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Class: 12
Subject: chemistry
Topic: Chemical Kinetics
No. of Questions: 20
Duration: 60 Min
Maximum Marks: 60

1. When the concentration of a reactant in the reaction A → Product is doubled the rate of the reaction is found to increase 4 times and when tripled the rate increased 9 times. Then the rate of the reaction is proportional to
   a. concentration of A
   b. square of the concentration of A
   c. cube root of the concentration of A
   d. cube of the concentration of A

   Ans. B
   Solution:
   $\text{Rate} = k[A]^x$ When concentration of A doubled rate increased 2^x times and it is found to be 4.
   When the concentration is tripled the rate increases 3^x times. But this is found to be 9.
   $\therefore \text{Rate} = k[A]^2$ or $\text{Rate} \propto [A]^2$
   Actually one data was enough.

2. By "the order of a reaction" we mean
   a. the number of reactants which take part in the reaction
   b. the least number of molecules of the reactant needed for the reaction
   c. the number of concentration terms in the velocity equation for the reaction
   d. the sum of powers to which the concentration terms are raised in the velocity equation

   Ans. D

3. A first order reaction has the rate constant 1.0 × 10-2 which of the following statement is false?
   a. The half-life is 69. 3 minutes
   b. 90% of the reactant will be used up in 230 minutes
   c. the half-life period is independent of the initial concentration of the reactant
   d. 25% of the reactant will be used up in 34.65 minutes

   Ans. D
   Solution:

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Option 1: Given $k = 10^{-2}$. Hence half life is $\frac{0.693}{10^{-2}} = 69.3$ min

Option 2 : 90% is nearly $3\frac{1}{3}$ half lives.

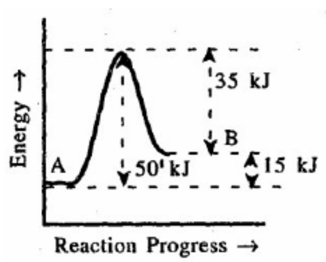
Hence the answer should be approximat ely $70 \times 3\frac{1}{3}$ which comes to 230 min.

Option 3: The reaction is first order. Hence half life is independen t of initial concentrat ion.

Option 4: Time taken for first 25% of the reaction is less than time taken for the next 25%. If first 50% is over in 69.3 minutes the time for the first 25% must be less than $\left(\frac{69.3}{2}\right)$, i.e., 34.65 minutes. Hence this option is wrong and the first three options are correct

4. An end othermi c reaction A →B has an activation energy 50 kJ / mole and the energy of the reaction is 15 KJ / mole. The activation energy of the reaction B →A is
   a. 50 KJ/mole
   b. 65 kJ /mole
   c. 35 KJ/mole
   d. Zero

   Ans. C
   Solution:
   $$E_{B\to A} = E_{A\to B} - \Delta E$$
   $$= 50 - 15 = 35 \text{ kJ / mole}$$



5. In a reaction, the graph of log K versus $\frac{1}{T}$ was a straight line with a slope equal to - 2000. Its energy of activation is
   a. 58 KJ/ mole
   b. 38 KJ/ mole
   c. 66 KJ mole
   d. 90 KJ/mole

   Ans. B
   Solution:

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$$\text{Slope} = -\frac{E}{2.303R}$$

$$-2000 = -\frac{E}{2.303R}$$

$$\therefore E = 2000 \times 2.303 \times 8.314 \text{ J}$$

$$= 38{,}290 = 38.29 \text{ kJ}$$

6. The temperature coefficient of a reaction is 2. If the velocity of the reaction is 5 at 25°C, then, the velocity of the reaction at 55° C is
   a. 20 times
   b. 30 times
   c. 40 times
   d. 80 times

   Ans. C
   Solution:
   Since temperature increases by 30°C, the rate increases 2^3 = 8 times. Original rate is 5. Hence final rate is 5 × 8 = 40

7. For a reaction A + B→C + D, if concentration of A is doubled without altering that of B, rate doubles. If concentration of B is. increased nine - times without altering that of A, rate triples. Order of the reaction is
   a. 1.33
   b. 1.5
   c. 1
   d. 2

   Ans. B
   Solution:
   The rate of the reaction $= k[A]^x\ [B]^y$
   When conc. of A is doubled, rate increases by 2^x times.Whe n conc B is increased 9 times rate increases 9^y times. Give
   $2^x = 2$ or $x = 1$
   $9^y = 3$ or $y = \frac{1}{2}$ Hence order is $1 + \frac{1}{2} = 1.5$

8. **Assertion (A)** The rate of a reaction is accelerated by the presence of a catalyst.

   Reason (R) The presence of a catalyst makes the value of ΔG^0 more negative
   a. Both (A) and (R) are true and (B) is the correct explanation of (A).
   b. Both (A) and (R) are true but (R) is not the correct explanation of (A).
   c. (A) is true but (R) is false.

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d. (A) is false but (R) is true.
Ans. C

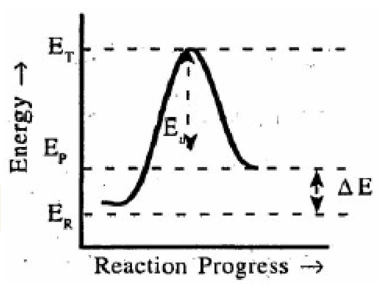
9. Which of the following statements about the order of reaction is true?
   a. A second order reaction is also bimolecular
   b. The order of a reaction can only be determined by experiment
   c. The order of a reaction increases with increase in temperature
   d. The order of a reaction can be determined from the balanced equation

Ans. B
Solution:
In the case of complex reaction order depends on the slowest step. In the case of single step reactions if the concentration of one or more reactants is very large compared to others, then they do not appear in the rate equation. In such cases the order cannot be obtained from the theoretical balanced chemical equation. Hence it has to be decided experimentally as given under option 2

10. In the case of endothermic reaction threshold energy is equal to
   a. heat of reaction+ activation energy of the reverse reaction
   b. heat of reaction + activation energy of the forward reaction
   c. heat of reaction + energy of the reactants
   d. energy of the reactants + heat of reaction + activation of the reverse reaction

Ans. D
Solution:
From the figure it is clear that

$E_T = E_R + \Delta E + E_a$



11. Rate equation for a second order reaction is
   a. $K = \frac{2.303}{t}\log\frac{a}{a-x}$
   b. $K = \frac{1}{t}\log\frac{a}{a(a-x)}$
   c. $K = \frac{1}{t}[\frac{a}{a(a-x)}]$
   d. $K = \frac{1}{t2} \quad \frac{a}{a(a-x)}$

Ans. C
Solution:

The rate equation for second order reaction is k $= \frac{1}{t}\left[\frac{1}{(a-x)} - \frac{1}{a}\right] = \frac{1}{t}\left[\frac{x}{a(a-x)}\right]$

12. The acid hydrolysis of an ester is followed by titration using alkali. The increase in the titre value at a given time is proportional to
    a. ester left over, (a - x)
    b. the amount of ester already hydrolysed, x
    c. neither the ester left over or ester already hydrolysed
    d. the amount of acid taken for hydrolysis plus the amount of ester already hydrolysed (Vo + x)

Ans. B
Solution:
$CH_3COOH + H_2O \rightarrow CH_3COOH + C_2H_5OH$. As more and more ester hydrolyses acetic acid formed accumulate s and titre value increases. The increase in the titre value $(V_t - V_0)$ is proportion al to the amount of acetic acid formed but this is proportion al to the amount of ester hydrolysed , x.

13. The rate expression for a reaction is $= \frac{dx}{dt} = K[A]^{3/2}$ The order of the reaction is
    a. 2
    b. 3
    c. 4
    d. 5

Ans. A

14. Velocity constant k or a reaction is affected by
    a. change in the concentration of the reactant
    b. change in the concentration of the product
    c. change of temperature
    d. none of the above

Ans. C
Solution:
Only temperature and the presence of a catalyst change the value of k

15. For the reaction $H_2 + Cl_2 \xrightarrow{Sunlight}$ HCl taking place on water, the order of reaction is
    a. 0
    b. 3
    c. 2

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d. 1

Ans. A

16. In one hour half of 2 moles of the reactant is lost as products. Then the amount remaining at the end of 4 hours is
    a. 0.25 moles
    b. 0.125 moles
    c. 0.66 moles
    d. 0.33 moles

    Ans. A
    Solution:
    Half-life is one hour. No.of half-lives passed in 4 hours = 4
    Initial amount = 2moles

$$\therefore \text{Amount at the end of 4 hours} = \frac{\text{Initial concentrat ion}}{2^4}$$

$$= \frac{2}{2^4} = \frac{1}{2^3} = \frac{1}{8} 0.125 \text{ moles}$$

17. For the reaction A → B, the rate increases by a factor of 2.25 when the concentration of A is increased by 1.5. What is the order of the reaction?
    a. 1
    b. 2
    c. 0
    d. 3

    Ans. B
    Solution:
    Rate = k [A] When concentration increase 1.5 times, rate increases 1.5 times. This is equal to 2.25 (1.5) = 2.25 on solving we get x = 2

18. The rate constant of a reaction is 10-5 mol lit-1 sec-1. Order of the reaction is
    a. 0
    b. 1
    c. 2
    d. 3

    Ans. A
    Solution:
    The units of k correspond to a zero order reaction. So order is identified from the units

19. Acid catalysed hydrolysis of ethyl acetate is found to be
    a. a second order reaction which is unimolecular
    b. a first order reaction which is bimolecular
    c. a second order reaction which is bimolecular
    d. none of the above statements are correct

Ans. B
Solution:

$$CH_3COOC_2H_5 + H_2O \xrightarrow[\text{Catalyst}]{H^+} CH_3COOOH + C_2H_5OH$$

$$\frac{dx}{dt} = k[CH_3COOC_2H_5]^1[H_2O]^0$$

Hence the reaction is first order which is bimolecular. The molecules involved are ester and water

20. A reaction that is of the first order with respect, to reactant A has a rate constant 6 min^{-1}. If we start with [A] = 0.5 mol L^{-1} when would [A] reach the value 0.05 mol^{-1} L^{-1}?
    a. 3.84 min
    b. 3 min
    c. 0.15 min
    d. 0.384 min

Ans. D
Solution:

$$k = \frac{2.303}{t}\log\frac{a}{a-x} \quad \text{or} \quad 6 = \frac{2.303}{t}\log\frac{0.5}{0.05} = \frac{2.303}{t}\log 10$$

$$6 = \frac{2.303}{t} \quad \therefore \quad t = \frac{2.303}{6} = 0.384\ \text{min}$$