

JN CHEMISTRY

Vidyanagar, HYDERABAD

JEE NEET

Date : 13/02/2019

Time : 00:30:00

Marks : 120

TEST ID: 5

CHEMISTRY

4.CHEMICAL KINETICS

Single Correct Answer Type

- Mathematical expression for $t_{1/4}$ i.e., when (1/4)th reaction is over following first order kinetics can be given by
 - $t_{1/2} = \frac{2.303}{k} \log 4$
 - $t_{1/2} = \frac{2.303}{k} \log 2$
 - $t_{1/2} = \frac{2.303}{k} \log \frac{4}{3}$
 - $t_{1/2} = \frac{2.303}{k} \log \frac{3}{4}$
- Pieces of wood burn faster than a log of wood of the same mass because
 - Surface area of log of wood is larger and needs more time to burn
 - Pieces of wood have large surface area
 - All pieces of wood catch fire at the same time
 - Block of wood has higher density than pieces of the same wood
- For the reaction system,
 $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$
Volume is suddenly reduced 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
 - Diminish to one-fourth of its initial value
 - Diminish to one-eighth of its initial value
 - Increase to eight time of its initial value
 - Increase to four time of its initial value
- According to the Arrhenius equation a straight line is to be obtained by plotting the logarithm of the rate constant of a chemical reaction ($\log k$) against
 - T
 - $\log T$
 - $\frac{1}{T}$
 - $\log \frac{1}{T}$
- The half-life period for zero order reaction $A \rightarrow$ product, is 100 min. How long will it take in 80% completion?
 - 80 min
 - 160 min
 - 100 min
 - 200 min
- The unit and value of rate constant and that of rate of reaction are same for
 - Zero order
 - First order
 - Second order
 - Third order
- For the following homogeneous reaction, the unit of rate constant is $A + B \xrightarrow{k} C$
 - $\text{mol}^{-1}\text{Ls}^{-1}$
 - s^{-1}
 - S
 - $\text{s}^{-1}\text{mol L}^{-1}$
- If E_f and E_r are the activation energies of the forward and reverse reactions and the reaction is known to be exothermic then
 - $E_f < E_r$
 - $E_f > E_r$
 - $E_f = E_r$
 - No relation can be given between E_f and E_r as data are not sufficient
- In respect of the equation $k = Ae^{-E_a/RT}$ in chemical kinetics, which one of the statement is correct?
 - R is Rydberg constant
 - K is equilibrium constant
 - E_a is energy of activation
 - A is adsorption factor
- Temperature coefficient of a reaction is 2. When temperature is increased from 30°C to 100°C , rate of the reaction increases by
 - 128 times
 - 100 times
 - 500 times
 - 250 times
- The order of reaction, with respect to one of the reacting component Y, is zero. It implies that
 - The reaction is going on at a constant rate.
 - The rate of reaction does not vary with temperature.
 - The reaction rate is independent of the concentration of Y.
 - The rate of formation of the activated complex is zero.
- The minimum energy required for a molecule to take part in a reaction is called
 - Threshold energy
 - Nuclear energy
 - Potential energy
 - Kinetic energy
- The rate constant of a first order reaction is

- $6.9 \times 10^{-3} \text{ s}^{-1}$. How much time will it take to reduce the initial concentration to its $1/8^{\text{th}}$ value ?
 a) 100s b) 200s c) 300s d) 400s
14. In Arrhenius plot intercept is equal to
 a) $-E_a/R$ b) $\ln A$
 c) $\ln k$ d) $\log_{10} a$
15. The rate constant of a zero order reaction is $0.2 \text{ mol dm}^{-3} \text{ h}^{-1}$. If the concentration of the reactant after 30 min is 0.05 mol dm^{-3} . Then its initial concentration would be
 a) 0.01 mol dm^{-3} b) 0.15 mol dm^{-3}
 c) 0.25 mol dm^{-3} d) 4.00 mol dm^{-3}
16. The order of a reaction with rate equal to $kC_A^{3/2} C_B^{-1/2}$ is
 a) 1 b) $-\frac{1}{2}$ c) $-\frac{3}{2}$ d) 2
17. For the reaction system $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$ if the volume of the reaction vessel is reduced to one-third of its original volume, what will be the order of the reaction?
 a) Diminished to one fourth of its initial value
 b) Diminished to one twenty seven of its initial value
 c) Increase to twenty seven times of its initial value
 d) Increase to four times of its initial value
18. The velocity constant of a reaction at 290 K was found to be 3.2×10^{-3} at 300 K, it will be
 a) 6.4×10^{-3} b) 1.28×10^{-2}
 c) 9.6×10^{-3} d) 3.2×10^{-4}
19. Which increases on increase of temperature?
 a) Energy of activation (E_a)
 b) Collision frequency (Z)
 c) Rate constant (k)
 d) Both (a) and (c)
20. The following data were obtained the first order decomposition of $2A(\text{g}) \rightarrow B(\text{g}) + C(\text{S})$ at a constant volume and at a particular temperature
- | S
N | Time | Total pressure in Pascal |
|--------|----------------------|--------------------------|
| 1 | At the end of 10 min | 300 |
| 2 | After completion | 200 |
- The rate constant in min^{-1} is
 a) 0.0693 b) 69.3
 c) 6.93 d) 6.93×10^{-4}
21. The activation energy of a reaction is zero. The

- rate constant for the reaction
 a) Decreases with decrease of temp
 b) Increases with increase of temp
 c) Decreases with increase of temp
 d) Is nearly independent of temp
22. The expression for rate constant of a first order chemical reaction is
 a) $k = \frac{1}{t} \cdot \frac{x}{a(a-x)}$
 b) $k = \frac{2.303}{t} \log_{10} \frac{a}{(a-x)}$
 c) $k = \frac{x}{t}$
 d) $k = \frac{1}{2t} \left[\frac{1}{(a-x)^2} - \frac{1}{a^2} \right]$
23. A first order reaction is 20% complete in 10 min. What is the rate constant of the reaction?
 a) 0.223 b) 0.0223 c) 0.322 d) 0.0322
24. Rate of reaction depends upon
 a) temperature b) catalyst
 c) concentration d) All of these
25. For a first order reaction, $A \rightarrow \text{products}$, the rate of reaction at $[A] = 0.2 \text{ M}$ is $1.0 \times 10^{-2} \text{ mol L}^{-1} \text{ min}^{-1}$. The half-life period for the reaction is
 a) 476 s b) 496 s c) 832 s d) 242 s
26. For a reaction, $x(\text{g}) \rightarrow y(\text{g}) + z(\text{g})$ the half-life period is 10 min. in what period of time would the concentration of X be reduce to 10% of original concentration?
 a) 20 min b) 33 min c) 15 min d) 25 min
27. Collision theory is applicable to
 a) First order reactions
 b) Zero order reactions
 c) Bimolecular reactions
 d) Intra-molecular reactions
28. For the order reaction with rate constant 'K' and initial concentration 'a', the half-life period given by
 a) $\frac{1n2}{k}$ b) $\frac{1}{ka}$
 c) $\frac{3}{2k \cdot a^2}$ d) None of these
29. A first order reaction is 75% complete after 32 min. when was 50% of the reaction completed?
 a) 16 min b) 8 min c) 4 min d) 32 min
30. Consider an endothermic reaction $X \rightarrow Y$ with the activation energies E_b and E_f for the backward and forward reactions respectively. In general

There is no definite relation between

a) E_b and E_f

b) $E_b = E_f$

c) $E_b > E_f$

d) $E_b < E_f$

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: ANSWER KEY :

1)	c	2)	b	3)	c	4)	c
5)	b	6)	a	7)	a	8)	a
9)	c	10)	a	11)	c	12)	a
13)	c	14)	b	15)	b	16)	a
17)	c	18)	a	19)	d	20)	a
21)	d	22)	b	23)	b	24)	d
25)	c	26)	b	27)	c	28)	a
29)	a	30)	d				

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: HINTS AND SOLUTIONS :

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1 (c)

$$t = \frac{2.303}{k} \log \frac{a}{(a-x)}$$

If $t = t_{1/4}$; $x = a/4$

$$\therefore t_{1/4} = \frac{2.303}{k} \log \frac{a}{(a-1/4)}$$

$$\frac{2.303}{k} \log \frac{4}{3}$$

3 (c)

$$\left(\frac{dx}{dt}\right) = k[NO]^2[o_2]$$

$$= k \left(\frac{n_{NO}}{V}\right)^2 \left(\frac{n_{O_2}}{V}\right)$$

$$\left(\frac{dx}{dt}\right) = \frac{k}{V^3} (n_{NO})^2 (n_{O_2})$$

$$\left(\frac{dx}{dt}\right) = \frac{k(n_{NO})^2 (n_{O_2})}{\left(\frac{V}{2}\right)^3}$$

$$= 8 \left(\frac{dx}{dt}\right)$$

5 (b)

For zero order reaction

$$k = \frac{a}{2t_{1/2}} = \frac{a}{2 \times 100} = \frac{a}{200}$$

When 80% completion take place

$$k = \frac{x}{t}$$

$$\frac{a}{200} = \frac{0.80a}{t}$$

$$t = 200 \times 0.8 = 160 \text{ min}$$

6 (a)

For zero order reaction, for example,



$$\frac{-d[A]}{dt} = k[A]^0$$

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

7 (a)

For the homogenous gaseous reaction,

$A + B \xrightarrow{k} c$, the rate law is

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

Or

$$k = \frac{dx}{dt \times [A][B]} \text{ mol L}^{-1}$$

time $\times \text{mol L}^{-1} \times \text{mol L}^{-1}$

Or unit of rate constant 'k' is

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

8 (a)

For exothermic reaction, activation energy of reverse reaction is greater than activation energy of forward reaction, i.e., $E_f < E_r$

10 (a)

Temperature coefficient

$$= \frac{\text{rate of reaction at } 35^\circ\text{C}}{\text{rate of reaction at } 25^\circ\text{C}} = 2$$

Thus, increase in rate is two times, when

temperature is increased 10°C . Hence, by the increase of 70°C ($100-30=70^\circ\text{C}$), the increase in rate will be

$$= (2)^7 \because 70^\circ = 7 \times 10^\circ$$

$$= 128 \text{ times}$$

11 (c)

The order of reaction with respect to a reacting compound Y, is zero. It means rate of reaction is independent of its concentration.

13 (c)

Given, N_0 = initial concentration = 1

N = concentration after time $t = \frac{1}{8}$

$$K = 6.9 \times 10^{-3} \text{ s}^{-1}$$

$$N = N_0 \left(\frac{1}{2}\right)^n$$

Or

$$\frac{1}{8} = 1 \left(\frac{1}{2}\right)^n$$

$$\therefore n = 3$$

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{6.9 \times 10^{-3}} = 100\text{s}$$

$$T = n \times t_{1/2}$$

$$= 3 \times 100$$

$$= 300\text{s}$$

\therefore after 300s it will be reduced to 1/8 of original concentration.

15 (b)

For zero order reaction

$$x = kt$$

$$= 0.2 \text{ mol dm}^{-3} \text{ h}^{-1} \times \frac{30}{60} \text{ h}$$

$$= 0.1 \text{ mol dm}^{-3}$$

$$\text{Now, concentration} = 0.05 \text{ mol dm}^{-3}$$

$$\text{Hence, initial concentration} = 0.1 + 0.05 = 0.15 \text{ mol dm}^{-3}$$

16 (a)

$$\text{Given, } r = KC_A^{3/2} C_B^{-1/2}$$

$$\therefore \text{order of reaction} = \frac{3}{2} + \left(-\frac{1}{2}\right)$$

$$= \frac{3-1}{2} = 1$$

17 (c)

The rate of reaction is

$$\text{rate} = k[\text{NO}]^2[\text{O}_2]$$

When the volume is reduced to $\frac{1}{3}$, the concentration of each reactant is increased by 3 times

$$\text{rate}' = k[3\text{NO}]^2[3\text{O}_2]$$

$$= 27k[\text{NO}]^2[\text{O}_2]$$

$$\frac{\text{rate}'}{\text{rate}} = \frac{27k[\text{NO}]^2[\text{O}_2]}{k[\text{NO}]^2[\text{O}_2]}$$

$$\text{rate}' = 27 \text{ rate}$$

18 (a)

The ratio of rate constant when temperature is raised 10°C , is called temperature coefficient. For most of the reaction, it has a value of 2.

Hence, for the given reaction,

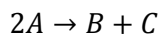
$$\text{Rate constant at } 290 \text{ K} = 3.2 \times 10^{-3}$$

$$\therefore \text{Rate constant at } 300 \text{ K} = 2 \times 3.2 \times 10^{-3} = 6.4 \times 10^{-3}$$

19 (d)

The collision frequency (Z) and rate constant (k) increase on increase of temperature. With the increase in temperature, the average kinetic energy of the molecules increases and this leads to an increase in number of collisions per unit time (Z). The rate constant (k) of a reaction is also increases with increase of temperature.

20 (a)



$$2p \quad 0 \quad 0$$

$$2p-x \quad x \quad x \quad \text{after 10 min}$$

$$0 \quad p \quad p \quad \text{after completion}$$

$$\text{Given, } P+P=200$$

After 10 min,

$$2p - x + x + x = 300 \text{ (given)}$$

$$2p + x = 300$$

$$x = 300 - 200 = 100$$

$$k = \frac{2.303}{10} \log \frac{200}{100} = 0.0693 \text{ min}^{-1}$$

21 (d)

$$\text{If } E_a = 0, k = Ae^{-E_a/RT} = Ae^0 = A$$

Hence, k becomes independent of T

23 (b)

$$k = \frac{2.303}{t} \log_{10} \frac{a}{a-x}$$

$$= \frac{2.303}{10} \log_{10} \frac{100}{80}$$

$$= \frac{2.303}{10} [\log 10 - 3 \log 2]$$

$$= \frac{2.303}{10} [1 - 3 \times 0.3010]$$

$$k = 0.0223$$

24 (d)

Rate of reaction depends upon nature of reactants, concentration of the reactants, temperature and presence of catalyst.

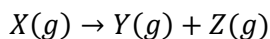
25 (c)

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

$$\therefore k = \frac{10^{-2}}{0.2} = 5 \times 10^{-2}$$

$$\text{Now, } t_{1/2} = \frac{0.693}{k} = \frac{0.693}{5 \times 10^{-2}} = 13.86 \text{ min}$$

26 (b)



The reaction is a first order reaction.

Hence,

$$k = \frac{0.693}{t_{1/2}} = \frac{2.303}{t} \log \frac{a}{(a-x)}$$

$$0.2234 \frac{0.693}{10} = \frac{2.303}{t} \log \frac{a}{a/10}$$

$$\text{Or } t = \frac{2.303 \times 10}{0.693} \times \log 10$$

$$= 33 \text{ min}$$

28 (a)

For the first order reaction,

$$t_{1/2} = \frac{1n2}{k}$$

$$\text{Or } t_{1/2} = \frac{0.693}{k}$$

29 (a)

$$k = \frac{2.303}{t} \log \frac{a}{a-x}$$

Given, reaction is 75% completed is 32 min

$$A=100, x=75$$

$$\therefore k = \frac{2.303}{32} \log \frac{100}{100-75} \quad \dots(1)$$

For 50% completion of reaction

$$A=100, x=50$$

$$\therefore k = \frac{2.303}{t} \log \frac{100}{100-50} \quad \dots(2)$$

$$\therefore \text{LHS of Eq. (1)} = \text{Eq. (2)}$$

$$\therefore \text{RHS of Eq. (1)} = \text{Eq. (2)}$$

$$\therefore \frac{2.303}{32} \log \frac{100}{100-75} = \frac{2.303}{t} \log \frac{100}{100-50}$$

$$\text{or } \frac{2.303}{32} \log 4 = \frac{2.303}{t} \log 2$$

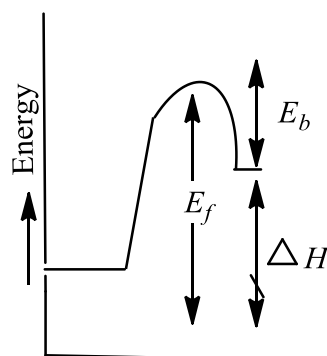
$$\text{Or } \frac{t}{32} = \frac{\log 2}{\log 4} \text{ or } t = \frac{32 \times \log 2}{2 \log 2}$$

$$\therefore t = 16 \text{ min}$$

\therefore reaction will be 50% completed in 16 min

30 (d)

$X \rightarrow Y$ is an endothermic reaction $\Delta H = +ve$



E_b = energy of activation of backward reaction

E_f = energy of activation of forward reaction

ΔH = heat of reaction

Thus, $E_f = E_b + \Delta H$

Thus, $E_f > E_b$