



## CHEMISTRY

### BOOKS - SURA CHEMISTRY (TAMIL ENGLISH)

#### CHEMICAL KINETICS

#### Evaluation Choose The Correct Answer

1. For a first order reaction  $A \rightarrow B$  the rate constant is  $x \text{ min}^{-1}$ . If the initial concentration of A is 0.01 M, the concentration of A after one hour is given by the expression.

A.  $0.01e^{-x}$

B.  $1 \times 10^{-2}(1 - e^{-60x})$

C.  $(1 \times 10^{-2})e^{-60x}$

D. none of these

**Answer: C**

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2. A zero order reaction  $X \rightarrow \text{Product}$ , with an initial concentration 0.02 M has a half life of 10 min. If one starts with concentration 0.04 M, then the half life is

A. 10 s

B. 5 min

C. 20 min

D. cannot be predicted using the given information

**Answer: C**

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3. Among the following graphs showing variation of rate constant with temperature (T) for a reaction the one that exhibits Arrhenius behavior over the entire temperature range is .....

A. 

B. 

C. 

D. 

**Answer: B**

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4. For a first order reaction  $A \rightarrow$  product with initial concentration  $x \text{ mol L}^{-1}$ , has a half life period of 2.5 hours. For the same reaction with initial concentration  $\left(\frac{x}{2}\right) \text{ mol L}^{-1}$  the half life is

A.  $(2.5 \times 2)$  hours

B.  $\left(\frac{2.5}{2}\right)$  hours

C. 2.5 hours

D. Without knowing the rate constant,  $t_{1/2}$  cannot be determined

from the given data

**Answer: D**



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5. For the reaction,  $2NH_3 \rightarrow N_2 + 3H_2$

$$\text{if } \frac{-d[NH_3]}{dt} = k_1[NH_3],$$

$$\frac{d[N_2]}{dt} = k_2[NH_3], \quad \frac{d[H_2]}{dt} = k_3[NH_3]$$

then the relation between  $k_1$ ,  $k_2$  and  $k_3$  is

A.  $k_1 = k_2 = k_3$

B.  $k_1 = 3k_2 = 2k_3$

C.  $1.5k_1 = 3k_2 = k_3$

D.  $2k_1 = k_2 = 3k_3$

**Answer: C**

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6. The decomposition of phosphine ( $PH_3$ ) on tungsten at low pressure is a first order reaction. It is because the

A. rate is proportional to the surface coverage

B. rate is inversely proportional to the surface coverage

C. rate is independent of the surface coverage

D. rate of decomposition is slow

**Answer: A**

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7. For a reaction  $\text{Rate} = k [\text{acetone}]^{\frac{3}{2}}$  then unit of rate constant and rate of reaction respectively is

A.  $(\text{mol L}^{-1} \text{s}^{-1}), (\text{mol}^{\frac{-1}{2}} \text{L}^{\frac{1}{2}} \text{s}^{-1})$

B.  $(\text{mol}^{\frac{-1}{2}} \text{L}^{\frac{1}{2}} \text{s}^{-1}), (\text{mol L}^{-1} \text{s}^{-1})$

C.  $(\text{mol}^{\frac{1}{2}} \text{L}^{\frac{1}{2}} \text{s}^{-1}), (\text{mol L}^{-1} \text{s}^{-1})$

D.  $(\text{mol L s}^{-1}), (\text{mol}^{\frac{1}{2}} \text{L}^{\frac{1}{2}} \text{s})$

**Answer: B**

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8. The addition of a catalyst during a chemical reaction alters which of the following quantities ?

A. Enthalpy

B. Activation energy

C. Entropy

D. Internal energy

**Answer: B**



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9. Consider the following statements :

(i) increase in concentration of the reactant increases the rate of a zero order reaction.

(ii) rate constant  $k$  is equal to collision frequency  $A$  if  $E_a = 0$

(iii) rate constant  $k$  is equal to collision frequency  $A$  if  $E_a = 0^\circ$

a plot of  $\ln(k)$  vs  $T$  is a straight line.

(v) a plot of  $\ln(k)$  vs  $\left(\frac{1}{T}\right)$  is a straight line with a positive slope.

Correct statements are

A. (ii) only

B. (ii) and (iv)

C. (ii) and (v)

D. (i), (ii) and (v)

**Answer: A**



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**10.** In a reversible reaction, the enthalpy change and the activation energy in the forward direction are respectively  $-x \text{ kJ mol}^{-1}$  and  $y \text{ kJ mol}^{-1}$ . Therefore, the energy of activation in the backward direction is

A.  $(y - x) \text{ kJ mol}^{-1}$

B.  $(x + y) \text{ J mol}^{-1}$

C.  $(x - y) \text{ kJ mol}^{-1}$

D.  $(x + y) \times 10^3 \text{ J mol}^{-1}$



**Answer: D**

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**11.** What is the activation energy for a reaction if its rate doubles when the temperature is raised from 200 K to 400 K ?

$$(R = 8.314JK^{-1}mol^{-1})$$

A.  $234.65kJ\ mol^{-1}K^{-1}$

B.  $434.65kJ\ mol^{-1}K^{-1}$

C.  $434.65J\ mol^{-1}K^{-1}$

D.  $334.65J\ mol^{-1}K^{-1}$

**Answer: C**

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12. For a first order reaction, the rate constant is  $6.909\text{min}^{-1}$ , the time taken for 75% conversion in minutes is

A.  $\left(\frac{3}{2}\right)\log 2$

B.  $\left(\frac{2}{3}\right)\log 2$

C.  $\left(\frac{3}{2}\right)\log\left(\frac{3}{4}\right)$

D.  $\left(\frac{2}{3}\right)\log\left(\frac{4}{3}\right)$

**Answer: B**

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13. In a first order reaction  $x \rightarrow y$ , if  $k$  is the rate constant and the initial concentration of the reactant  $x$  is  $0.1\text{ M}$ , then, the half life is

A.  $\left(\frac{\log 2}{k}\right)$

B.  $\left(\frac{0.693}{(0.1)k}\right)$

C.  $\left(\frac{In2}{k}\right)$

D. none of these

**Answer: C**

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**14.** Assertion : rate of reaction doubles when the concentration of the reactant is doubles if it is a first order reaction.

Reason : rate constant also doubles

A. Both assertion and reason are true and reason is the correct explanation of assertion.

B. Both assertion and reason are true but reason is not the correct explanation of assertion.

C. Assertion is true but reason is false.

D. Both assertion and reason are false.

**Answer: C**



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**15.** The rate constant of a reaction is  $5.8 \times 10^{-2} \text{ s}^{-1}$ . The order of the reaction is

- A. First order
- B. zero order
- C. Second order
- D. Third order

**Answer: A**



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16. For the reaction  $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ , the value of rate of disappearance of  $N_2O_5$  is given as  $6.5 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$ .

The rate of formation of  $NO_2$  and  $O_2$  is given respectively as

A.  $(3.25 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1})$  and  $(1.3 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1})$

B.  $(1.3 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1})$  and  $(3.25 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1})$

C.  $(1.3 \times 10^{-1} \text{ mol L}^{-1} \text{ s}^{-1})$  and  $(3.25 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1})$

D. none of these

**Answer: C**

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17. During the decomposition of  $H_2O_2$  to give dioxygen, 48 g  $O_2$  is formed per minute at certain point of time. The rate of formation of water at this point is

A.  $0.75\text{mol min}^{-1}$

B.  $1.5\text{mol min}^{-1}$

C.  $2.25\text{mol min}^{-1}$

D.  $3.0\text{mol min}^{-1}$

**Answer: D**

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**18.** If the initial concentration of the reactant is doubled, the time for half reaction is also doubled. Then the order of the reaction is

A. Zero

B. one

C. Fraction

D. none

Answer: A

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19. In a homogeneous reaction

$A \rightarrow B + C + D$ , the initial pressure was  $P_0$  and after time  $t$  it was

$P$ . Expression for rate constant in terms of  $P_0$ ,  $P$  and  $t$  will be

.....

A.  $k = \left( \frac{2.303}{t} \right) \log \left( \frac{2P_0}{3P_0 - P} \right)$

B.  $k = \left( \frac{2.303}{t} \right) \log \left( \frac{2P_0}{P_0 - P} \right)$

C.  $k = \left( \frac{2.303}{t} \right) \log \left( \frac{3P_0 - P}{2P_0} \right)$

D.  $k = \left( \frac{2.303}{t} \right) \log \left( \frac{2P_0}{3P_0 - 2P_0} \right)$

Answer: A

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20. If 75% of a first order reaction was completed in 60 minutes, 50% of the same reaction under the same conditions would be completed in

- A. 20 minutes
- B. 30 minutes
- C. 35 minutes
- D. 75 minutes

**Answer: B**

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21. The half life period of a radioactive element is 140 days. After 560 days, 1 g of element will be reduced to

- A.  $\left(\frac{1}{2}\right)g$



B.  $\left(\frac{1}{4}\right)g$

C.  $\left(\frac{1}{8}\right)g$

D.  $\left(\frac{1}{16}\right)g$

**Answer: D**

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**22.** The correct difference between first and second order reactions is that

A. A first order reaction can be catalysed , a second order reaction cannot be catalysed.

B. The half life of a first order reaction does not depend on  $[A_0]$ , the half life of a second order reaction does depend on  $[A_0]$ .

C. The rate of a order reaction does not depend on reactant concentrations, the rate of a second order reaction does depend on reactant concentrations.

D. The rate of a first order reaction does depend on reactant concentrations , the rate of a second order reaction does not depend on reactant concentrations.

**Answer: B**

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23. After 2 hours, a radioactive substance becomes  $\left(\frac{1}{16}\right)^{th}$  of original amount. Then the half life (in min) is

A. 60 minutes

B. 120 minutes

C. 30 minutes

D. 15 minutes

**Answer: C**

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## Answer The Following Questions

1. Introduction: average rate and instantaneous rate

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2. Define Rate law and Rate constant.

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3. Derive integrated rate law for a zero order reaction  $A \rightarrow \text{product}$ .

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4. Define half life of a reaction, Show that for a first order reaction half life is independent of initial concentration.

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5. What is an elementary reaction ? Given the differences between order and molecularity of a reaction.

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6. Explain the rate determining step with an example.

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7. Describe the graphical representation of first order reaction.

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8. Write the law for the following reactions.

A reaction that is  $3/2$  order in  $x$  and zero order in  $y$ .

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9. Write the law for the following reactions.

A reaction that is second order in  $\text{NO}$  and first order in  $\text{Br}_2$ .

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10. Explain the effect of catalyst on reaction rate with an example.





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11. The rate law for a reaction of A, B and C has been found to be rate  $= [A]^2[B][L]^{\frac{3}{2}}$ . How would the rate of reaction change when Concentration of [L] is quadrupled



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12. The rate law for a reaction of A, B and C has been found to be rate  $= [A]^2[B][L]^{\frac{3}{2}}$ . How would the rate of reaction change when Concentration of both [A] and [B] are doubled



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13. The rate law for a reaction of A, B and C has been found to be rate  $= [A]^2[B][L]^{\frac{3}{2}}$ . How would the rate of reaction change when Concentration of [A] is halved

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14. The rate law for a reaction of A, B and C has been found to be rate  $= [A]^2[B][C]^{\frac{3}{2}}$ . How would the rate of reaction change when Concentration of [A] is reduced to  $\left(\frac{1}{3}\right)$  and concentration of [C] is quadrupled.

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

B.  $\frac{4}{3}$

C.  $\frac{4}{9}$

D.  $\frac{8}{9}$

**Answer: c**

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15. The rate of formation of a dimer in a second order reaction is  $7.5 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$  at  $0.05 \text{ mol L}^{-1}$  monomer concentration. Calculate the rate constant.

A. 0.15

B. 3

C. 0.3

D. 1.5

**Answer: b**

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16. For a reaction  $x + y + z \rightarrow$  products the rate law is given by rate  $k = [x]^{\frac{3}{2}} [y]^{\frac{1}{2}}$  what is the overall order of the reaction and what is the order of the reaction with respect to z.

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17. Explain briefly the collision theory of bimolecular reactions.

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18. Write Arrhenius equation and explains the terms involved.

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19. The decomposition of  $Cl_2O_7$  at 500 K in the gas phase to  $Cl_2$  and  $O_2$  is a first order reaction. After 1 minute at 500 K, the pressure of  $Cl_2O_7$  falls from 0.08 to 0.04 atm. Calculate the rate constant in  $s^{-1}$ .

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20. Hydrolysis of methyl acetate in aqueous solution has been studied by titrating the liberated acetic acid against sodium hydroxide. The concentration of an ester at different temperatures is given below.

t (min)	0	20	40	60	$\infty$
v (mL)	20.2	25.6	29.5	32.8	50.4

Show that the reaction is the first order reactions.

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21. Explain pseudo first order reaction with an example.

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22. Identify the order for the following reactions

Rusting of Iron

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23. Identify the order for the following reactions

Radioactive disintegration of  ${}_{92}\text{U}^{238}$

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24. Identify the order for the following reactions

$2A + 3B \rightarrow \text{products}$ , rate =  $k[A]^{1/2}[B]^2$

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25. A gas phase reaction has energy of activation  $200\text{kJ mol}^{-1}$ . If the frequency factor of the reaction is  $1.6 \times 10^{13}\text{s}^{-1}$ . Calculate the rate constant at 600 K. ( $e^{-40.09} = 3.8 \times 10^{-18}$ ).

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26. For the reaction  $2x + y \rightarrow L$ . Find the rate law from the following data.

[X] (min)	[Y] (min)	rate ( $M s^{-1}$ )
0.2	0.02	0.15
0.4	0.02	0.30
0.4	0.08	1.20

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27. How do concentrations of the reactant influence the rate of reaction ?

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28. How do nature of the reactant influence rate of reaction ?

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29. The rate constant for a first order reaction is  $1.54 \times 10^{-3} \text{ s}^{-1}$ .

Calculate its half life time.

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30. The half life of the homogeneous gaseous reaction  $SO_2Cl_2 \rightarrow SO_2 + Cl_2$  which obeys first order kinetics is 8.0 minutes.

How long will it take for the concentration of  $SO_2Cl_2$  to be reduced to 1% of the initial value ?

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31. The time for half life change in a first order decomposition of a substance A is 60 seconds. Calculate the rate constant. How much of A will be left after 180 seconds ?

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32. A zero order reaction is 20% complete in 20 minutes. Calculate the value of the rate constant. In what time will the reaction be 80% complete ?

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33. The activation energy of a reaction is  $22.5 \text{ k Cal mol}^{-1}$  and the value of rate constant at  $40^\circ \text{ C}$  is  $1.8 \times 10^{-5} \text{ s}^{-1}$ . Calculate the frequency factor, A.

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34. Benzene diazonium chloride in aqueous solution decomposes according to the equation  $C^6H^5N^2Cl \rightarrow C_6H_5Cl + N_2$  Starting with an initial concentration of  $10 \text{ g L}^{-1}$ , the volume of  $N_2$  gas obtained at  $50^\circ \text{ C}$  at different intervals of time was found to be as

under :

t (min):	6	12	18	24	30	$\infty$
Vol. of $N_2$ (ml):	19.3	32.6	41.3	46.5	50.4	58.3

Show that the above reaction follows the first order kinetic. What is the value of the rate constant ?

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**35.** From the following data, show that the decomposition of hydrogen peroxide is a reaction of the order :

t (min)	0	10	20
V (ml)	46.1	29.8	19.3

Where t is the time in minutes and V is the volume of standard  $KMnO_4$  solution required for titrating the same volume of the reaction mixture.

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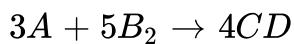
36. A first order reaction is 40% complete in 50 minutes. Calculate the value of the rate constant. In what time will the reaction be 80% complete ?



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### Evaluate Yourself

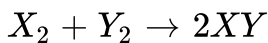
1. Write the rate expression for the following reactions, assuming them as elementary reactions.



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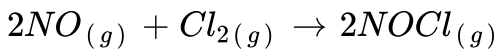
2. Write the rate expression for the following reactions, assuming them as elementary reactions.





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3. Find the individual and overall order of the following reaction using the given data.



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4. In a first order reaction A products 60% of the given sample of a decomposes in 40 min. What is the half of the reaction ?

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5. The rate constant for a first order reaction is  $2.3 \times 10^{-4} \text{ s}^{-1}$ . If the initial concentration of the reactant is 0.01m. What concentration will remain after 1 hour ?

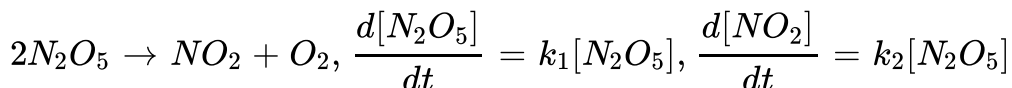
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6. For a first order reaction the rate constant at 500 k is  $8 \times 10^{-4} \text{ s}^{-1}$ . Calculate the frequency, if the energy of activation for the reaction is  $190 \text{ kJ mol}^{-1}$ .

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### Additional Questions And Answers Choose The Correct Answer

1.



and  $\frac{dO_2}{dt} = k_3[N_2O_5]$ , the relation between  $k_1$ ,  $k_2$  and  $k_3$  is

A.  $2k_1 = 4k_2 = k_3$

B.  $k_1 = k_2 = k_3$

C.  $2k_1 = k_2 = 4k_3$

D.  $2k_1 = k_2 = k_3$

**Answer: C**

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2. What would be the rate of disappearance of oxygen, if the rate of formation of nitric oxide (NO) is  $3.6 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$  ?

A.  $4 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

B.  $4 \times 10^{-3} \text{ mol}^{-1} \text{ L}^{-1} \text{ s}^{-1}$

C.  $4.5 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

D.  $4.5 \times 10^{-3} \text{mol}^{-1} \text{L}^{-1} \text{s}^{-1}$

**Answer: C**

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3. For a reaction,  $2A + B \rightarrow 3C$ , The rate of appearance of C at time 't' is  $1.2 \times 10^{-4} \text{mol L}^{-1} \text{s}^{-1}$ . Identify the rate of reaction.

A.  $4 \times 10^{-5} \text{mol L}^{-1} \text{s}^{-1}$

B.  $4.5 \times 10^{-1} \text{mol L}^{-1} \text{s}^{-1}$

C.  $3.6 \times 10^{-4} \text{mol L}^{-1} \text{s}^{-1}$

D. None of these

**Answer: A**

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4. For the reaction,  $2N_2O_5 \rightarrow 4NO_2 + O_2$ , select the correct statement.

- A. Rate of formation of  $O_2$  is same as rate of formation of  $NO_2$
- B. Rate of disappearance of  $N_2O_5$  is two times the rate of formation of  $O_2$ .
- C. Rate of formation of  $O_2$  is 0.5 times rate of disappearance of  $N_2O_5$ ,
- D. Rate of formation of  $NO_2$  is equal to rate of disappearance of  $N_2O_5$

**Answer: C**

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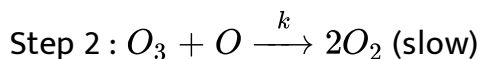
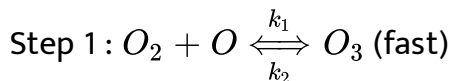
5. In pseudo - order reactions

- A. The actual order of reaction is different from that expected using rate law expression
- B. The concentration at least one reactant is taken in large excess.
- C. The concentration of reactant taken in excess may be taken as constant
- D. All of these

**Answer: D**

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6. The depletion of ozone involves the following steps :



The predicted order of the reaction will be

A. 1

B. II

C. III

D. Zero

**Answer: A**



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7. What would be the activation energy of a reaction when the temperature is increased from  $27^{\circ}C$  to  $37^{\circ}C$ ?

A.  $534\text{kJ mol}^{-1}$

B.  $53.4\text{kJ mol}^{-1}$

C.  $5.34\text{kJ mol}^{-1}$

D. None of these

**Answer: B**

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8.  $A + B \rightarrow C$ ,  $\Delta H = + 60\text{kJ mol}^{-1}$ .  $E_{a_f} = 150\text{kJ}$ . What is the activation energy of the backward reaction ?

A. 210 kJ

B. 105 kJ

C. 90 kJ

D. 145 kJ

**Answer: C**

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9. The Unit of rate constant and rate of reaction are same for

A. First order



B. second order

C. Third order

D. zero order

**Answer: D**

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**10.** Which of the following does not affect the rate of reaction ?

A. Amount of the reactant taken

B. Physical state of the reactant

C.  $\Delta H$  of reaction

D. Size of vessel

**Answer: C**

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11. Which of the following statement is not correct ?

- A. Molecularity of a reaction cannot be fractional
- B. Molecularity of a reaction cannot be more than three
- C. Molecularity of a reaction can zero.
- D. Molecularity is assigned for each elementary step of mechanism.

**Answer: C**

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12. Which order reaction obeys the expression  $t_{1/2} \propto \frac{1}{[A]}$  ?

- A. First
- B. Second

C. Third

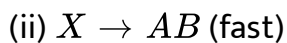
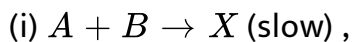
D. zero

**Answer: B**



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**13.** For an exothermic chemical process occurring in 2 steps as



The progress of the reaction can be best described by (x - intermediate).

A. 

B. 

C. 

D. None of these

Answer: C



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14. The graph between. The log K versus  $\frac{1}{T}$  is a straight line. The slope of the line is

A.  $\frac{-2.303R}{Ea}$

B.  $\frac{-Ea}{2.303R}$

C.  $\frac{2.303R}{Ea}$

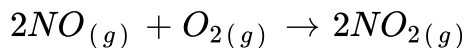
D.  $\frac{Ea}{2.303R}$

Answer: B

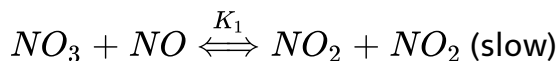
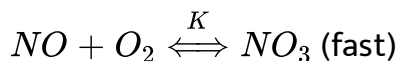


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15. Nitric oxide (NO) reacts with oxygen to produce nitrogen dioxide



If the mechanism of reaction is



A. Rate  $K' [NO][O_2]$

B. Rate =  $K' [NO][O_2]_2$

C. Rate =  $K' [NO]^2 [O_2]$

D. Rate  $K' [NO]^3 [O_2]$

**Answer: C**

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16. The addition of a catalyst during a chemical reaction alters which of the following quantities ?

A. Activation energy

B. Entropy

C. Internal energy

D. Enthalpy

**Answer: A**

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17. A reaction having equal activation energies for forward and reverse reactions has

A.  $\Delta G = 0$

B.  $\Delta H = 0$

C.  $\Delta H = \Delta G = \Delta S = 0$

D.  $\Delta S = 0$

**Answer: B**

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**18.** The given reaction  $2FeCl_3 + SnCl_2 \rightarrow 2FeCl_2 + SnCl_4$  is an example of

- A. I order
- B. II order
- C. III order
- D. None of these

**Answer: C**

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**19.** Enzymes increase the rate of reactions.

- A. By lowering activation energy
- B. By increasing activation energy
- C. By changing equilibrium constant
- D. By forming enzyme substrate complex

**Answer: A**

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**20.** Activation energy of a chemical reaction can be determined by

- A. Evaluating rate constants at two different temperatures
- B. Evaluating velocities of reaction at two different temperatures
- C. Evaluating rate constant at standard temperature
- D. Changing concentration of reactants

**Answer: A**





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21.  $2A \rightarrow B + C$ . It would be a zero order reaction when.

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

**Answer: B**



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22. What will be the rate constant of a 1 order reaction, if its half life is given to be 20 min ?

- A.  $13.86\text{min}^{-1}$

B.  $28.86\text{min}^{-1}$

C.  $3.47 \times 10^{-2}\text{min}^{-1}$

D. None of these

**Answer: A**

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**23.** How much time will be taken for 20 gm to reduce 5 g ? [

$R = 2 \times 10^{-3}\text{s}^{-1}$  (1 order reaction)] [ $\log 4 = 0.6021$ ]

A.  $693.1\text{s}$

B.  $693.1\text{s}^{-1}$

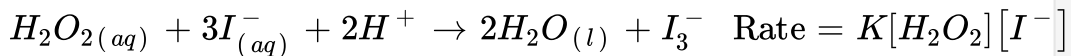
C.  $6.931\text{s}$

D.  $6.931\text{s}^{-1}$

**Answer: A**

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24. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.



A. 2,  $L \text{ mol}^{-1} s^{-1}$

B. 1,  $s^{-1}$

C.  $\frac{3}{2}$ ,  $L^{1/2} \text{ mol}^{-1/2} s^{-1}$

D. None of these

**Answer: A**

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25. During decomposition of an activated complex

- A. energy is always released
- B. energy is always absorbed
- C. energy does not change
- D. products may be formed

**Answer: A**

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**26.** A first order reaction is 50% completed in  $1.26 \times 10^{14}$ . How much time would it take for 100 % completion ?

- A.  $1.26 \times 10^{15} s$
- B.  $2.52 \times 10^{14} s$
- C.  $2.52 \times 10^{28} s$
- D. Infinite

**Answer: D**

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**27.** Concentration is expressed in ?

A.  $\frac{\text{number of moles / litre}}{\text{time in sec}}$

B.  $\frac{\text{time in sec}}{\text{number of moles / litre}}$

C.  $\frac{\text{number of moles / litre}}{\text{volume}}$

D.  $\frac{\text{volume}}{\text{number of moles / litre}}$

**Answer: A**

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**28.** During a chemical reaction, the concentration of reaction

- A. increases
- B. decreases
- C. remains constant
- D. first increases and then decreases

**Answer: B**



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29. For the second order reaction  $t_{\frac{1}{2}} \propto$

A.  $\frac{1}{a^2}$

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

C. constant

D. a

**Answer: B**



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30. The unit of zero order rate constant is

A. litre  $\text{mol}^{-1} \text{sec}^{-1}$

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

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

D. litre $^2 \text{sec}^{-1}$

**Answer: B**



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31. The excess energy which a molecule must possess to become active is known as

A. kinetic energy

B. threshold energy

C. potential energy

D. activation energy

**Answer: D**

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**32. Arrhenius equation is**

A.  $k = Ae^{-1/RT}$

B.  $k = Ae^{RT/E_a}$

C.  $k = Ae^{-E_a/RT}$

D.  $k = Ae^{E_a/RT}$

**Answer: C**

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33. The term A in Arrhenius equation is called as

- A. Probability factor
- B. Activation energy
- C. Collision factor
- D. Frequency factor

**Answer: D**

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34. The half life period of a first order reaction is 10 minutes. Then its rate constant is

- A.  $6.93 \times 10^2 \text{min}^{-1}$
- B.  $0.693 \times 10^{-2} \text{min}^{-1}$

C.  $6.932 \times 10^{-2} \text{min}^{-1}$

D.  $69.3 \times 10^{-1} \text{min}^{-1}$

**Answer: C**

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**35.** For a reaction :  $aA \rightarrow bB$ , the rate of reaction is doubled when the concentration of A is increased by four times. The rate of reaction is equal to

A.  $k[A]^a$

B.  $k[A]^{\frac{1}{2}}$

C.  $k[A]^{\frac{1}{a}}$

D.  $k[A]$

**Answer: B**

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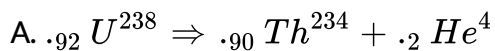
36. Compound A reacts by first order kinetics. At  $25^{\circ}C$ , the rate constant of the reaction is  $0.60 \text{ sec}^{-1}$ . What is the half life of A ?

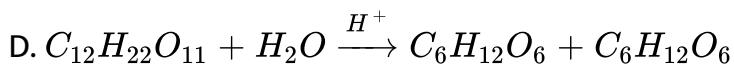
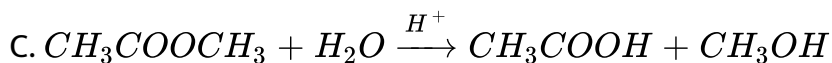
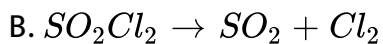
- A. 1.15 sec
- B. 0.4158 sec
- C. 0.093 sec
- D. 1.29 sec

**Answer: A**

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37. Pick out the odd one.





**Answer: C**

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**38.** If the initial concentration of the reactants is doubled in a zeroth order reaction, then rate

A. remains constant

B. doubled

C. is reduced to half of its value

D. is increased by four times of initial rate

**Answer: C**



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39. The rate of a reaction is expressed as  $k[A]^2[B]^1$ , the reaction is said to be

- A. second order with respect to A
- B. first order with respect to B
- C. overall order of the reaction is third order
- D. all the above

**Answer: D**



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40. Which one of the following is an example of pseudo first order reaction ?

- A. Acid hydrolysis of ester
- B. Decomposition of HI
- C. Synthesis of  $NH_3$
- D. All radioactive transformations

**Answer: A**

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**41.** The rate constant of a first order reaction is  $2.0 \times 10^{-6} s^{-1}$ . The initial concentration of the reactant is  $0.10 \text{ mol dm}^{-3}$ . What is the value of the initial rate ?

- A.  $2.0 \times 10^{-7} \text{ mol dm}^{-3} s^{-1}$
- B.  $2.0 \times 10^{-6} \text{ mol dm}^{-3} s^{-1}$
- C.  $2.0 \times 10^{-5} \text{ mol dm}^{-3} s^{-1}$
- D.  $2.0 \times 10^{-7} \text{ mol dm}^{-3} s^{-1}$

**Answer: A**



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**42.** If the activation energy is high, then the rate of the reaction is

A. high

B. moderate

C. low

D. cannot be predicted

**Answer: C**



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**43.** Pick out the effect of catalyst on activation energy ?

- A. Catalyst lowers the activation energy
- B. Catalyst provides alternate path to the reaction
- C. Both (a) and (b)
- D. None of these

**Answer: C**

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## Additional Questions And Answers Fill In The Blanks

1. In Arrhenius equation, if EA is positive and  $T_2 > T_1$ , then \_\_\_\_\_

A.  $k_1 = k_2$

B.  $k_2 < k_1$

C.  $k_1 = \frac{1}{k_2}$

D.  $k_2 > k_1$



**Answer: D**



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2. For the reaction  $A \rightarrow C$ , it is found that the rate of the reaction quadruples when the concentration of A is doubled. The rate for the reaction is  $\text{Rate} = [A]^n$ . The value of n is \_\_\_\_\_

A. 1

B. 2

C. 0

D. 3

**Answer: B**



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3. In the graph showing Maxwell, Boltzmann distribution of energy

-----

- A. area under the curve must not change with increase in temperature.
- B. area under the curve increases in temperature.
- C. area under the curve decreases with increase in temperature.
- D. None of these above

**Answer: A**



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4. For a complex reaction -----

- A. Order of overall reaction is same as molecularity of the slowest step.

- 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. None of these above.

**Answer: A**



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5. In any unimolecular reaction \_\_\_\_\_

- A. Only two reacting species is involved in the rate determining step.
- B. The order and the molecularity of slowest step are equal to one.

C. The molecularity of the reaction is one and order is zero.

D. Both molecularity and order of the reaction are one.

**Answer: B**

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6. Rate law cannot be determined from balanced chemical equation if

-----

A. Reverse reactions is not involved

B. It is an elementary reaction

C. It is a sequence of elementary reactions

D. All of the reactants is in excess. Rate law can be determined

from balanced chemical equation if it is an elementary reaction.

**Answer: C**

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7. The value of rate constant of a pseudo first order reaction \_\_\_\_\_.

- A. Independent on the concentration of reactants present in small amount
- B. Depends on the concentration of reactants present in excess
- C. Independent of the concentration of reactants
- D. Depends only on temperature.

**Answer: B**

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8.  $CH_3COOCH_3 + H_2O \xrightarrow{H^+} CH_3COOH + CH_3OH$  is an example of \_\_\_\_\_ order reaction.

- A. first
- B. zero
- C. third
- D. pseudo

**Answer: D**

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9. When the  $E_a$  of a reaction zero then the rate constant of the reaction is equal to \_\_\_\_\_

- A.  $2.303K$
- B.  $\frac{K}{2.303}$
- C.  $\left(t_{\frac{1}{2}}\right)$
- D.  $A$

**Answer: D**

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**10.** By the order of reaction we mean \_\_\_\_\_

- A. the sum of powers to which the concentration terms are raised in the rate equation
- B. the number of reactants take part in the reaction
- C. the number of concentration terms in the velocity equation for the reaction
- D. the least number of product molecule needed for the reaction

**Answer: A**

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11. The oxidation of potassium iodide by potassium persulphate as per the rate law, rate  $k[K_2S_2O_8][KI]$ . The order with respect to potassium iodide is \_\_\_\_\_

- A. two
- B. one
- C. three
- D. four

**Answer: B**

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12. If the rate law for a reaction is  $A + B \rightarrow$  is  $C \frac{d[A]}{dt} \times \frac{1}{2} = k[A]^n[B]^m$  then the order of a reaction is \_\_\_\_\_

- A. n
- B. m



C.  $n + m$

D.  $m - n$

**Answer: C**

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13. For a reaction  $2A + B \rightarrow 3C$ , express the rate of reaction in terms of formation of the product \_\_\_\_\_

A.  $\frac{1}{2} \frac{d[A]}{dt}$

B.  $\frac{-1}{3} \frac{d[C]}{dt}$

C.  $\frac{1}{3} \frac{d[C]}{dt}$

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

**Answer: C**

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14. Energy of activation of a reactant is reduced by \_\_\_\_\_

- A. reduced pressure
- B. increased pressure
- C. reduced temperature
- D. increased temperature

**Answer: D**

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15. Activation energy is equal to \_\_\_\_\_

- A. Threshold energy + Energy of colloding molecules
- B. Threshold energy
- C. Threshold energy  $\times$  Energy of colloidng molecules

D. Threshold energy - Energy of colliding molecules

Answer: A

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16. For the reaction  $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$  the rate of the reaction in terms of ammonia is \_\_\_\_\_

A.  $+\frac{1}{2} \frac{d[NH_3]}{dt}$

B.  $-\frac{1}{2} \frac{d[NH_3]}{dt}$

C.  $\frac{-d[NH_3]}{dt}$

D.  $\frac{+d[NH_3]}{dt}$

Answer: A

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17. The magnitude of order of a reaction may be \_\_\_\_\_

- A. fractional
- B. zero
- C. integral values
- D. All of these

**Answer: D**



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18. For a reaction,  $E_a = 0$  and  $k = 4.2 \times 10^5 \text{ sec}^{-1}$  at 300 K, the value of  $k$  at 310 K will be \_\_\_\_\_

- A.  $4.2 \times 10^5 \text{ sec}^{-1}$
- B.  $8.4 \times 10^5 \text{ sec}^{-1}$
- C.  $8.4 \times 10^{-5} \text{ sec}^{-1}$

D. unpredictable

**Answer: A**

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19. For an elementary reaction, its order is never \_\_\_\_\_ since it is a \_\_\_\_\_ step process.

A. integral, single

B. fractional, single

C. zero, one

D. fractional, zero

**Answer: B**

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20. In the acid hydrolysis of an ester what is the time taken for complete hydrolysis ?

- A. 8 hours
- B. 45 minutes
- C. Both (a) and (b)
- D. None

**Answer: A**

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21.  $CH_3COOCH_3 + H_2O \xrightarrow{H^+} CH_3COOH + CH_3OH$  is an example of \_\_\_\_\_ order reaction.

- A. first
- B. zero

C. third

D. pseudo

**Answer: D**



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22. The minimum energy that all colliding molecules must possess so as to make the collisions more effective and successful is \_\_\_\_\_.

A. Activation energy

B. colliding energy

C. threshold energy

D. kinetic energy

**Answer: C**



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23. For a general reaction  $aA + bB \rightarrow \text{Products}$ , the rate of the reaction is equal to \_\_\_\_\_.

A.  $k[A]^p[B]^q$

B.  $k[A][B]$

C.  $k$

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

**Answer: A**



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24. The time required for 50% completion of the reaction is known as \_\_\_\_\_.

A. Average life period



B. Half - life period

C. Rate

D. None of these

**Answer: B**



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**25.** In a second order reaction, if one of the concentration is excess, the order of the reaction is \_\_\_\_\_ order reaction.

A. first

B. pseudo first

C. third

D. zero

**Answer: B**

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26. The half - life period of a first order reaction is 69.3 seconds. Its rate constant is \_\_\_\_\_.

A.  $10^{-2} s^{-1}$

B.  $10^{-4} s^{-1}$

C.  $10 s^{-1}$

D.  $10^2 s^{-1}$

**Answer: A**

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27. If  $[A]$  is the concentration of A at any time  $t$  and  $[A_0]$  is the concentration at  $t = 0$ , then for the first order reaction, the rate equation can be written as \_\_\_\_\_.

$$\text{A. } k = \frac{2.303}{t} \log \left[ \frac{A}{A_0} \right]$$

$$\text{B. } k_t = 2.303 \log \left[ \frac{A_0}{A} \right]$$

$$\text{C. } k = \frac{2.303}{t} \log \left[ \frac{A_0}{[A_0] - [A]} \right]$$

$$\text{D. } k = \frac{2.303}{t} \log \left[ \frac{A_0}{A} \right]$$

**Answer: B**

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**28.** All radioactive transformations follow \_\_\_\_\_ order kinetics.

A. zero

B. first

C. second

D. third

**Answer: B**



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29. Activation energy of a reactant is reduced by \_\_\_\_\_.

- A. increased temperature
- B. reduced temperature
- C. increased perssure
- D. reduced pressure

**Answer: A**



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### Additional Questions And Answers Assertio Reason

1. Assertion : If temperature does not affect the rate of reaction,  $E_a = 0$ .

Reason : Lesser the activation energy, slower will be the reaction.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.
- B. Both assertion and reason are true but reason is not the correct explanation of assertion.
- C. Assertion is true but reason is false.
- D. Both assertion and reason are false.

**Answer: C**

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2. Define the rate of a reaction.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.

B. Both assertion and reason are true but reason is not the correct explanation of assertion.

C. Assertion is true but reason is false.

D. Both assertion and reason are false.

**Answer: A**

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**3.** Assertion : Order and molecularity of a reaction are always equal.

Reason : Complex reactions takes place in steps and fastest step determine the molecularity of reaction.

A. Both assertion and reason are true and reason is the correct explanation of assertion.

B. Both assertion and reason are true but reason is not the correct explanation of assertion.

C. Assertion is true but reason is false.

D. Both assertion and reason are false.

**Answer: D**

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4. Assertion : Hydrolysis of ester in acidic medium follows pseudo first order kinetics.

Reason : Hydrolysis of ester is independent of the concentration of acid used.

A. Both assertion and reason are true and reason is the correct explanation of assertion.

B. Both assertion and reason are true but reason is not the correct explanation of assertion.

C. Assertion is true but reason is false.

D. Both assertion and reason are false.

**Answer: A**

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5. Assertion : In presence of positive catalyst, activation energy & threshold energy decreases.

Reason : Minimum energy required to permit a reaction is known as threshold energy.

A. Both assertion and reason are true and reason is the correct explanation of assertion.

B. Both assertion and reason are true but reason is not the correct explanation of assertion.

C. Assertion is true but reason is false.

D. Both assertion and reason are false.



**Answer: B**

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**6.** Assertion : Rate constant determined from Arrhenius equation are fairly accurate for simple as well as complex molecule.

Reason : Reactant molecules undergo chemical change irrespective of their orientation during collision.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.
- B. Both assertion and reason are true but reason is not the correct explanation of assertion.
- C. Assertion is true but reason is false.
- D. Both assertion and reason are false.

**Answer: C**



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7. Assertion : All collision of reactant molecule lead to product formation.

Reason : Product formation is independent of orientation of the reactant molecules.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.
- B. Both assertion and reason are true but reason is not the correct explanation of assertion.
- C. Assertion is true but reason is false.
- D. Both assertion and reason are false.

**Answer: D**



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8. Assertion : The enthalpy of reaction remains constant in the presence of catalyst.

Reason : A catalyst participating in the reaction forms different activated complex and lowers down the activation energy of reactant and product remains the same.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.
- B. Both assertion and reason are true but reason is not the correct explanation of assertion.
- C. Assertion is true but reason is false.
- D. Both assertion and reason are false.

**Answer: A**



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9. Assertion : Order and molecularity are same.

Reason : Order is determined experimentally and molecularity is the sum of the stoichiometric coefficient of rate determining elementary step.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.
- B. Both assertion and reason are true but reason is not the correct explanation of assertion.
- C. Assertion is true but reason is false.
- D. Both assertion and reason are false.

**Answer: D**



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**10. Assertion :** Order of the reaction can be zero or fractional.

**Reason :** We cannot determine order from balanced chemical equation.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.
- B. Both assertion and reason are true but reason is not the correct explanation of assertion.
- C. Assertion is true but reason is false.
- D. Both assertion and reason are false.

**Answer: B**

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**11. Assertion :** Rate constant of zero order reaction has same units as the rate reaction.

**Reason :** Rate constant of zero order reaction does not depend upon unit of concentration.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.
- B. Both assertion and reason are true but reason is not the correct explanation of assertion.
- C. Assertion is true but reason is false.
- D. Both assertion and reason are false.

**Answer: C**



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**12. Assertion :** The order of reaction can have fractional value.

**Reason :** Order cannot be determined from a stiochiometrically balance equation.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.
- B. Both assertion and reason are true but reason is not the correct explanation of assertion.
- C. Assertion is true but reason is false.
- D. Both assertion and reason are false.

**Answer: B**



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**13. Assertion :** A catalyst is a substance which alters the rate of a reaction.

**Reason :** In the presence of catalyst the energy of activation is increased.

A. Both assertion and reason are true and reason is the correct explanation of assertion.

B. Both assertion and reason are true but reason is not the correct explanation of assertion.

C. Assertion is true but reason is false.

D. Both assertion and reason are false.

**Answer: C**



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14. Assertion : Hydrolysis of methyl acetate by HCl is a pseudo first order reaction.

Reason : HCl is used as catalyst in the above reaction.

- A. Both assertion and reason are true and reason is the correct explanation of assertion.
- B. Both assertion and reason are true but reason is not the correct explanation of assertion.
- C. Assertion is true but reason is false.
- D. Both assertion and reason are false.

**Answer: B**

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**Additional Questions And Answers Correct Statement S**

1. Which one of the following statements regarding order is correct ?

- A. Order should be determined only by experiment.
- B. Order of complex reaction are less than 3.
- C. Order can be determined from stoichiometric equation.
- D. Order must be a whole number.

**Answer: A**

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2. Two reaction  $A \rightarrow B$  and  $C \rightarrow D$  has the energy of activation 40 kJ and 60 kJ respectively. Which of the following statement is correct ?

- A. Comparison of rate cannot be determined
- B. The reaction  $A \rightarrow B$  proceeds at a faster rate compared to the reaction  $C \rightarrow D$

C. The reaction  $A \rightarrow B$  proceeds at a slower rate compared to the reaction  $C \rightarrow D$ .

D. Comparison of the cannot be determined

**Answer: B**

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## Additional Questions And Answers Incorrect Statement S

1. 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 not alters enthalpy change of the reaction.

**Answer: A**

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2. Consider the following statements and identify the incorrect statement(s).

(i) Decomposition of  $H_2O_2$  is an II order reaction

(ii)  $t_{1/2}$  is independent of initial concentration of a reaction.

(iii) Fractional order reactions are observed depending on their rates.

(iv) Rate =  $k[A]^p[B]^q$ ,  $p + q =$  order.

A. only (ii)

B. both (ii) and (iii)

C. only (i)

D. None of these

**Answer: C**





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3. Mark the incorrect statements.

- A. The rate of a reaction increase with increasing temperature.
- B. The rate of a reaction increases with the increase in the concentration of the reactants
- C. Gas phase reactions are slower than reactions involving solid reactants
- D. The rate of a reaction is affected by the surface are of the reactant.

**Answer: C**



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#### 4. About "Collision theory"

- A. Collision theory used to predict the rates of chemical reactions for gases.
- B. This theory is based on the kinetic theory of gases
- C. Chemical reactions occur as a result of collision between the reacting molecules
- D. Decrease in concentration of the reactant brings about more collisions.

**Answer: D**



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#### 5. Mark the incorrect statements.

- A. Rate of a reaction depends on the initial concentration of reactants
- B. Rate constant of a reaction does not depend on the initial concentration of reactants
- C. Concentration and surface area decreases the number of collision
- D. The molecularity of a reaction is the no. of molecules or ions that participate in the rate determining step.

**Answer: C**

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## Additional Questions And Answers Very Short Answer

1. What is the study of chemical kinetics used for ?

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2. For a reaction  $A + B \rightarrow C$ , the rate of the reaction is denoted  $\frac{-dA}{dt}$  or  $\frac{-dB}{dt}$  or  $\frac{+dC}{dt}$ . State the significance of plus and minus sign.

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3. Rate of chemical reaction is not uniform throughout. Justify your answer.

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4.  $H_{2(g)} + Cl_{2(g)} \xrightarrow{h\nu} 2HCl_{(g)}$  The reaction proceeds with a uniform rate throughout. What do you conclude ?

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5. Why is instantaneous rate preferred over average rate ?

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6. For a chemical reaction, Variation in the concentration In [A] vs time in seconds is given as



What is the order of the reaction ?

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7. For a chemical reaction, Variation in the concentration In [A] vs time in seconds is given as



Given the relationship between  $k$  and  $t^{\left(\frac{1}{2}\right)}$

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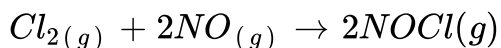
8. The decomposition reaction of ammonia gas on platinum surface has a rate constant  $R = 2.5 \times 10^{-4} \text{ mol L}^{-1}$ . What is the order of the reaction.

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9. The reaction  $A + 2B \rightarrow C$  obeys the rate equation. Rate =  $K[A]^{\frac{1}{2}}[B]^{\frac{3}{2}}$  What is the order of the reaction ?

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10. For the reaction



The rate law is expressed as

$$\text{rate} = K[\text{Cl}_2][\text{NO}]^2$$

What is the overall order of this reaction

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11. How does the value of rate constant vary with reactant constant.

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12. Why does the rate of any reacting generally decreases during the course of the reaction ?

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13. Answer the following :

Effect the adding catalyst on activation energy and Gibb's energy ( $\Delta G$ ).

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**14.** Answer the following :

Why do we heat the solution of oxalic acid in redox titration against  $KMnO_4$  ?

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**15.** Write the units of zeroth, first, second and third order rate constants.

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**16.** A first order reaction has a specific reaction rate of  $10^{-3} s^{-1}$ . How much time will it take for 10 gm of the reactant to reduce to 2.5 gm ?

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17. What would be the activation energy of a reaction when the temperature is increased from  $27^{\circ}C$  to  $37^{\circ}C$  ?

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18. In a reaction,  $2A \rightarrow$  products, the concentration of A decreases from  $0.5\text{mol L}^{-1}$  to  $0.4\text{mol L}^{-1}$  in 10 minutes. Calculate the rate during this interval ?

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19. Mention the factor that affected the rate of a chemical reaction.

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1. Prove that the time required for the completion  $\frac{3^{th}}{4}$  of the reaction of a first order is twice the time required for the completion of a half of the reaction.

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2. Molecularity of any reaction is not equal to zero. Why?

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3. For which type of reactions, order and molecularity have the same value?

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4. A reaction is of second order in A and first order in B.

Write the differential rate equation.

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5. A reaction is of second order in A and first order in B.

How is the rate affected on increasing the concentration of A three times ?

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6. A reaction is of second order in A and first order in B.

How is the rate affected when the concentration of both A and B is doubled ?

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7. Given examples for first order reaction.

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8. Give the characteristics of first order reaction.

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9. The rate constant, the activation energy and frequency factor of a chemical reaction at  $25^\circ\text{C}$  are  $3.0 \times 10^{-4}\text{ s}^{-1}$ ,  $104.4\text{ kJ mol}^{-1}$  and  $6.0 \times 10^{14}\text{ s}^{-1}$  respectively. What is the value of the rate constant when  $T \rightarrow \infty$ ?

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10. The energy of activation for the formation of hydrogen iodide is  $150\text{ kJ mol}^{-1}$ . The rate constant of this reaction at  $673\text{ K}$  is



$2.3 \times 10^{-3}$ . Calculate the rate constant 773 K.

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11. A first order reaction is found to have a rate constant  $k = 7.39 \times 10^{-5} \text{ s}^{-1}$ . Find the half life of this reaction.

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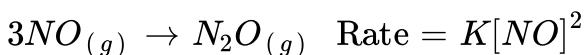
12. The rate constant  $k$  for the first order gas phase decomposition of ethyl iodide,  $C_2H_5I \rightarrow C_2H_4 + HI$  is  $1.60 \times 10^{-5} \text{ s}^{-1}$  at 600 K and  $6.36 \times 10^{-3} \text{ s}^{-1}$  at 700 K. Calculate the energy of activation for this reaction.

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13. The activation energy for the reaction,  $2HI_{(g)} \rightarrow H_{2(g)} + I_{2(g)}$  is  $209.5 \text{ KJ mol}^{-1}$  at 581 K. Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy.

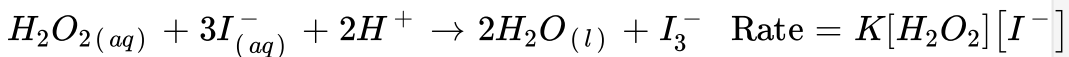
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14. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.



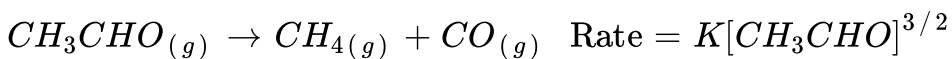
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15. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.



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16. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.



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17. From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.



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18. The decomposition of  $NH_3$  on platinum surface is zero order reaction what are the rates of production of  $N_2$  and  $H_2$  if  $k = 2.5 \times 10^{-4} mol^{-1} Ls^{-1}$ .

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19. A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is doubled

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20. A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is reduced to half

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21. What is the effect of temperature on the rate constant of a reaction ? How can this temperature effect on rate constant be represented quantitatively ?

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**22.** Reaction is first order in A and second in B.

Write the different rate equation.

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**23.** Reaction is first order in A and second in B.

How is the rate affected on increasing the concentration of B three times ?

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**24.** Reaction is first order in A and second in B.

How is the rate affected when the concentrations of both A and B are doubled ?

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25. Calculate the half - life of a first order reaction from their rate constants given below.

$$200s^{-1}$$

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26. Calculate the half - life of a first order reaction from their rate constants given below.

$$2 \text{ min}^{-1}$$

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27. Calculate the half - life of a first order reaction from their rate constants given below.

$$4 \text{ years}^{-1}$$

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28. The rate constant for a first order reaction is  $60s^{-1}$ . How much time will it take to reduce the initial concentration of the reactant to its  $\frac{1}{16}$  values ?

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29. Write the differences between rate and rate constant of a reaction.

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## Additional Questions And Answers Long Answer

1. For the reaction  $2A + B \rightarrow A_2B$ . The rate =  $k[A][B]^2$  with  $2.0 \times 10^{-6} mol^{-2} L^2 s^{-1}$ . Calculate the initial rate of the reaction,

when  $[A] = 0.1 \text{ mol L}^{-1}$ ,  $[B] = 0.2 \text{ mol L}^{-1}$ . Calculate the rate of reaction after  $[A]$  is reduced to  $0.06 \text{ mol L}^{-1}$ .

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2. In a pseudo first order hydrolysis of ester in water, the following results were obtained.

1	0	30	60	90
$[\text{Ester}] \text{ mol L}^{-1}$	0.55	0.31	0.17	0.085

Calculate the average rate of reaction between the time interval 30 to 60 seconds.

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3. In a pseudo first order hydrolysis of ester in water, the following results were obtained.

1	0	30	60	90
$[\text{Ester}] \text{ mol L}^{-1}$	0.55	0.31	0.17	0.085



Calculate the pseudo first order rate constant for the hydrolysis of ester.

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4. Write an account of the Arrhenius equation for rates of chemical reactions. (or) Write an account of the Arrhenius equation for the effect of temperature on the rates of chemical reactions.

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5. State the characteristics of order of reactions. (OR) Give the characteristics of order of a reaction.

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1. Explain how will you find activation energy of a reaction by graphical method. (or) Draw the graph between  $\log k$  vs  $\frac{1}{T}$ . What is the relationship between its slope and activation energy.

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2. How will you determine the rate constant for the decomposition of nitrogen pentoxide in  $CCl_4$ .

Decomposition of nitrogen pentoxide in  $CCl_4$ .

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## Numerical Problems

1. For the reaction  $R \rightarrow P$ , the concentration of a reactant changes from 0.03 M to 0.02 M in 25 minutes. Calculate the average rate of reaction using of time both in minutes and second.



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2. The conversion of molecules  $x$  to  $y$  follows second order kinetics. If concentration of  $x$  is increased to three times how will it affect the rate of formation of  $y$ ?

For the reaction  $x \rightarrow y$  as it follows second order kinetics wherefore the rate of formation of  $y$ ?



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3. A first order reaction laws on rate constant  $1.15 \times 10^{-3} \text{ s}^{-1}$ . How long will 5 g of this reactant take to reduce to 3 g?



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4. The decomposition of  $NH_3$  on platinum surface is zero reaction.

What are the rate of production of  $N_2$  and  $H_2$  is

$$K = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1} ?$$



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5. Reaction is first order in A and second in B.

Write the different rate equation.



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6. Reaction is first order in A and second in B.

How is the rate affected on increasing the concentration of B three times ?



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7. Reaction is first order in A and second in B.

How is the rate affected when the concentrations of both A and B are doubled ?

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8. The specific reaction rates of a chemical reaction are  $2.45 \times 10^{-5} \text{ sec}^{-1}$  at 273 K and  $1.62 \times 10^{-4} \text{ sec}^{-1}$  at 303 K.

Calculate the activation energy.

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9. Rate constant of a first order reaction is  $0.45 \text{ sec}^{-1}$ , calculate its half life.

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10. A first order reaction completes 25% of the reaction in 100 mins.

What are the rate constant and half life values of the reactions ?

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11. If 30 % of a first order reaction is completed in 12 mins, what percentage will be completed in 65.33 mins?

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12. Show that for a first order reaction the time required for 99.9% completion is about 10 times its half life period.

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13. The half life period of a first order reactions is 10 mins. What percentage of the reactant will remain after one hour ?

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14. The initial rate of a first order reaction is  $5.2 \times 10^{-6} \text{ mol lit}^{-1} \text{ s}^{-1}$  at 298 K. When the initial concentration of reactant is  $2.6 \times 10^{-3} \text{ mol lit}^{-1}$ , calculate the first order rate constant of the reaction at the same temperature.

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### Unit Test Choose The Correct Answer

1. Consider the following statements :

(i) increase in concentration of the reactant increases the rate of a

zero order reaction.

(ii) rate constant  $k$  is equal to collision frequency  $A$  if  $E_a = 0$

(iii) rate constant  $k$  is equal to collision frequency  $A$  if  $E_a = 0$

(iv) a plot of  $\ln(k)$  Vs  $T$  is a straight line.

(v) a plot of  $\ln(k)$  Vs  $\left(\frac{1}{T}\right)$  is a straight line with a positive slope.

Correct statement are \_\_\_\_\_.

A. (ii) only

B. (ii) and (iv)

C. (ii) and (v)

D. (i) (ii) and (v)

**Answer: A**



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2. A zero order reaction  $X \rightarrow \text{Product}$ , with an initial concentration 0.02 M has a half life of 10 min. If one starts with concentration 0.04



M, then the half life is

- A. 10 s
- B. 5 min
- C. 20 min
- D. cannot be predicted using the given information

**Answer: C**

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3. The rate constant of a reaction is  $5.8 \times 10^{-2} \text{ s}^{-1}$ . The order of the reaction is

- A. First order
- B. zero order
- C. Second order

D. Third order

**Answer: A**

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4. If the initial concentration of the reactant is doubled, the time for half reaction is also doubled. Then the order of the reaction is

A. zero

B. one

C. Fraction

D. none

**Answer: A**

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5. The half life period of a radioactive element is 140 days. After 560 days, 1 g of element will be reduced to

A.  $\left(\frac{1}{2}\right)g$

B.  $\left(\frac{1}{4}\right)g$

C.  $\left(\frac{1}{8}\right)g$

D.  $\left(\frac{1}{16}\right)g$

**Answer: D**

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### Unit Test Short Answer

1. The reaction  $A + 2B \rightarrow C$  obeys the rate equation. Rate =  $K[A]^{\frac{1}{2}}[B]^{\frac{3}{2}}$  What is the order of the reaction ?

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2. Define average rate and instantaneous rate.

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### Unit Test Answer In A Paragraph

1. A first order reaction is found to have a rate constant  $k = 7.39 \times 10^{-5} \text{ s}^{-1}$ . Find the half life of this reaction.

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### Unit Test Answer The Following In Detail

1. Describe the graphical representation of first order reaction.

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2. A first order reaction is 40% complete in 50 minutes. Calculate the value of the rate constant. In what time will the reaction be 80% complete ?



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