CHEMISTRY

BOOKS - GRB CHEMISTRY (HINGLISH)

CHEMICAL KINETICS

STRAIGHT OBJECTIVE TYPE

1. $xA + yB \rightarrow zC$. If $-\frac{d[A]}{dt} = -\frac{d[B]}{dt} = 1.5\frac{d[C]}{dt}$, 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 : $xA \rightarrow yB$,

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

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. Conside the chemical reaction,

$N_2(g)3H_2(g) \rightarrow 2NH_3(g)$

The rate of reaction can be expressed in terms of time derrivate of concentration of $N_2(g), H_2(g)$ or $NH_3(g)$ Identift the correct relationship amongst the rate expression :

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

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

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

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

$H_2 + I_2 \to 2HI$ is

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

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

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

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) $\rightarrow$ products, occurring at constant volume the correct relation between $\frac{dC_A}{dt}, \frac{dn_A}{dt}$ and $\frac{dP_A}{dt}$ is :

$\left[C_A \rightarrow \text{Concentration of reactant A}, n_A \rightarrow \text{Moles of reactant A}, P_A \rightarrow \text{Partial pres}\right.$

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

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

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 ?

$BrO_3^{\ominus}(aq) + 5\underline{Br}^{\ominus}(aq) + 6H^{\oplus}(aq) \rightarrow 3\underline{Br_2}(l) + 3H_2O(l)$

A. $\frac{d[Br_2]}{dt} = \frac{5}{3}\frac{d[Br^-]}{dt}$

B. $\frac{d[Br_2]}{dt} = \frac{d[Br^-]}{dt}$

C. $\frac{d[Br_2]}{dt} = -\frac{d[Br^-]}{dt}$

D. $\frac{d[Br_2]}{dt} = -\frac{3}{5}\frac{d[Br^-]}{dt}$

Answer: D

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7. For a hypothetical reaction,

$A + 3B \rightarrow P \quad \Delta H =$ - $2x$ kJ/mole of A and

$M \rightarrow 2Q + R \quad \Delta = + x$ kJ/mole of M

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

$$Ag^{+} + 2NH_3 \Leftrightarrow \left[Ag\left(NH_3\right)_2^{+}\right]$$

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

$$\left[Ag\left(NH_3 \_ (2)^{+}\right]\right.$$

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. 1×10^5

C. 1×10^{-5}

D. 1×10^{-3}

Answer: A

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

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

A. 9×10^{-2}

B. 10^{-2}

C. 4.5×10^{-2}

D. 6×10^{-2}

Answer: D

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11. If I is the intenisty 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

$2SO_2 + O_2 \rightarrow 2SO_3$

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

A. 50 $\mathrm{g\ min^{-1}}$

B. 40 $\mathrm{g\ min^{-1}}$

C. 200 $\mathrm{g\ min^{-1}}$

D. 20 $\mathrm{g\ min^{-1}}$

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

A. $4A + B \rightarrow 2C + 3D$

B. $B + 3D \rightarrow 4A + 2C$

C. $4A + 2B \rightarrow 2C + 3D$

D. $B + \left(\frac{1}{2}\right)D \rightarrow 4A + 3$

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

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

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

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 apperance of $'B'$ by the expression:

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

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

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

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 disappearnce 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. 0.06atm min^{-1}

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

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

D. 0.36atm 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 6.8×10^{-3} gm/min, then rate of disappearance of $H_2(g)$ at the same condition will be :

A. 6.8×10^{-3} gm/min

B. 1.02×10^{-2} gm/min

C. 16×10^{-4} gm/min

D. 1.2×10^{-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 :

$2K_2Cr_2O_7 + 8H_2SO_4 + 3C_2H_5OH \rightarrow 2Cr_2(SO_4)_3 + 2K_2SO_4 + 3CH_3COOH + 1$

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 :

$A + 2B \rightarrow 3C, \quad \Delta H = -400 kJ/\text{mole of A}$

$2D + E \rightarrow 2F, \quad \Delta H = +300 kJ/\text{mole of E}$

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

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

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

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

Answer: D

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

$$CH_3 - C||S - NH_2 + H_2O \xrightarrow{H_2O} CH_3 - \overset{\overset{O}{||}}{C} - NH_2 + H_2S$$

Rate= K [thioacetamide]$\left[H^+\right]$

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_3

C. 0.1M TA + 0.20M HCOOH

D. 0.15M TA + 0.15M HCl

Answer: B

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24. The instataneous 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 :

$$2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$$

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

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 :

$4NH_3(g) + 3O_2(g) \rightarrow 2N_2(g) + 6H_2O(g)$

If the rate of formation of N_2 at a certain temperature is $3.0 mol. L^{-1}. s^{-1}$, what is the rate of disappearance of O_2 ?

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

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

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

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

Answer: C

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27. For the reaction $A + B \rightarrow C$, the rate law is : 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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28. $2N_2H_4(g) + N_2O_4(g) \rightarrow 3N_2(g) + 4H_2O(g)$

If $N_2H_4(g)$ disappears at a rate of 0.12 mol L min, at what rate does $N_2(g)$ appear?

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

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

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

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

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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30. $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

The rate of disappearance of $N_2O_5(g)$ at a certain temperature is $0.016 \text{mol.L}^{-1}\text{min}^{-1}$. What is the rate of formation of $NO_2(g)$ (in mol. L^{-1}. 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 $\left[H_2O_2\right] = 0.150$ M , the decomposition rate was measured to be $4.83 \times 10^{-6} M. s^{-1}$. What is the rate constant for the reaction?

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

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

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

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

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 disappeadrance of O_2 compare to the rate of productiion of CO_2? The rate of disappearance of O_2 is :

A. the same ass 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. $\text{mol.L}^{-1}.s^{-1}$

B. mol.L^{-1}

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

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

Answer: A

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

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$.

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

A. 2.4×10^{-3}mol/min

B. 1.8×10^{-3}mol/min

C. 1.2×10^{-3}mol/min

D. 8.0×10^{-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,

ltBrgt $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$.

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

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

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

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

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

Answer: D

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

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

What is the rate of formation of oxygen gas (in 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 :

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$

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

A. -1.38M.min^{-1}

B. -0.880M.min^{-1}

C. -0.275M.min^{-1}

D. -0.220M.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 dounled, 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 :

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

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

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

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

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

C. $[H_2]^{3/2}[Br_2]^0$

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]lt1 then $r_1 > r_2 > r_3$

C. If [A]gt1 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 $\left(BrO_3\right)^-$ and Br^- ions is given by the expression $-\frac{d\left(BrO_3^-\right)}{dt} = k\left[BrO_3^-\right]\left[Br^-\right]\left[H^+\right]^2$ it means

A. rate constant of overall reaction is 4 $\sec^{-1}$

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 H^+ ions will increase the reaction rate by 4 times

Answer: D

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7. For a reaction $A + 2B \rightarrow C$, rate is given by $R = K[A][B]^2$. 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 rection 3A $\rightarrow$ Products the value of $k = 1 \times 10^{-3}$ L/(mol-min) the value of $-\dfrac{d[A]}{dt}$ in mol/L-sec when [A] = 2 M is :

A. 6.67×10^{-3}

B. 1.2×10^{-2}

C. 2×10^{-4}

D. 4×10^{-3}

Answer: C

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10. For the non-equilibrium process,

A + B $\rightarrow$ 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 indroduced into a 1.0 L vessel and the initial rate was 1.0×10^{-2} mol $L^{-1}s^{-1}$, rate when half reactants have been turned into products is :

A. 1.25×10^{-3} mol $L^{-1}s^{-1}$

B. 1.0×10^{-2} mol $L^{-1}s^{-1}$

C. 2.50×10^{-3} mol $L^{-1}s^{-1}$

D. 2.0×10^{-2} mol $L^{-1}s^{-1}$

Answer: A

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11. The rate constant for the reaction

$2N_2O_5 \rightarrow 4NO_2 + O_2$

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

A. 1.4

B. 1.2

C. 0.04

D. 0.8

Answer: D

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12. Conisder a reaction $aG + bH \rightarrow$ 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

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 $2NO(g) + O_2(g) \rightarrow 2NO(g)$ 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-eight 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.

A. $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$

B. $CH_3\overset{\overset{O}{||}}{C}-OCH_3(aq) \xrightarrow{[H^+]} CH_3\overset{\overset{O}{||}}{C}-OH + CH_3OH$

C. $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$

D. $H_2O_2(aq) \rightarrow H_2O(l) + \frac{1}{2}O_2(g)$

Answer: B

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18. For a process A + B $\rightarrow$ 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 1×10^{-2} mol/L-sec. The rate of reaction when 50% of the reactant have been converted to product would be :

A. 1×10^{-2} mol/L-sec

B. 2.5×10^{-3} mol/L-sec

C. 5×10^{-2} mol/L-sec

D. 5×10^{-3} mol/L-sec

Answer: D

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

$$CH_3C(O)CH_3 + I_2 \xrightarrow{H^+} CH_3C(O)CH_2I + HI$$

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

$$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$$

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 :

$A(aq) + H_2O \rightarrow B(aq) + C(aq)$

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. 3.6×10^{-3}

D. 1.8×10^{-3}

Answer: B

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22. The rate law for a certain reaction is found to be : 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 : $2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$

Rate = $k[NO]^2\left[H_2\right]$

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 :

$$\left(CH_3\right)_3CBr(aq) + OH^-(aq) \rightarrow \left(CH_3\right)_3COH(aq) + Br^-(aq)$$

it is found that halving the concentration of $\left(CH_3\right)_3CBr$ causes the reaction rate to be halved but halving the concentration of OH^- has no effect on the rate. What is the rate law?

A. Rate = $k\left[\left(CH_3\right)_3CBr\right]^{1/2}\left[OH^-\right]$

B. Rate = $k\left[\left(CH_3\right)_3CBr\right]^{2}\left[OH^-\right]$

C. $k\left[\left(CH_3\right)_3CBr\right]^{1/2}$

D. $k\left[\left(CH_3\right)_3CBr\right]$

Answer: D

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25. A hypothetical reaction has a rate law of : 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 twise 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 , rate = $k[CO]\left[NO_2\right]$.

What are the units for the rate constant, k?

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

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

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

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

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 → C The rate remains constant when the concentration of A is doubled and the concentration of B is held concentration of B is doubled and the concentration of A 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 $2.0M. s^{-1}$. If the rate law is rate = k[A], how fast does [B] decrease under the same conditions?

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

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

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

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

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 = $k\left[H_2O_2\right]\left[I^-\right]$. 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

$2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O(g)$

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 `rarr C, the rate equation for this reaction is given as

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 itelf?

A. Quadrupled

B. Doubled

C. Halved

D. The same

Answer: B

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33. For a rate law of the form, 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 reapect of N_2O_5.

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

If the half-life for this reaction is 19.0 minutes, what is the rate constant, k for r = $k[N_2O_5]$?

A. 0.0182min^{-1}

B. 0.0263min^{-1}

C. 0.0365min^{-1}

D. 0.0526min^{-1}

Answer: A

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C. Integrated Rate Laws

1. The rate constant of reaction,

2A + B → 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 theee hours, and so on. The dimenison of the velocity constant (rate constant) are

A. $hour^{-1}$

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

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

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

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 raction 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 $(A) \xrightarrow{k_1}$ product, $(B) \xrightarrow{k_2}$ 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 $\left(t_{1/2} = 5\text{ min}\right)$ and B$\left(t_{t/2} = 10\text{ min}\right)$ 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 I-order reaction is completed to the extent of 60% and 20% in time intevals, 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 → products, the concentration of reactant are $C_0, aC_0, a^2C_0, a^3C_0$...... after time interval 0, t, 2t.... 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 → 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 $0.05mL$) contains 3×10^{-6}mole$H^{\oplus}$ ions. If the rate constant of disappearance of $H^{\oplus}$ ions is $1 \times 10^{7} molL^{-1}s^{-1}$, how long would it take for $H^{\oplus}$ ions in the drop of disappear?

A. 6×10^{-8} sec

B. 6×10^{-7} sec

C. 6×10^{-9} sec

D. 6×10^{-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. $t_{7/8} = t_{1/2}\left[2^{n-1} - 1\right]$

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

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

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 occuring 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-II : $t_{7/8} = t_{3/4} \times 2$

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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15. $3A \rightarrow B + C$

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 it 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 $2A \rightarrow$ product having rate constant of reaction 1.386×10^{-2}min.

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 decoposition of reactant at concentration 0.1 M is $1.386 \times 10^{-3} M / \text{ min}$

D. Rate of decoposition of reactant at concentration 0.1 M is $1.386 \times 10^{-3} M/\text{sec.}$

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) → 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 $t_{1/2} = \frac{\left(2 - \sqrt{2}\right)}{k} \times C_0^{1/2}$ 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 from of the rate equation is :

$k = \frac{1}{t(n -)}\left[\frac{10}{C^{n-1}} - \frac{1}{C_0^{n-1}}\right]$ where C_0 and C are the values of the reactant concentration at the start and after tme 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. $t_{3/4} = t_{1/2}\left[2^{n-1} + 1\right]$

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

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

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

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

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

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

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

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 $k = 0.025 M s^{-1}$ for the disappearance of A. What will be the concentration of A after 15 seconds if the initial concentration is $0.50 M$?

A. 0.50 M

B. 0.375 M

C. 0.125 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 Ist 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) → 2C(g) + D(g), the law is given as $R = [A]^{1/3}.[B]^{2/3}$. 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 $1 \times 10^{-3} \text{L mol}^{-1} s^{-1}$

B. Its half-life is inversely proportional to its initial concentration

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

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

Answer: C

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32. $A(g) \rightarrow B(g) + C(g)$

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

At the start, pressure is 100 mm and after 10 min, pressure is 120 mm. Hence, rate constant $\left(\text{min}^{-1}\right)$ is :

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

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

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

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

Answer: C

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33. For the Ist order reaction :

A(g) $\rightarrow$ B(g) + C(g) + D(s)

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 canstant for the reaction is :

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

B. 2 hr^{-1}

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

D. 1 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 $\left[H^{+}\right]$ on rate of reaction.

B. Rate of reaction will be same if 0.05 M HCl is taken or $0.05 \mathrm{M}\ \mathrm{H}_2SO_4$ 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 $\rightarrow$ Product, the order of reaction is equal to :

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

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

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

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?

A. $CH_3 - \overset{\overset{O}{||}}{C} - CH_3 + I_2 \rightarrow CH_2I - \overset{\overset{O}{||}}{C} - CH_3 + HI$

B. $H_2 + Cl_2 \xrightarrow{hv} 2HCl$

C. $CH_3 - \overset{\overset{O}{||}}{C} - OCH_3 + H_2O \xrightarrow{[H^+]} CH_3 - \overset{\overset{O}{||}}{C} - O - H + CH_3OH$

D. $H_2O_2(g) \rightarrow H_2O_{(l)} + \frac{1}{2}O_2(g)$

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 $\%$ if 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. 0.24min^{-1}

C. 0.14min^{-1}

D. 0.060min^{-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 pH = 5 for any concentration of sugar. However if pH = 6, the half life changed to 500 minutes. The law expression of sugar inversion can be written as:

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

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

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

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

Answer: C

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45. The reaction $A \xrightarrow{k}$ Products, is zero order while the reaction $B \xrightarrow{k}$ 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 2M

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

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 $0.2 \text{mole}/\text{litre}$?

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 1.386mol 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 form 800mol dm^{-3} to 50mol dm^{-3} in $2 \times 10^4 s$. The rate constant of the reaction (in s^{-1}) is

A. 3.45×10^{-5}

B. 1.38×10^{-4}

C. 1.00×10^{-4}

D. 5.00×10^{-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 $\left(C = C_0 e^{-k_1^t}\right)$ 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 $\left(T_{av}\right)$ 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 Ist 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 $0.0541 s^{-1}$ at $25^{\circ} C$. What is the half-life for this reaction?

A. $18.5 s$

B. $12.8 s$

C. $0.0781 s$

D. $0.0375 s$

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 $3.3 \times 10^{-3} s^{-1}$. 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 $2.08 \times 10^{-2} s^{-1}$. 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 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 dicomposition of a certain compound in solution is first order. If the concentration of the compound is dounled, what happens to the reaction's half-life?

A. It doubles

B. Ift 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. $22.7s^{-1}$

D. $9.86s^{-1}$

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. $time^{-1}$

C. M.time

D. $M.time^{-1}$

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 :

A $\rightarrow$ P, $K = 10^{-2}$(mol/litre)sec^{-1}

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 $mol.L^{-1}.time^{-1}$.

D. The rate of formation of products in $mol.L^{-1}.time^{-1}$.

Answer: B

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D. Methods to Determine the Rate Law

1. $A + B \rightarrow$ 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 $\rightarrow$ 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,

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

when [A] = 0.01 M and rate is 1.41×10^{-4}M s^{-1}

when[A] = 0.02 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 $\to$ C when $1M$ A was taken with $10^{-4}M$ B, time taken for B to reduce to half was found to be 10 seconds. Calculate $t_{1/2}$ when 1 M A is reacted with $10^{-5}M$ 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 $\left(CH_3COOC_2H_5\right)$ by NaOH (Saponification of ethyl acetate by NaOH is second order reaction) is studied by titration of the reaction mixture initially having $1 : !$ 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,

$$A(g) + 2B(g) \rightarrow C(g) + D(g) \quad \left(\frac{dx}{dt}\right) = k[A][B]^2$$

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 $\left(\frac{dx}{dt}\right) = k\left[H^{+}\right]^{n}$ 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 constatn 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. $k[Zn]\left[H^{+}\right]$

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

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

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

Answer: A

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10. For a gaseous reaction : 2A(g) → 3B(g)+4C(g), occurring in a rigid vessel, if initially pressure is 3 atm and afer 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 $\rightarrow$ 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 $L.mol:^{-1}.s^{-1}$?

A. zero

B. First

C. Second

D. Third

Answer: C

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14. The time elapsed between 33% and 67% completionb 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) $\rightarrow$ 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 fermentaion 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 a acid catalysed hydrolysis of an organic compound A, the half-life of A changes from 100 min (when carried out in a buffer sollution of pH=3) to 1 min (when carried out in a buffer solution of pH=4). Both the half lives are independent of concentration nof organic compound. If the rate law is represented as $R - K\left[H^{+}\right]^{a}[A]^{b}$ 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 $\rightarrow$ 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,

$2ICI(g) + H_2(g) \rightarrow 2HCl(g) + I_2(g)$

At a certain temperature thae ate constane is found to be $1.63 \times 10^{-6} L/mil - s^{-1}$. 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 $\rightarrow$ 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 molcules as shown below, occurs at a temperature os 639 K. The rate constant $k = 3.02 \times 10^{-5} M^{-1} s^{-1}$

$$HI(g) \rightarrow \frac{1}{2}H_2(g) + \frac{1}{2}I_2(g)$$

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[ester]$\left[H^{+}\right]$

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 $30\,^{\circ}C$ has a time for half change of 100 min, when careied out in a buffer solution at pH=5, and 10 min. when carried out at pH=4. Both times of half change are independent of the initial concentration of A. If the rate constant K is given by $\frac{-d[A]}{dt} = K[A]^{a}\left[H^{+}\right]^{b}$ 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 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 $A_2 \text{in mm min}^{-1}$ 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. $\left(\frac{1}{600}\right)\ln 1.25 \sec^{-1}$

B. ((2.303)/(10))"log"1.5"min"^(-1)`

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

D. none of these

Answer: A

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5. In the reaction $NH_4NO_2(aq) \rightarrow N_2(g) + 2H_2O(l)$ the volume of N_2 after 20 min and after a long time is 40 ml and 70 ml respectively. The value of rate constant is :

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

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

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

D. $\left(\frac{2.303}{10}\right)$"log"((11)/(7))"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 $10^{-3}PA^{-1}\sec^{-1}$. IF initial pressure of ethane is 3×10^{5} PA, how many sec would it take for the pressure to reach 5×10^{5} PA

A. 1800.2 sec

B. 3.33×10^{-2} sec

C. 6.66×10^{-3}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 concentraion of reactant is 3M?

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

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

C. 5xx10^(-3)"M min"^(-1)`

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

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 sec^{-1}. If initially 2 M of A is taken then what will be concentration of C afterr 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 $\rightarrow$ product (1st order reaction)

conc.(mol/lit)	0.01	0.0025
time(min)	0	40

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

A. 3.43×10^{-4}

B. 1.73×10^{-4}

C. 3.43×10^{-5}

D. 1.73×10^{-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 willl 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_∞ 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. $V = \left(V_t - V_0\right)$

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

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

Answer: C

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

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

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

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 $\left(C_{12}H_{22}O_{11}\right)$ is first-order reaction and is studied by measuring angle of rotation at different instants of time

$$C_{12}H_{22}O_{11}\text{Sucrose}d + H_2O \xrightarrow{H^+} C_6H_{12}O_6\text{Glucose}d + C_6H_{12}O_6\text{Fructose}l$$

If $\left(r_\infty - r_0\right) = a$ and $\left(r_\infty - r_t\right) = (a - x)$ (where r_0, r_t and r_∞) 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 opticaly 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,

A(g) $\rightarrow$ 2B(g) + C(g)

is observed to be first order over the excess of liquid water at $25\,^{\circ}C$. If is found that after 10 minutes the total pressure of system is 188 torr. The rate costant of the reaction (in hr^{-1})$is:[Given: vapourpressureof$H_(2)O$at$ 25^(@)$is28 \rightarrow rr($"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 form 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:

A $\rightarrow$ 2B + 3C

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. 2.6×10^{-3}

D. 6.67×10^{-4}

Answer: C

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19. The rate constant for an isomerisation reaction is $2.079 \times 10^{-5} \sec^{-1}$ .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. $2.079 \times 10^{-5} M / \sec$

C. $10^5 M / \sec$

D. $0.693 \times 10^{-5} M / \sec$

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, tolal pressure is 200 mm of Hg, 325 mm of Hg and 450 mm of Hg?

A. 0.693min^(-1)`

B. 6.93 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 :

A(g) $\rightarrow$ B(g) + C(g)+ D(g)

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 :

$H_2O_2(aq) \rightarrow H_2O(l) + \frac{1}{2}O_2(g).$

the half life of reaction is 30 min. If the volume of $O_{\circ}(g)$ 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 :

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

The reaction is performed at constant volume and temperature, starting with only pure A(g). If P_T and P_{∞} 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 :

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

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

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

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

Answer: C

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26. A substance 'A' decomposes in solution following the first order kinetics. Flask I constains 1 L of 1 M solution of A and flask II constains 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 :

A(g) +B(g) $\rightarrow$ 2C(g) + D(g),

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 = 1.386×10^{-1} min^{-1}

A. 5 min

B. 10 sec

C. 600 sec

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

Answer: C

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28. Consdier a first order gas phase reaction,

A(g) $\rightarrow$ 2B(g) + C(g)

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

$2A(g) \rightarrow 2B(g) + C(g)$

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, $\left[Co\left(NH_3\right)_5Br\right]^{2+} + H_2O \rightarrow \left[Co\left(NH_3\right)_5\left(H_2O\right)\right]^{3+} + Br^-$ is folllowed 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. 3.51×10^{-2} min^{-1}

C. 6.93×10^{-2} min^{-1}

D. 3.51×10^{-3} 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 $N_2O_\$(g)$ 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 $t = 10$ 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 $0.00854s^{-1}$. Calculate the concentation 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 concentation of 1.22 M, how long does it take for its concentration to fall to 0.150 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 $CH_3NC \rightarrow CH_3CN$ 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 form 0.1 M to 0.025 M is :

A. $\frac{\text{lm } 2}{1200}$

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	∞
Optical Rotation	82°	22°	2°

If some impurity, find optical rotation after 2 hours :

A. 7°

B. 12°

C. 22°

D. 42°

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 mim. 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 :

$[A]_T = \left[10 = 0.2T^2\right]M$

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 :

$$C_4H_8 \xrightarrow{\Delta} 2C_2H_4$$

The rate constant is $2.48 \times 10^{-4} \sec^{-1}$. 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 :

A(g) → B(g) + C(g)

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 mole $L^{-1}\sec^{-1}$

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 $\mathrm{E} = 1.9 \times 10^{4} KJ$

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

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

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

Answer: A

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

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

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 $25^{\circ}C$ than at $0^{\circ}C$ if the activation energy is 65 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 $25^{\circ}C$ are $3.0 \times 10^{-4}s^{-1}, 104.4\text{KJ mol}^{-1}$ and

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

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

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

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

C. infinite

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

Answer: B

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8. For a given reaction, energy of activation for forward reaction $\left(E_{af}\right.$ is 80 kJ mol^{-1}. $\Delta H = -40\text{kJ mol}^{-1}$ for the reaction. A catalyst lowers E_{af} to 20 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 physicall 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 → B (uncatalysed reaction)

$A \xrightarrow{\text{catalyst}} B$ (catalyst reaction)

The activation energy is lowered by 8.314KJ 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 $A \to B$ it is observed that % of activated molecules at a temperature of 400 K is equal % $\frac{100}{e^{10}}$ % . Activation energy of the reaction is given by :

A. 33.256 k J

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 $27^{\circ}C$ is e^2 times the rate of uncatalysed reaction at $727^{\circ}C$. 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, $A = 1.25 \times 10^8 s^{-1}$, 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}sec^{-1}.

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

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

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

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

Answer: B

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

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

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 $\text{reaction}_1 > \text{reaction}_2$

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 ? [ln2 =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 $\sec^{-1}$ and $0.3\sec^{-1}$ respectively (for R-I) and $0.2\sec^{-1}$ and $0.8\sec^{-1}$ (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[Reactant] where $K = a.\,e^{-E_{\alpha}/RT}$. 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 raectant, low temperature and low activation energy.

C. Low cocentration 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 revers reaction for $A_2 + B_2 \rightarrow 2AB$ are 180 kJ mol^{-1} and 200 kJ mol^{-1} respectively. The pressure of a catalyst lowers the activation energy of both (forwar and reverse) reactions by $100kJmol^{-1}$. The magnitude of enthalpy change of the reaction $\left(A_2 + B_2 \rightarrow 2AB\right)$ in the presence of catalyst will be (in 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 scal and k is in terms of $\sec^{-1}$

Identify the incorrect options.

A. There is no finite temperature at which rate constant can be $4 \times 10^6 \sec^{-1}$

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 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 forllow sthe equations ln $k = 30 - \frac{40}{T} + 20T^2 - 30\ln T$ based on the this information, indetify 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 becomes negative

D. Rate constant will follows Arrhenius equations.

Answer: A

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28. For a certain gaseous reactions 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. $\dfrac{10}{2.303R \times 298 \times 308}$

B. $\dfrac{2.303 \times 10}{298 \times 308R}$

C. $\dfrac{0.693 \times 10}{290 \times 308}$

D. $\dfrac{0.693R \times 298 \times 308}{10}$

Answer: D

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29. Following are the values of E_a and ΔH for three reactions carried out at the same temperature :

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

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

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

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

A. $\begin{matrix} \text{Fastest} & \text{Slowest} \\ I & II \end{matrix}$

B. $\begin{array}{ll} \text{Fastest} & \text{Slowest} \\ II & III \end{array}$

C. $\begin{array}{ll} \text{Fastest} & \text{Slowest} \\ I & III \end{array}$

D. can't be predicted

Answer: B

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

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

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

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

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 differe 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 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 eendothermic 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 $27^{\circ} C$. 87.5% of the same reaction occurs in 30min at $57^{\circ} C$. The activation energy of reaction is:

[In 2=0.7, In 3=1.1]

A. $2.64 kJ/mol$

B. 2.64 Kcal/mol

C. 10.97 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 $(3100R \times In2)$ and pre-exponential factor $A = 4096hr^{-1}$. How long will it take the concentration of the drug In the blood to fall to half of its intial value at 310K?

(Given: In $2 = 0.7$)

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 $17kJ$ per mole of A. The heat of the reaction is $40kJ$. Calculate the activation energy for the reverse reaction $B \rightarrow A$.

A. 75 KJ/mole

B. 67 KJ/mole

C. 57 KJ/mole

D. 17 KJ/mole

Answer: C

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39. For a gas reaction $A \rightarrow P$ at T (K) the rate is given by :

Rate $= k' p_A^2$ 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 threshould 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 $4 \times 10^{-2} M^{-1} \sec^{-1}$, when concentration of reaction is 2 moles per litre.

A. $1.28 M \sec^{-1}$

B. $5.12 M \sec^{-1}$

C. $2.56 M \sec^{-1}$

D. $8 \times 10^{-2} M \sec^{-1}$

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 chemial reaction can be determined by â€¦â€¦.. .

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. $\left(A \to B, k_A = 10^{15} e^{-2000/T}, \right), \left(C \to D, k_C = 10^{14} e^{-1000/T}\right)$

Temperature T K at which $\left(k_A = k_C\right)$ 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 zereo order reaction.

B. The rate of reaction remains same throughout the reaction in a first order reaction 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 atomoshphere H_2O and O react bimolecularly to form two OH radicals . ΔH 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.

$k = Ae^{-\frac{Ea}{RT}}$

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 rasises 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 ΔH

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 ofr 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 occure 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° 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° C.

Answer: D

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58. $2NO(g) + Cl_2(g) \rightarrow 2NOCl, \Delta H = -38KJ$

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 chorine 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 temperture 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 reacation 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° C is four times the rate at 50° C . What is its activation energy?

A. 1152 KJ. mol^{-1}

B. 80.1 KJ. mol^{-1}

C. 54.0 KJ. mol^{-1}

D. 27.8 KJ. mol^{-1}

Answer: D

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67. A reaction is endothermic with $\Delta H = 100$ KJ/mol. If the activation enthalpy of the forward reaction is 140. 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,

$2NO(g) + Cl_2 \rightarrow 2NOCl.$

Which of the following is/are required for a successful reaction between NO and Cl_2 molecules?

(P) Proper orientation

(Q) NO/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 Rate =k$\left[C_{12}H_{22}O_{11}\right]$. 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 $k = 8.54 \times 10^{-4} Ms^{-1}$ at 45° C and an activation energy, $E_a = 90.8 KJ$. What is the value of K at 25° C?

A. $4.46 \times 10^{-5} M^{-1} s^{-1}$

B. $8.54 \times 10^{-5} M^{-1} s^{-1}$

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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73. $C(a) + CO_2(g) \rightarrow 2CO(g) \quad \Delta H = 172 KJ \text{mol}^{-1}$

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 eh 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 temperate increases?

(P) Collision are more frequent between molecules at higher temperatures.

(Q) A greater fraction of collison have sufficient energy ot 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 rated increase by the sme 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 $\left(k_{\text{eq}}\right)$ and on the forward rate constant $\left(k_f\right)$?

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 $N_2 + 3H_2 \Leftrightarrow 2NH_3$, If rate of formation of NH_3 is 0.001 $Kghr^{-1}$, then rate of consumption of H_2 is 0.0015 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:

(P) $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$,

Activation energy E_a

(Q) $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$,

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,

$A(g) \rightarrow B(g), \Delta H$ is -40 KJ/mol.

If the ratio of the activation energies of the forward $\left(E_f\right)$ and reverse $\left(E_b\right)$ reactions is $\frac{2}{3}$ then:

A. E_f =60 KJ/mol, E_b=100 KJ/mol

B. E_f =30 KJ/mol, E_b=70 KJ/mol

C. E_f =80 KJ/mol, E_b=120 KJ/mol

D. E_f =70 KJ/mol, E_b=30 KJ/mol

Answer: C

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81. A reacation takes place in three steps with actiation energy E_{a_1}=180 KJ/mol , E_{a_2} =80 KJ/mol , E_{a_3}=50 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 $k_1, k_2 a$ 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 form $100 KJmol^{-1}$ to $80 KJmol^{-1}$ At what temperature the rate of reaction in the absence of catalyst at $500K$ 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 $\lim_{T \to \infty} \log_{10}$ K equals to:

A. In 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 s 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 $MnO_2(s)$.

$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

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 $75\,^\circ$ C is 30.0 times that at $25\,^\circ$ C . What is its activation energy?

A. 58.6 KJ $.mol^{-1}$

B. 25.5KJ $.mol^{-1}$

C. 7.05 KJ $.mol^{-1}$

D. 1.51 KJ $.\text{mol}^{-1}$

Answer: A

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87. The reaction $A + B \rightarrow AB$ has an enthalpy of reaction of -85.0 KJ-mol^{-1}. If the activation ehthalpy for the forward reaction is 120.0 KJ mol^{-1}, What is the activation energy for the reverse reaction $AB \rightarrow A + B$?

A. 35.0 KJ $.\text{mol}^{-1}$

B. 85.0 KJ $.\text{mol}^{-1}$

C. 12.0 KJ $.\text{mol}^{-1}$

D. 205.0 KJ $.\text{mol}^{-1}$

Answer: D

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88. Which equation indicates the presence of a catalyst in the reaction?

A. $A + B \rightarrow D + B$

B. $A + B \rightarrow C + D$

C. $A + A \rightarrow D$

D. $A \rightarrow B + C$

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 KJ mol^{-1}

B. 23.3 KJ mol^{-1}

C. 53.58 KJ mol^{-1}

D. 178 KJ mol^{-1}

Answer: C

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90. A particular reaction rate increases by a a factor of five when the temperature is increased from 5° to 27° C. What is the activation energy of the reaction?

A. 6.10 KJ $.\text{mol}^{-1}$

B. 18.9 KJ $.\text{mol}^{-1}$

C. 50.7 KJ $.\text{mol}^{-1}$

D. 157 KJ $.\text{mol}^{-1}$

Answer: C

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91. Rate of disappearance of the reactant A at two different temperature is given by $A \rightarrow B$

$\frac{-d[A]}{dt} = 2 \times 10^{-2}\sec^{-1}[A] - 4 \times 10^{-3}\sec^{-1}[B] at 300K$

$\frac{-d[A]}{dt} = 4 \times 10^{-2}\sec^{-1}[A] - 16 \times 10^{-4}\sec^{-1}[B] at 400K$ 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 $CaCo_3$, 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 $CaCO_3$

C. Adding 100 mL of 1.0 M HCl to 2.0 g of powdered $CaCO_3$

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 $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$ the experimental data suggestion that $r = k[H_2][Br_2]^{1/2}$. 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:

$H_2(g) + 2ICl(g) + I_2(g)$ This reaction is first-order in $H_2(g)$ and also first-order is $ICl(g)$. Which of these proposed mechansim can be cnsistent with the given information about this reaction?

Mechanism I:

$$H_2(g) + 2ICl(g) \rightarrow 2HCl(g) + I_2(g)$$

Mechanism II:

$$H_2(g) + 2ICl(g) \xrightarrow{\text{slow}} HCl(g) + HI(g)$$

$$HI(g) + ICl(g) \xrightarrow{\text{first}} HCl(g) + I_2(g)$$

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) $X + Y \Leftrightarrow M$ (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 heat the apparent rate constant for such a reaction is $k_{app} = \frac{k_1 C}{1 + \alpha C}$ where C is the concentration of the reactant k_1 and α are constants. Calculate the value of C for which k_{app} has 90° 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. 5×10^{-5} mole/litre

Answer: C

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6. Trimolecular reactions are uncommon because

A. the probabilty fo 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 propsoed for the reaction of NO with Br_2 to form NOBr.

$NO(g) + Br_2(g) \Leftrightarrow NOBr_2(g)$,

$NOBr_2(g) + NO(g) \rightarrow 2NOBr(g)$ (slow step)

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 f $NO_2(g)$ and $O_3(g)$ is first-order in NO_2 and $O_3(g)$

$2NO_2(g) + O_3(g) \rightarrow N_2O_5(g) + O_2(g)$

The reaction can take place by mechansim:

(P) $NO_2 + O_3 \xrightarrow{\text{slow}} NO_3 + O_2$

$NO_3 + NO_2 \xrightarrow{\text{fast}} N_2O_5$

$(Q) O_3 \overset{k_a \text{fast}}{\Leftrightarrow} k_b O_2 + [O]$

$NO_2 + O \xrightarrow{\text{slow}} NO_3$

$NO_3 + NO_2 \xrightarrow{\text{fast}} N_2O_5$

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.

Step (i) : $O_3 \overset{K_1}{\Leftrightarrow} K_2 O_2(g) + O(g)$ [Fast]

Step (ii): $O_3(g) + O(g) \overset{K_3}{\rightarrow} 2O_2(g)$ [Slow]

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 $300\,^{\circ}$ C or $200\,^{\circ}$ C. Which of the following mechanism will become improbable?

A. $A + B \Leftrightarrow D$ (fast)

$D \rightarrow C$ (slow)

B. $A + B \Leftrightarrow D$ (slow)

$D \rightarrow C$ (fast)

C. $A + B \Leftrightarrow D$ (fast)

$D \Leftrightarrow E$ (fast)

$E \rightarrow C$ (slow)

D. $A \overset{hv}{\Leftrightarrow} A$ (fast)

$A + B \rightarrow C$ (slow)

Answer: B

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11. For a photochemical dimerisation of a substance a, the following rate law is obtained.

$$\frac{d\left[A_2\right]}{dt} = \frac{k_1k_3I[A]}{k_2 + k_4[A]}$$

If it is known us obeying zero order kinetics then what will be the value of rate of appearance of the dimer?

A. I

B. k_1k_3I

C. $\frac{k_1k_3I}{k_4}$

D. $\frac{k_1k_3}{k_4}$

Answer: C

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12. For a two step reaction,

$A \Leftrightarrow R + B \quad R + C \xrightarrow{k_2} P$

(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 preparartion 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 stoicchiometric reactions:

Proposal A:

$H_2O(g) + SO_3(g) \rightarrow H_2SO_4(g)$

Proposal B:

$2H_2O(g) + SO_3(g) \rightarrow H_2SO_4(g) + H_2O(g)$

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:

$$SO_3 + 2H_2O \overset{k_1}{\Leftrightarrow} k_{-1} SO_3.2H_2O \quad \text{(Fast)}$$

$$SO_3.2H_2O \overset{k_2}{\rightarrow} H_2SO_4 + H_2O \quad \text{(slow)}$$

($SO_3.2H_2O$ is a complex which is stabilized by hydrogen bonds and $k_2 < < k_1$ 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:

Step I: $A + B \underset{k_2}{\overset{k_1}{\Leftrightarrow}} I$

Step II: $B + I \xrightarrow{k_3} C + D$

In the first step is a fast equilibruim , then the incorrect statement is :

A. Order of reacton with respect to A is 1.

B. Order of reacton with respect to B is 2.

C. Overall rate of reaction is ,$r = K_3 . [A][B]^2$

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 mechansim as shown.

From the mechanism identify the option which is incorrect.

$A \rightarrow 1.5B$ (overall reaction)

Steps-1: $A \underset{k_2}{\overset{k_1}{\Leftrightarrow}} B + C$ (fast)

Step-2: $A + C \xrightarrow{k_3} 2B$ (slow)

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 ad backward reaction of first and that of second step.

Answer: A

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16. For the following reaction:

$$\left(CH_3\right)_3CCl + H_2O \to \left(CH_3\right)_3COH + HCl, \left(\frac{dx}{dt}\right) = k$$

$\left[\left(CH_3\right)_3CCl\right]$ hence , rate determining step can be:

A. $\left(CH_3\right)_3CCl \to \left(CH_3\right)_3C^+ + Cl^-$

B. $\left(CH_3\right)_3CCl + H_2O \to \left(CH_3\right)_3COH + HCl$

C. $\left(CH_3\right)_3C^+ + H_2O \to \left(CH_3\right)_3COH + H^+$

D. $H^+ + Cl^- \to HCl$

Answer: A

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17. The mechanism of reaction :$A(g) \xrightarrow{pt(s)} B(g)$ is :

Step-I: A(g) + Surface sites $\overset{k_1}{\Leftrightarrow} k_2A$ (absorbed)

Step-II: A (absorbed) $\xrightarrow{k_3} B(g) +$ Surface sites

The rate law of this reaction s $r = \dfrac{k_1 k_3 [A]}{k_2 + k_1 [A]}$ (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 suface 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 :

$$\text{I. } NO + NO \Leftrightarrow N_2O_2 \quad \text{(fast)}$$
$$\text{II. } N_2O_2 + H_2 \rightarrow N_2O + H_2O \quad \text{(slow)}$$
$$\text{III. } N_2O + H_2 \rightarrow N_2 + H_2O \quad \text{(fast)}$$

The rate constant of step II is $1.2 \times 10^{-4}\text{mole}^{-1}L\text{min}^{-1}$ while equilibrium constant of step I is 1.4×10^{-2}. What is the rate of reaction when concentration of NO and H_2 each is 0.5 mole L^{-1} ?

A. 2.1×10^{-7} mol$L^{-1}\text{min}^{-1}$

B. 3.2×10^{-6} mol$L^{-1}\text{min}^{-1}$

C. 3.5×10^{-4} mol$L^{-1}\text{min}^{-1}$

D. None of above

Answer: A

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20. For the reaction $2A_3 \Leftrightarrow 3B_2$

Mechanism

$A_3 \Leftrightarrow B_2 + I^*, \quad k_c$ (fast)

$A_3 + I^* \rightarrow 2B_2, \quad k$ (slow)

For the net reaction, correct statement is :

A. order is one but molcularity 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?

$2A \Leftrightarrow$ intermediate 1 (fast equilibrium)

intermediate $1 + B \rightarrow$ intermediate 2 (slow)

intermediate$2 + B \rightarrow A_2B_2$ (fast)

A. Rate=$k[A]^2$

B. Rate $= [B]^2$

C. Rate=$k[A][B]$

D. Rate =$k[A]^2[B]$

Answer: D

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22. For the reaction,

$2H_2(g) + 2NO(g) \rightarrow N_{20(g)+2H_2O(g)}$

Rate $= k\left[H_2\right][NO]^2$.

This mechanism has been proposed:

Step 1: $H_2 + NO \rightarrow H_2O + N$

Step2 : $N = NO \rightarrow N_2 + O$

Step 3 : $O + H_2 \rightarrow H_2O$

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 determineing step.

B. This mechanism is consistent with the rate law if step 2 is the rate detemining 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

$O_3(g) \Leftrightarrow O_2(g) + O(g)$ (fast equilibrium)

$O(g) + O_3(g) \rightarrow 2O_2(g)$ (slow)

Which rate law is consistent with this mechanism?

A. Rate $= k\left[O_3\right]$

B. Rate $= k\left[O_3\right]^2$

C. Rate$=k\left[O_3\right][O]$

D. Rate $= k\left[O_3\right]^2\left[O_2\right]^{-1}$

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.

$SO_2(aq) + 2H_2O(l) \rightarrow HSO_3^-(aq) + H_3^+(aq)$

$2HSO_3^-(aq) + O_2(aq) \rightarrow S_2O_7^{2-}(aq) + H_2O(l)$

$S_2O_7^{2-}(aq) + 3H_2O(l) \rightarrow 2SO_4^{2-}(aq) + 2H_3O^+(aq)$

Which species in this mechanism can be given the following designation?

A. $\begin{array}{lll} \text{Reactant} & \text{catayst} & \text{Intermediate} \\ SO_2(aq) & H_2O(l) & HSO_3^-(aq) H_3O^+(aq) \end{array}$

B. $\begin{array}{lll} \text{Reactant} & \text{catayst} & \text{Intermediate} \\ SO_2(aq) & HSO_3^-(aq) & S_2O_7^{2-}(aq) \end{array}$

C. $\begin{array}{lll} \text{Reactant} & \text{catayst} & \text{Intermediate} \\ SO_2(aq) H_2O(l) & S_2O_7^{2-}(aq) & HSO_3^{-1}(aq) \end{array}$

D. $\begin{array}{lll} \text{Reactant} & \text{catayst} & \text{Intermediate} \\ SO_2(aq) H_2O(l) & \text{none} & HSO_3^-(aq) S_2O_7^{2-}(aq) \end{array}$

Answer: D

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25. Ozone in the earth's atmosphere decomposes according to the equation: $2O_3(g) \rightarrow 3O_2(g)$ This reaction is thought to occur via the two-step mechanism:

Step 1:$O_3(g) \Leftrightarrow O_2(g) + O(g)$ 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)

Step 2 : $C_3H_7^+ + Cl^- \rightarrow C_3H_7Cl$ (fast)

Which species is an intermediate in this reaction?

A. CH_3OH

B. $C_3H_7^+$

C. I^-

D. Cl^-

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 law 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. ltbr. Step 1: $A + E \Leftrightarrow AE$ (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.

$H_2(g) + 2ICI(g) \rightarrow 2HCl(g) + I_2(g)$

one proposed mechanism is

$H_2(g) + ICI(g) \rightarrow HICI(g) + H(g)$ (fast)

$H(g) + ICl(g) \rightarrow HCl(g) + I(g)$ (fast)

$HICl(g) \rightarrow HCl(g) + I(g)$ (fast)

$I(g) + I(g) \rightarrow I_2(g)$ (fast)

Intermediates in this reaction include which of the following?

A. HICl only

B. I only

C. HICl and H only

D. HICl, H and I

Answer: D

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30. Which elementary reaction characteristic(s) change(s) signigicantly for a 10° 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.

$RCOOR' + H_3O^+ \rightarrow RCOHOR'^+ + H_2O$

$RCOHOR'^+ + H_2O \rightarrow RC(OH)OR'(OH_2) + RC(OH)OR'(OH_2)^+ + H_2O \rightarrow R$

Which species is considered an intermediate?

A. $RCOHOR'^+$

B. H_3O^+

C. $RCOOR'$

D. R'OH

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

$NO_2(g) + CO(g) \rightarrow CO_2(g) + NO(g)$

has been studied and the following mechanism mechanism has been proposed:

$NO_2(g) + NO_2(g) \rightarrow NO_3(g) + NO(g)$ (slow)

$NO_3(g) + CO(g) \rightarrow NO_2(g) + CO_2(g)$ (fast)

What rate law corresponding to this mechanism?

A. Rate $= k[NO_2]$

B. Rate $=k[NO_2][CO]$

C. Rate $=k[NO_2]^2$

D. Rate $=k\left[NO_2\right]^2[CO]$

Answer: C

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34. For the reaction , $2A + B \rightarrow C + D$, the rate law is rate =k[B].

Which of the following mechanism would be consistent with this information?

A. $A + B \rightarrow M$ (slow)

$A = M \rightarrow C + D$ (fast)

B. $A + A \rightarrow M$ (fast)

$B + M \rightarrow C + D$ (slow)

C. $B \rightarrow M$ (slow)

$M + A \rightarrow N$ (slow)

$N + A \rightarrow C + D$ (fast)

D. $B \rightarrow M$ (fast)

$M + A \rightarrow N$ (slow)

$N + A \rightarrow C + D$(fast)

Answer: C

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35. Consider the proposed mechanism for the destruction of ozone in the stratosphere:

$O_3 + Cl \rightarrow ClO. + O_2$

$ClO + O_3 \rightarrow Cl. + 2O_2$

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 fo 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 definte value

B. Rate constant for every reaction can be defined and have fixed definite vale

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 .

$2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O(g)$

The rate low of this reaction will be ,if mechanism of reaction is

Step1:$2NO \Leftrightarrow N_2O_2$[fast equilibrium]

Step2: $N_2O_2 + H_2 \rightarrow N_2O + H_2O$[slow]

Step3:$N_2O + H_2 \rightarrow N_2 + H_2O$[fast]

A. $r = k\left[H_2\right][NO]$

B. $r = k\left[H_2\right]^2[NO]^2$

C. $r = k\left[H_2\right][NO]^2$

D. $r = k\left[H_2\right]^2[NO]$

Answer: C

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38. Select the correct Statement .

A. On addition of reactant at equilibrium, equlibrium of atomisation will always be negative.

B. Enthalpy of atommisation will always be negative.

C. moecularity of indiviualstep in a complex reaction mechaniem 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,

$2A + 2B \rightarrow \text{Product}$

the rate law is Rate = $k[A][B]^2$ .which mechanism is constant with this information ?

A. $B + B \Leftrightarrow C$

$C + A \rightarrow \text{Product(slow)}$

B. $A + B \rightarrow C\text{(slow)}$

$C + D \rightarrow \text{poduct}$

C. $A + A \rightarrow C$

$B + B \rightarrow C$

$C + B \rightarrow \text{Product}$

D. $A + B \Leftrightarrow C$

$B + C \rightarrow D$("slow")D+Ato"Product"`

Answer: D

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40. Consider this gas phase reaction ,

$Cl_2(g) + CHCl_3(g) \rightarrow HCl(g) + CCl_4(g)$

The reaction is found experimentally to follow this rate law.

Rate $= k\left[CHCl_3\right]\left[Cl_2\right]^{1/2}$

Based on this information , what conclusions can be drawn about this proposed mechanism?

step1:$Cl_2(g) \rightarrow 2Cl(g)$

Step2:$Cl_2(g) + CHCl_3(g) \rightarrow HCL(g) + CCl_3(g)$

Step3:$Cl(g) + \mathrm{CCl}_3(g) \rightarrow \mathrm{CCl}(g)$

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 ,

$NO_2(g) + CO(g) \rightarrow NO(g) + CO_2(g)$

At temperatures below 500K , the rate law is rate $= k\left[NO_2\right]^2$ which mechanism is consistent with this information?

Mechanism1:

$NO_2 + NO_2 \rightarrow NO_3 + NO(\text{slow})$

$CO + NO_3 \rightarrow CO_2 + NO_2(\text{fast})$

Mchanism2:

$NO_2 + NO_2 \rightarrow NO_3 + NO(\text{fast})$

$CO + NO_3 \rightarrow CO_2 + NO_2(\text{slow})$

A. 1only

B. 2 only

C. Either1or2

D. Neither1 nor2

Answer: A

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42. Consider this reaction,

$2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O(g)$

The rate law for this for reaction is rate $= k\left[H_2\right][NO]^2$.

Under what conditions could these Steps represent the mechanism?

Step1: $2NO \rightarrow N_2O_2$

Step2: $N_2O_2 + H_2 \rightarrow N_2O + H_2O$

Step3:$N_2O + H_2 \rightarrow N_2 + H_2O$

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

$$Step1: A + B \overset{E_{a-1}}{\Leftrightarrow} {}_{E_{a-1}}C + D$$

$$Step2: 2C \overset{E_{a,2}}{\rightarrow} G + H$$

Step 2 is rate -determining Given the activation energies $E_{a.1} = 120KJ/mol, E_{a, -1} = 96KJ/mol$ and$E_{a, 2 = 196KJ/mol}$ Find E_a for the overall reaction.

$[2A + 2B \rightarrow 2D + G + H]$

A. 154

B. 244

C. 354

D. none of these

Answer: B

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44. For any reaction ,

$A + B \rightarrow C + D$

Rate law obtained is Rate=k[A][B]

Select the correct option(s).

A. Raction must be elemenary

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:

$P \overset{k_1}{\Leftrightarrow} k_2 2Q(\text{fast}), 2Q + p \overset{k_3}{\rightarrow} R(\text{slow})$ the rate law for the net reaction $(p \rightarrow R)$is:

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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compllcatio 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. $-\frac{d[A]^2}{dt} = \frac{d[b]^2}{dt} = \frac{d[C]}{dt}$ is the relation among

B. $2A \Leftrightarrow 2B + C$ 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 reactionis:

A. $2A + \frac{1}{B} \Leftrightarrow C$

B. $2A + B \Leftrightarrow C$

C. $2A \Leftrightarrow C + B^{-1}$

D. none of these

Answer: B

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3. At a given temperature ,$k_1 = k_2$ for the reaction,

$A + B \Leftrightarrow C + D$

$If\left[\frac{dx}{dt}\right] = k_1[A][B] - k_2[C][D]$ in which set o fthe concentration , the reaction ceases?

A. $\begin{matrix} ([\mathrm{A}]) & ([B]) & ([C]) & ([D]) \\ (0.1\mathrm{M}) & (0.2M) & (0.3M) & (0.4M) \end{matrix}$

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 $1.0 \times 10^{-2} dm^3 mol^{-1}$ and $3.0 \times 10^{-2} dm^3 mol^{-1} s^{-1}$. If the corresponding energies of activation of the correspoing energies of activation of the parallel reaction are 60.0 Kj mol^{-1} and 70.0 KJ mol^{-1} respectively ,what is the apparent overall energy of activation ?

A. $130.0 KJmol^{-1}$

B. $67.5 KJmol^{-1}$

C. $100.0 KJmol^{-1}$

D. $65.0 KJmol^{-1}$

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, Cand D as shown:

$$A \xrightarrow{10^{-3}\text{sec}^{-1}} B \xrightarrow{10^{6}\text{sec}^{-1}} C \xrightarrow{10^{12}\text{sec}^{-1}} D$$

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:

$A \xrightarrow{k_1} 2B$

$2A \xrightarrow{k_2} 3C$

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 min^{-1} ,then value of K_1 is :

A. 0.036 min^{-1}

B. 0.03 min^{-1}

C. 0.054 min^{-1}

D. 0.06 min^{-1}

Answer: B

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8. For the sequential first order reactions:

$$\left(, A \xrightarrow{k_1 = 2\times 10^{-4} s^{-1}}, B \xrightarrow{k_2 = 10 s^{-1}}, C),(t=0,0.4M ,0,0):\}`$$

the time after which the concentration of C cecomes 0.3 M is:

A. $\frac{In2}{k_1}$

B. $\frac{In4}{k_1}$

C. $\frac{In2}{k_2}$

D. $\frac{In4}{k_2}$

Answer: B

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9. A substance undergoes a series of chemical reaction as shown

$A \xrightarrow{k_1} B \xrightarrow{k_2} C \xrightarrow{k_3} D$ with rate constant

$k_1 = \frac{In2}{2000}\sec^{-1}, k_2 = \frac{In2}{10}\sec^{-1}, k_3 = 20In2\sec^{-1}$ What will be the value of $\frac{[A]}{[C]}$ once steady stateis obtained?

{[ ] represents concentration}

A. 40000

B. 20000

C. 200

D. 400

Answer: A

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10. The reaction $Cis - X \Leftrightarrow$ trans -X 1st order in both directions .At $25^{\circ}C$, the equlibrium constant is 0.10and the constant $k_f = 3 \times 10^{-4}\sec^{-1}$ 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 calcualate ratio of number of atoms of B to C when steady state is obtained.

$$A \xrightarrow{K_1} B \xrightarrow{K_2} C \xrightarrow{K_3} D$$

where $K_1 = \frac{In2}{10}, K_2 = 10In2, K_3 = 10^4 In2$

A. 10

B. 10^3

C. 10^{-3}

D. 10^4

Answer: B

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12. For the reversible reaction : $Ao \overset{K_1}{\Leftrightarrow} K_2B, k_1 = 0.02$min"^(-1) and $k_2 = 0.03 \text{ min}^{-1}$. The reaction is stated 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 ,

$A \Leftrightarrow B, \dfrac{d[A]}{dt} = 5 \times 10^{-4}[B] - 4 \times 10^{-3}[A]M\text{min}^{-1}$ Starting with only A at 0.1 M concentration calculate concentration of B after time t=9200sec.

[Given:In 2=0.69]

A. $\dfrac{0.8}{9}M$

B. $\dfrac{0.4}{9}M$

C. $\dfrac{0.1}{9}M$

D. $\dfrac{0.2}{9}M$

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 is0.063 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,

$$A \xrightarrow{k_1} B \xrightarrow{k_2} \xrightarrow{k_3} D$$

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

$k_1 = \dfrac{In2}{20 \times 60}, k_2 = \dfrac{In2}{30}?$

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

B. 10

C. 20

D. 40

Answer: D

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17. For the reversible reaction

the initial concentrations of A and B are Am and bm,and the equillibrium

concentrations are $(a - x)M$ and $(b + x)$ respectively. The value of x is:

A. $\dfrac{K_1a + K_2b}{K_1 + K_2}$

B. $\dfrac{K_1a - K_2b}{K_1 + K_2}$

C. $\dfrac{K_1 + K_2}{K_1a + K_2b}$

D. $\dfrac{K_1 + K_2}{K_1a - K_2b}$

Answer: B

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1. Which of the following isotopes will shows radioactive disintegration?

A. $._{83}Bi^{209}$

B. $._{82}Bi^{210}$

C. $._{6}C^{12}$

D. $._{82}Pb^{206}$

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. β - 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 particuular instant aand 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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6. $._{z}^{M}A(g) \rightarrow ._{z-4}^{M-8}B(g) + (\alpha\text{ - particles})$

(α - participles are helium nuclei, so will form helium gas by trapping electrons)

The radioactive disintegration follows first-rder kinetics. Starting with 1 mol of A in a 11-litre closed flask at $27^{\circ}C$ 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. conter, 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,

$X^{40} + \cdot_0 n^1 \rightarrow Y^{30} + Z^{11}$

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 mumber 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 $._{63}Eu^{150}$ shows sequential decay emitting 1α and 1β particles.

A. 3

B. 2

C. 4

D. 5

Answer: A

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11. A samp,le of a radioactive elements that contains 1.0×10^3 nuclei decays to 6.2×10^1 nuclei in 10minutes. What is its specific day constant?

A. 6.2 min^{-1}

B. 1.2 min^{-1}

C. 0.28 min^{-1}

D. 0.062 min^{-1}

Answer: C

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12. Two radioactive material A and B have disintegration constants 10λ and 2λ respectively. If initially they have same number of nuclei, then the ration of 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 $\left(\beta^{+}\right)$?

A. $._{7}^{12}N$

B. $._{8}^{18}O$

C. $._{9}^{20}F$

D. $._{10}^{20}Ne$

Answer: A

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14. Which type of radioactive decay produces a daughter nucleus with a higher atomic number?

A. α

B. β^{-}

C. γ

D. β^{+}

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 $._{11}^{20}Na$?

A. Alpha

B. Beta

C. Gamma

D. Electron capture

Answer: D

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17. Which nucleous is not radioactive?

A. K-38

B. K-39

C. K-42

D. K-43

Answer: B

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18. The elements Lawrenciym was first synthesized by the reaction

$\cdot {}^{252}_{98}Cf + \cdot {}^{258}_{103}Lr + \_$

What products ar needed to balance this equation?

A. $\frac{4}{2}\alpha + \frac{1}{0}n$

B. 5°_{-1e}

C. 5°_{1e}

D. $5\,{}_{0}^{1}n$

Answer: D

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19. The isotope $.^{14}C$ undergoes radioactive decay slowly. Which mode of decay is most likey?

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 prduces 2000 counts per minutes in a Giege counter. Afte 120hours, 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. 2.6days

B. 12days

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 $\alpha \text{particles}$, 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 β - particles then A and B are isobars

D. If X is α - particle and Y is β - particle then A and B are isodiaphers

Answer: D

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23. During a deacay of 952gm $._{92}U^{238}\text{to}._{82}Pb^{206}$, total 18xx10^(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. $B_{\circ}C$ and AD

Answer: B

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25. A radioactive nuclide is produced at a constant rate α - per second/ It's decay constant is $\lambda \sec^{-1}$. If N_0 b 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 calcicum and can replace calcium in bones. The radiation from Sr^{90} can damage bone narrow 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 $\lambda \text{for} Sr^{90} = 0.23 yr^{-1}$:

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,

$\cdot_{Z}^{A}X \rightarrow \cdot_{Z-4}^{A-8}Y,$ " " $t_{1/2=1600yrs}$.

If initial activity was 10^7 dps, how many α - particles will be emitted per second after 4800yrs?

A. $1.25 \times 10^6 s^{-1}$

B. $2.5 \times 10^6 s^{-1}$

C. $1.25 \times 10^7 s^{-1}$

D. $5 \times 10^7 s^{-1}$

Answer: B

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29. Magnesium (Z=12) has isotopes that range form $Mg - 20, \text{to} Mg - 31, \text{Only} Mg - 24, Mg - 25,$ and $Mg - 26$ are not radioactive. What mode of radioactive deacy would convert. What mode of radioavtive deacy 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 emissin

D. Positron emission

Answer: D

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30. The radioisotpe, 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 min^{-1}

B. 0.0693 min^{-1}

C. 0.100 min^{1}

D. 6.93 min^{-1}

Answer: B

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31. Gadolinum-153, which is used to detch osteoprosis, half a half-life of 242days. Which value is closet to the percentage of the $Gd-153$ left in a patient's system after 2 years (730days)?

A. 0.33

B. 0.225

C. 0.125

D. 0.0625

Answer: C

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32. The radioisotpe, N-13,has a half-life of 10.0 minutes is used to image organs in the body. If an injected sample has an activity of 40 microcuries $(40, \mu Ci)$, what is its activity after 25 minutes in the body?

A. $0.75 \mu Ci$

B. $3.5 \mu Ci$

C. $7.1 \mu Ci$

D. $12 \mu Ci$

Answer: C

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33. A radioactive mixture contaning a short lived species A and short lived species B. both emitting α - particles at a given instant, emit at rate 10,000 α - participle per minute. 10minutes later, it emits at the rate of 7000 particles per minutes. It half lives of the species are 10minutes 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

$$ {}_{32}^{68}Ge + {}_{-1}^{0}e \xrightarrow{\text{electron capture}} {}_{Z}^{A}? + X\text{-}rays $$

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 ${}_{15}P^{32}$ 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 deteched $\left(t_{1/2} = 14.2 days\right)$?

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 form 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 α - decay and α - 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 $\left(t_{1/2}\text{for uranium} = 4 \times 10^{10} years\right)$:

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:

$._{82}Pb^{214} \xrightarrow{\beta\text{-}decay} A \xrightarrow{\alpha\text{-}decay} B \xrightarrow{\beta\text{-}decay} C$

A. $._{82}Pb^{210}$

B. $._{82}Pb^{212}$

C. $._{78}Pb^{210}$

D. $._{78}Pb^{210}$

Answer: A

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43. The activity of a radioactive sample initially is 3200 dps and after 8hours activity is 100 dps. What will be the activity after 4.8hr 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

$$\cdot_{92}Xe^{238} \xrightarrow{-\alpha} Y \xrightarrow{-\beta} Z \xrightarrow{-\beta} L \xrightarrow{-nx} \cdot_{84}M^{218}$$

the value of n will be

A. 5

B. 4

C. 3

D. 6

Answer: B

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45. $._{13}^{27}Al$ is a stble isotope. $._{13}^{29}Al$ is expected disintegrate by:

A. αemission

B. β "emission"

C. Positron emission

D. proton emission

Answer: B

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46. Loss of a β - 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 λ_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 :

$\cdot{}^{238}_{92}M \rightarrow {}^{X}_{Y}N + 2{}^{4}_{2}\text{He}\ ,{}^{X}_{Y}N \rightarrow {}^{A}_{B}L + 2\beta^{+}$

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 nucleaon of oxygen nucleus is [if $m_0 = 15.834a\mu \text{and} m_{He} = 4.0026a\mu$]:

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. Them Y will decay at a faster rate than X.

(ii) The electron emitted in beta radiation originates from decay of a neutron un a nucleus.

(iii) The half-life of^{215} At is 100 ms. The time taken for the radioacivity of a sample of^{215} At to decay to $1/16th$ 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 llives 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. $.^{A}X_{Z}+\gamma \rightarrow .^{A}X_{Z-1}+a+b$

B. $.^{A}X_{Z}+.^{1}n_{0} \rightarrow .^{A-3}X_{Z-2}+C$

C. $.^{A}X_{Z} \rightarrow .^{A}X_{Z}+f$

D. $.^{A}X_{Z}+e_{-1} \rightarrow .^{A}X_{Z-1}+g$

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. $F_{\mathrm{pp}}>F_{\mathrm{pn}}>F_{\mathrm{nn}}$

B. $F_{\mathrm{pp}}=F_{\mathrm{pn}}=F_{\mathrm{nn}}$

C. $F_{\mathrm{pp}}>F_{\mathrm{pn}}>F_{\mathrm{nn}}$

D. $F_{\mathrm{pp}}<F_{\mathrm{pn}}=F_{\mathrm{nn}}$

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 $._{Z}^{A}\left(t_{1/2}=5days\right)$ How many number of atoms will decay during eleventh day? [$N_A =$ Avogradro'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 :

$A \xrightarrow{\lambda_1} B, \lambda_1 = 1.8 \times 10^{-2} \sec^{-1}$

$2A \xrightarrow{\lambda_2} C, \lambda_2 = 10^{-3} \sec^{-1}$

A. 52.63 sec

B. 500 sec

C. 50 sec

D. none of these

Answer: c

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56. A sample of $.^{14}CO_2$ was to be mixed with ordinary CO_2 for a biological tracer experiment. In order that 10cm^3 of diluted gas should have 10^4 dis/min, what activity $(\text{in} \mu Ci)$ of radioactive carbon is needed to prepare 60L of diluted gas at 1 atm and 273 K?

$\left[1Ci = 3.7 \times 10^{10} \text{dps}\right]$

A. $270 \mu Ci$

B. $27\mu Ci$

C. $2.7\mu Ci$

D. $2700\mu Ci$

Answer: b

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57. Wooden article and freshly cut tree show activity 7.6 and 15.2 $\min^{-1} g^{-1}$ of carbon ($t_{1/2}$ = 5760year) respectively. The age of the article is a)5760 year b)$5760 \times \frac{15.2}{7.6} year$ c)$5760 \times \frac{7.6}{15.2} year$ d)$5760 \times 15.2 - 7.6 year$

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 activily 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 thespeciman is T, the number of atoms that have disintegrated in the time $\left(T_2 - T_1\right)$ is equal to :

A. $\left(R_1 T_1 - R_2 T_2\right)$

B. $\left(R_1 - R_2\right)$

C. $\left(R_1 - R_2\right)/T$

D. $\left(R_1 - R_2\right)T/0.693$

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 $N^{14}H_3 \text{and} H_2$

B. the formation of $B^{11}H_3 \text{and} H_2$

C. the formation of $C_2^{14}H_4 \text{and} H_2$

D. the formation of $C^{12}H_3, N^{14}H_2 \text{and} H_2$

Answer: a

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61. A radioactive isotope $.^{40}K$ with a half-life of 1.26×10^9 years, decay to $.^{40}Ar$. A sample of rock from the moon was found to contain both element K and Ar and they are in the rartio 1:7 .What is the age of the rock?(Neglect decay of $.^{40}K$ to $.^{40}Ca$)

A. 2.52×10^9 year

B. $\frac{1.26 \times 10^9}{\text{In}2} \times \text{In}\left(\frac{7}{8}\right)$ year

C. $\frac{1.26 \times 10^9}{\text{In}2} \times \text{In}(7)$ year

D. 3.78×10^9 year

Answer: d

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62. A positron is emitted from $._{11}Na^{23}$. 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 1.0×10^3 nuclie decays to 6.2×10^1 nuclei in 10minutes . What is its sepecific decay constant?

A. 62 min^{-1}

B. 1.2min^{-1}

C. 0.28min^{-1}

D. 0.062min^{-1}

Answer: c

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Reasoning Type

1. Statement-1 : Conservation of a γ 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 explantion 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 disapperance of I_2.

Statement-2: The rate of disappearance of I_2 is one half the rate of disapperance of $S_2O_3^{2-}$ ions.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explantion 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

$A + 2B \rightarrow C(\text{rate } = k[A]^1[B]^0)$

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 explantion 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 occuring on solid surface are zero order reactions

Statement-2: $N_2O(g) \xrightarrow{\text{Au}} N_2(g) + \frac{1}{2}O_2$, rate $= k\left[N_2O\right]^0 = k$=constant is a zero order reaction.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explantion 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.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explantion 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 explantion 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, temperture will have no effect on the rate constant.

Statement -2: Lower the acitvation energy faster is the reaction.

A. Statement-1 is True, statement-2 is True, Statement-2 is a correct explantion 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 $A(g) \rightarrow B(g)$

$-r_A = 2.5P_A \quad at400K$

$-r_A = 2.5P_A \quad at600K$

Activation energy is 4135 J//mol//k,

$(Take: R = 8.314 J/mol/k, \quad \log 2 = 0.3, \log 3 = 0.48)$

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 explantion 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 explantion 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 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 explantion 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: Th 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 $45\ ^{\circ} C$ 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 explantion 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 explantion 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 endothemic reactiuon, 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 explantion 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 catayst provides an alternative path to the reaction in which conversion of reactants into products take place quickly.

Statement-2: The catalyst forms an activated comlex 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 explantion 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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Multiple Objective type

1. A reaction : $2A(g) + 3B(g) \rightarrow C(g)$ obeys the following rate low, 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 vey large amount as compared to 'A' then half life of the reaction will be inversely depended 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,

$I : A \rightarrow B \quad \text{Rate constant} = k_1 \sec^{-1}$

$II : C \rightarrow D \quad \text{Rate constant} = k_2 M^{-1} \sec^{-1}$

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 initia 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 remian same throughtout 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 remian 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 cataylst 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 tha acitivation energy on collisions will always give product formation.

B. All the biolmolecular collisions between reactants may not results in product formation.

C. Reactnts 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:

$$2A \rightarrow B, \ -\frac{d[A]}{dt} = \left(0.04 \min^{-1}\right). [A]$$

$$3A \rightarrow 2C, \ -\frac{d[A]}{dt} = \left(0.03 \min^{-1}\right). [A]$$

Which of the following statement(s) is/are incorrect regarding the reactions?

A. The overall rate constant for the disappearance of 'A' is $0.17 \min^{-1}$.

B. The molar ration 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 form the start of reaction will be 50.

D. Half life for the disappearance of 'A' is 10min, if In 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

MethodI: $-\frac{1}{V}.\frac{dn_A}{dt}-k_1.C_a{}^n$

Method II: $-\frac{dp_A}{dt}=k_2.P_A{}^n$

Wehre $C_A=\frac{n_A}{V}=$ 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. $k_1 = k_2.(RT)$, when $n = 0$

D. $k_1 = k_2$.(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. $\frac{4}{2}$ He is formed due to emission of beta particle from tritium $\frac{3}{1}$ H.

C. When positron $\left(\begin{matrix}0\\+1e\end{matrix}\right)$ is emitted, $\frac{n}{P}$ ration increases.

D. None of above

Answer: A::C

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9. Select the correct statement (s).

A. The value of rate constatnt cannot exced the value of Arrhenius factor.

B. Molecularity of multiple step reaction can be obtained from mechanism.

C. Half lifeof a foruth order reaction is linearly dependent on intial concentration of reactant

D. reactions with order ≥ 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 reafion 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 halr-period ?

A. It is proportional to intial concentration for zeroth order

B. Average life $= 1.44 \times$ half-life for first order reaction.

C. Tiem of 75% comletion of reaction is thrice of halr-life (intial harl-life) period in second order reaction

D. 99.9% reaction takes place in 100 minutes for the case when reate constant is 0.693 min^{-1}

Answer: A::B::C::D

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12. $Zn + 2H^{+} \rightarrow Zn^{2+} + H_2$

Half-life period is independent of concentration of zinc at constant pH. For the constant concentraio 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 connentration of zinc is made fourn 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 $\left(\min +^{-1}\right) = 5 - \frac{2000}{T(K)}$ We can conclud:

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 temeprature.

B. evaluating velocities of reaction at two different temperatures

C. evaluating rate constant at two different temperature

D. cahnging 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 of3.

D. Molecularity of a complex reaction,

` A+2B to 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 date" In $2 = 0.7$, ln $\frac{323}{25} = 2.6$

A. the time taken for that body to go from 323° C "to" 25° 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° C "to" 25° 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 $6.93 \times 10^{-6} gm/L/day$ due to the emission of polluting gases from thermal power plant, but at the sane time it is decomposing and following first order kinetic with half lif e of 100 days.

Based on above infromation, select the true statement (s)

A. Concentration of SO_3 in Kota is 1.25×10^{-5} M (Asssume 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 $\approx 1.2 \times 10^{-8}$ M.

C. If 10^3 L of air passed throught 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 8×10^5 Litre aid /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 tiem $t_1, [A]_2 =$ concentration at time t_2

A. $\dfrac{\ln r_2 - \ln r_1}{\ln[A]_1}$

B. $\dfrac{\ln\left[A_0\right]_2 - \ln\left[A_0\right]_1}{\ln\left[t_{1/2}\right]_2 - \ln\left[t_{1/2}\right]_1}$

C. $\dfrac{\ln\left(-d\frac{A}{k}'\,dt\right)}{\ln[A]}$

D. $\dfrac{\ln\left(\frac{r}{k}\right)}{\ln[A]}$

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 $._{-1}^{0}\beta$ 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

$$2NH_3(g) \xrightarrow[\text{Platinum castalyst}]{1130K} N_2(g) + 3H_2(g)$$

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. Rateof decompostion of ammonia will remain constant until ammonia disppears 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 corrct 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)

$$\overset{k_2}{A \Leftrightarrow k_1 B}$$

k_1 and k_2 are the rate constant.

If equlibrium constant (K) is greater than unity, then :

A. rate of forward reaction is always greater then rate of backward reaction.

B. amount of product at equilibrium is greater than the amount of reactant.

C. activation energy for the forward direction $\left(E_{of}\right)$ is greater then activation energy for backward reaction $\left(E_{ab}\right)$

D. addition of a cayalyst 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 $k = mol^{-5/3}L^{5/3}\sec^{-1}$

B. Units of $k = mol^{-2/3}L^{2/3}\sec^{-1}$

C. On diluting the solution 8 times rate will bocome 32 times the initial rate

D. The reaction is a compex 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 foloowingf 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. $2X(g) + Y(g) + 3Z(g) \rightarrow$ 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 raction decreases by reducing the concentration of Y to haly of the orginal value

C. The half life of Z increases by increasing its concentration if $[X] > > [Z]$

D. On dubling 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 miximum

B. specific activity of U_3O_8 will be maximum

C. on increasing temperature, activity of all three samples will increase

D. 7α - 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 cassel shows α - $decay$ and β - $decay$ to given _ $(82)^{206}Pb$. 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 the following is/are correct for the nucler process and the products of the process ?

A. Mass of Pb obtained in time t hour =103mg.

B. If the temperatures 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. α particales show more ionisation power rhan β particles.

D. *lmbda* 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 wlwmwntry reaction ?

A. Order is same as molecularicty.

B. Order is less than the molecularity.

C. Order is grater 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 decteases 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 reactionis same as molcularity 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 interger.

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 gnergies are 54, 10, 11 and 12 $respectively. Theirb \in d \in ge \neq rgiesare$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 : `Dgt Bgt 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 redioactivity ?

A. Half life is independent of initial amount of redioactive 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 - 238and 235 are different.

Answer: A::D

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39. Which of the following may infuluence 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 $A \underset{k_2 = 2 \times 10^2 s^{-1}}{\overset{k_1 = 4 \times 10^2 s^{-1}}{\Leftrightarrow}} B$ initial concentration of A is 21 mol L^{-1} . Select the correct statement:

A. Equilibrium concentration of A is 14 mol L^{-1}

B. Equilibrium conentration of B is 14 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.

(a) $O_3(g) \overset{k_1}{\Leftrightarrow} k_2 O_2(g) + O(g)$

(b)$O_3(g) + O(g) \xrightarrow{k_3} 2O_2$

Also it is known that $k_1 > > k_3$ and $k_2 > > k_3$

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.

(a) $O_3(g) \overset{k_1}{\Leftrightarrow} k_2 O_2(g) + O(g)$

(b) $O_3(g) + O(g) \xrightarrow{k_3} 2O_2$

Also it is known that $k_1 > > k_3$ and $k_2 > > k_3$

If ΔH 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.

(a) $O_3(g) \overset{k_1}{\Leftrightarrow} k_2 O_2(g) + O(g)$

(b) $O_3(g) + O(g) \overset{k_3}{\rightarrow} 2O_2$

Also it is known that $k_1 > > k_3$ and $k_2 > > k_3$

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 $= 10^{-1}\text{moles/ min}$ if initialy 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 necleus 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 λ_1 and λ_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. 2.5×10^{-8}

B. 4×10^{-2}

C. $\frac{1}{16} \times 10^{-5}$

D. 4×10^{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 necleus The series comprising all such elements is termed as radioactive disintegration series.

A radioactive series is formes such that after each α decay there are two consecutive β 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

$$\frac{dlnk}{dT} = \frac{E_a}{RT^2}$$

where symbols have usual meaning.

Assuming Arrhenius factor to be constant and activation energy to be dependent on temperature and varying as $\left(0.02T^2\right)$ 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	$Rate of Reaction\left[M\sec^{-1}\right]$
1	$10^{-2}M$	$3\times10^{-3}M$	2×10^{-2}
2	$2\times10^{-2}M$	$3\times10^{-3}M$	4×10^{-2}
3	2×10^{-2}	$6\times10^{-3}M$	8×10^{-2}

Answer the question which follow

Reaction: $A(g) + B(g) \rightarrow C(g)$

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. $\frac{4}{3}\times10^{-3}$ sec

B. $\frac{3}{4}\times10^{-3}$ sec

C. $\frac{1}{8}\times10^{-4}\sec$

D. $\frac{8}{3}\times10^{-3}\sec$

Answer: B

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8. The general defination of the activation energy E_a of any rate process, applicable whether or not E_a varies with T, is:

$$E_a = RT^2 . \frac{d(\ln k)}{dT}$$

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. $166.28 kcal/mol$

B. $80.0 kcal/mol$

C. $40.0 kcal/mol$

D. $20.9 kcal/mol$

Answer: C

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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.

$2A(g) \rightarrow 3B(g) + 2C(g)$

Time (min)	10 min	30 min	∞ *time*
Pressure increase (mm of Hg)	30 mm	52.5 min	60 min

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 $\wedge (18)F$ for the study of brain by injecting a quantity of fluoro substituted glucose into the blood of a patient The glucose accummulates in the region where the brain is active and needs nourishment.

If a sample of glucose that contains $.^{18}F$ is injected into the blood what percentange 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 $\wedge (18)F$ for the study of brain by injecting a quantity of fluoro substituted glucose into the blood of a patient The glucose accummulates in the region where the brain is active and needs nourishment.

How long does it take for 99.9% decay of $.^{18}F$?

A. Infinite time

B. 16.67 hourse

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 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: l n $\frac{10}{9}$, $ln 2.5 = 0.9, ln\frac{5}{3} = 0.5\Big]$

The rate constant of reaction is:

A. 0.1min^{-1}

B. 1.0min^{-1}

C. 0.01min^{-1}

D. 0.023min^{-1}

Answer: C

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13. In an investigation of the kinetics of the reaction

$MnO_4^- + Cr^{3+} \rightarrow CrO_4^{2-} + Mn^{4+} at 25°$ C

False and Roller measured the times required to carry the reaction to various degrees of completion, first as a function of MnO_4^- concentration and then as a function of Cr^{3+} concentration. In each case after difinite intervals of time, 25 ml aliquots of the reaction mixture were removed and added rapidly to a solution containing 60 ml of $1.2 M H_2SO_4$ and 25 ml of 0.5 M KBr to occur the following reaction

$2MnO_4^- + 10Br^- + 16H^+ \rightarrow 2Mn^{2+} + 5Br_2 + 8H_2O$

Free bromine instantly liberated was extracted by CS_2 The $Cr_2O_7^{2-}$ That had been formed by the reaction

$2Cr_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$

Was titrated with 0.01 N $FeSO_4$ in the reaction

$Cr_2O_7^{2-} + 6Fe^{2+} + 16H^+ + 2SO_4^{2-} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 2HSO_4^- + 7H_2O$

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
$\left[MnO_4^-\right](mol/lt)$	1	2	1
$\left[Cr^{3+}\right](mol/lt)$	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 mi
0.2	36 min	18 min	72 mi
0.4	60 min	30 min	121 m
0.6	80 min	40 min	162 m

What is the order of reaction with respect to $\left[Cr^{3+}\right]$?

A. 1

B. 2

C. 1.5

D. 0.5

Answer: A

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$MnO_4^- + Cr^{3+} \rightarrow CrO_4^{2-} + Mn^{4+} at 25°$ C

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$Volume of Cr_2O_7^{2-}(0.01N) present (ml)$	Time taken (min)		
	I	II	III
0.1	22 min	11 min	45 mi
0.2	36 min	18 min	72 mi
0.4	60 min	30 min	121 m
0.6	80 min	40 min	162 m

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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15. $A(g) \rightarrow 2B(g) + C(g)$

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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16. $A(g) \rightarrow 2B(g) + C(g)$

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. $Ea_1 > Ea_2 \quad \text{if} \quad T_1 > T_2$

B. $Ea_1 < Ea_2 \quad \text{if} \quad T_1 > T_2$

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
$A \rightarrow B$	$T_1 K$	Ea_1	k_1
$A \rightarrow B$	$T_2 K$	Ea_2	k_2

Set-II (with catalyst) (consider $+ve$ catalyst only)

Reaction	Temperature	E(activation)	k
$A \rightarrow B$	$T_1 K$	Ea_3	k_3
$A \rightarrow B$	$T_2 K$	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:

(I) $S_2O_8^{2-} + I^- \rightarrow SO_4I^- + SO_4^{2-}$ (fast)

$I^- + SO_4I^- \xrightarrow{k_1} I_2 + SO_4^{2-}$ (slow)

$I^- + I_2 \xrightarrow{k_2} I_3^-$ (fast)

(II) $S_2O_8^{2-} + I^- \xrightarrow{k_1} S_2O_8I^{3-}$ (slow)

$S_2O_8I^{3-} \xrightarrow{k_2} 2SO_4^{2-} + I^+$ (fast)

$I^+ + I^- \xrightarrow{k_3} I_2$ (fast)

$I_2 + I^- \xrightarrow{k_4} I_3^-$ (fast)

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:

(I) $S_2O_8^{2-} + I^- \rightarrow SO_4I^- + SO_4^{2-}$ (fast)

$I^- + SO_4I^- \xrightarrow{k_1} I_2 + SO_4^{2-}$ (slow)

$I^- + I_2 \xrightarrow{k_2} I_3^-$ (fast)

(II) $S_2O_8^{2-} + I^- \xrightarrow{k_1} S_2O_8I^{3-}$ (slow)

$S_2O_8I^{3-} \xrightarrow{k_2} 2SO_4^{2-} + I^+$ (fast)

$I^+ + I^- \xrightarrow{k_3} I_2$ (fast)

$I_2 + I^- \xrightarrow{k_4} I_3^-$ (fast)

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:

(I) $S_2O_8^{2-} + I^- \rightarrow SO_4I^- + SO_4^{2-}$ (fast)

$I^- + SO_4I^- \xrightarrow{k_1} I_2 + SO_4^{2-}$ (slow)

$I^- + I_2 \xrightarrow{k_2} I_3^-$ (fast)

(II) $S_2O_8^{2-} + I^- \xrightarrow{k_1} S_2O_8I^{3-}$ (slow)

$S_2O_8I^{3-} \xrightarrow{k_2} 2SO_4^{2-} + I^+$ (fast)

$I^+ + I^- \xrightarrow{k_3} I_2$ (fast)

$I_2 + I^- \xrightarrow{k_4} I_3^-$ (fast)

For the reaction $I_2 + 2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2I^-$

(P) $-\frac{d[I_2]}{dt} = -\frac{1}{2}\frac{d[S_2O_3^{2-}]}{dt}$

(Q) $-\frac{d[I_2]}{dt} = -2\frac{d[S_2O_3^{2-}]}{dt}$

(R) $\frac{d[I^-]}{dt} = -2\frac{d[I_2]}{dt} \times \frac{d[S_2O_3^{2-}]}{dt}$

(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:

$A \xrightarrow{k_1} C$ and $A \xrightarrow{k_2} D$

where the stoichimetric coefficients are taken as unity for simplicity. THe rate law is

$$\left(\frac{d[A]}{dt}\right) = -k_1[A] - k_2[A] = -\left(k_1 + k_2\right)[A]$$

$$\Rightarrow [A] = [A]_0 e^{-\left(k_1 + k_2\right)t}$$

For C, we have $\left(\frac{d[C]}{dt}\right) = k_1[A] = k_1[A]_0 e^{-\left(k_1 + k_2\right)t}$

Multiplication by dt and integration from time 0(where $[C]_0 = 0$ to an arbitary time t gives

$$[C] = \frac{k_1[A]_0}{k_1 + k_2}\left(1 - e^{-\left(k_1 + k_2\right)t}\right)$$

Similarly integration of $\left(\frac{d[D]}{dt}\right)$ gives

$$[D] = \frac{k_2[A]_0}{k_1 + k_2}\left(1 - e^{-\left(k_1+k_2\right)t}\right)$$

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) $CH_3COOH \xrightarrow{k_1=3s^{-1}} CH_4+CO_2$

(ii) $CH_3COOH \xrightarrow{k_2=4s^{-1}} CH_2CO+H_2O$

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

$$CH_3OH + (C_6H_5)_3CCl \rightarrow (C_6H_5)_3C.OCH_3 + HCI$$

A B C

The following sets of data were observed:

Set	Initial concentration $[A]$	$[B]_0$	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

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24. 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

$$CH_3OH + (C_6H_5)_3\text{CCl} \rightarrow (C_6H_5)_3C.\,OCH_3 + HCI$$

A B C

The following sets of data were observed:

Set	Initial concentration [A]	[B]$_0$	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 constant of the above experiment is:

A. 1.3×10^{-1}

B. 2.6×10^{-2}

C. 2.6×10^{-1}

D. 1.3×10^{-2}

Answer: C

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:

(I) $A + B \rightarrow AB \cdot \; \rightarrow C + D, k_1 = 1 \times 10^{-5} M^{-1} s^{-1}$

(II) $A \rightarrow A \cdot \; \rightarrow E, k_1 = 1 \times 10^{-4} M^{-1} s^{-1}$

$E + B \rightarrow C + D, k_2 = 1 \times 10^{10} M^{-1} s^{-1}$ (species with * are short-lived)

Rate according to mechanism II when concentration of each reactant is 1 M will be:

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

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

C. $1 \times 10^{-6} Ms^{-1}$

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

Answer: A

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:

(I) $A + B \rightarrow AB \cdot \rightarrow C + D, k_1 = 1 \times 10^{-5} M^{-1} s^{-1}$

(II) $A \rightarrow A \cdot \rightarrow E, k_1 = 1 \times 10^{-4} M^{-1} s^{-1}$

$E + B \rightarrow C + D, k_2 = 1 \times 10^{10} M^{-1} s^{-1}$ (species with * are short-lived)

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 occues as:

$2N_2O_5 \rightarrow 4NO_2 + O_2$

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 occues as:

$2N_2O_5 \rightarrow 4NO_2 + O_2$

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 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. $108g/hr, 92g/hr$

C. $32g/hr, 64g/hr$

D. $54g/hr, 46g/hr$

Answer: B

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29. The thermal decomposition of N_2O_5 occues as:

$2N_2O_5 \rightarrow 4NO_2 + O_2$

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 $6.2 \times 10^{-4} \mathrm{sec}^{-1}$

(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

$aA + bB(\Leftrightarrow)cC + dD$ can be given by:

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 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: $k = Ae^{-\left(E_a/RT\right)}$ 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 ΔH 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

$aA + bB(\Leftrightarrow)cC + dD$ can be given by:

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 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: $k = Ae^{-\left(E_a/RT\right)}$ 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 ΔH are energy of activation and enthalpy of reaction respectively

For a gaseous phase Ist order reaction

$A(g) \rightarrow B(g) + 2C(g)$

(rate constant $K = 10^{-2}time^{-1}\big)$

in a closed vessel of 2 litre containing 5 mole of A(g) at 27° C which of the following is incorrect?

A. Rate of a appearance of $C(g) is 5 \times 10^{-2} mol L^{-1} t^{-1}$

B. Rate of disappearance of $A(g) is 6.15 \times 10^{-1} atm t^{-1}$

C. Rate of disappearance of $A(g) is 5.0 \times 10^{-2} mol t^{-1}$

D. Rate of appearance of B(g) $is 5 \times 10^{-2} mol L^{-1} t^{-1}$

Answer: D

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32. The instantaneous rate of an elementary chemical reaction

$aA + bB(\Leftrightarrow)cC + dD$ can be given by:

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 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: $k = Ae^{-\left(E_a/RT\right)}$ 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 ΔH 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° with origin, then:

A. rate constant $= 3.98 time^{-1}$ and $a = 1$

B. rate constant $= 3.98 molL^{-1}t^{-1}$ and $a = 1$

C. rate constant $= 1.99 time^{-1}$ and $a = 1$

D. rate constant $= 1.99 molL^{-1}t^{-1}$ and $a = 2$

Answer: A

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33. The rate law for reaction $A + B \rightarrow C$ is

Rate $= K[A][B]$

Given $K = 6.93 \times 10^{-4} M^{-1} \sec^{-1}$

Starting with $[A] = 1M$ and $[B] = 2M$ what is the rate in (M$\sec^{-1}$) when $[A]$ changes to 0.25 M?

A. 2.16×10^{-3}

B. 2.16×10^{-4}

C. 8.64×10^{-4}

D. 8.64×10^{-3}

Answer: B

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34. From the following data answer the questions Reaction $A + B \rightarrow P$

$[A]M$	$[B]M$	$Initiallyrate\left(M\sec^{-1}\right)$	
		$at300K$	$at400K$
2.5×10^{-4}	3.0×10^{-5}	5.0×10^{-4}	2.0×10^{-3}
5.0×10^{-4}	6.0×10^{-5}	4.0×10^{-3}	
1.0×10^{-3}	6.0×10^{-5}	1.6×10^{-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 effeiciency or quantum yield (ϕ) 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

$$(CH_3)_2CO \xrightarrow{hv} C_2H_6 + CO$$

If quantum yield in 0.8 then rate of formation of $C_2H_6(mol/s)$ is :

A. 8×10^{-9}

B. 1.6×10^{-9}

C. 16×10^{-9}

D. 4×10^{-9}

Answer: A

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36. Quantium efficiency or quantum yield (ϕ) 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

$$2A \xrightarrow{hv} B + 3C$$

In a first order reaction 75% of the reactant disappears in 1.386 h the rate constant of the reaction is close to:

A. $7.2 \times 10^{-1} s^{-1}$

B. $3.6 \times 10^{-3} s^{-1}$

C. $1.8 \times 10^{-3} s^{-1}$

D. $2.8 \times 10^{-4} s^{-1}$

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 β^{-}, β^{+} (positron) or α-particle depending upon the $\frac{n}{p}$ ratio of unstable nuclei and stable nuclei

$\cdot_{53}P^{135} \rightarrow Q + a$

$Q \rightarrow R + b$

[Note : only stable isotope of element P and Q are $\cdot_{53}P^{135}$ and $\cdot_{54}Q^{137}$ respectively] Element P,Q,R do not show any resemblence to currently known element

$\cdot_{53}P^{135} \rightarrow Q + a, t_{1/2} = 1000$ hrs

$Q \rightarrow R + b, t_{1/2} = 10$ 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 chemica reaction at 8.00 A.M. in the morning at the laboratory temperature of 27° 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° 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 catayst adding which at 4.00 P.M. at 127° C he could meet the target of 5.00 P.M. and 90% Answer the following questions based on the above observation (Use $ln\frac{10}{9} = 0.1 ln\frac{9}{5} = 0.6, ln10 = 2.3 ln5 = 1.6, ln8 = 2$)

What was the activation energy of the catalyzed pathway?

A. $4.92 kcal/mol$

B. $3.92 kcal/mol$

C. $4.72 kcal/mol$

D. $9.84 kcal/mol$

Answer: B

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39. Kinetic of acidic hydrolysis of ester is a pseudo Ist order reaction

$CH_3COOCH_3(aq) + H_2\_(excees)(l)$

$\xrightarrow{H^+} CH_3COOH(aq) + CH_3OH(aq)$

Rate law is given by $r = K\left[H^+\right]\left[H_2O\right]\left[CH_3COOCH_3\right]$

$K = 1.8 \times 10^{-3} M^{-2} \sec^{-1}$ where H^+ ion concentration is given by acid catalyst in an experiment 1 M CH_3COOCH_3 is hydrolyscd using 0.1 M HCI as catayst.

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 α the element has a decay constant λ At time $t = 0$ there are N_0 nuclei of the element

If $\alpha = 2N_0\lambda$ the number of nuclei of A after $t = \frac{ln2}{\lambda}$ 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 α the element has a decay constant λ 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 $t = \frac{ln2}{\lambda}$:

A. $0.5N_0$

B. $1.5N_0$

C. $\frac{(4ln2 - 1)N_0}{2}$

D. $\frac{(4ln2 - 3)N_0}{2}$

Answer: C

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42. Nuclei of a radioactive element 'A' are being produced at a constant rate α the element has a decay constant λ 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 $._{19}K^{40}$ to $._{18}Ar^{40}$ precise measurements of the amount of K^{40} relative to 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 $._{-1}\beta^{o}$ - decay

C. Isotopes having even number of protons and neutrons must be stable nuclei

D. Isodiaphers are produced due to α-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. $\Delta m = at$ mass of $._{5}B^{8}$ - at mass of $._{4}Be^{8}$

B. $\Delta m = at$ mass of $._{5}B^{8}$ - at mass of $._{4}Be^{8}$ - mass of one electron

C. $\Delta m = at$ mass of $._{5}B^{8}$ - at mass of $._{4}Be^{8}$ + mass of one electron

D. $\Delta m = at$ mass of $._{5}B^{8}$ - at mass of $._{4}Be^{8}$ - 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 $.^{98}Tc$ The isotope is radioactive with half life of 8 hours The activity just after the injection is $32\mu Ci$

What will be activity after 48 hrs of the overall excreted material till that time?

A. $0.125\mu Ci$

B. $0.375\mu Ci$

C. $0.5\mu Ci$

D. $1\mu Ci$

Answer: B

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46. A reaction is said to be first order if it's rate is proportional to the concentration of reactant Let us consider a reaction

$A(g) \rightarrow B(g) + c(g)$

At $t = 0a00$

At time t $a - xxx$

The rate of reaction is given by the expression $\frac{dx}{dt} = k(a - x)$ and integrated rate equation for a given reaction is represted 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 $1.386 \times 10^{-2} \min^{-1}$ 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 initialy 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 necleus The series comprising all such elements is termed as radioactive disintegration series.

If a radioactive disintegration series is observed involving only α and β decays then which of the following isotopes cannot be a part of it if the parent isotope of the series is $._{91}Pa^{234}$?

A. $._{86}Rn^{222}$

B. $._{85}At^{216}$

C. $._{82}Pb^{210}$

D. $._{90}Th^{230}$

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: $k = A\sqrt{T}e^{-Ea/RT}$ (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

$$\frac{dlnk}{dT} = \frac{E_a}{RT^2}$$

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	$Rate of Reaction\left[M\sec^{-1}\right]$
1	$10^{-2}M$	$3\times10^{-3}M$	2×10^{-2}
2	$2\times10^{-2}M$	$3\times10^{-3}M$	4×10^{-2}
3	2×10^{-2}	$6\times10^{-3}M$	8×10^{-2}

Answer the question which follow

Reaction: $A(g)+B(g)\rightarrow C(g)$

What will be the value of rate constant for the above reaction?

A. $\frac{2}{3} \times 10^3 M \text{ min}^{-1}$

B. $\frac{2}{3} \times 10^3 M^{-1} \text{ min}^{-1}$

C. $4 \times 10^4 M^{-1} \text{ min}^{-1}$

D. $4 \times 10^4 M \text{ min}^{-1}$

Answer: B

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Comprehension type 6

1. The general defination of the activation energy E_a of any rate process, applicable whether or not E_a varies with T, is:

$$E_a = RT^2 . \frac{d(\ln k)}{dT}$$

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 pre- exponential factor of reaction is:

A. $20^{40}s^{-1}$

B. $e^{27.72}s^{-1}$

C. $2^{4}s^{-1}$

D. $2^{400}s^{-1}$

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.

$2A(g) \rightarrow 3B(g) + 2C(g)$

Time (min)	10 min	30 min	$\infty time$
Pressure increase (mm of Hg)	30 mm	52.5 min	60 min

What will be average life of molecules of 'A'?

A. 10 min

B. 5 min

C. ∞

D. $\frac{10}{ln2} \text{ min}$

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 $\wedge(18)F$ for the study of brain by injecting a quantity of fluoro substituted glucose into the blood of a patient The glucose accummulates in the region where the brain is active and needs nourishment.

What is the average life for decomposition of 18_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: $\ln \frac{10}{9}$, $ln2.5 = 0.9$, $ln\frac{5}{3} = 0.5$]

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

$MnO_4^- + Cr^{3+} \rightarrow CrO_4^{2-} + Mn^{4+} at 25°$ C

False and Roller measured the times required to carry the reaction to various degrees of completion, first as a function of MnO_4^- concentration and then as a function of Cr^{3+} concentration. In each case after difinite intervals of time, 25 ml aliquots of the reaction mixture were removed and added rapidly to a solution containing 60 ml of $1.2MH_2SO_4$ and 25 ml of 0.5 M KBr to occur the following reaction

$$2MnO_4^- + 10Br^- + 16H^+ \rightarrow 2Mn^{2+} + 5Br_2 + 8H_2O$$

Free bromine instantly liberated was extracted by CS_2 The $Cr_2O_7^{2-}$ That had been formed by the reaction

$$2Cr_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$$

Was titrated with 0.01 N $FeSO_4$ in the reaction

$$Cr_2O_7^{2-} + 6Fe^{2+} + 16H^+ + 2SO_4^{2-} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 2HSO_4^- + 7H_2O$$

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
$\left[MnO_4^-\right](mol/lt)$	1	2	1
$\left[Cr^{3+}\right](mol/lt)$	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 mi
0.2	36 min	18 min	72 mi
0.4	60 min	30 min	121 m
0.6	80 min	40 min	162 m

What is the order of reaction with respect to $\left[MnO_4^-\right]$?

A. 2

B. 1

C. 0.5

D. 1.5

Answer: B

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Comprehension type11

1. $A(g) \rightarrow 2B(g) + C(g)$

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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Comprehension type12

1. Set -I (without catalyst)

Reaction	Temperature	E(activation)	k
$A \rightarrow B$	$T_1 K$	Ea_1	k_1
$A \rightarrow B$	$T_2 K$	Ea_2	k_2

Set-II (with catalyst) (consider $+ve$ catalyst only)

Reaction	Temperature	E(activation)	k
$A \rightarrow B$	$T_1 K$	Ea_3	k_3
$A \rightarrow B$	$T_2 K$	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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Comprehension type 13

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:

(I) $S_2O_8^{2-} + I^- \rightarrow SO_4I^- + SO_4^{2-}$ (fast)

$I^- + SO_4I^- \xrightarrow{k_1} I_2 + SO_4^{2-}$ (slow)

$I^- + I_2 \xrightarrow{k_2} I_3^-$ (fast)

(II) $S_2O_8^{2-} + I^- \xrightarrow{k_1} S_2O_8I^{3-}$ (slow)

$S_2O_8I^{3-} \xrightarrow{k_2} 2SO_4^{2-} + I^+$ (fast)

$I^+ + I^- \xrightarrow{k_3} I_2$ (fast)

$I_2 + I^- \xrightarrow{k_4} I_3^-$ (fast)

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 ° C in benzene solution containing 0.10 M pyridine

$$CH_3OH + (C_6H_5)_3CCl \rightarrow (C_6H_5)_3C.OCH_3 + HCI$$

A B C

The following sets of data were observed:

Set	Initial concentration $[A]$	$[B]_0$	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	$0.0077M$

Rates $\frac{d[C]}{dt}$ in sets I, II and III are respectively (in M min^{-1})

A.

I	II	III
1.30×10^{-4}	2.6×10^{-4}	1.02×10^{-3}

B.

I	II	*III*
0.033	0.0039	0.0077

C.

I	II	III
0.02×10^{-4}	0.04×10^{-4}	0.017

D.

I	II	III
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:

(I) $A + B \rightarrow AB^{\cdot} \rightarrow C + D, k_1 = 1 \times 10^{-5} M^{-1} s^{-1}$

(II) $A \rightarrow A^{\cdot} \rightarrow E, k_1 = 1 \times 10^{-4} M^{-1} s^{-1}$

$E + B \rightarrow C + D, k_2 = 1 \times 10^{10} M^{-1} s^{-1}$ (species with * are short-lived)

Rate according to mechanism I when concentration of each reactant is 0.1 M will be:

A. $1 \times 10^{-7} Ms^{-1}$

B. $1 \times 10^{-6} Ms^{-1}$

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

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

Answer: A

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Comprehension type 17

1. The thermal decomposition of N_2O_5 occues as:

$2N_2O_5 \rightarrow 4NO_2 + O_2$

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:

A. $N_2O_5 \xrightarrow{slow} NO_2 + NO_3$

$N_2O_5 + NO_3 \xrightarrow{f*} 3NO_2 + O_2$

B. $N_2O_5 \xrightarrow{f*} NO_2 + NO_3$

$N_2O_5 + NO_3 \xrightarrow{slow} 3NO_2 + O_2$

C. $N_2O_5 \xrightarrow{f*} 2NO_2 + \frac{1}{2}O_2$

D. $N_2O_5 \xrightarrow{slow} NO + NO_2 + 2O_2$

$N_2O_5 + NO_2 \xrightarrow{f*} 3NO_2 + \frac{1}{2}O_2$

Answer: A

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Comprehension type 18

1. The instantaneous rate of an elementary chemical reaction

$aA + bB(\Leftrightarrow)cC + dD$ can be given by:

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 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: $k = Ae^{-\left(E_a/RT\right)}$ 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 ΔH are energy of activation and enthalpy of reaction respectively

For a chemical reaction :$aA \rightarrow bB$log[(d[A])/(dt)]=log [(d[B])/(dt)+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

Rate $= K[A][B]$

Given $K = 6.93 \times 10^{-4} M^{-1} \sec^{-1}$

Find the time taken(sec) when concentration of $[A]$ changes from 10^{-4} M to 5×10^{-5} M

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 $A + B \rightarrow P$

$[A]M$	$[B]M$	$Initiallyrate\left(M\sec^{-1}\right)$	
		$at300K$	$at400K$
2.5×10^{-4}	3.0×10^{-5}	5.0×10^{-4}	2.0×10^{-3}
5.0×10^{-4}	6.0×10^{-5}	4.0×10^{-3}	
1.0×10^{-3}	6.0×10^{-5}	1.6×10^{-2}	

The value of rate constant at 300 K is $\left(M^{-2}\sec^{-1}\right)$

A. 2.667×10^{8}

B. 2.667×10^{5}

C. 2.667×10^{4}

D. 2.667×10^{9}

Answer: A

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Comprehension type 22

1. Quantium efficiency or quantum yield (ϕ) 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

$$2A \xrightarrow{hv} B + 3C$$

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 $7.2 \times 10^{-3} Js^{-1}$ (Given $N_A = 6 \times 10^{23}, h = 6.6 \times 10^{-34}$ in S.I unit) The rate of formation of C (mol/s) is

A. 1.2×10^{-8}

B. 8×10^{-8}

C. 8×10^{-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 β^{-}, β^{+} (positron) or α-particle depending upon the $\frac{n}{p}$ ratio of unstable nuclei and stable nuclei

$\cdot {}_{53}P^{135} \rightarrow Q + a$

$Q \rightarrow R + b$

[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 resemblence to currently known element

Particles a and b can be respectively

A. $._{2}He^{4}$, $-1^{e^{o}}$

B. . $-1^{e^{o}}, ._{2}He^{4}$

C. . $-1^{e^{o}}, ._{+}e^{o}$

D. $._{2}He^{4}, ._{2}He^{4}$

Answer: B::C

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Comprehension type 24

1. An analyst starts a first order chemica reaction at 8.00 A.M. in the morning at the laboratory temperature of 27° 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° 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 catayst adding which at 4.00 P.M. at 127° C he could meet the target of 5.00 P.M. and 90% Answer the following questions based on the above observation (Use $ln\frac{10}{9} = 0.1 ln\frac{9}{5} = 0.6, ln10 = 2.3 ln5 = 1.6, ln8 = 2$)

What was the activation energy of the original pathway?

A. $10.14 kcal/mol$

B. $5.52 kcal/mol$

C. $2.64 kcal/mol$

D. $7.92 kcal/mol$

Answer: B

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Comprehension type 26

1. Kinetic of acidic hydrolysis of ester is a pseudo Ist order reaction

$CH_3COOCH_3(aq) + H_2\_(excees)(l)$

$\xrightarrow{H^+} CH_3COOH(aq) + CH_3OH(aq)$

Rate law is given by $r = K\left[H^+\right]\left[H_2O\right]\left[CH_3COOCH_3\right]$

$K = 1.8 \times 10^{-3} M^{-2} \sec^{-1}$ where H^+ ion concentration is given by acid catalyst in an experiment 1 M CH_3COOCH_3 is hydrolyscd using 0.1 M HCl as catayst.

Calculate the time at which ester concentration reduce to 0.25 M $[ln2 = 0.7]$ (Given Density of pure $H_2O = 1gm/ml$)

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 α the element has a decay constant λ At time $t = 0$ there are N_0 nuclei of the element

The number of nuclei of A at time 't' is

A. $\frac{\alpha}{\lambda}\left(1 - e^{-\lambda t}\right)$

B. $N_0 e^{-\lambda t}$

C. $\frac{1}{\lambda}\left[\alpha - \left(\alpha - \lambda N_0\right)e^{-\lambda t}\right.$

D. $\frac{N_0 . \alpha}{\lambda}\left[1 - \left(\left(1 - \frac{\lambda}{\alpha}\right)\right)e^{-\lambda t}\right]$

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 $._{19}K^{40}$ to $._{18}Ar^{40}$ precise measurements of the amount of K^{40} relative to 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 $\left(\lambda of K^{40} = 6.93 \times 10^{-10} year^{-1}\right)$

A. 1.2×10^{8} years

B. 2×10^{9} years

C. 2×10^{10} years

D. 2.4×10^{9} years

Answer: B

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Comprehension type 29

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,

$._4Be^{10} \rightarrow ._5B^{10} + e^-$ is

A. $\Delta m = at$ mass of $._4Be^{10}$- at mass of $._5B^{10}$

B. $\Delta m = at$ mass of $._4Be^{10}$-at mass of $._5B^{10}$- mass of one electron

C. $\Delta m = at$ mass of $._4Be^{10}$ at mass of $._5B^{10} +$ mass of one electron

D. $\Delta m = at$ mass of $._4Be^{10}$ -at mass of $._5B^{10}$ - mass of two electrons

Answer: A

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Comprehension type 30

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}Tc The isotope is radioactive with half life of 8 hours The activity just after the injection is $32\mu Ci$

How much time will elapse before the activity of patient falls to $16\mu Ci$?

A. 3.8 hrs

B. 4.8 hrs

C. 6 hrs

D. 8 hrs

Answer: C

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Comprehension type32

1. A reaction is said to be first order if it's rate is proportional to the concentration of reactant Let us consider a reaction

$A(g) \rightarrow B(g) + c(g)$

At $t = 0 a 0 0$

At time t $a - x x x$

The rate of reaction is given by the expression $\frac{dx}{dt} = k(a - x)$ and integrated rate equation for a given reaction is represted 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.

Thermal decomposition of compound X is a first order reaction If 75% of X is decompossed 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) $\frac{lnk_2 - lnk_1}{k_2 - k_1}$
(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

C. P Q R S
2 4 1 3

D. P Q R S
4 3 2 1

Answer: A

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2.

	Column-I
(a)	Reaction connot be completed in finite time
(b)	Reaction may be elementary
(c)	As reaction proceeds time required forreducing to half of the amount keeps on decreasin

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3.

	Column-I	Column-II
(a)	$+ve + ve$	(p)charges obtained on dispersion medium and particles of desp
(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 electrophore
		(t)According to Arrhenius theory the sign ofslope 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 propertie
(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	Column-II
(a)	$A + B \rightarrow C + Dr = k_1[A][B]$	(p)Unit of rate constant possess concen
(b)	$A + B \rightarrow C + Dr = k_2[A][B]$	(q)Rate constant for the reaction of bot
(c)	$A + B \rightarrow C + Dr = k_2[A]^0[B]^0$	(r)Rate of consumption of at least one
(d)	$2A + B \rightarrow 2C + 3Dr = k_3[A]^0[B]^0$	(s)If both reactants are taken instoichiom

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6.

	Column-I	Column-II
(a)	$2N_2O_5(g) \xrightarrow{1storder} 4NO_2(g) + O_2(g)$	(p)All the gaseous products are p
(b)	$2H_2O_2(aq) \xrightarrow{zero\ \mathrm{or}\ der} 2H_2O(g) + O_2(g)$	(q)Hybridization of reactant invol
(c)	$2NH_3(g) \xrightarrow{zero\ \mathrm{or}\ der} N_2(g) + 3H_2(g)$	(r)As the reaction proceeds half li
(d)	$2C1_2O_7(g) \xrightarrow{zero\ \mathrm{or}\ der} 4C1O_2(g) + 3O_2(g)$	(s)Rate of production of gases de

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7.

	Column-I
(a)	If the activation energy is 65 kJ then howmuch time faster a reaction proceed at25 $^\circ Ct$
(b)	Rate constant of a first order reaction is $0.0693 \min^{-1}$ if we start with $20 molL^{-1}$ it is reduce
(c)	Half lives of first order and zero orderreactions are same ratio of rates at the start of rea
(d)	The half life periods are given $[A](M)$ 0.06770.1360.272 $t_{1/2}(\sec)$ 240480960order of t

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8.

	Column-I	Column-II
(a)	Zero	$(p) k = \frac{1}{2t}\left[\frac{1}{(a-x)^2} - \frac{1}{a^2}\right]$
(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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9.

	Column-I(Order)	Column-II(Unit of rate constant)
(a)	Zero	$(p)L^2mol^{-2}s^{-1}$
(b)	First	$(q)Lmol^{-1}s^{-1}$
(c)	second	$(r)molL^{-1}s^{-1}$
(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 byNa_2S_2O
(b)	$S_2O_8^{2-} + 2I^- \rightarrow 2SO_4^{2-} + I_2$	(q) Titration by$KMnO$
(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 concentrati
(d)	Third	(s)50% reaction takes same time evenIf concentration is halve

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12. If t_x represnts 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)	$t_{5/9}$	$(p) Equal to 54 sec$ if $t_{1/3}$ is 18 sec in case of first order reaction
(b)	$t_{19/27}$	$(q) Equal to 32 sec$ if $t_{1/14}$ is 16 sec in case of first order reactio
(c)	$t_{7/8}$	$(r) Equal to 56 sec$ if $t_{1/3}$ is 4 sec in case of second order reactio
(d)	$t_{7/16}$	$(t) Equal to 30 sec$ if $t_{1/3}$ is 18 sec incase of zero order reaction
		$(t) Equal to 28 sec$ 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 $._{98}^{250}$ Cf if its half life is 6.93 min . Express your answer in terms of 10^{16} dps.

$\left(\text{Use}: N_A = 6 \times 10^{23}\right)$

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2. Displacement of the hydroxy1 group of alcohol can take place with variety of reagents. One such reaction is

$HBr + CH_3CH_2OH \rightarrow CH_3CH_2Br + H_2O$

The above reaction has a two-step mechanism.

$(a) CH_3CH_2OH + H^+ \overset{k_{eq}}{\Leftrightarrow} CH_3CH_2OH_2^+$

$(b) CH_3CH_2OH_2^+ + Br^- \overset{k_2}{\rightarrow} CH_3CH_2Br + H_2O$

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 $10^{-6} M/\sec$.

$\left[\text{Given}: K_{eq} = 4M^{-1} \text{and} K_2 = 5 \times 10^{-2} M^{-1} \sec^{-1}\right]$

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3. The Arrhenius equation for two first order equation $A \rightarrow B$ and $C \rightarrow D$ is given by

$k_1 = 10^{12} \quad e^{-81.28(kJ)/(RT)}$

$k_2 = 10^{11} \quad e^{-43.10(KJ)RT}$

At what temperature k_1 becomes equal to k_2. The unit of activation energy is kJ/mol

$\text{Use}: In10 = 2.3 \text{and} R = 8.3 J/K/\mathrm{mol}$

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4. An isotope of potassium K_{40} undergoes two parallel types of decy, one by electron capture and other by β decay with half lives as 1.3×10^9 years and $\frac{1.3}{9} \times 10^9$ years respectively If in a sample of a mineral, mass ratio of $K: ArCa \text{is} 5 \text{and} 16$ 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 you answer is 2×10^9 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 :

$A \rightarrow 2B + C$

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 hars Assume constant temperature of $25\,^{\circ}C$, throughout . The vapour pressure of pure water at $25\,^{\circ}C$ 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 .

$A(g) \rightarrow 2B(g) + C(g) + D(g)$

If molar masses of A,B,C and D are 450 , 100 , 50 and 200 respectively and rate constant of disappearance of $A is 0.693 \times 10^{-3} sec^{-1}$, 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 $25^{\circ}C$ and in 15 min at $55^{\circ}C$. The approximate value of `(K_(35^(@)C))/(K_(25^(@) C))is :

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8. For a first order polymerisation reaction:

$nA(g) \rightarrow A_n(g)$

occuring at constant volume and temperature the half-life of polymerisation of 'A' is 20 min. If the total pressure of system is 2atm at $t = 0 \text{and} 1.2 \text{atm at} t = 20 \text{min}$. 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.

$\left[\text{Given : radius of nucleus } = \frac{4}{3} \times 10^{-13} A^{1/3} \text{cm where}' A' \text{ represents mass number}\right.$

$\left[\text{Express your answer in terms of} 10^8 \text{dps}/g.\right]$

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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 $0.5 L \text{of} 2 M H_2O_2$ solution (in kJ)

$H_2O_2(aq) \rightarrow H_2O(l) + \frac{1}{2}O_2(g)$

$\Delta H = 100 kJ/\text{mole}$

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11. The total nubmer of αandβ particles emitted in the nuclear reaction

$\cdot{}^{238}_{92}U \rightarrow {}^{214}_{82}Pb$ is :

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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 : In 2= 2.3

[Express your answer by dividing it by 1000.]

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13. For the first order decomposition reaction:

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

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. $[\text{Given}: In3 = 1.1 \text{and} In2 = 0.7]$[Assume initially O_2 is absent]

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14. For a gaseous reaction,

$2A(g) + B(g) \rightarrow C(g), \Delta H = -30\text{Kcal}/\text{mole at}300K$

If the reaction follows the rate law $\frac{d[C]}{dt} = 4 \times 10^{-3}[A]^2[B]M/\text{min}$ and initially concentration of $B \text{is} [B] = 10^{-3}M$ and concentration of A is $[A] = 1M$, 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}cal/min]

$[\text{Use}: R = 2\text{cal}/\text{mol}K]$

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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 then . $-0.186\,^\circ C$ (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.

$\left[K_f\left(H_2O\right) = 1.86K - Kg\text{mole}^{-1}\right]$

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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 : In 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 $\left[t_{1/x}\right.$ 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:

$$A. \xrightarrow{k_1 = 0.2 \min^{-1}} B \xrightarrow{k_2 = 0.2 \min^{-1}} C$$

$t = 0aM \quad 0 \quad 0$

The time (in min) at which concentration of B becomes maximum is :

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19. A first order reaction,

$3A(g) \rightarrow 2B(g) + 3C(g)$

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 $._{92}^{235}U$ undergoes controlled nuclear fission to $._{54}^{142}Xe$ and $._{38}^{90}Sr$ is :

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21. For the reaction $A(g) \rightarrow 2B(g)$

$$\frac{d[B]}{dt} = 6 \times 10^{-4} M\sec^{-1} \text{when}[A] = 0.1M$$
$$\frac{d[B]}{dt} = 2.4 \times 10^{-3} M\sec^{-1} when[A] = 0.4M$$

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 In k (rate constant) at 100 K. Give your answer by multiplying with 10 $[\text{Given}: In 1000 \cong 7]$

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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.

$H_3A \rightarrow H_2B + HC, k = 0.04 \text{min}^{-1}$

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 $t = 25$min is :

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25. To carry out metabolim oxygen is taken up by haemoglobin (Hb) to from oxyhaemoglobin $\left(HbO_2\right)$ according to the elementary reaction:

$$Hb(aq) + O_2(aq) \xrightarrow{K} HbO_2(aq)$$

the value of K is $2.0 \times 10^6 M^{-1} s^{-1}at37\,^\circ C$(body temperature). For an average adult the concentrations of Hb and O_2 in the blood in the lungs are $8.0 \times 10^{-6}M$and$1.5 \times 10^{-6}M.$ respectively. The rate of formation of HbO_2increases ot $1.6 \times 10^{-4}Ms^{-1}$ during an exercise to meet the demand of increased metabolism rate. Assuming the Hb concentration to ramain same, what must the oxygen concentration be to sustain this rate of HbO_2formation?

[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 :

$$A \xrightarrow{k = 10^{-3}\,\text{min.}^{-1}} 2B + C$$

the specific rotations of A,B and C are $+40^\circ$, $+10^\circ$ and -30° per mole , respectively Initially A and C were present in 4:3 mole ratio After what time (in min), the sample becomes optically inactive?

$$\left[\text{Given} In\frac{7}{5} = 0.34, In\frac{20}{13} = 0.43\right]$$

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27. Gaseous decomposition of A follows Ist order kinetics . Pure A (g) is taken in a sealed flask where decomposition occurs as

$A(g) \rightarrow 2B(g) + C(g)$

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 $\sec^{-1}$.

Given : Molecular weight of A = 16, Molecular weight of B =4 , Molecular weight of C=8

$[In3 = 1.1, In2 = 0.7]$

[Write your answer by multiplying it with 100.]

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28. For a reaction : $A(g) \rightarrow nB(g)$ the rate constat is $6.93 \times 10^{-4}\text{sec}^{-1}$. the reaction is performed at constant pressure and tomperature of 24.63 atm and 300K starting with 1 mole of pure A.

If concentration of B after 2000 sec is $\frac{3}{3.25}$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 $2.4 \times 10^{-3} molL^{-1}s^{-1} on 20\,\%$ reaction of A and the rate is $9.6 \times 10^{-5} molL^{-1}s^{-1} on 84\,\%$ 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 $\left(\text{insec}^{-1}\right) k_1 \text{and} k_2$ respectively. The energy of activations for the two reactions are 152.30 kJ $\text{mol}^{-1} \text{and} 157.7 kJ\text{mol}^{-1}$ as well as frequency factors are $10^{13} \text{and} 10^{14}$ 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 :

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

is given as rate $= k[NO]^2 . \left[O_2\right]$. 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

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

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_1andK_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 $(\text{in mol}/1/\text{min})$(at time =0) of the reaction using concentration in moles per litre and time in minutes. Reactions 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 $NaOH$. $(\log 2 = 0.30, \log 3 = 0.48, In10 = 2.3)$ (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,

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

rate of reaction $= 0.1\text{atm}/\text{sec}$. Initially only NH_3 is present and its pressure $= 3$atm . 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 $[A]_t^4 = \frac{1}{t+1}$ where 't' is time in sec and $\left[A_t\right]$ 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? ltbregt $._{29}^{63}Cu + ._{1}^{1}H \rightarrow 6._{0}^{1}n + a + 2_{1}^{1}H + X$

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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 :

$A_2(g) \rightarrow 2A(g)$

An empty flask was filled with $A_2(g) \text{and} N_2(g)$ 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 $2 \times 10^{-3} M \text{and} 10^{-3} M$ are equal to $2.4 \times 10^{-4} \text{mol dm}^{-3} \text{sec}^{-1} \text{and} 0.6 \times 10^{-4} \text{mol dm}^{3} \text{sec}^{-1}$ respectively. Find rate constant of reaction in units $\left[mol^{-1} dm^{3n-3} \sec^{-1}\right]$ 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 $\alpha \text{and} \beta$emission. Calculate the total number of

$\cdot_{-(1)}^{0}\beta$ 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 redionuclides 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 Ist order reactions:

$A \rightarrow P \quad \ldots\ldots(i)$

$B \rightarrow Q \quad \ldots\ldots(ii)$

Reaction (i) is 75% completion in 4 hrs while reaction (ii) takes 16 hr for 75% completion under indentical 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 ot $1/3$ of the original activity $\left(A_0\right)$ 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 $27\,^{\circ}C$ uncatalysed reaction equals the rate constant at $\cdot_{-73\,^{\circ}C}$ for cataysed 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 $._{90}^{232}Th$ and it's 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 $._{90}^{232}Th$?

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55. $xA + yB \rightarrow zC.$

(Here x, y, z are simplest whole number rations)

$If - \frac{d[A]}{dt} = - \frac{d[B]}{dt} = 1.5\frac{d[C]}{dt} = \text{then} x + y + z is:$

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56. $A(g) \rightarrow B(g) + C(g)$

Initial concentration of A is 20 M and concentration of C after 18 minutes is 15 M then calculate half life time (in minues) 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 $\left(\text{in}C_i\right)$ after 12000 yrs $\left(t_{1/2}\text{of}C^{14} = 6000\text{yrs}\right)$

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58. A radioactive element decays by following three different parallel paths :

$A \xrightarrow{\lambda_1} B, \lambda_1 = 5 \times 10^{-2}\text{sec}^{-1}$

$2A \xrightarrow{\lambda_2} C, \lambda_2 = 3 \times 10^{-2}\text{sec}^{-1}$

$3A \xrightarrow{\lambda_3} D, \lambda_3 = 5 \times 10^{-3}\text{sec}^{-1}$

Calculate average life- time of element (in sec.)

$\left[\lambda_1, \lambda_2, \lambda_3\text{are decay constans for respective reactions}\right]$

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59. In reaction $A(g) \rightarrow B(g) + C(g)$

if initial pressure fo $A(g)$ is 100 m.m. 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 $0.693\sec^{-1}$. Determine time (in sec) required for 93.75% hydrolysis of ester.

$[\text{In}2 = 0.693]$

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61. If rate of reaction becomes double when temperature is increases from $27^{\circ} C \text{to} 37^{\circ} C$. Then find activation energy of reaction in calorie.

$(R = 2\text{cal}/\text{mol} - K)I\text{in}2 = 0.7)$

[Fill your answer after dividing by 10.]

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62. $._{Z}^{M}A(g) \rightarrow ._{Z-4}^{M-8}B(g) + (\alpha \text{ - particles})$

(α. particles are helium nuclei, so will form He gas by trapping electrons).

The radioactive disintergration follows 1st order kinetics, starting with 1 mole of A in a 16.4 litre closed flask at $127\,^{\circ}C$.

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 6.93×10^{15}dps then find weight of X (in mg). $\left(T_{1/2} = 100\text{minutes.}, N_A = 6 \times 10^{23}\right)$

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