diluted gas at 1 atm and 273 K?

$$[1\text{Ci} = 3.7 \times 10^{10} \text{dps}]$$

- A.  $270\mu\text{Ci}$

B.  $27\mu\text{Ci}$

C.  $2.7\mu\text{Ci}$

D.  $2700\mu\text{Ci}$

**Answer: b**

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57. Wooden article and freshly cut tree show activity  $7.6$  and  $15.2$   $\text{min}^{-1}\text{g}^{-1}$  of carbon ( $t_{1/2} = 5760\text{year}$ ) respectively. The age of the article is a)  $5760$  year b)  $5760 \times \frac{15.2}{7.6}\text{year}$  c)  $5760 \times \frac{7.6}{15.2}\text{year}$  d)  $5760 \times 15.2 - 7.6\text{year}$

A.  $5760$

B.  $5760 \times \left(\frac{15.2}{7.6}\right)$

C.  $5760 \times \left(\frac{7.6}{15.2}\right)$

D.  $5760 \times (15.2 \times 7.6)$

**Answer: a**



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58. A radioactive sample had an initial activity of 56 dpm (disintegration per min). After 69.3 min it was found to have an activity of 28 dpm. Find the number of atoms in a sample having an activity of 10 dpm.

- A. 693
- B. 1000
- C. 100
- D. 10000

**Answer: b**



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59. The radioactivity of sample is  $R_1$  at a time  $T_1$  and  $R_2$  at a time  $T_2$ . If the half-life of the specimen is  $T$ , the number of atoms that have disintegrated in the time  $(T_2 - T_1)$  is equal to :

A.  $(R_1T_1 - R_2T_2)$

B.  $(R_1 - R_2)$

C.  $(R_1 - R_2)/T$

D.  $(R_1 - R_2)T/0.693$

**Answer: d**



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**60.**  $C^{14}$  is a beta active nucleus. A sample of  $C^{14}H_4$  gas kept in a closed vessel shows increase in pressure with time . This is due to:

A. the formation of  $N^{14}H_3$  and  $H_2$

B. the formation of  $B^{11}H_3$  and  $H_2$

C. the formation of  $C_2^{14}H_4$  and  $H_2$

D. the formation of  $C^{12}H_3$ ,  $N^{14}H_2$  and  $H_2$

**Answer: a**

61. A radioactive isotope  $^{40}\text{K}$  with a half-life of  $1.26 \times 10^9$  years, decay to  $^{40}\text{Ar}$ . A sample of rock from the moon was found to contain both element K and Ar and they are in the ratio 1:7. What is the age of the rock? (Neglect decay of  $^{40}\text{K}$  to  $^{40}\text{Ca}$ )

A.  $2.52 \times 10^9$  year

B.  $\frac{1.26 \times 10^9}{\ln 2} \times \ln\left(\frac{7}{8}\right)$  year

C.  $\frac{1.26 \times 10^9}{\ln 2} \times \ln(7)$  year

D.  $3.78 \times 10^9$  year

Answer: d

62. A positron is emitted from  $^{23}_{11}\text{Na}$ . The ratio of the atomic mass and atomic number of the resulting nuclide is

A.  $\frac{22}{10}$

B.  $\frac{22}{11}$

C.  $\frac{23}{10}$

D.  $\frac{23}{12}$

**Answer: c**



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**63.** A sample of a radioactive element that contains  $1.0 \times 10^3$  nuclei decays to  $6.2 \times 10^1$  nuclei in 10 minutes. What is its specific decay constant?

A.  $62 \text{ min}^{-1}$

B.  $1.2 \text{ min}^{-1}$

C.  $0.28 \text{ min}^{-1}$

D.  $0.062 \text{ min}^{-1}$

Answer: c



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## Reasoning Type

1. Statement-1 : Conservation of a  $\gamma$  photon into an electron and a positron is an example of pair production.

Statement-2: Pair production refers to the creation of an elementary particle and its antiparticle , usually when a photon interacts with a nucleus.

- A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.
- B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1
- C. Statement-1 is True, Statement-2 is False.



D. Statement-1 is False, Statement-2 is True.

Answer: a

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2. Statement-1 : In the reaction

$I_2 + SO_2O_3^{2-} \rightarrow S_4O_4^{2-} + 2I^-$  the rate of disappearance of thiosulphate ions is twice the rate of disappearance of  $I_2$ .

Statement-2: The rate of disappearance of  $I_2$  is one half the rate of disappearance of  $S_2O_3^{2-}$  ions.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: b

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### 3. Statement-1 For



the half life time of reaction is only defined when conc. Of A and B are in stoichiometric ratio.

Statement -2: For above given order half life of reaction is directly proportional to conc. of A and B not conc. of B due to its zero order.

- A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.
- B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1
- C. Statement-1 is True, Statement-2 is False.
- D. Statement-1 is False, Statement-2 is True.

Answer: c

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4. Statement-1: Many reaction occurring on solid surface are zero order reactions

Statement-2:  $N_2O(g) \xrightarrow{Au} N_2(g) + \frac{1}{2}O_2$ , rate =  $k[N_2O]^0 = k = \text{constant}$  is a zero order reaction.

- A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.
- B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1
- C. Statement-1 is True, Statement-2 is False.
- D. Statement-1 is False, Statement-2 is True.

Answer: b

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5. Statement-1: Half life of a certain radioactive element is 100 days . After 200 days , fraction left undecayed will be 25 % .

Statement-2:  $\frac{N}{N_0} = \left(\frac{1}{2}\right)^n$  , where symbols have standard meaning.

$$N_0 = \left(\frac{1}{2}\right)^n$$

- A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.
- B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1
- C. Statement-1 is True, Statement-2 is False.
- D. Statement-1 is False, Statement-2 is True.

**Answer: a**



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6. Statement -1: Time taken for the completion of 75% of a 1st order reaction is double that  $t_{1/2}$ .

Statement-2: Time taken for completion of any fraction of 1st order reaction is a constant value.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

**Answer: b**



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7. Statement-1: If the activation energy of reaction is zero, temperature will have no effect on the rate constant.

Statement -2: Lower the activation energy faster is the reaction.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

**Answer: b**



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8. Statement-1: For a reaction  $A(g) \rightarrow B(g)$

$$-r_A = 2.5P_A \text{ at } 400K$$

$$-r_A = 2.5P_A \text{ at } 600K$$

Activation energy is 4135 J/mol/k,

(Take:  $R = 8.314 \text{ J/mol/k}$ ,  $\log 2 = 0.3$ ,  $\log 3 = 0.48$ )

Statement-2: Since for any reaction, values of rate constant at two different temperatures are same therefore activation energy of the reaction is zero.

- A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.
- B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1
- C. Statement-1 is True, Statement-2 is False.
- D. Statement-1 is False, Statement-2 is True.

**Answer: b**



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9. Statement -1: In  $A \xrightarrow{k_1} B \xrightarrow{k_2} C$

If half life of A is very less as compared to B, then, net reaction is A to C with rate constant  $(k_1 \times k_2)$

Statement-2: Slowest step is the rate determining step si B to C is rate determining step.

- A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.
- B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1
- C. Statement-1 is True, Statement-2 is False.
- D. Statement-1 is False, Statement-2 is True.

**Answer: d**



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10. Statement-1: For the reaction  $2A + B \rightarrow C$ , the rate of disappearance of A is twice the rate of disappearance of B.

Statement-2: For the reaction :  $2A + B \rightarrow C$  Rate of reactions is  $\frac{d[C]}{dt}$

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

**Answer: b**



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11. Statement-1: The plot of atomic number (y-axis) versus number of neutrons (x-axis) for stable nuclei shows a curvature towards x-axis from the line of  $45^\circ$  slope as the atomic number is increased.

Statement-2: Proton-proton electrostatic repulsions begin to overcome attractive forces involving protons and neutrons in heavier nuclides.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

**Answer: a**

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12. Statement-1: Temperature coefficient of a one step reaction may be negative.

Statement-2: The rate of reaction having negative order with respect to a reactant decreases with the increase in concentration of the reactant.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

**Answer: d**



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13. Statement-1: In a reversible endothermic reaction,  $E_{act}$  of forward reaction is higher than that of backward reaction.

Statement-2: The threshold energy of forward reaction is more than that of backward reaction.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

**Answer: c**



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14. Statement-1: A catalyst provides an alternative path to the reaction in which conversion of reactants into products take place quickly.

Statement-2: The catalyst forms an activated complex of lower potential energy, with the reactants by which more number of molecules are able to cross the barrier per unit of time.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

**Answer: a**



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1. A reaction :  $2A(g) + 3B(g) \rightarrow C(g)$  obeys the following rate law, Rate of reaction =  $[A]^3[B]^{-2}$ . Select the incorrect options.

A. The reaction will occur in a single step.

B. If concentration of 'A' and 'B' both are doubled then rate will increase to double the original value.

C. If 'B' is taken in very large amount as compared to 'A' then half life of the reaction will be inversely dependent on cube of its initial concentration.

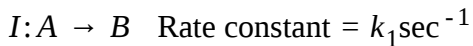
D. If both 'A' and 'B' are taken in equal concentration then half life will be dependent on their concentration.

**Answer: A:C**



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2. For two reactions,



Starting with initial concentration of 1M each, time taken to reach to 0.5M is same, then, identify the correct options.

A.  $k_1 > k_2$

B.  $k_1 < k_2$

C. Rate of first reaction at 0.5M concentration gt rate of second reaction at 0.5M concentration.

D. Initial rate of first reaction lt initial rate of second reaction.

**Answer: B::C::D**



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3. For a gaseous reaction,  $A + B \rightarrow 2C$ , the rate law is given as

$$R = K[A]^{-1}[B]^2.$$

Select the statements which are not correct.

- A. If initially concentration of A is double of B then half life of reaction will remain same throughout the reaction.
- B. If initial A is taken in very large amount then half life of reaction will keep on increasing as reaction proceeds.
- C. If initially B is taken in very large amount then half life of reaction will remain same throughout the reaction.
- D. If A and B are taken with equal concentration, then both will be reduced to half of original in same time interval.

**Answer: A::C**

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4. which of the following are correct about rate of reaction?

- A. Average rate and instantaneous rate can never be equal.



- B. Rate of reaction increases with increases in temperature.
- C. Concentration of catalyst affect rate of reaction.
- D. Small quantity of enzyme is sufficient to increases the rate of biological reaction.

**Answer: B::C::D**

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5. Identify the option(s) which is/are correct w.r.t collision theory for biomolecular collisions.

- A. Fraction of reactant molecules having "extra energy above average value" greater than activation energy on collisions will always give product formation.
- B. All the biomolecular collisions between reactants may not result in product formation.

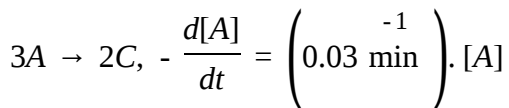
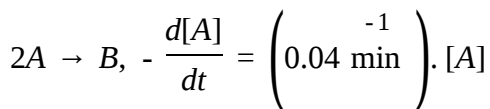
C. Reactants molecules colliding with appropriate orientation may result in product formation.

D. Above a particular finite temperature, all the reactant molecules colliding will give product formation.

**Answer: B::C**

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**6.** For the simultaneous reactions:



Which of the following statement(s) is/are incorrect regarding the reactions?

-1

A. The overall rate constant for the disappearance of 'A' is  $0.17 \text{ min}^{-1}$ .

- B. The molar ratio of 'B' and 'C' after 10min from the start of reaction is 2:3
- C. The mole percent of 'B' in the total product formed upto 20 min from the start of reaction will be 50.
- D. Half life for the disappearance of 'A' is 10min, if  $\ln 2=0.7$ .

**Answer: A::B**

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7. For the gaseous reaction :  $A(g) \rightarrow$  Products, the rate may be expressed as

Method I:  $-\frac{1}{V} \cdot \frac{dn_A}{dt} = k_1 \cdot C_a^n$

Method II:  $-\frac{dp_A}{dt} = k_2 \cdot P_A^n$

Where  $C_A = \frac{n_A}{V}$  = molar concentration of A and  $P_A$  is the partial pressure of A at time 't' and 'n' is the order of reaction. The reaction is occurring at

constant temperature,  $T = 300K$  Assume ideal behaviour of gas. Select the correct statement (s).

A.  $k_1 = K_2$  for any value of 'n'

B.  $k_1 = k_2$  when  $n = 1$

C.  $k_1 = k_2 \cdot (RT)$ , when  $n = 0$

D.  $k_1 = k_2 \cdot (RT)$ , when  $n=2$

**Answer: B::D**



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8. Select correct statement(s).

A. The emission of gamma radiation involves transition between energy levels within the nucleus.

B.  $\frac{4}{2}\text{He}$  is formed due to emission of beta particle from tritium  $\frac{3}{1}\text{H}$ .

C. When positron  $\left( \begin{smallmatrix} 0 \\ +1e \end{smallmatrix} \right)$  is emitted,  $\frac{n}{p}$  ratio increases.

D. None of above

**Answer: A::C**

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9. Select the correct statement (s).

A. The value of rate constant cannot exceed the value of Arrhenius factor.

B. Molecularity of multiple step reaction can be obtained from mechanism.

C. Half life of a fourth order reaction is linearly dependent on initial concentration of reactant

D. reactions with order  $\geq 1$  cannot get completed in finite time interval.

**Answer: A::D**



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10. Select the correct statements.

- A. The molecularity of an elementary reaction indicates how many reactant species take part in the step.
- B. The rate law of an elementary reaction can be predicted by simply seeing the stoichiometry of reaction.
- C. The slowest elementary step in sequence of the reaction governs the overall rate of formation of product.
- D. A rate law is often derived from a proposed mechanism by imposing the steady state approximation. Or assuming that there is a pre-equilibrium.

**Answer: A::B::C::D**



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11. Which of the following statements are correct about half-period ?

A. It is proportional to initial concentration for zeroth order

B. Average life =  $1.44 \times$  half-life for first order reaction.

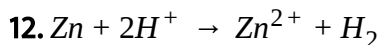
C. Time of 75 % completion of reaction is thrice of half-life (initial half-life) period in second order reaction

D. 99.9 % reaction takes place in 100 minutes for the case when rate constant is  $0.693 \text{ min}^{-1}$

Answer: A::B::C::D



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Half-life period is independent of concentration of zinc at constant pH.

For the constant concentration of Zn, rate becomes 100 times when pH is decreased from 3 "to" 2. Hence,

A.  $\frac{dx}{dt} = k[Xn]^0[H^+]^2$

B.  $\left(\frac{dx}{dt}\right) = k[Zn][H^+]^2$

C. rate is not affected if concentration of zinc is made four times and that of  $H^+$  ion is halved

D. rate becomes four times if concentration of  $H^+$  ions is doubled at constant Zn concentration.

**Answer: B::C::D**



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13. Rate constant  $k$  varies with temperature by equation,  $\log k$

$\left(\text{min}^{-1}\right) = 5 - \frac{2000}{T(K)}$  We can conclude:

A. pre-exponential factor  $A$  is 5

B.  $E_a$  is 2000 kcal

C. pre-exponential factor  $A$  is  $10^5$



D.  $E_a$  is 9.212 kcal

**Answer: C::D**

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14. Activation energy of a chemical reaction can be determined by:

- A. evaluating rate constant at standard temperature.
- B. evaluating velocities of reaction at two different temperatures
- C. evaluating rate constant at two different temperatures
- D. changing concentration of reactants

**Answer: B::C**

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15. Which of the following statements are correct ?

A. Law of mass action and rate and law expressions are same for single step reactions.

B. Order of the slowest elementary reaction of a complex reaction gives the order of the complex reaction.

C. Both order and molecularity have normally a maximum value of 3.

D. Molecularity of a complex reaction,

$A + 2B \rightarrow C$  is 3.

**Answer: A::B::C**

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16. If the rate of reaction,  $2SO_2(g) + O_2(g) \xrightarrow{Pt} 2SO_3(g)$  is given by:

$$\text{Rate} = K \frac{[SO_2]}{[SO_3]^{1/2}}$$

which statements are correct?

A. The overall order of reaction is  $-\frac{1}{2}$

B. the overall order of reaction is  $+\frac{1}{2}$

C. The reaction slows down as the product  $SO_3$  is build up

D. The rate of reactions does not depend upon concentraion of  $SO_3$  formed

**Answer: B::C**

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17. For the reaction,

A to Products (order =n),

the time of completion of reaction is :

A. Infinite for all value of ' n '

B. Infinite for  $n = 1$

C.  $\frac{[A_0]^{1-n}}{K(1-n)}$  for  $n \neq 1$

D.  $\frac{[A_0]^{1-n}}{K(1-n)}$  for  $n < 1$

**Answer: B::D**

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**18.** Two very good approximations, the cooling of a hot body to room temperature follows first-order kinetics (in this case, however, the unit the is changing is temperature (in kelvin) not molarity) If the rate constant for a body is  $0.4s^{-1}$  then:

[Given data"  $\ln 2 = 0.7$ ,  $\ln \frac{323}{25} = 2.6$

- A. the time taken for that body to go from  $323^{\circ}C$  "to"  $25^{\circ}C$  is 17.5 sec.
- B. the time taken for that body ot go from 1192 K "to" 298 K` is 35 sec.
- C. the time taken for that body to go from  $323^{\circ}C$  "to"  $25^{\circ}C$  is 65 sec.
- D. the time taken for that body to go from 1192 K "to" 298 K is 130 sec.

**Answer: A::B**

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19.  $SO_3$  gas is entering the environment at a constant rate of  $6.93 \times 10^{-6} \text{ gm/L/day}$  due to the emission of polluting gases from thermal power plant, but at the same time it is decomposing and following first order kinetic with half life of 100 days.

Based on above information, select the true statement (s)

- A. Concentration of  $SO_3$  in Kota is  $1.25 \times 10^{-5} \text{ M}$  (Assume  $SO_3$  present in Kota with constant concentration means rate of formation and dissociation of  $SO_3$  are equal).
- B. If  $SO_3$  emission is stopped then after 1000 days its concentration will reduce to  $\approx 1.2 \times 10^{-8} \text{ M}$ .
- C. If  $10^3 \text{ L}$  of air passed through 1 L pure water (assuming all  $SO_3$  to dissolved in it) and resulting solution is titrated against 1 N NaOH solution of which 15 ml is consumed.
- D. An industry is manufacturing  $H_2SO_4$  at the rate of 980 kg per day with the use of  $SO_3$  in air it should use  $8 \times 10^5 \text{ Litre air/day}$ .

Answer: A::B



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20. The order of reaction A to product can be given by the expression (s) [where  $r$ =rate of reaction,  $[A]_1$  = concentration at time  $t_1$ ,  $[A]_2$  = concentration at time  $t_2$ ]

A.  $\frac{\ln r_2 - \ln r_1}{\ln[A]_1}$

B.  $\frac{\ln[A]_2 - \ln[A]_1}{\ln[t_{1/2}]_2 - \ln[t_{1/2}]_1}$

C.  $\frac{\ln\left(-\frac{d[A]}{dt}\right)}{\ln[A]}$

D.  $\frac{\ln\left(\frac{r}{k}\right)}{\ln[A]}$

Answer: A::C::D



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21. Select to correct statements.

A. Catalyst can change the spontaneity of reaction

B. If  $\frac{n}{p}$  is higher than  $\left(\frac{n}{p}\right)$ (stabel) then  ${}^0_{-1}\beta$  partical is emitted

C. Binding energy per atom first incjreases then decreases with atomic mass

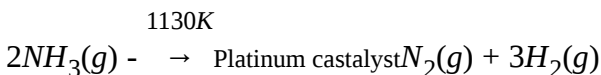
D. Rate of radiocative disintegration is endependent of temperature

Answer: B::D



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22. At high pressure the following reaction is zero order



Which of the folowing option s are correct for this reaction ?

A. Rate of reaction = Rate constant

B. Rate of the reaction depends on concentration of ammonia.

C. Rate of decomposition of ammonia will remain constant until ammonia disappears completely.

D. Further increase in pressure will change the rate of reaction.

**Answer: A::C**

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**23.** During decomposition of an activated complex :

A. energy is always released

B. energy is always absorbed

C. energy does not change

D. reactant may be formed

**Answer: A::D**

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24. For the reaction  $A + 3B \rightarrow C$ , select the correct statement :

A.  $\frac{d[C]}{dt} = \frac{-d[A]}{dt}$

B.  $\frac{3d[C]}{dt} = \frac{d[A]}{dt}$

C. Rate law must be  $r = k[A][B]^3$

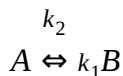
D. Units for rate of reaction are independent of order of reaction

Answer: A:D



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25. For a reversible reaction (first order in both directions)



$k_1$  and  $k_2$  are the rate constant.

If equilibrium constant (K) is greater than unity, then :

- A. rate of forward reaction is always greater than rate of backward reaction.
- B. amount of product at equilibrium is greater than the amount of reactant.
- C. activation energy for the forward direction ( $E_{of}$ ) is greater than activation energy for backward reaction ( $E_{ab}$ )
- D. addition of a catalyst will increase both  $k_1$  and  $k_2$  by same factor

**Answer: B::D**

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26. for a given reaction, rate =  $k[A][B]^{2/3}$  correct option (s) /are:

A. Units of  $k = \text{mol}^{-5/3} \text{L}^{5/3} \text{sec}^{-1}$

B. Units of  $k = \text{mol}^{-2/3} \text{L}^{2/3} \text{sec}^{-1}$

- C. On diluting the solution 8 times rate will become 32 times the initial rate
- D. The reaction is a complex reaction

**Answer: B::D**

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**27. Rate of radiocative decay for a radioactive element depends on :**

- A. amount of radioactive element
- B. temperature
- C. pressure
- D. istopic from of radioactive element

**Answer: A::D**

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28. Which of the following statements are correct for temperature dependence of an exothermic reversible reaction ?

- A. On increasing temperature,  $K_f$  increases while  $K_b$  decreases.
- B. On increasing temperature, both  $K_f$  and  $K_b$  increases.
- C. On increasing temperature, increases in  $K_b$  must be more than increase in  $K_f$
- D. On increasing temperature percentage increase in  $K_b$  will be more than percentage increase in  $K_f$

**Answer: B::D**

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29.  $2X(g) + Y(g) + 3Z(g) \rightarrow \text{Products}$

Choose the correct statement (s).

- A. If 75 % of X undergoes reaction in 20 sec, 50 % of X will react in 10 sec if  $[Z] > [X]$
- B. Rate of reaction decreases by reducing the concentration of Y to half of the original value
- C. The half life of Z increases by increasing its concentration if  $[X] > [Z]$
- D. On doubling the concentration of X,Y and Z, rate of reaction become 8 times

**Answer: A::D**

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**30.** Three different samples of radioactive substances each containing equal moles of given substance are taken then :

A. activity of  $U_3O_8$  will be maximum

B. specific activity of  $U_3O_8$  will be maximum

C. on increasing temperature, activity of all three samples will increase

D.  $7\alpha$  - particles will be emitted when  $U^{235}$  decay to stable nuclei

**Answer: A::D**

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31. A sample  $_{92}^{238}U$  when kept at 298 K in a closed vessel shows  $\alpha$  - decay and  $\beta$  - decay to give  $_{82}^{206}Pb$ . After  $t$  hour the volume of the gas collected in the vessel at 1 atm, 273K is found to be 89.6 ml. Then which of the following is/are correct for the nuclear process and the products of the process ?

A. Mass of Pb obtained in time  $t$  hour = 103mg.

B. If the temperature is increased by  $10^\circ C$  then the time taken for the same amount of gas to be produced will be  $\frac{t}{2}$  hour.

C.  $\alpha$  particles show more ionisation power than  $\beta$  particles.

D.  $\lambda$  radiations undergoes no deviation while traveling through electric or magnetic field.

**Answer: A::C::D**

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32. Which of the following statements are applicable to a balanced chemical equation of an elementary reaction ?

- A. Order is same as molecularity.
- B. Order is less than the molecularity.
- C. Order is greater than the molecularity.
- D. Molecularity can never be zero.

**Answer: A::D**

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33. The activation energies of two reactions I and II are  $E_a$  and  $2E_a$  respectively. If the temperature of the reacting systems is increased from T to T', predict which of the following alternative is /are correct ?

A.  $\frac{k'_I}{k_I} > 1$

B.  $\frac{k'_{II}}{k_{II}} > 1$

C.  $\frac{k'_I}{k_I} < \frac{k'_{II}}{k_{II}}$

D.  $\frac{k'_I}{k_I} = 2 \frac{k'_{II}}{k_{II}}$

Answer: A::B::C



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34. Which of the following statements are in accordance with the Arrhenium equation?

A. Rate of a reaction increases with increase in temperature.

B. Rate of a reactrionincreases with dectease in activation energy.



C. Rate constant decreases exponentially with increase in temperature

D. Rate of reaction decreases with decrease in activation energy.

**Answer: A::B**



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**35.** For a complex reaction :

A. order of overall reaction is same as molecularity of the slowest step

(provided slowest step is having no reaction intermediate)

B. order of overall reaction is less than the molecularity of the slowest step.

C. order of overall reaction is greater than molecularity of the slowest step.

D. molecularity of the slowest step is never zero or non integer.

**Answer: A::D**



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36. Mark the incorrect statements.

- A. Catalyst provides an alternative pathway to reaction mechanism.
- B. Catalyst raises the activation energy.
- C. Catalyst lowers the activation energy.
- D. Catalyst alters enthalpy change of the reaction.

**Answer: B::D**



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37. There are four nuclei A, B, C and D having mass numbers 9, 10, 11 and 12 respectively. Their binding energies are 54, 10, 11 and 12 MeV respectively. Their  $b \in d \in g \neq r$  are 54, 70, 66 and 78 MeV, respectively.

Which of the following statement is/are true ?

- A. The most stable nuclei is B.
- B. A and C have equal stabilities.
- C. The relative order of stability is :  $D > B > C = A$ .
- D. D is more stable than C but less stable than B.

**Answer: A::B::D**

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**38.** Which of the following are correct for radioactivity ?

- A. Half life is independent of initial amount of radioactive substance.
- B. On increasing temperature half life will decrease.
- C. The half life of  $C - 14$  in  $CO_2$  is different form than in  $C_6H_{12}O_6$ .
- D. Half life of  $U - 238$  and  $235$  are different.

**Answer: A::D**

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39. Which of the following may influence the rate of chemical reactions ?

- A. Catalyst
- B. Nature of reactants
- C. Concentration of reactant
- D. Temperature

Answer: A::B::C::D



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40. For a reversible reaction  $A \rightleftharpoons B$  initial concentration of A is  $21 \text{ mol L}^{-1}$ . Select the correct statement:

$$k_1 = 4 \times 10^2 \text{ s}^{-1}$$

$$k_2 = 2 \times 10^2 \text{ s}^{-1}$$

initial

- A. Equilibrium concentration of A is  $14 \text{ mol L}^{-1}$
- B. Equilibrium concentration of B is  $14 \text{ mol L}^{-1}$ .

C. The concentration of A reduce by 50% of equilibrium concentration after 11.55 sec .

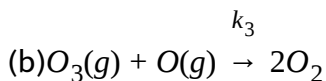
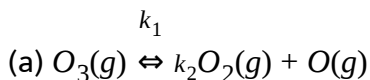
D. The concentration of A reduce to 50% after 23.1 sec.

**Answer: B::C::D**

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## Comprehension type 1

1. It is observed that when ozone undergoes decomposition to form  $O_2(g)$  a two step mechanism is observed.



Also it is known that  $k_1 \gg k_3$  and  $k_2 \gg k_3$

What will be the overall order of the reaction?

A. 1

B. 2

C. 3

D. -1

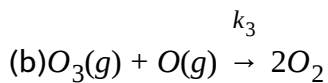
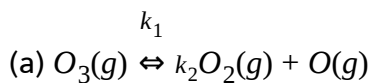
**Answer: A**



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## Comprehension type

1. It is observed that when ozone undergoes decomposition to form  $O_2(g)$  a two step mechanism is observed.



Also it is known that  $k_1 \gg k_3$  and  $k_2 \gg k_3$

If  $\Delta H$  of first reaction is 20 kJ and  $E_a$  of second step is 50 kJ then net activation energy will be:

A. 50 kJ

B. 20 kJ

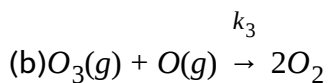
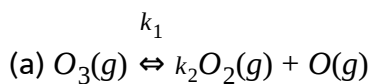
C. 30 kJ

D. 70 kJ

**Answer: D**

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2. It is observed that when ozone undergoes decomposition to form  $O_2$  (g) a two step mechanism is observed.



Also it is known that  $k_1 \gg k_3$  and  $k_2 \gg k_3$

If initially mixture of oxygen and ozone is taken such that Ozone is in very large amount, then, identify the correct statement.

A. The rate will increase as the reaction proceeds.

- B. The rate will decrease as the reaction proceeds
- C. The rate will remain constant throughout the reaction.
- D. The rate will initially increase and then decreases.

**Answer: B**

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3. Two liquids A and B mix to form an ideal binary liquid solution. On adding solid solute C to the solution, A starts polymerising into a hexamer soluble solid ' $A'_6$ '. Following zero order kinetics with a rate constant  $= 10^{-1}$  moles/min if initially 10 moles of A and 20 moles of B were taken to form liquid solution and 5 moles of C were added then answer the following questions based on above information and data given below: [Data: vapour pressure of pure A=100 torr, vapour pressure of pure B=90 torr]

Which of the following statements is incorrect regarding the above process?



- A. The vapour pressure will keep on decreasing initially.
- B. The vapour pressure will become constant 100 min after addition of
- C.
- C. Two hours after addition of C, the vapour pressure will become 72 torr
- D. Four hours after addition of C, the vapour pressure will becomes 67.5 torr.

**Answer: C**

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4. Radioactive decay follows first order kinetics and the rate constant is often termed as decay constant. Certain radioactive substance may undergo sequential decays in order to convert into a stable nucleus. The series comprising all such elements is termed as radioactive disintegration series.

A substance A undergoes sequential decay as shown  $A \xrightarrow{\lambda_1} B \xrightarrow{\lambda_2} C$ . if the decay constant  $\lambda_1$  and  $\lambda_2$  are  $4 \times 10^{-2} \text{ min}^{-1}$  and  $16 \times 10^5 \text{ min}^{-1}$  respectively then the molar ratio of B to A after a very long time will be:

A.  $2.5 \times 10^{-8}$

B.  $4 \times 10^{-2}$

C.  $\frac{1}{16} \times 10^{-5}$

D.  $4 \times 10^7$

**Answer: A**



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5. Radioactive decay follows first order kinetics and the rate constant is often termed as decay constant. Certain radioactive substance may undergo sequential decays in order to convert into a stable nucleus. The series comprising all such elements is termed as radioactive disintegration series.

A radioactive series is formed such that after each  $\alpha$  decay there are two consecutive  $\beta$  decay and the cycle repeats. How many different elements this series can have if there are 12 members in the series?

A. 12

B. 4

C. 3

D. 6

**Answer: C**



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6. In order to analyse variation of rate constant with temperature Arrhenius equation is used. The two parameters involved pre-exponential factor and activation energy are assumed to be constant in the theory while in reality they may vary with temperature. It is further observed that Arrhenius factor is proportional to  $\sqrt{T}$  and hence the equation can be restated as:  $k = A\sqrt{T}e^{-Ea/RT}$  (where  $A'$  is temperature independent).

However, for most of the analysis its variation is neglected. Also, if activation energy is temperature dependent then Arrhenius equation does not hold true and the following equation should be used

$$\frac{d \ln k}{dT} = \frac{E_a}{RT^2}$$

where symbols have usual meaning.

Assuming Arrhenius factor to be constant and activation energy to be dependent on temperature and varying as  $(0.02T^2)$  cal (if T is in Kelvin scale) then calculate by what factor will rate constant increase if temperature is increased from 200 K to 400 K?

- A.  $e^2$  times
- B.  $e^{-2}$  times
- C.  $\sqrt{2}e^2$  times
- D. 2 times

**Answer: A**

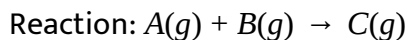


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7. In order to experimentally determine order, initial rate method can be used. Once order is determined, integrated rate law can be obtained by using concentration of reactants. Based on this information and data given below,

	[A] Molarity	[B] Molarity	Rate of Reaction $[Msec^{-1}]$
1	$10^{-2}M$	$3 \times 10^{-3}M$	$2 \times 10^{-2}$
2	$2 \times 10^{-2}M$	$3 \times 10^{-3}M$	$4 \times 10^{-2}$
3	$2 \times 10^{-2}$	$6 \times 10^{-3}M$	$8 \times 10^{-2}$

Answer the question which follow



What will be the time taken for half of the 'A' initially taken to consume if at the same temperature reaction is started taking [A] and [B] to be at 2 M concentration?

A.  $\frac{4}{3} \times 10^{-3} \text{ sec}$

B.  $\frac{3}{4} \times 10^{-3} \text{ sec}$

C.  $\frac{1}{8} \times 10^{-4} \text{ sec}$

D.  $\frac{8}{3} \times 10^{-3} \text{ sec}$

**Answer: B**

8. The general definition of the activation energy  $E_a$  of any rate process, applicable whether or not  $E_a$  varies with T, is:

$$E_a = RT^2 \cdot \frac{d(\ln k)}{dT}$$

For a first order reaction, the dependence of rate constant on temperature is given as:

$$\ln k \left[ /s^{-1} \right] = 27.72 - \frac{2.0 \times 10^4}{T[K]}$$

The activation energy of reaction at 300 K is:

A.  $166.28 \text{ kcal/mol}$

B.  $80.0 \text{ kcal/mol}$

C.  $40.0 \text{ kcal/mol}$

D.  $20.9 \text{ kcal/mol}$

**Answer: C**

9. In order to determine order/rate constant of any gaseous reaction pressure data at constant volume and temperature can be analysed. For a gaseous reaction occurring in a rigid vessel at 300 K following data was observed.



Time (min)	10 min	30 min	$\infty$ time
Pressure increase (mm of Hg)	30 mm	52.5 mm	60 mm

What will be the total increase in pressure 20 min after the reaction?

- A. 45 mm of Hg
- B. 50 mm of Hg
- C. 55 mm of Hg
- D. 40 mm of Hg

**Answer: A**



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10. Fluorine - 18 is a radioactive isotope that decays by positron emission to form oxygen - 18 with a half-life of 100 min. Physicians use  $^{18}\text{F}$  for the study of brain by injecting a quantity of fluoro substituted glucose into the blood of a patient. The glucose accumulates in the region where the brain is active and needs nourishment.

If a sample of glucose that contains  $^{18}\text{F}$  is injected into the blood what percentage will remain after 5 hours?

A. 12.5

B. 50

C. 25

D. 6.25

**Answer: A**



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11. Fluorine - 18 is a radioactive isotope that decays by positron emission to form oxygen - 18 with a half-life of 100 min. Physicians use  $^{18}\text{F}$  for the study of brain by injecting a quantity of fluoro substituted glucose into the blood of a patient. The glucose accumulates in the region where the brain is active and needs nourishment.

How long does it take for 99.9 % decay of  $^{18}\text{F}$  ?

- A. Infinite time
- B. 16.67 hours
- C. 10 hrs
- D. 33.33 hours

**Answer: B**



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12. The solvolysis of cinnamyl chloride can be studied spectrophotometrically by observing the decrease in Absorbance of the

adsorption maximum at 260 nm. The following observations were made in ethanoic NaOH at 298 K.

Time (min)	0	10	20
absorbance at 260 nm	0.4	0.36	0.324

Absorbance is directly proportional to the concentration of cinnamyl chloride.

$$\left[ \text{Given: } \ln \frac{10}{9}, \ln 2.5 = 0.9, \ln \frac{5}{3} = 0.5 \right]$$

The rate constant of reaction is:

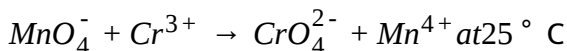
- A.  $0.1 \text{ min}^{-1}$
- B.  $1.0 \text{ min}^{-1}$
- C.  $0.01 \text{ min}^{-1}$
- D.  $0.023 \text{ min}^{-1}$

**Answer: C**

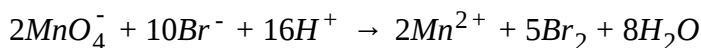


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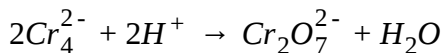
13. In an investigation of the kinetics of the reaction



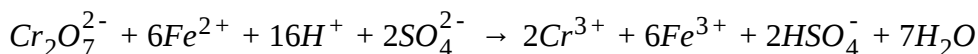
False and Roller measured the times required to carry the reaction to various degrees of completion, first as a function of  $\text{MnO}_4^-$  concentration and then as a function of  $\text{Cr}^{3+}$  concentration. In each case after definite intervals of time, 25 ml aliquots of the reaction mixture were removed and added rapidly to a solution containing 60 ml of 1.2M  $\text{H}_2\text{SO}_4$  and 25 ml of 0.5 M KBr to occur the following reaction



Free bromine instantly liberated was extracted by  $\text{CS}_2$ . The  $\text{Cr}_2\text{O}_7^{2-}$  that had been formed by the reaction



Was titrated with 0.01 N  $\text{FeSO}_4$  in the reaction



The number of millilitres of 0.01 N  $\text{Cr}_2\text{O}_7^{2-}$  Present in the mixture at the indicated reaction time is given in the table. In a set of three experiments the result were as follows:

Experiment No	I	II	III
$[MnO_4^-]$ (mol/lit)	1	2	1
$[Cr^{3+}]$ (mol/lit)	1	1	0.5
Volume of $Cr_2O_7^{2-}$ (0.01N) present (ml)	Time taken (min)		
	I	II	III
0.1	22 min	11 min	45 min
0.2	36 min	18 min	72 min
0.4	60 min	30 min	121 min
0.6	80 min	40 min	162 min

What is the order of reaction with respect to  $[Cr^{3+}]$ ?

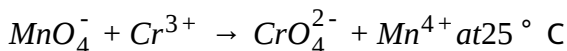
- A. 1
- B. 2
- C. 1.5
- D. 0.5

**Answer: A**

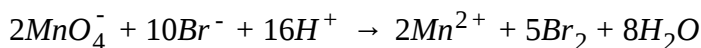


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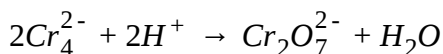
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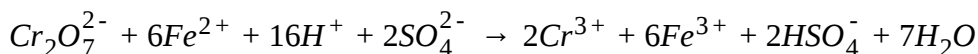
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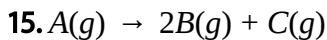
Overall order and type of reaction are respectively:

- A. 1.5 , complex
- B. 2, elementary
- C. 1, complex
- D. 2.5 complex

**Answer: B**



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Initially at  $t=0$  gas A was present with some amount of gas 'C' At  $t=0$  mole fraction of gas C is  $\frac{1}{3}$  After some time  $t = t_1$  total pressure is half of the final total pressure at  $t = t_x$  (a very long time) Assume this decomposition is a first order, at a constant temperature It is also given at  $t = t_x$  final total pressure is 35 bar.

Rate constant  $(k)=(\log 64 - \log 49) s^{-1}$  values of  $t_1$  in second is:

A. 2.15 s

B. 1.5 s

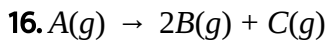
C. 2.3 s

D. 1.15 s

**Answer: D**



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Initially at  $t=0$  gas A was present with some amount of gas 'C' At  $t=0$  mole fraction of gas C is  $\frac{1}{3}$  After some time  $t = t_1$  total pressure is half of the final total pressure at  $t = t_x$  (a very long time) Assume this decomposition is a first order, at a constant temperature It is also given at  $t = t_x$  final total pressure is 35 bar.

Ratio of rate constant at  $t=0$  to  $t = t_1$  to  $t = t_x$  is:

A. 2:3:4

B. 1:1:1

C. 1:3:5

D. 1:3:7

**Answer: B**



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17. Set -I (without catalyst)

Reaction	Temperature	E(activation)	k
$A \rightarrow B$	$T_1K$	$Ea_1$	$k_1$
$A \rightarrow B$	$T_2K$	$Ea_2$	$k_2$

Set-II (with catalyst) (consider +ve catalyst only)

Reaction	Temperature	E(activation)	k
$A \rightarrow B$	$T_1K$	$Ea_3$	$k_3$
$A \rightarrow B$	$T_2K$	$Ea_4$	$k_4$

For the Set-I:

A.  $Ea_1 > Ea_2$  if  $T_1 > T_2$

B.  $Ea_1 < Ea_2$  if  $T_1 > T_2$

C.  $Ea_1 = Ea_2$

D.  $Ea_1 = 0.5Ea_2$

Answer: C



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### 18. Set -I (without catalyst)

Reaction	Temperature	E(activation)	k
$A \rightarrow B$	$T_1K$	$Ea_1$	$k_1$
$A \rightarrow B$	$T_2K$	$Ea_2$	$k_2$

### Set-II (with catalyst) (consider +ve catalyst only)

Reaction	Temperature	E(activation)	k
$A \rightarrow B$	$T_1K$	$Ea_3$	$k_3$
$A \rightarrow B$	$T_2K$	$Ea_4$	$k_4$

### Comparing Set-I and II:

A.  $k_4 > k_3$  and  $k_2 > k_1$ , if  $T_2 > T_1$  (endothermic)

B.  $k_4 < k_3$  and  $k_2 > k_1$  if  $T_2 < T_1$  (endothermic)

C.  $k_4 > k_3$  and  $k_2 > k_1$  if  $T_2 < T_1$  (exothermic)

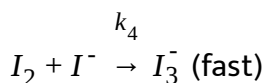
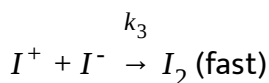
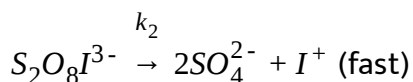
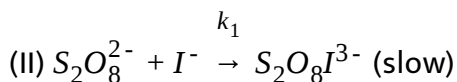
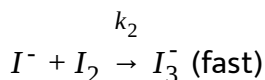
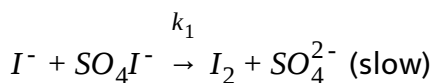
D.  $k_4 < k_3$  and  $k_2 < k_1$ , if  $T_2 > T_1$  (exothermic)

**Answer: A**



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19. The reaction  $S_2O_8^{2-} + 3I^- \rightarrow 2SO_4^{2-} + I_3^-$  is of first order both with respect to the persulphate and iodide ions. Taking the initial concentration as 'a' and 'b' respectively and taking x as the concentration of the trioxide at time t a differential rate equation can be written. Two suggested mechanisms for the reaction are:



How could the progress of this reaction be best monitored?

A. By monitoring the colour of the reaction mixture

B. By titration of  $I_3^-$  with hypo

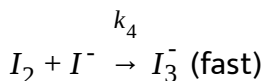
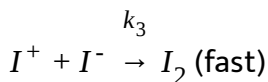
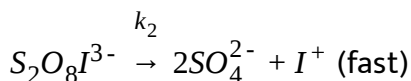
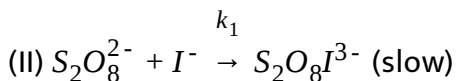
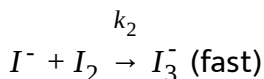
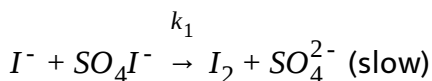
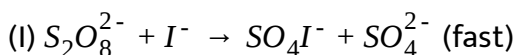
C. By precipitation of  $I^-$  with  $Ag^+$

D. By monitoring the change in pressure.

**Answer: B**

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20. The reaction  $S_2O_8^{2-} + 3I^- \rightarrow 2SO_4^{2-} + I_3^-$  is of first order both with respect to the persulphate and iodide ions. Taking the initial concentration as 'a' and 'b' respectively and taking x as the concentration of the trioxide at time t a differential rate equation can be written. Two suggested mechanisms for the reaction are:



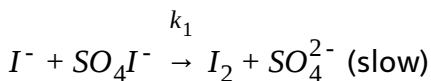
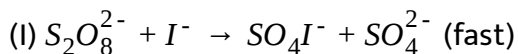
Which mechanism is consistent with the facts given about the reaction rate equation?

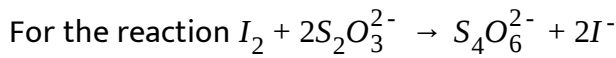
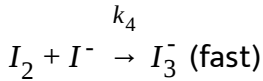
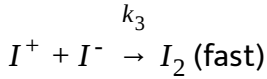
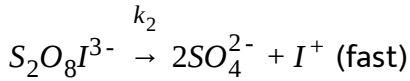
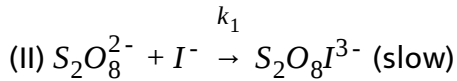
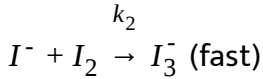
- A. Mechanism(I)
- B. Mechanism(II)
- C. Both (I) and (II)
- D. Neither (I) nor (II)

**Answer: B**

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21. The reaction  $S_2O_8^{2-} + 3I^- \rightarrow 2SO_4^{2-} + I_3^-$  is of first order both with respect to the persulphate and iodide ions. Taking the initial concentration as 'a' and 'b' respectively and taking x as the concentration of the trioxide at time t a differential rate equation can be written. Two suggested mechanisms for the reaction are:





$$\text{(P) } -\frac{d[I_2]}{dt} = -\frac{1}{2} \frac{d[S_2O_3^{2-}]}{dt}$$

$$\text{(Q) } -\frac{d[I_2]}{dt} = -2 \frac{d[S_2O_3^{2-}]}{dt}$$

$$\text{(R) } \frac{d[I^-]}{dt} = -2 \frac{d[I_2]}{dt} \times \frac{d[S_2O_3^{2-}]}{dt}$$

$$\text{(S) } \frac{d[S_4O_6^{2-}]}{dt} = \frac{1}{2} \frac{d[I^-]}{dt}$$

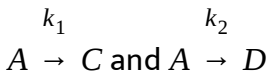
- A. only (P)
- B. (P) and (S)
- C. (Q) and (S)
- D. only (R)

**Answer: B**



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**22.** Frequently a species can react in different ways to give a variety of products. For example, toluene can be nitrated at the ortho, meta, or para positions. We shall consider the simplest case, that of two competing irreversible first-order reactions:



where the stoichiometric coefficients are taken as unity for simplicity. The rate law is

$$\left( \frac{d[A]}{dt} \right) = -k_1[A] - k_2[A] = -(k_1 + k_2)[A]$$

$$\Rightarrow [A] = [A]_0 e^{-(k_1 + k_2)t}$$

For C, we have  $\left( \frac{d[C]}{dt} \right) = k_1[A] = k_1[A]_0 e^{-(k_1 + k_2)t}$

Multiplication by  $dt$  and integration from time 0 (where  $[C]_0 = 0$ ) to an arbitrary time  $t$  gives

$$[C] = \frac{k_1[A]_0}{k_1 + k_2} \left( 1 - e^{-(k_1 + k_2)t} \right)$$

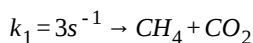
Similarly integration of  $\left(\frac{d[D]}{dt}\right)$  gives

$$[D] = \frac{k_2[A]_0}{k_1 + k_2} \left(1 - e^{-(k_1 + k_2)t}\right)$$

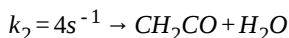
The sum of the rate constants  $k_1 + k_2$  appears in the exponentials for

both [C] and [D] At any time, we also have,  $\frac{C}{D} = \frac{k_1}{k_2}$

At high temperature, acetic acid decomposition into  $CO_2$  and  $CH_4$  and simultaneously into  $CH_2CO$  (ketene) and  $H_2O$



(i)  $CH_3COOH$



(ii)  $CH_3COOH$

What is the fraction of acetic acid is reacting as per reaction(i)?

A.  $\frac{3}{4}$

B.  $\frac{3}{7}$

C.  $\frac{4}{7}$

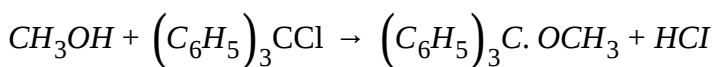
D. None of these

**Answer: B**

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23. Study the following experiment and answer the question at the end of it The following reactions were studied at 25 ° C in benzene solution containing 0.10 M pyridine



A B C

The following sets of data were observed:

Set	Initial concentration [A]	[B] <sub>0</sub>	Time different	Final concentration[C]
I	0.10M	0.05M	25 min	0.0033M
II	0.10M	0.10M	15 min	0.0039M
III	0.20M	0.10M	7.5 min	0.0077M

Rate law of the above experiment is:

A.  $r = k[A][B]$

B.  $r = k[A]^2[B]$

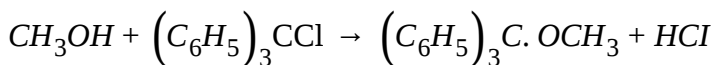
C.  $r = k[A][B]^2$

D.  $r = k[A]^2[B]^0$

**Answer: B**



24. Study the following experiment and answer the question at the end of it The following reactions were studied at  $25^{\circ}\text{C}$  in benzene solution containing  $0.10\text{ M}$  pyridine



A B C

The following sets of data were observed:

Set	Initial concentration [A]	[B] <sub>0</sub>	Time different	Final concentration[C]
I	$0.10\text{M}$	$0.05\text{M}$	25 min	$0.0033\text{M}$
II	$0.10\text{M}$	$0.10\text{M}$	15 min	$0.0039\text{M}$
III	$0.20\text{M}$	$0.10\text{M}$	7.5 min	$0.0077\text{M}$

Rate constant of the above experiment is:

A.  $1.3 \times 10^{-1}$

B.  $2.6 \times 10^{-2}$

C.  $2.6 \times 10^{-1}$

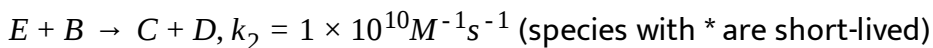
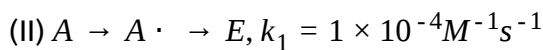
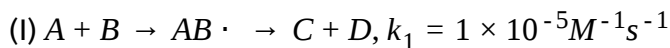
D.  $1.3 \times 10^{-2}$

**Answer: C**



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25. Study the two photochemical reactions and answer the questions given below: For the overall reaction between A and B to yield C and D two mechanisms are proposed:



Rate according to mechanism II when concentration of each reactant is 1 M will be:

A.  $1 \times 10^{-4} M s^{-1}$

B.  $1 \times 10^{10} M s^{-1}$

C.  $1 \times 10^{-6} M s^{-1}$

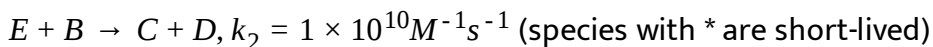
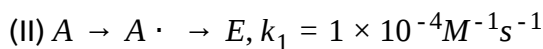
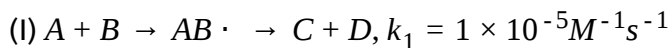
D.  $1 \times 10^{-10} M s^{-1}$

**Answer: A**



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26. Study the two photochemical reactions and answer the questions given below: For the overall reaction between A and B to yield C and D two mechanisms are proposed:



At what concentration of B, rates of two mechanism are equal?

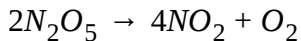
- A. 1 M
- B. 5 M
- C. 7 M
- D. 10 M

**Answer: D**



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27. The thermal decomposition of  $N_2O_5$  occurs as:



Experimental studies suggest that rate of decomposition of  $N_2O_5$  rate of formation of  $NO_2$  or rate of formation of  $O_2$  all becomes double if concentration of  $N_2O_5$  is doubled.

If rate constants for decomposition of  $N_2O_5$  formation of  $NO_2$  and  $O_2$  are  $k_1$ ,  $k_2$  and  $k_3$  respectively, then:

A.  $k_1 = k_2 = k_3$

B.  $2k_1 = k_2 = 4k_3$

C.  $k_1 = 2k_2 = k_3$

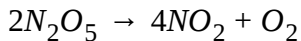
D.  $k_1 = k_2 = 2k_3$

**Answer: B**



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28. The thermal decomposition of  $N_2O_5$  occurs as:



Experimental studies suggest that rate of decomposition of  $N_2O_5$  rate of formation of  $NO_2$  or rate of formation of  $O_2$  all becomes double if concentration of  $N_2O_5$  is doubled.

If rate of formation of  $O_2$  is  $16 \text{ g/hr}$  then rate of decomposition of  $N_2O_5$  and rate of formation of  $NO_2$  respectively is

A. cannot be calculated without knowing rate constants

B.  $108 \text{ g/hr}$ ,  $92 \text{ g/hr}$

C.  $32 \text{ g/hr}$ ,  $64 \text{ g/hr}$

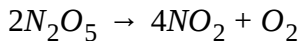
D.  $54 \text{ g/hr}$ ,  $46 \text{ g/hr}$

**Answer: B**



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29. The thermal decomposition of  $N_2O_5$  occurs as:



Experimental studies suggest that rate of decomposition of  $N_2O_5$  rate of formation of  $NO_2$  or rate of formation of  $O_2$  all becomes double if concentration of  $N_2O_5$  is doubled.

The container of 2 litre contains 4 moles of  $N_2O_5$ . On heating to  $100^\circ C$   $N_2O_5$  undergo complete dissociation to  $NO_2$  and  $O_2$ . Select the correct options if rate constant for decomposition of  $N_2O_5$  is  $6.2 \times 10^{-4} \text{sec}^{-1}$

(P) Total mole ratio before and after dissociation is 4:2

(Q) Half-life of  $N_2O_5$  is 1117 sec and it is independent of temperature

(R) Time required to complete 40% of reaction is 824 sec

(S) If volume of container is doubled the ratio of decomposition becomes half of the initial rate:

A. P,R,S

B. P,Q,R,S

C. R,S

D. Q,R,S

Answer: C



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30. The instantaneous rate of an elementary chemical reaction

$aA + bB(\rightleftharpoons)cC + dD$  can be given by:

$$\text{rate} = k_f[A]^a[B]^b - k_b[C]^c[D]^d$$

where  $k_f$  and  $k_b$  are rate constants for forward and backward reactions respectively for the reversible reaction if the reaction is an irreversible

one, the rate is expressed as  $\text{rate} = k[A]^a[B]^b$  where  $k$  is rate constant for the given irreversible reaction and  $(a+b)$  is the order of reaction it is

also evident from the stoichiometry of reaction that rates of disappearance of A is  $\frac{a}{b}$  times the rate of disappearance of B. The

variation of rate constant  $k$  with temperature is expressed in terms of

Arrhenius equation:  $k = Ae^{-\left(\frac{E_a}{RT}\right)}$  whereas the ratio  $\frac{k_f}{k_b}$  is expressed in

terms of van't Hoff isochore:  $\frac{K_f}{K_b} = Ae^{-\Delta H/RT}$  where  $E_a$  and  $\Delta H$  are

energy of activation and enthalpy of reaction respectively



The variation of  $K$  and  $\frac{K_f}{K_b}$  with increase in temperature shows the following effects:

(P) For endothermic reaction  $K$  increases,  $\frac{K_f}{K_b}$  also increases

(Q) For exothermic reaction  $K$  decreases  $\frac{K_f}{K_b}$  also decreases

(R) For exothermic reaction  $K$  and  $\frac{K_f}{K_b}$  both increases

(S) For exothermic reaction  $K$  increases and  $\frac{K_f}{K_b}$  decreases

(T) For exothermic reaction  $K$  and  $\frac{K_f}{K_b}$  both decreases.

A. (P),(S)

B. (R),(T)

C. (Q),(R)

D. (Q),(R),(T)

**Answer: A**



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### 31. The instantaneous rate of an elementary chemical reaction

$aA + bB \rightleftharpoons cC + dD$  can be given by:

$$\text{rate} = k_f[A]^a[B]^b - k_b[C]^c[D]^d$$

where  $k_f$  and  $k_b$  are rate constants for forward and backward reactions

respectively for the reversible reaction if the reaction is an irreversible

one, the rate is expressed as  $\text{rate} = k[A]^a[B]^b$  where  $k$  is rate constant

for the given irreversible reaction and  $(a+b)$  is the order of reaction it is

also evident from the stoichiometry of reaction that rates of

disappearance of A is  $\frac{a}{b}$  times the rate of disappearance of B. The

variation of rate constant  $k$  with temperature is expressed in terms of

Arrhenius equation:  $k = Ae^{-\left(\frac{E_a}{RT}\right)}$  whereas the ratio  $\frac{k_f}{k_b}$  is expressed in

terms of van't Hoff isochore:  $\frac{K_f}{K_b} = Ae^{-\Delta H/RT}$  where  $E_a$  and  $\Delta H$  are

energy of activation and enthalpy of reaction respectively

For a gaseous phase 1st order reaction



(rate constant  $K = 10^{-2} \text{time}^{-1}$ )

in a closed vessel of 2 litre containing 5 mole of A(g) at  $27^\circ \text{C}$  which of

the following is incorrect?

A. Rate of appearance of  $C(g)$  is  $5 \times 10^{-2} \text{ mol L}^{-1} \text{ t}^{-1}$

B. Rate of disappearance of  $A(g)$  is  $6.15 \times 10^{-1} \text{ atm t}^{-1}$

C. Rate of disappearance of  $A(g)$  is  $5.0 \times 10^{-2} \text{ mol t}^{-1}$

D. Rate of appearance of  $B(g)$  is  $5 \times 10^{-2} \text{ mol L}^{-1} \text{ t}^{-1}$

**Answer: D**

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**32.** The instantaneous rate of an elementary chemical reaction

$aA + bB \rightleftharpoons cC + dD$  can be given by:

$$\text{rate} = k_f[A]^a[B]^b - k_b[C]^c[D]^d$$

where  $k_f$  and  $k_b$  are rate constants for forward and backward reactions respectively for the reversible reaction if the reaction is an irreversible

one, the rate is expressed as  $\text{rate} = k[A]^a[B]^b$  where  $k$  is rate constant

for the given irreversible reaction and  $(a+b)$  is the order of reaction it is

also evident from the stoichiometry of reaction that rates of

disappearance of A is  $\frac{a}{b}$  times the rate of disappearance of B. The

variation of rate constant  $k$  with temperature is expressed in terms of

Arrhenius equation:  $k = Ae^{-\left(\frac{E_a}{RT}\right)}$  whereas the ratio  $\frac{k_f}{k_b}$  is expressed in

terms of van't Hoff isochore:  $\frac{K_f}{K_b} = Ae^{-\Delta H/RT}$  where  $E_a$  and  $\Delta H$  are

energy of activation and enthalpy of reaction respectively

For an elementary reaction  $aA \rightarrow$  product the graph plotted between

$\log \left[ -\frac{d[A]}{dt} \right]$  vs. concentration gives a straight line with intercept equal

to 0.6 and showing an angle of  $45^\circ$  with origin, then:

A. rate constant =  $3.98 \text{time}^{-1}$  and  $a = 1$

B. rate constant =  $3.98 \text{molL}^{-1} \text{t}^{-1}$  and  $a = 1$

C. rate constant =  $1.99 \text{time}^{-1}$  and  $a = 1$

D. rate constant =  $1.99 \text{molL}^{-1} \text{t}^{-1}$  and  $a = 2$

**Answer: A**



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33. The rate law for reaction  $A + B \rightarrow C$  is

$$\text{Rate} = K[A][B]$$

$$\text{Given } K = 6.93 \times 10^{-4} \text{M}^{-1}\text{sec}^{-1}$$

Starting with  $[A] = 1\text{M}$  and  $[B] = 2\text{M}$  what is the rate in ( $\text{Msec}^{-1}$ ) when  $[A]$  changes to  $0.25\text{M}$ ?

A.  $2.16 \times 10^{-3}$

B.  $2.16 \times 10^{-4}$

C.  $8.64 \times 10^{-4}$

D.  $8.64 \times 10^{-3}$

**Answer: B**



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34. From the following data answer the questions Reaction  $A + B \rightarrow P$

[A]M	[B]M	Initiallyrate ( $Msec^{-1}$ )	
		at300K	at400K
$2.5 \times 10^{-4}$	$3.0 \times 10^{-5}$	$5.0 \times 10^{-4}$	$2.0 \times 10^{-3}$
$5.0 \times 10^{-4}$	$6.0 \times 10^{-5}$	$4.0 \times 10^{-3}$	
$1.0 \times 10^{-3}$	$6.0 \times 10^{-5}$	$1.6 \times 10^{-2}$	

The energy of activation for reaction ( $kcal/mol$ ) is ( $\log 2 = 0.3$ )

A. 1.68

B. 3.36

C. 6.72

D. 1.12

**Answer: B**

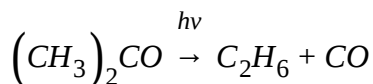


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35. An important parameter of a photochemical reaction is the quantum efficiency or quantum yield ( $\phi$ ) which is defined as

$$\phi = \frac{\text{moles of the substance reaction}}{\text{moles of photons absorbed}}$$

Absorption of UV radiation decompose acetone according to the reaction



If quantum yield in 0.8 then rate of formation of  $\text{C}_2\text{H}_6$  (mol/s) is :

A.  $8 \times 10^{-9}$

B.  $1.6 \times 10^{-9}$

C.  $16 \times 10^{-9}$

D.  $4 \times 10^{-9}$

**Answer: A**



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**36.** Quantum efficiency or quantum yield ( $\phi$ ) of photochemical reaction is given by:

$$\phi = \frac{\text{moles of the substance reacted}}{\text{moles of photons absorbed}}$$

Absorption of UV radiation decomposes A according to the reaction

$h\nu$



In a first order reaction 75% of the reactant disappears in 1.386 h the rate constant of the reaction is close to:

A.  $7.2 \times 10^{-1} \text{s}^{-1}$

B.  $3.6 \times 10^{-3} \text{s}^{-1}$

C.  $1.8 \times 10^{-3} \text{s}^{-1}$

D.  $2.8 \times 10^{-4} \text{s}^{-1}$

**Answer: D**



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**37.** Radioactive elements can be categorised into

(a) Neutron rich nuclide

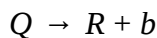
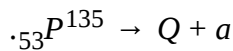
(b) Neutron poor nuclide

In order to achieve stable  $\frac{n}{p}$  ratio these nuclide either emits  $\beta^-$ ,  $\beta^+$

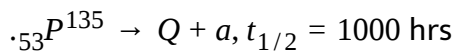
(positron) or  $\alpha$ -particle depending upon the  $\frac{n}{p}$  ratio of unstable nuclei



and stable nuclei



[Note : only stable isotope of element P and Q are  ${}_{53}P^{135}$  and  ${}_{54}Q^{137}$  respectively] Element P,Q,R do not show any resemblance to currently known element



$Q \rightarrow R + b, t_{1/2} = 10 \text{ min}$  Number of nuclei of Q and R respectively after 1000 hr if we start with 2 mol P  $\left[ N_A = 6 \times 10^{23} \right]$

A.  $6 \times 10^{23}, 6 \times 10^{23}$

B.  $6 \times 10^{22}, 6 \times 10^{23}$

C.  $2 \times 10^{20}, 6 \times 10^{23}$

D.  $10^{20}, 6 \times 10^{23}$

**Answer: D**



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38. An analyst starts a first order chemical reaction at 8.00 A.M. in the morning at the laboratory temperature of  $27^{\circ}\text{C}$ . At 1.00 P.M. he discovered that only 10% of the reaction was complete by that time. To speed-up the reaction he increased the temperature to  $127^{\circ}\text{C}$ . At 4.00 P.M. he found that only 50% of the reaction was complete. Anyhow he did not want to stay in laboratory beyond 5.00 P.M. but he could not leave the laboratory until the reaction was 90% complete. Fortunately he found a suitable catalyst adding which at 4.00 P.M. at  $127^{\circ}\text{C}$  he could meet the target of 5.00 P.M. and 90%. Answer the following questions based on the

above observation (Use  $\ln\frac{10}{9} = 0.1$ ,  $\ln\frac{9}{5} = 0.6$ ,  $\ln 10 = 2.3$ ,  $\ln 5 = 1.6$ ,  $\ln 8 = 2$ )

What was the activation energy of the catalyzed pathway?

A.  $4.92\text{kcal/mol}$

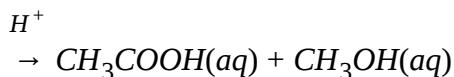
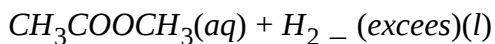
B.  $3.92\text{kcal/mol}$

C.  $4.72\text{kcal/mol}$

D.  $9.84\text{kcal/mol}$

**Answer: B**

39. Kinetic of acidic hydrolysis of ester is a pseudo 1st order reaction



Rate law is given by  $r = K[H^+][H_2O][CH_3COOCH_3]$

$K = 1.8 \times 10^{-3} M^{-2} \text{sec}^{-1}$  where  $H^+$  ion concentration is given by acid catalyst in an experiment 1 M  $CH_3COOCH_3$  is hydrolysed using 0.1 M HCl as catalyst.

Reaction mixture is titrated against standard NaOH solution at different times. If initially 10 ml of NaOH was required while after long time 100 ml of NaOH is required then find volume of NaOH required at 230.3 sec

A. 91 ml

B. 81 ml

C. 75 ml

D. 50 ml

**Answer: A**



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40. Nuclei of a radioactive element 'A' are being produced at a constant rate  $\alpha$  the element has a decay constant  $\lambda$  At time  $t = 0$  there are  $N_0$  nuclei of the element

If  $\alpha = 2N_0\lambda$  the number of nuclei of A after  $t = \frac{\ln 2}{\lambda}$  will become:

A. zero

B.  $2N_0$

C.  $1.5N_0$

D.  $0.5N_0$

**Answer: C**



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41. Nuclei of a radioactive element 'A' are being produced at a constant rate  $\alpha$  the element has a decay constant  $\lambda$  At time  $t = 0$  there are  $N_0$  nuclei of the element

If  $\alpha = 2N_0\lambda$  the number of nuclei of A after undergone radioactivity decay

till time  $t = \frac{\ln 2}{\lambda}$ :

A.  $0.5N_0$

B.  $1.5N_0$

C.  $\frac{(4\ln 2 - 1)N_0}{2}$

D.  $\frac{(4\ln 2 - 3)N_0}{2}$

**Answer: C**



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42. Nuclei of a radioactive element 'A' are being produced at a constant rate  $\alpha$  the element has a decay constant  $\lambda$  At time  $t = 0$  there are  $N_0$

nuclei of the element

If  $\alpha = 4N_0\lambda$  the number of nuclei of A when A has reached steady state:

A. 0

B.  $4N_0$

C.  $2N_0$

D.  $N_0$

**Answer: B**



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**43.** Radioactive elements were incorporated into the earth when the solar system formed. All rocks and minerals contain tiny amount of these radioactive elements which breakdown spontaneously into more stable atoms overtime. A commonly used radiometric dating technique relies on the breakdown of  ${}_{19}\text{K}^{40}$  to  ${}_{18}\text{Ar}^{40}$ . Precise measurements of the amount of  $\text{K}^{40}$  relative to  $\text{Ar}^{40}$  in an igneous rock can tell the age of rock.

Choose the correct statements(s)

- A. Rate of disintegration of unstable nuclei increases with increase in number of nuclei and temperature
- B. Isotopes are formed due to  ${}_{-1}\beta^0$  - decay
- C. Isotopes having even number of protons and neutrons must be stable nuclei
- D. Isodiaphers are produced due to  $\alpha$ -emission

**Answer: D**

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**44.** Mass defect in the nuclear reactions may be expressed in terms of the atomic masses of the parent and daughter nuclides in place of their nuclear masses.

The mass defect of the nuclear reaction:  ${}_{5}B^8 \rightarrow {}_{4}Be^8 + e^+$  is

A.  $\Delta m = \text{at mass of } {}_{5}B^8 - \text{at mass of } {}_{4}Be^8$

B.  $\Delta m = \text{at mass of } {}_{5}B^8 - \text{at mass of } {}_{4}Be^8 - \text{mass of one electron}$

C.  $\Delta m = \text{at mass of } {}_5\text{B}^8 - \text{at mass of } {}_4\text{Be}^8 + \text{mass of one electron}$

D.  $\Delta m = \text{at mass of } {}_5\text{B}^8 - \text{at mass of } {}_4\text{Be}^8 - \text{mass of two electrons}$

**Answer: D**

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45. A human body excretes certain material through sweating by law similar to radioactivity if technitium is injected in some form in human body the body exretes half the amount in 24 hours A patient is given an injection containing  ${}^{98}\text{Tc}$  The isotope is radioactive with half life of 8 hours The activity just after the injection is  $32\mu\text{Ci}$

What will be activity after 48 hrs of the overall excreted material till that time?

A.  $0.125\mu\text{Ci}$

B.  $0.375\mu\text{Ci}$

C.  $0.5\mu\text{Ci}$

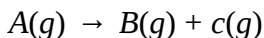


D.  $1\mu Ci$

**Answer: B**

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**46.** A reaction is said to be first order if its rate is proportional to the concentration of reactant. Let us consider a reaction



At  $t = 0$ ,  $a = 0$

At time  $t$ ,  $a - x$

The rate of reaction is given by the expression  $\frac{dx}{dt} = k(a - x)$  and

integrated rate equation for a given reaction is represented as

$k = \frac{1}{t} \ln \left( \frac{a}{a - x} \right)$  where  $a$  = initial concentration and  $(a - x)$  = concentration of

A after time  $t$ .

Consider a reaction  $A(g) \rightarrow 3B(g) + 2C(g)$  with rate constant

$1.386 \times 10^{-2} \text{ min}^{-1}$  starting with 2 moles of A in 12.5 litre vessel initially if

reaction is allowed to take place at constant pressure and at allowed to

take place at constant pressure and at 298 K then find the concentration of B after 100 min.

- A. 0.04 min
- B. 0.36 M
- C. 0.09 M
- D. None of these

**Answer: C**

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## Comprehension type 2

1. Two liquids A and B mix to form an ideal binary liquid solution. On adding solid solute C to the solution, A starts polymerising into a hexamer soluble solid ' $A'_6$ '. Following zero order kinetics with a rate constant  $= 10^{-1}$  moles/ min. If initially 10 moles of A and 20 moles of B were taken to form liquid solution and 5 moles of C were added then

answer the following questions based on above information and data given below:[Data: vapour pressure of pure A=100 torr, vapour pressure of pure B=90 torr]

The vapour pressure of the solution 1 hr after solid C is added will be given by :

A.  $\frac{220}{3}$  torr

B. 98 torr

C.  $\frac{2200}{29}$  torr

D.  $\frac{2200}{24}$  torr

**Answer: A**



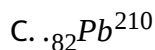
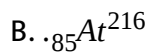
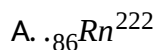
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### Comprehension type 3

1. Radioactive decay follows first order kinetics and the rate constant is often termed as decay constant. Certain radioactive substance may

undergo sequential decays in order to convert into a stable nucleus. The series comprising all such elements is termed as radioactive disintegration series.

If a radioactive disintegration series is observed involving only  $\alpha$  and  $\beta$  decays then which of the following isotopes cannot be a part of it if the parent isotope of the series is  ${}_{91}\text{Pa}^{234}$ ?



**Answer: B**



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Comprehension type 4

1. In order to analyse variation of rate constant with temperature Arrhenius equation is used the two parameters involved pre-exponential factor and activation energy are assumed to be constant in the theory while in reality they may vary with temperature It is further observed that Arrhenius factor is proportional to  $\sqrt{T}$  and hence the equation can be restated as:  $k = A\sqrt{T}e^{-E_a/RT}$  (where  $A'$  is temperature independent). However, for most of the analysis its variation is neglected Also, if activation energy is temperature dependent then Arrhenius equation does not hold true and the following equation should be used

$$\frac{d \ln k}{dT} = \frac{E_a}{RT^2}$$

where symbols have usual meaning.

For a reaction where activation energy is 800 cal, by what factor will rate constant increase if Arrhenius factor is assumed to be temperature dependent and temperature is changed from 200 K to 400 K?

A.  $e^{+1}$  times

B.  $\sqrt{2}e^{+1}$  times

C.  $\frac{e^{+1}}{\sqrt{2}}$  times

D.  $\sqrt{2}$  times

Answer: B

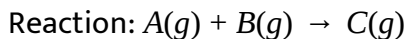
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## Comprehension type 5

1. In order to experimentally determine order, initial rate method can be used. Once order is determined, integrated rate law can be obtained by using concentration of reactants. Based on this information and data given below,

	[A] Molarity	[B] Molarity	Rate of Reaction $[Msec^{-1}]$
1	$10^{-2}M$	$3 \times 10^{-3}M$	$2 \times 10^{-2}$
2	$2 \times 10^{-2}M$	$3 \times 10^{-3}M$	$4 \times 10^{-2}$
3	$2 \times 10^{-2}$	$6 \times 10^{-3}M$	$8 \times 10^{-2}$

Answer the question which follow



What will be the value of rate constant for the above reaction?

A.  $\frac{2}{3} \times 10^3 M^{-1} \text{ min}$

B.  $\frac{2}{3} \times 10^3 M^{-1} \text{ min}$

C.  $4 \times 10^4 M^{-1} \text{ min}$

D.  $4 \times 10^4 M^{-1} \text{ min}$

**Answer: B**

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## Comprehension type 6

1. The general definition of the activation energy  $E_a$  of any rate process, applicable whether or not  $E_a$  varies with T, is:

$$E_a = RT^2 \cdot \frac{d(\ln k)}{dT}$$

For a first order reaction, the dependence of rate constant on temperature is given as:

$$\ln k [s^{-1}] = 27.72 - \frac{2.0 \times 10^4}{T [K]}$$

The pre-exponential factor of reaction is:

A.  $20^{40}\text{s}^{-1}$

B.  $e^{27.72}\text{s}^{-1}$

C.  $2^4\text{s}^{-1}$

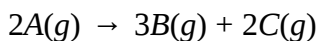
D.  $2^{400}\text{s}^{-1}$

**Answer: B**

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## Comprehension type 7

1. In order to determine order/rate constant of any gaseous reaction pressure data at constant volume and temperature can be analysed. For a gaseous reaction occurring in a rigid vessel at 300 K following data was observed.



Time (min)	10 min	30 min	$\infty$ time
Pressure increase (mm of Hg)	30 mm	52.5 mm	60 mm

What will be average life of molecules of 'A'?



A. 10 min

B. 5 min

C.  $\infty$

D.  $\frac{10}{\ln 2}$  min

**Answer: D**

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## Comprehension type 8

1. Fluorine - 18 is a radioactive isotope that decays by positron emission to form oxygen - 18 with a half-life of 100 min. Physicians use  $^{18}\text{F}$  for the study of brain by injecting a quantity of fluoro substituted glucose into the blood of a patient. The glucose accumulates in the region where the brain is active and needs nourishment.

What is the average life for decomposition of  $^{18}\text{F}$ ?

A. 100 min

B. 200 min

C. 69.3 min

D. 144 min

**Answer: D**

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## Comprehension type 9

1. The solvolysis of cinnamyl chloride can be studied spectrophotometrically by observing the decrease in Absorbance of the adsorption maximum at 260 nm. The following observation were made in ethanoic NaOH at 298 k.

Time (min)	0	10	20
absorbance at 260 nm	0.4	0.36	0.324

Absorbance is directly proportional to the concentration of cinnamyl chloride.

[Given:  $\ln \frac{10}{9}, \ln 2.5 = 0.9, \ln \frac{5}{3} = 0.5$ ]

The order of reaction (solvolysis) is:

A. 0

B. 1

C. 2

D.  $\frac{1}{2}$

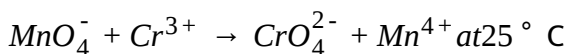
**Answer: B**



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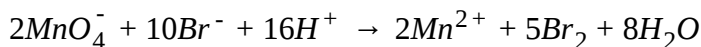
## Comprehension type 10

1. In an investigation of the kinetics of the reaction

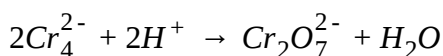


False and Roller measured the times required to carry the reaction to various degrees of completion, first as a function of  $\text{MnO}_4^-$  concentration

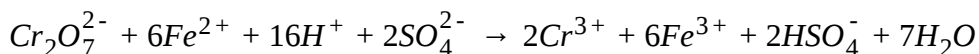
and then as a function of  $Cr^{3+}$  concentration. In each case after definite intervals of time, 25 ml aliquots of the reaction mixture were removed and added rapidly to a solution containing 60 ml of 1.2M  $H_2SO_4$  and 25 ml of 0.5 M KBr to occur the following reaction



Free bromine instantly liberated was extracted by  $CS_2$  The  $Cr_2O_7^{2-}$  That had been formed by the reaction



Was titrated with 0.01 N  $FeSO_4$  in the reaction



The number of millilitres of 0.01 N  $Cr_2O_7^{2-}$  Present in the mixture at the indicated reaction time is given in the table In a set of three experiments the result were as follows:

Experiment No	I	II	III
$[MnO_4^-]$ (mol/lit)	1	2	1
$[Cr^{3+}]$ (mol/lit)	1	1	0.5
Volume of $Cr_2O_7^{2-}$ (0.01N) present (ml)	Time taken (min)		
	I	II	III
0.1	22 min	11 min	45 min
0.2	36 min	18 min	72 min
0.4	60 min	30 min	121 min
0.6	80 min	40 min	162 min

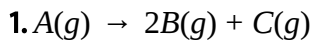
What is the order of reaction with respect to  $[MnO_4^-]$ ?

- A. 2
- B. 1
- C. 0.5
- D. 1.5

**Answer: B**



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Initially at  $t=0$  gas A was present with some amount of gas 'C' At  $t=0$  mole fraction of gas C is  $\frac{1}{3}$  After some time  $t = t_1$  total pressure is half of the final total pressure at  $t = t_x$  (a very long time) Assume this decomposition is a first order, at a constant temperature It is also given at  $t = t_x$  final total pressure is 35 bar.

At  $t = t_1$  pressure of gas B is:

- A. 2.5 bar
- B. 1.25 bar
- C. 5.0 bar
- D. data is insufficient

**Answer: A**



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### 1. Set -I (without catalyst)

Reaction	Temperature	E(activation)	k
$A \rightarrow B$	$T_1K$	$Ea_1$	$k_1$
$A \rightarrow B$	$T_2K$	$Ea_2$	$k_2$

### Set-II (with catalyst) (consider +ve catalyst only)

Reaction	Temperature	E(activation)	k
$A \rightarrow B$	$T_1K$	$Ea_3$	$k_3$
$A \rightarrow B$	$T_2K$	$Ea_4$	$k_4$

For the Set-I:

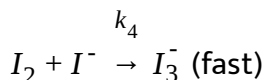
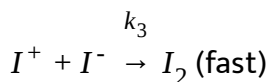
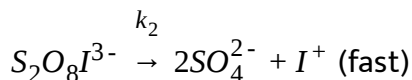
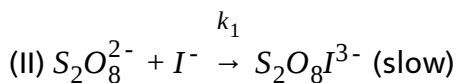
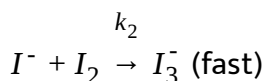
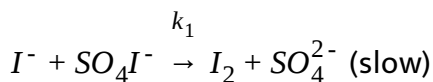
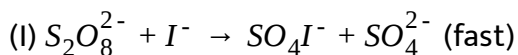
- A. If  $T_1 > T_2$ ,  $k_1 > k_2$  always
- B. If  $T_1 > T_2$ ,  $k_1 > k_2$  (for exothermic reaction)
- C. If  $T_1 > T_2$ ,  $k_1 < k_2$  (for endothermic reaction)
- D.  $Ea_1 \neq Ea_2$

**Answer: A**



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1. The reaction  $S_2O_8^{2-} + 3I^- \rightarrow 2SO_4^{2-} + I_3^-$  is of first order both with respect to the persulphate and iodide ions. Taking the initial concentration as 'a' and 'b' respectively and taking x as the concentration of the trioxide at time t a differential rate equation can be written. Two suggested mechanisms for the reaction are:



The general differential equation for the above reaction is:

$$A. \frac{dx}{dt} = k[a - x][b - 3x]$$

$$B. \frac{dx}{dt} = -k[a - x][b - 3x] (k > 0)$$

$$C. \frac{dx}{dt} = k[a - x][b - x] (k > 0)$$



$$D. \frac{dx}{dt} = -k[a-x][b-x] (k > 0)$$

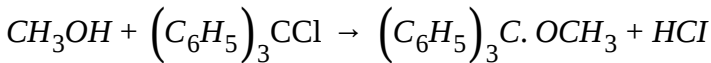
Answer: A



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## Comprehension type 15

1. Study the following experiment and answer the question at the end of it. The following reactions were studied at  $25^\circ \text{C}$  in benzene solution containing  $0.10 \text{ M}$  pyridine



A B C

The following sets of data were observed:

Set	Initial concentration [A]	[B] <sub>0</sub>	Time different	Final concentration [C]
I	$0.10\text{M}$	$0.05\text{M}$	25 min	$0.0033\text{M}$
II	$0.10\text{M}$	$0.10\text{M}$	15 min	$0.0039\text{M}$
III	$0.20\text{M}$	$0.10\text{M}$	7.5 min	$0.0077\text{M}$

Rates  $\frac{d[C]}{dt}$  in sets I, II and III are respectively (in  $\text{M min}^{-1}$ )

- |    |                       |                       |                       |
|----|-----------------------|-----------------------|-----------------------|
|    | I                     | II                    | III                   |
| A. | $1.30 \times 10^{-4}$ | $2.6 \times 10^{-4}$  | $1.02 \times 10^{-3}$ |
|    | I                     | II                    | III                   |
| B. | 0.033                 | 0.0039                | 0.0077                |
|    | I                     | II                    | III                   |
| C. | $0.02 \times 10^{-4}$ | $0.04 \times 10^{-4}$ | 0.017                 |
|    | I                     | II                    | III                   |
| D. | None of these         |                       |                       |

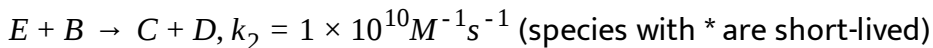
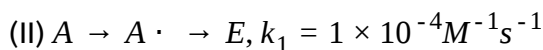
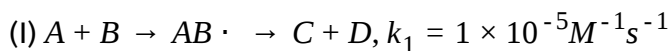
**Answer: A**



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## Comprehension type 16

1. Study the two photochemical reactions and answer the questions given below: For the overall reaction between A and B to yield C and D two mechanisms are proposed:



Rate according to mechanism I when concentration of each reactant is 0.1 M will be:

A.  $1 \times 10^{-7} \text{Ms}^{-1}$

B.  $1 \times 10^{-6} \text{Ms}^{-1}$

C.  $1 \times 10^{-5} \text{Ms}^{-1}$

D.  $1 \times 10^{-4} \text{Ms}^{-1}$

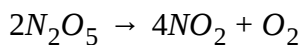
**Answer: A**



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## Comprehension type 17

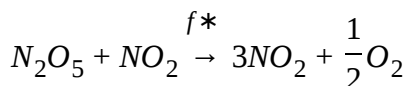
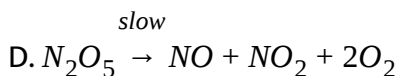
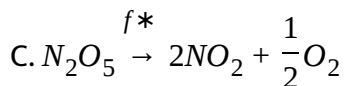
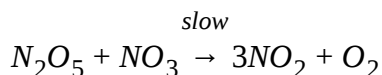
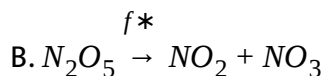
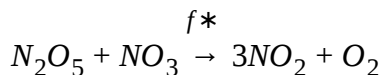
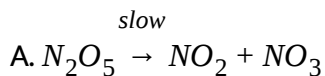
1. The thermal decomposition of  $N_2O_5$  occurs as:



Experimental studies suggest that rate of decomposition of  $N_2O_5$  rate of formation of  $NO_2$  or rate of formation of  $O_2$  all becomes double if

concentration of  $N_2O_5$  is doubled.

The correct mechanism for decomposition of  $N_2O_5$  is:



**Answer: A**



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**Comprehension type 18**

# 1. The instantaneous rate of an elementary chemical reaction

$aA + bB \rightleftharpoons cC + dD$  can be given by:

$$\text{rate} = k_f[A]^a[B]^b - k_b[C]^c[D]^d$$

where  $k_f$  and  $k_b$  are rate constants for forward and backward reactions

respectively for the reversible reaction if the reaction is an irreversible

one, the rate is expressed as  $\text{rate} = k[A]^a[B]^b$  where  $k$  is rate constant

for the given irreversible reaction and  $(a+b)$  is the order of reaction it is

also evident from the stoichiometry of reaction that rates of

disappearance of A is  $\frac{a}{b}$  times the rate of disappearance of B. The

variation of rate constant  $k$  with temperature is expressed in terms of

Arrhenius equation:  $k = Ae^{-\left(\frac{E_a}{RT}\right)}$  whereas the ratio  $\frac{k_f}{k_b}$  is expressed in

terms of van't Hoff isochore:  $\frac{K_f}{K_b} = Ae^{-\Delta H/RT}$  where  $E_a$  and  $\Delta H$  are

energy of activation and enthalpy of reaction respectively

For a chemical reaction:  $aA \rightarrow bB$   $\log\left[\frac{d[A]}{dt}\right] = \log\left[\frac{d[B]}{dt}\right] + 0.3$

Then the ratio of  $a$  and  $b$  is approximately:

A. 3

B. 0.3

C. 2

D. 0.5

**Answer: C**



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### Comprehension type19

1. The rate law for reaction  $A + B \rightarrow C$  is

$$\text{Rate} = K[A][B]$$

$$\text{Given } K = 6.93 \times 10^{-4} M^{-1} \text{sec}^{-1}$$

Find the time taken(sec) when concentration of  $[A]$  changes from  $10^{-4} M$  to  $5 \times 10^{-5} M$

$$\text{Given: } [B] = 1M$$

A. 10

B. 100

C. 1000

D. 10000

**Answer: C**



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## Comprehension type 21

1. From the following data answer the questions Reaction  $A + B \rightarrow P$

[A]M	[B]M	Initiallyrate ( $Msec^{-1}$ )	
		at300K	at400K
$2.5 \times 10^{-4}$	$3.0 \times 10^{-5}$	$5.0 \times 10^{-4}$	$2.0 \times 10^{-3}$
$5.0 \times 10^{-4}$	$6.0 \times 10^{-5}$	$4.0 \times 10^{-3}$	
$1.0 \times 10^{-3}$	$6.0 \times 10^{-5}$	$1.6 \times 10^{-2}$	

The value of rate constant at 300 K is ( $M^{-2}sec^{-1}$ )

A.  $2.667 \times 10^8$

B.  $2.667 \times 10^5$

C.  $2.667 \times 10^4$

D.  $2.667 \times 10^9$

Answer: A



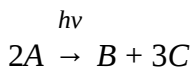
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## Comprehension type 22

1. Quantum efficiency or quantum yield ( $\phi$ ) of photochemical reaction is given by:

$$\phi = \frac{\text{moles of the substance reacted}}{\text{moles of photons absorbed}}$$

Absorption of UV radiation decomposes A according to the reaction



The quantum yield of the reaction at 330 nm is 0.4. A sample of 'A' absorbs monochromatic radiation at 330 nm at the rate of  $7.2 \times 10^{-3} \text{ J s}^{-1}$  (Given  $N_A = 6 \times 10^{23}$ ,  $h = 6.6 \times 10^{-34}$  in S.I unit) The rate of formation of C ( $\text{mol/s}$ ) is

A.  $1.2 \times 10^{-8}$



B.  $8 \times 10^{-8}$

C.  $8 \times 10^{-9}$

D. None of these

**Answer: A**

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## Comprehension type23

1. Radioactive elements can be categorised into

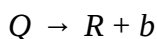
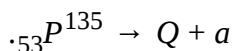
(a) Neutron rich nuclide

(b) Neutron poor nuclide

In order to achieve stable  $\frac{n}{p}$  ratio these nuclide either emits  $\beta^-$ ,  $\beta^+$

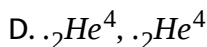
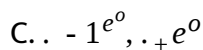
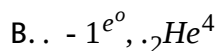
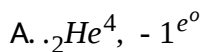
(positron) or  $\alpha$ -particle depending upon the  $\frac{n}{p}$  ratio of unstable nuclei

and stable nuclei



[Note : only stable isotope of element P and Q are  ${}_{53}P^{135}$  and  ${}_{54}Q^{137}$  respectively] Element P,Q,R do not show any resemblance to currently known element

Particles a and b can be respectively



**Answer: B::C**

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## Comprehension type 24

1. An analyst starts a first order chemical reaction at 8.00 A.M. in the morning at the laboratory temperature of  $27^{\circ}C$ . At 1.00 P.M. he discovered that only 10% of the reaction was complete by that time. To

speed-up the reaction he increased the temperature to  $127^{\circ}\text{C}$ . At 4.00 P.M. he found that only 50% of the reaction was complete. Any how he did not want to stay in laboratory beyond 5.00 P.M. but he could not leave the laboratory until the reaction was 90% complete. Fortunately he found a suitable catalyst adding which at 4.00 P.M. at  $127^{\circ}\text{C}$  he could meet the target of 5.00 P.M. and 90%. Answer the following questions based on the above observation (Use  $\ln\frac{10}{9} = 0.1\ln\frac{9}{5} = 0.6$ ,  $\ln 10 = 2.3\ln 5 = 1.6$ ,  $\ln 8 = 2$ )

What was the activation energy of the original pathway?

A.  $10.14\text{kcal/mol}$

B.  $5.52\text{kcal/mol}$

C.  $2.64\text{kcal/mol}$

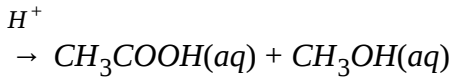
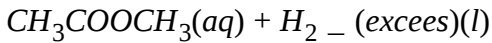
D.  $7.92\text{kcal/mol}$

**Answer: B**



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1. Kinetic of acidic hydrolysis of ester is a pseudo 1st order reaction



Rate law is given by  $r = K[\text{H}^+][\text{H}_2\text{O}][\text{CH}_3\text{COOCH}_3]$

$K = 1.8 \times 10^{-3} \text{M}^{-2}\text{sec}^{-1}$  where  $\text{H}^+$  ion concentration is given by acid catalyst in an experiment 1 M  $\text{CH}_3\text{COOCH}_3$  is hydrolysed using 0.1 M HCl as catalyst.

Calculate the time at which ester concentration reduce to 0.25 M

$[\ln 2 = 0.7]$  (Given Density of pure  $\text{H}_2\text{O} = 1 \text{gm/ml}$ )

- A. 70 sec
- B. 140 sec
- C.  $\frac{700}{9}$  sec
- D.  $\frac{350}{9}$  sec

**Answer: B**



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## Comprehension type 27

1. Nuclei of a radioactive element 'A' are being produced at a constant rate  $\alpha$  the element has a decay constant  $\lambda$  At time  $t = 0$  there are  $N_0$  nuclei of the element

The number of nuclei of A at time 't' is

A.  $\frac{\alpha}{\lambda} (1 - e^{-\lambda t})$

B.  $N_0 e^{-\lambda t}$

C.  $\frac{1}{\lambda} \left[ \alpha - (\alpha - \lambda N_0) e^{-\lambda t} \right]$

D.  $\frac{N_0 \cdot \alpha}{\lambda} \left[ 1 - \left( \left( 1 - \frac{\lambda}{\alpha} \right) e^{-\lambda t} \right) \right]$

**Answer: C**



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## Comprehension type 28

1. Radioactive elements were incorporated into the earth when the solar system formed. All rocks and minerals contain tiny amount of these radioactive elements which breakdown spontaneously into more stable atoms overtime. A commonly used radiometric dating technique relies on the breakdown of  ${}_{19}\text{K}^{40}$  to  ${}_{18}\text{Ar}^{40}$ . Precise measurements of the amount of  $\text{K}^{40}$  relative to  $\text{Ar}^{40}$  in an igneous rock can tell the age of rock.

An igneous rock sample was found to contain 0.2 gm potassium and 0.6 gm of Ar. The age of the igneous rock is  $(\lambda \text{ of } \text{K}^{40} = 6.93 \times 10^{-10} \text{ year}^{-1})$

A.  $1.2 \times 10^8$  years

B.  $2 \times 10^9$  years

C.  $2 \times 10^{10}$  years

D.  $2.4 \times 10^9$  years

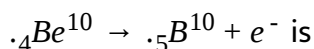
**Answer: B**



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1. Mass defect in the nuclear reactions may be expressed in terms of the atomic masses of the parent and daughter nuclides in place of their nuclear masses.

The mass defect of nuclear reaction,



- A.  $\Delta m = \text{at mass of } {}_{.4}\text{Be}^{10} - \text{at mass of } {}_{.5}\text{B}^{10}$
- B.  $\Delta m = \text{at mass of } {}_{.4}\text{Be}^{10} - \text{at mass of } {}_{.5}\text{B}^{10} - \text{mass of one electron}$
- C.  $\Delta m = \text{at mass of } {}_{.4}\text{Be}^{10} - \text{at mass of } {}_{.5}\text{B}^{10} + \text{mass of one electron}$
- D.  $\Delta m = \text{at mass of } {}_{.4}\text{Be}^{10} - \text{at mass of } {}_{.5}\text{B}^{10} - \text{mass of two electrons}$

**Answer: A**



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1. A human body excretes certain material through sweating by law similar to radioactivity if technitium is injected in some form in human body the body exretes half the amount in 24 hours A patient is given an injection containing  $^{98}\text{Tc}$  The isotope is radioactive with half life of 8 hours The activity just after the injection is  $32\mu\text{Ci}$

How much time will elapse before the activity of patient falls to  $16\mu\text{Ci}$ ?

A. 3.8 hrs

B. 4.8 hrs

C. 6 hrs

D. 8 hrs

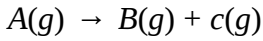
**Answer: C**



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1. A reaction is said to be first order if its rate is proportional to the concentration of reactant. Let us consider a reaction



At  $t = 0$   $a$

At time  $t$   $a - x$

The rate of reaction is given by the expression  $\frac{dx}{dt} = k(a - x)$  and integrated rate equation for a given reaction is represented as

$$k = \frac{1}{t} \ln \left( \frac{a}{a - x} \right) \text{ where } a = \text{initial concentration and } (a - x) = \text{concentration of}$$

$A$  after time  $t$ .

Thermal decomposition of compound  $X$  is a first order reaction. If 75% of  $X$  is decomposed in 100 min, how long will it take for 90% of the compound to decompose? [Given:  $\log 2 = 0.30$ ]

- A. 190 min
- B. 176.66 min
- C. 166.66 min
- D. 156.66 min

Answer: C



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## match the column type

1. For the sequential first order reaction:  $A \xrightarrow{k_1} B \xrightarrow{k_2} C$

$t=0$   $[A_0]$   $0$   $0$  Match the following lists:

List-I

List-II

(P) Time for  $\left( + \frac{d[C]}{dt} \right)_{\max}$  when  $k_1 = k_2 = k$

(1)  $\frac{1}{k}$

(Q) Time for  $\left( + \frac{d[C]}{dt} \right)_{\max}$  when  $k_1 \neq k_2$

(2)  $\frac{\ln k_2 - \ln k_1}{k_2 - k_1}$

(R)  $[B]$  when  $k_1 = k_2 \frac{d[B]}{dt} = 0$  and  $\frac{d^2[B]}{dt^2} = -ve$

(3)  $\frac{A_0}{e}$

(S)  $[B]$  when  $k_1 \neq k_2 \frac{d[B]}{dt} = 0$  and  $\frac{d^2[B]}{dt^2} = -ve$

$[A_0] \left( \frac{k_2}{k_1} \right)^{\frac{k_2}{k_1 - k_2}}$

A. P Q R S  
1 2 3 4

B. P Q R S  
2 1 4 3

P Q R S

C. 2 4 1 3

P Q R S

D. 4 3 2 1

**Answer: A**



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**2.**

Column-I

- (a) Reaction cannot be completed in finite time
- (b) Reaction may be elementary
- (c) As reaction proceeds time required for reducing to half of the amount keeps on decreasing



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3.

Column-I	Column-II
(a) +ve + ve	(p)charges obtained on dispersion medium and particles of despo
(b) -ve + ve	(q)Sign of slope and intercept (either x or y)respectively of the s
(c) +ve - ve	(r)Sign of order of reaction andrespectively of reactions which undergoe
(d) -ve - ve	(s)Charges of electrodes where coagulationoccurs during electrophor (t)According to Arrhenius theory the sign of slope and y intercept resp



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4. Assume that the reaction considered here is homogeneous gaseous

reaction  $A(g) \rightarrow B(g)$

Column-I(containing order of the reaction)	Column-II(containing properties)
(a) Order less than 1	(p)Reaction will not undergo 1
(b) Order equal to zero	(q)Rate of reaction will remain
(c) Order greater than or equal to 1	(r)Rate of reaction may increas (s)Reaction can never be eleme



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5.

Column-I

- (a)  $A + B \rightarrow C + D$   $r = k_1[A][B]$   
(b)  $A + B \rightarrow C + D$   $r = k_2[A][B]$   
(c)  $A + B \rightarrow C + D$   $r = k_2[A]^0[B]^0$   
(d)  $2A + B \rightarrow 2C + 3D$   $r = k_3[A]^0[B]^0$

Column-II

- (p) Unit of rate constant possess concn  
(q) Rate constant for the reaction of both  
(r) Rate of consumption of at least one  
(s) If both reactants are taken in stoichiometric



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6.

Column-I

- (a)  $2N_2O_5(g) \xrightarrow{\text{1st order}} 4NO_2(g) + O_2(g)$   
(b)  $2H_2O_2(aq) \xrightarrow{\text{zero or der}} 2H_2O(g) + O_2(g)$   
(c)  $2NH_3(g) \xrightarrow{\text{zero or der}} N_2(g) + 3H_2(g)$   
(d)  $2Cl_2O_7(g) \xrightarrow{\text{zero or der}} 4ClO_2(g) + 3O_2(g)$

Column-II

- (p) All the gaseous products are products  
(q) Hybridization of reactant involves  
(r) As the reaction proceeds half life  
(s) Rate of production of gases depends



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7.

Column-I

- (a) If the activation energy is 65 kJ then how much time faster a reaction proceed at 25 °C than at 5 °C?
- (b) Rate constant of a first order reaction is 0.0693 min<sup>-1</sup> if we start with 20 mol L<sup>-1</sup> it is reduced to 10 mol L<sup>-1</sup> after how much time?
- (c) Half lives of first order and zero order reactions are same ratio of rates at the start of reaction.
- (d) The half life periods are given [A] (M) 0.06770.1360.272 t<sub>1/2</sub> (sec) 240480960 order of the reaction



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Column-I

Column-II

- (a) Zero
- (p)  $k = \frac{1}{2t} \left[ \frac{1}{(a-x)^2} - \frac{1}{a^2} \right]$
8. (b) First
- (q)  $k = \frac{1}{t} \left[ \frac{1}{a-x} - \frac{1}{a} \right]$
- (c) second
- (r)  $k = \frac{x}{t}$
- (d) Third
- (s)  $k = \frac{1}{t} \log_e \left( \frac{a}{(a-x)} \right)$



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Column-I(Order)	Column-II(Unit of rate constant)
(a) Zero	(p) $L^2 mol^{-2} s^{-1}$
9. (b) First	(q) $L mol^{-1} s^{-1}$
(c) second	(r) $mol L^{-1} s^{-1}$
(d) Third	(s) $s^{-1}$

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10.

Column-I(Reaction)	Column-II(Method of)
(a) $2N_2O_5(g) \rightarrow 2N_2O_4(g) + O_2(g)$	(p) Tiration by $Na_2S_2O_3$
(b) $S_2O_8^{2-} + 2I^- \rightarrow 2SO_4^{2-} + I_2$	(q) Titration by $KMnO_4$
(c) $2H_2O_2 \rightarrow 2H_2O + O_2$	(r) Titration by NaOH
(d) $C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$	(s) Measuring pressure
(e) $CH_3CHO(g) \rightarrow CH_4(g) + CO(g)$	(t) Measuring angle of
(f) $CH_3COOC_2H_5 + H_2O \xrightarrow{H^+} CH_3COOH + C_2H_5OH$	(u) Measuring pressure

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11.

Column-I(Order)	Column-II(Property)
(a) Zero	(p) Half life $\propto \frac{1}{a^2}$
(b) First	(q) Half life $\propto \frac{1}{a}$
(c) second	(r) Half life is doubled on doubling the initial concentration
(d) Third	(s) 50% reaction takes same time even if concentration is halved

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12. If  $t_x$  represents time required for a fraction  $x$  of a reactant to be reacted during a reaction involving only one reactant then match column I with column II.

Column-I	Column-II
(a) Zero order	(p) if $t_{1/2} = 5$ min $t_{3/4} = 15$ min
(b) First order	(q) if $t_{1/8} = 10$ min $t_{1/4} = 20$ min
(c) Order greater than 1	(r) if $t_{3/4} = 20$ min $t_{7/8} = 30$ min
	(s) Reactant will never be 100% reacted in finite time

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13.  $t_{x/y}$  = time in which  $x/y$  fraction of reactant converts into product.

Column-I      Column-II

- (a)  $t_{5/9}$       (p)  $\text{Equal to } 54 \text{ sec}$  if  $t_{1/3}$  is 18 sec in case of first order reaction
- (b)  $t_{19/27}$       (q)  $\text{Equal to } 32 \text{ sec}$  if  $t_{1/14}$  is 16 sec in case of first order reaction
- (c)  $t_{7/8}$       (r)  $\text{Equal to } 56 \text{ sec}$  if  $t_{1/3}$  is 4 sec in case of second order reaction
- (d)  $t_{7/16}$       (t)  $\text{Equal to } 30 \text{ sec}$  if  $t_{1/3}$  is 18 sec in case of zero order reaction
- (t)  $\text{Equal to } 28 \text{ sec}$  if  $t_{1/2}$  is 16 sec in case of zero order reaction

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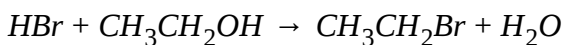
## Subjective Type

1. Calculate the specific activity of a radioactive substance  ${}_{98}^{250}\text{Cf}$  if its half life is 6.93 min . Express your answer in terms of  $10^{16}$  dps.

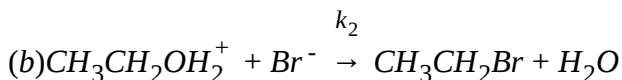
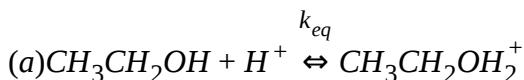
(Use:  $N_A = 6 \times 10^{23}$ )

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2. Displacement of the hydroxyl group of alcohol can take place with variety of reagents. One such reaction is



The above reaction has a two-step mechanism.



The slow and fast can be identified by the fact that rate of displacement of hydroxyl by halide ions depends on the type of halide ion .

Calculate the rate of the formation of Ethyl Bromide when concentration of alcohol is 0.5 M and HBr is  $10^{-1}$  M. Assume complete dissociation of HBr. Express your answer in terms of  $10^{-6}\text{M}/\text{sec}$ .

$$\left[ \text{Given: } K_{eq} = 4\text{M}^{-1} \text{ and } K_2 = 5 \times 10^{-2}\text{M}^{-1}\text{sec}^{-1} \right]$$



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3. The Arrhenius equation for two first order equation  $A \rightarrow B$  and  $C \rightarrow D$  is given by

$$k_1 = 10^{12} e^{-81.28(kJ)/(RT)}$$

$$k_2 = 10^{11} e^{-43.10(KJ)RT}$$

At what temperature  $k_1$  becomes equal to  $k_2$ . The unit of activation energy is kJ/mol

Use:  $\ln 10 = 2.3$  and  $R = 8.3 J/K/mol$

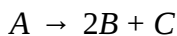
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4. An isotope of potassium  $K_{40}$  undergoes two parallel types of decay, one by electron capture and other by  $\beta$  decay with half lives as  $1.3 \times 10^9$  years and  $\frac{1.3}{9} \times 10^9$  years respectively. If in a sample of a mineral, mass ratio of  $K:Ar:Ca$  is 5 and 16 then calculate age of the mineral if it is known that all  $Ca^{40}$  in the mineral is not from the radioactive decay of potassium.

[Express your answer in terms of  $10^7$  years for e.g. if your answer is  $2 \times 10^9$  years fill 0200 in OMR sheet]

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5. Decomposition of non-volatile solute 'A' into another non-volatile solute B and C, when dissolved in water follows first order kinetics as :



when one mole of A is dissolved in 180 gm of water and left for decomposition, the vapour pressure of solution was found to be 20 mm Hg after 12 hrs. Determine the vapour pressure of the solution (in mm of Hg) after 24 hrs. Assume constant temperature of  $25^{\circ}\text{C}$ , throughout .

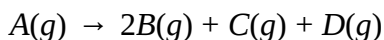
The vapour pressure of pure water at  $25^{\circ}\text{C}$  is 24mm Hg.

[Fill your answer by multiplying it with 100]



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6. A gaseous substance A undergoes first order dissociation to give B ,C and D as shown .



If molar masses of A,B,C and D are 450 , 100 , 50 and 200 respectively and rate constant of disappearance of A is  $0.693 \times 10^{-3}\text{sec}^{-1}$ , then calculate

ratio of rate of effusion initially and after 2000 seconds.

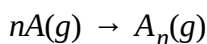
[Multiply the answer by  $26\sqrt{52}$  and fill the value in the OMR.]

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7. A first order reaction occurs 40 % in 120 min at  $25^\circ\text{C}$  and in 15 min at  $55^\circ\text{C}$ . The approximate value of  $\frac{k_{(35^\circ\text{C})}}{k_{(25^\circ\text{C})}}$  is :

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8. For a first order polymerisation reaction:



occurring at constant volume and temperature the half-life of polymerisation of 'A' is 20 min. If the total pressure of system is 2atm at  $t = 0$  and 1.2atm at  $t = 20\text{min}$ . then the value of 'n' is :

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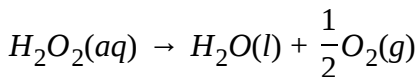
9. Calculate specific activity of a radioactive nucleus having average life of  $\frac{10^{15}}{216}$  sec. radius of the nucleus equal to 8 fermi meter.

[ Given : radius of nucleus =  $\frac{4}{3} \times 10^{-13} A^{1/3}$  cm where 'A' represents mass number ]

[ Express your answer in terms of  $10^8$  dps/g. ]

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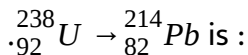
10.  $H_2O_2$  decomposes in an aqueous solution to give  $H_2O$  and oxygen gas. The rate constant of disappearance is  $2 \times 10^{-2} \text{sec}^{-1}$ . Calculate the amount of heat liberated per second initially from 0.5L of 2M  $H_2O_2$  solution (in kJ)



$$\Delta H = 100 \text{kJ/mole}$$

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11. The total number of  $\alpha$  and  $\beta$  particles emitted in the nuclear reaction



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12. The Arrhenius equation for two first order equation

$A \rightarrow B$  and  $C \rightarrow D$  is given by

$$k_1 = 10^{16} e^{-79.9(Kcal)/RT}, k_2 = 10^{12} e^{-43.1(kcal)/RT}$$

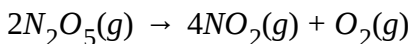
Calculate the temperature (Kelvin) at which  $k_1$  becomes equal to  $k_2$ .

Given :  $\ln 2 = 2.3$

[Express your answer by dividing it by 1000.]

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13. For the first order decomposition reaction:

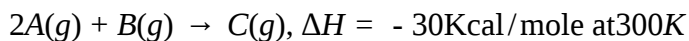


Initially the total pressure is found to be 650 torr and after a very long time total pressure is found to be 1550 torr. If after 4 minutes from the

start of the reaction partial pressure of  $O_2 = 100$  torr , calculate half life of the decomposition in minutes. [Given:  $\ln 3 = 1.1$  and  $\ln 2 = 0.7$ ] [Assume initially  $O_2$  is absent]

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14. For a gaseous reaction,



If the reaction follows the rate law  $\frac{d[C]}{dt} = 4 \times 10^{-3} [A]^2 [B] \text{ M/min}$  and initially concentration of  $B$  is  $[B] = 10^{-3} \text{ M}$  and concentration of  $A$  is  $[A] = 1 \text{ M}$ , then calculate the rate at which heat will be liberated per minute initially if reaction occurs in a rigid container of volume 10 litres.

[Express answer in  $10^{-1} \text{ cal/min}$ ]

[Use:  $R = 2 \text{ cal/molK}$ ]

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15. 5 milli-moles of a solid A was dissolved in 5 moles of  $H_2O$ . On adding to the solvent, A starts polymerising into another insoluble solid following zero order kinetics. On adding 6 milli-moles of another solid solute C (after 20 minute) the polymerisation completely stops. The insoluble solid polymer is removed and the resulting solution was cooled to a temperature less than  $-0.186^\circ C$  (freezing point of solution) to cause solidification of some liquid water. Calculate the value of X if rate constant for polymerisation reaction is represented as  $10^{-X}$  moles/minute.

$$\left[ K_f(H_2O) = 1.86K - Kgmole^{-1} \right]$$



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16. For the first order reaction :  $A(g) \rightarrow 2B(g) + C(g)$  the half life for the decomposition of A is 3 min at 300 K . Calculate the time (in min ) in which partial pressure of A(g) will drop from 2 bar to 0.5 bar at 400 K. Given activation energy of the reaction is 840 R.

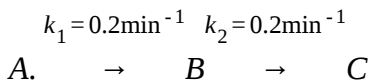
[Take :  $\ln 2=0.7$ ]

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17. For a third order reaction the ratio of  $t_{1/3}$  and  $t_{2/3}$  is T [ $t_{1/x}$  represents the time in which  $\frac{1}{x}$  fraction of reactant get reacted]. The value of '32 T' is :

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18. For the sequential reaction:

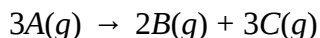


$$t = 0 \quad aM \quad 0 \quad 0$$

The time (in min) at which concentration of B becomes maximum is :

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19. A first order reaction,



Starting with pure A the pressure developed after 4 min and infinite time

is 4.5 atm and 5 atm respectively then calculate time (in minutes) required for 87.5% decomposition of A .

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20. The number of neutrons emitted when  ${}_{92}^{235}\text{U}$  undergoes controlled nuclear fission to  ${}_{54}^{142}\text{Xe}$  and  ${}_{38}^{90}\text{Sr}$  is :

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21. For the reaction  $A(g) \rightarrow 2B(g)$

$$\frac{d[B]}{dt} = 6 \times 10^{-4} \text{Msec}^{-1} \text{ when } [A] = 0.1 \text{M}$$

$$\frac{d[B]}{dt} = 2.4 \times 10^{-3} \text{Msec}^{-1} \text{ when } [A] = 0.4 \text{M}$$

Find the time taken (in seconds) for concentration of A to change from 0.6 M to 0.15 M.

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22. If activation energy of reaction is given as  $(2500 + 3T) R$  then calculate the value of  $\ln k$  (rate constant) at 100 K. Give your answer by multiplying with 10 [Given:  $\ln 1000 \cong 7$ ]

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23.  $2A + 3B \rightarrow 4C$  is a complex reaction with rate law,  $r = k[A]^0[B]^1$ . if initial conc. of A is 'a' and that of B is 'b' then what must be the ratio of  $\frac{b}{a}$  so that half life of A becomes equal to half life of B? Give your answer by multiplying  $\frac{b}{a}$  with 10.

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24. A tribasic acid,  $H_3A$ , dissociates into a dibasic acid,  $H_2B$  and a monobasic HC, obeying first order kinetics.

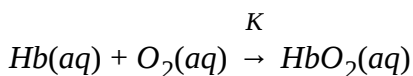


the kinetics is studied by withdrawing a definite volume (5 ml) of the

reaction mixture at different times and titrating it with 0.4 M Na OH solution. If the volume of Na OH solution needed for complete titration at  $t = 0$  is 25 ml, then the volume (in ml) of Na OH solution needed for titration at  $t = 25\text{min}$  is :

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25. To carry out metabolism oxygen is taken up by haemoglobin (Hb) to form oxyhaemoglobin ( $\text{HbO}_2$ ) according to the elementary reaction:

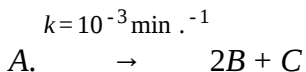


the value of  $K$  is  $2.0 \times 10^6 \text{M}^{-1} \text{s}^{-1}$  at  $37^\circ \text{C}$  (body temperature). For an average adult the concentrations of Hb and  $\text{O}_2$  in the blood in the lungs are  $8.0 \times 10^{-6} \text{M}$  and  $1.5 \times 10^{-6} \text{M}$ , respectively. The rate of formation of  $\text{HbO}_2$  increases to  $1.6 \times 10^{-4} \text{M s}^{-1}$  during an exercise to meet the demand of increased metabolism rate. Assuming the Hb concentration to remain same, what must the oxygen concentration be to sustain this rate of  $\text{HbO}_2$  formation?

[If the answer is  $X$  then fill OMR by multiplying  $X$  with  $10^6$ .]

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26. An optically active substance A is decomposing into optically active substance B and C as :



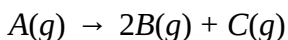
the specific rotations of A, B and C are  $+40^\circ$ ,  $+10^\circ$  and  $-30^\circ$  per mole, respectively. Initially A and C were present in 4:3 mole ratio. After what time (in min), the sample becomes optically inactive?

$$\left[ \text{Given } \ln \frac{7}{5} = 0.34, \ln \frac{20}{13} = 0.43 \right]$$



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27. Gaseous decomposition of A follows 1st order kinetics. Pure A (g) is taken in a sealed flask where decomposition occurs as



After 10 sec., a leak was developed in the flask. On analysis of the effused gaseous mixture (Obeying Graham's law) coming out initially moles of B(g) were found to be double of A. What is rate constant in  $\text{sec}^{-1}$ .

Given : Molecular weight of A = 16, Molecular weight of B = 4 , Molecular weight of C = 8

[ $\ln 3 = 1.1$ ,  $\ln 2 = 0.7$ ]

[Write your answer by multiplying it with 100.]

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28. For a reaction :  $A(g) \rightarrow nB(g)$  the rate constant is  $6.93 \times 10^{-4} \text{sec}^{-1}$ . the reaction is performed at constant pressure and temperature of 24.63 atm and 300K starting with 1 mole of pure A.

If concentration of B after 2000 sec is  $\frac{3}{3.25} \text{M}$  then calculate the value of n

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29. For the reaction ,  $A(aq) \rightarrow 2B(aq)$ , 50 % reaction occurs in 10 min and next 75% reaction (after the concentration of A becomes half of initial concentration), occurs in 1.0 hour at , constant temperature. The order of reaction is :

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30. For the reaction :  $A(aq) \rightarrow 2B(aq) + C(aq)$ ,

the rate is  $2.4 \times 10^{-3} \text{ molL}^{-1} \text{ s}^{-1}$  on 20 % reaction of A and the rate is  $9.6 \times 10^{-5} \text{ molL}^{-1} \text{ s}^{-1}$  on 84 % reaction of A the order of reaction is :

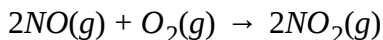
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31. The rate of decomposition for methyl nitrite and ethyl nitrite can be given in terms of rate constant (in  $\text{sec}^{-1}$ )  $k_1$  and  $k_2$  respectively. The energy of activations for the two reactions are  $152.30 \text{ kJ mol}^{-1}$  and  $157.7 \text{ kJ mol}^{-1}$  as well as frequency factors are  $10^{13}$  and  $10^{14}$  respectively for the decomposition of methyl and ethyl nitrite. Calculate the approx. temperature at which rate constant will be same for the two reactions.

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**32.** The rate law of a chemical reaction given below :



is given as rate =  $k[NO]^2 \cdot [O_2]$ . How will the rate of reaction change if the volume of reaction vessel is reduced to  $\frac{1}{4}$ th of its original value ?

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**33.** Compounds A and B react with a common reagent according to first order kinetics in both cases. If 99% of A must react before 1% of B has reacted. What is the minimum ratio for their respective rate constants?

$$\left( \text{Given: } \frac{2}{2 - \log^{99}} = 458 \right)$$

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**34.** The rate of decomposition of a substance increases by a factor 2.25 for 1.5 times increases in concentration of substance at same temperature. Find order of the reaction



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**35.** In a II order reaction when the concentration of both the reactants are equal. The reaction is completed 20% in 500 sec. How long (in seconds) it would take for the reactions to go to 60% completion?



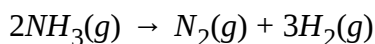
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**36.** In a kinetic study of the reduction of nitric oxide with hydrogen, the initial pressure of 340 mm, an equimolar mixture of gases was reduced to half the value in 102 seconds. In another experiment the initial pressure of 288 mm, under the same conditions was reduced to half the value in 140 sec. Calculate the order of the reaction.



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**37.** Decomposition of ammonia on platinum surface follows the change



If the rate obeys  $\frac{-d[NH_3]}{dt} = \frac{k_1[NH_3]}{1 + k_2[NH_3]}$ , what will be the order for decomposition of  $NH_3$  if  $[NH_3]$  is very very less,  $K_1$  and  $K_2$  are constant?

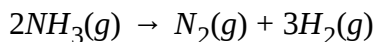
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**38.** A quantity of ethyl acetate is mixed with an excess of sodium hydroxide at  $25^\circ C$ . 100 c.c. of the mixture is immediately titrated against 0.05N Hydrochloric acid of which 75 c.c were required for neutralisation. After 30 minutes 50 c.c of the mixture required, similarly 25 c.c of the acid. When the original reaction of ester was complete 25 c.c of the mixture required 6.25 c.c of the second order velocity constant (in mol/l/min)(at time =0) of the reaction using concentration in moles per litre and time in minutes. Reaction is first order each w.r.t. NaOH and ester. Indicator chosen for above titration is such that it gives end point when only hydrochloric acid reacts with NaOH. ( $\log 2 = 0.30$ ,  $\log 3 = 0.48$ ,  $\ln 10 = 2.3$ ) (Given your Answer after multiplying with a factor of 10 and excluding the decimal places)



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39. For a zero order chemical reaction,



rate of reaction = 0.1atm/sec. Initially only  $\text{NH}_3$  is present and its pressure = 3atm . Claculate total pressure at  $t = 10\text{sec}$ .



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40. A substance 'A' undergoes a reaction such that its concentration at anytime  $t$  (in sec.) can be represented by the equation  $[\text{A}]_t^4 = \frac{1}{t+1}$  where 't' is time in sec and  $[\text{A}_t]$  represents molar concentration. Calculate rate of disappearance of 'A' at concentration of 2M.



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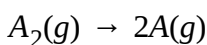
41. The periodic table consists of 18 groups. An isotope of copper on bombardment with protons, undergoes a nuclear reaction yielding element X as shown below . To which group, element X belongs in the periodic table? It bregt  ${}_{29}^{63}\text{Cu} + {}_1^1\text{H} \rightarrow {}_0^1\text{n} + a + 2{}_1^1\text{H} + \text{X}$

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42. The ratio of activities of two radionuclides X and Y in a mixture at time  $t = 0$  was found to be 8:1 after two hour's the ratio of activities become 1:1. If the  $t_{1/2}$  of radionuclide X is 20 min find the  $t_{1/2}$  [in minutes] of radionuclide Y.

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43. A diatomic gaseous species  $A_2(g)$  decomposes into atomic A by first order kinetics as :



An empty flask was filled with  $A_2(g)$  and  $N_2(g)$  at an initial pressure of 800

mm of Hg at 600 K and sealed. After a very long time gases in the flask developed a pressure 1400mm of Hg. If half-life for the decomposition process is 2 hr, what was the pressure in the after 4 Hr from start? Assume  $N_2$  to be an inert gas.

[Find your answer in cm of Hg]

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44. The rate of reaction starting with initial concentration of  $2 \times 10^{-3}M$  and  $10^{-3}M$  are equal to  $2.4 \times 10^{-4} \text{mol dm}^{-3} \text{sec}^{-1}$  and  $0.6 \times 10^{-4} \text{mol dm}^3 \text{sec}^{-1}$  respectively. Find rate constant of reaction in units  $\left[ \text{mol}^{-1} \text{dm}^{3n-3} \text{sec}^{-1} \right]$  where  $n$ =order of reaction .

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45. An unknown element X has atomic number 88 and mass number 228. This element is decaying by  $\alpha$  and  $\beta$  emission. Calculate the total number of

${}_{-1}^0\beta$  particles emitted by element.



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46. At 300 K 50% of molecule collide with energy greater than or equal to  $E_a$ . At what temperature 25% molecule will have energy greater than or equal to  $E_a$ ?



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47. 90% of a first order reaction was completed in 3 min. When (in minutes) will 99.9% of the reaction be complete?



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48. The ratio of initial activities of two samples of radionuclides A and B

are  $\left(\frac{A_A}{B_B}\right) = \frac{1}{16}$ . If  $t_{1/2}(A)$  and  $t_{1/2}(B)$  are 30 min and 7.5 min activity of both

samples will be same ?

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**49.** Consider the following two 1st order reactions:



Reaction (i) is 75% completion in 4 hrs while reaction (ii) takes 16 hr for 75% completion under identical conditions . By how many hours. Half life of (i) reaction is greater than the half life of (i)?

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**50.** The activity of a radioactive sample decreases to  $\frac{1}{3}$  of the original activity ( $A_0$ ) in a period of 9 years.

After 9 years more ,its activity is  $\frac{A_0}{x}$ . Find the value of X.

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51. Reaction :  $A \rightarrow B$  follows zero order kinetics and initial concentration of A is 0.01M.

If concentration of A is 0.008 M after 10 min, calculate half-life (in minute).

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52. A catalyst lowers the activation energy of a reaction in such a manner that rate constant at  $27^\circ\text{C}$  uncatalysed reaction equals the rate constant at  $-73^\circ\text{C}$  for catalysed reaction . By how many kJ activation energy barrier is reduced by catalyst? Activation energy for the reaction is 24kJ.

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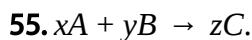
53. If first order reaction ( $A \rightarrow P$ ), calculate  $\frac{t}{t_{1/2}}$  if  $\frac{15}{16}$

fraction of reactant is decayed in 't' time where  $t_{1/2}$  is half life.

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54. An ore is found to contain  ${}_{90}^{232}\text{Th}$  and its stable end product is in atom ratio of 1:3 respectively. How many times the age of ore will be that of half life of  ${}_{90}^{232}\text{Th}$ ?

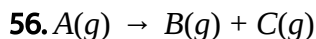
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(Here  $x, y, z$  are simplest whole number ratios)

$$\text{If } -\frac{d[\text{A}]}{dt} = -\frac{d[\text{B}]}{dt} = 1.5\frac{d[\text{C}]}{dt} = \text{then } x + y + z \text{ is:}$$

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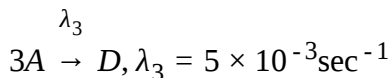
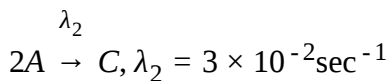
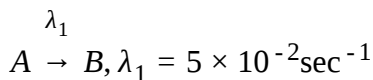
Initial concentration of A is 20 M and concentration of C after 18 minutes is 15 M then calculate half life time (in minutes) of reaction (Assuming decomposition of A follows first order Kinetics).

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57. A radioactive sample of  $C^{14}$  showing 20 curie activity. Calculate its activity (in  $C_i$ ) after 12000 yrs ( $t_{1/2}$  of  $C^{14} = 6000$  yrs)

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58. A radioactive element decays by following three different parallel paths :



Calculate average life- time of element (in sec.)

[ $\lambda_1, \lambda_2, \lambda_3$  are decay constants for respective reactions]

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59. In reaction  $A(g) \rightarrow B(g) + C(g)$

if initial pressure of  $A(g)$  is 100 mm. of Hg half-life of reaction is found to

be 10 minute but if initial pressure of A is 200 mm of Hg half-life of reaction is found to be 2.5 minute then what will be order of reaction ?

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**60.** The acid catalysed hydrolysis of ethyl acetate is first order with respect to ester and rate constant for the hydrolysis reaction is  $0.693\text{sec}^{-1}$ . Determine time (in sec) required for 93.75 % hydrolysis of ester.

[ $\ln 2 = 0.693$ ]

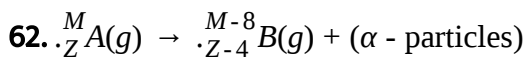
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**61.** If rate of reaction becomes double when temperature is increases from  $27^\circ\text{C}$  to  $37^\circ\text{C}$ . Then find activation energy of reaction in calorie.

( $R = 2\text{cal/mol} \cdot \text{K}$ ) [ $\ln 2 = 0.7$ ]

[Fill your answer after dividing by 10.]

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( $\alpha$  particles are helium nuclei, so will form He gas by trapping electrons).

The radioactive disintegration follows 1st order kinetics, starting with 1 mole of A in a 16.4 litre closed flask at  $127^\circ \text{C}$ .

pressure (atm) developed after two half lives is :

( $R = 0.082 \text{ litre atm/mol-K}$ )



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63. A radioactive element X (atomic weight = 200) shows activity  $6.93 \times 10^{15} \text{ dps}$  then find weight of X (in mg).

( $T_{1/2} = 100 \text{ minutes.}, N_A = 6 \times 10^{23}$ )



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