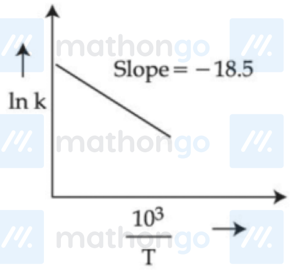
Q1 - 24 June - Shift 1

The rate constants for decomposition of acetaldehyde have been measured over the temperature range 700 –1000 K. The data has been analysed by plotting In k vs $\frac{10^3}{T}$ graph.The value of activation energy for the reaction is___ kJ mol^{-1}. (Nearest integer) (Given : $R = 8.31\ J\ K^{-1}\ mol^{-1}$)



Space for your notes:

Q2 - 24 June - Shift 2

The correct order of bound orders of C_2^{2-}, N_2^{2-} and O_2^{2-} is, respectively.

(A) $C_2^{2-} < N_2^{2-} < O_2^{2-}$ (B) $O_2^{2-} < N_2^{2-} < C_2^{2-}$

(C) $C_2^{2-} < O_2^{2-} < N_2^{2-}$ (D) $N_2^{2-} < C_2^{2-} < O_2^{2-}$

Space for your notes:

Q3 - 25 June - Shift 1

For a given chemical reaction

$$\gamma_1 A + \gamma_2 B \rightarrow \gamma_3 C + \gamma_4 D$$

Concentration of C changes from 10 mmol dm^{-3} to 20 mmol dm^{-3} in 10 seconds. Rate of appearance of D is 1.5 times the rate of disappearance of B which is twice the rate of disappearance A. The rate of appearance of D has been experimentally determined to be 9 mmol dm^{-3} s^{-1}. Therefore the rate of reaction is ________mmol dm^{-3} s^{-1}. (Nearest Integer)

Space for your notes:

Q4 - 25 June - Shift 2

At 345 K, the half life for the decomposition of a sample of a gaseous compound initially at 55.5 kPa was 340 s. When the pressure was 27.8 kPa, the half life was fund to be 170 s. The order of the reaction is________. [integer answer]

Space for your notes:

Q5 - 26 June - Shift 1

A flask is filled with equal moles of A and B. The half lives of A and B are 100 s and 50 s respectively and are independent of the initial concentration. The time required for the concentration of A to be four times that of B is ________s.

(Given : ln 2 = 0.693)

Space for your notes:

Q6 - 26 June - Shift 2

Catalyst A reduces the activation energy for a reaction by 10 kJ mol^{-1} at 300 K. The ratio of rate constants, $\frac{k_{T,Catalysed}}{k_{T,Uncatalysed}}$ is e^x. The value of x is _______. [nearest integer]

[Assume theat the pre-exponential factor is same in both the cases.

Given R = 8.31 J K^{-1} mol^{-1}]

Space for your notes:

Q7 - 27 June - Shift 1

The rate constant for a first order reaction is given by the following equation:

$$\ln k = 33.24 - \frac{2.0 \times 10^4 K}{T}$$

The Activation energy for the reaction is given by _______ kJ mol^{-1}. (In Nearest integer)

(Given: R = 8.3 J K^{-1} mol^{-1})

Space for your notes:

Q8 - 27 June - Shift 2

It has been found that for a chemical reaction with rise in temperature by 9K the rate constant gets doubled. Assuming a reaction to be occurring at 300 K, the value of activation energy is found to be _______ kJ mol^{-1}. [nearest integer]

(Given ln 10 = 2.3, R = 8.3 $JK^{-1}mol^{-1}$, log2 = 0.30)

Space for your notes:

Q9 - 28 June - Shift 1

For a first order reaction $A \rightarrow B$, the rate constant, $k = 5.5 \times 10^{-14} s^{-1}$. The time required for 67% completion of reaction is x × 10^{-1} times the half life of reaction. The value of x is ________ (Nearest integer)

(Given : log 3 = 0.4771)

Space for your notes:

Q10 - 28 June - Shift 2

A radioactive element has a half life of 200 days. The percentage of original activity remaining after 83 days is ______. (Nearest integer)

(Given : antilog 0.125 = 1.333, antilog 0.693 = 4.93)

Space for your notes:

Q11 - 29 June - Shift 1

The activation energy of one of the reactions in a biochemical process is 532611 J mol^{-1}. When the temperature falls from 310 K to 300 K, the change in rate constant observed is $k_{300} = x \times 10^{-3} k_{310}$. The value of x is ________.

[Given: ln10 = 2.3

R=8.3 J K^{-1} mol^{-1}]

Space for your notes:

Q12 - 29 June - Shift 2

The equation

$k = (6.5 \times 10^{12} s^{-1})\, e^{-26000K/T}$

is followed for the decomposition of compound A. The activation energy for the reaction is _____ kJ mol^{-1}. [nearest integer]

(Given: $R = 8.314\ J\ K^{-1}\ mol^{-1}$)

Space for your notes:

Answer Key

Q1 (154)	**Q2** (C)	**Q3** (1)	**Q4** (0)
Q5 (200)	**Q6** (4)	**Q7** (166)	**Q8** (59)
Q9 (16)	**Q10** (75)	**Q11** (1)	**Q12** (216)

Q1 (154)

$$\ln k = \ln A - \frac{Ea}{10^3 RT} \times 10^3 = \ell nA + \frac{10^3}{T}\left[-\frac{Ea}{10^3 RT}\right]$$

From the graph

$$\frac{-Ea}{10^3 \times R} = -18.5$$

Ea = 153.735 kJ/mol

~154

Q2 (C)

Given $t_{0.90} = t_{0.90} = xt_{1/2}$

First order rate constant

$$K = \frac{\ln 2}{t_{1/2}} = \frac{1}{xt_{1/2}} \ln \frac{A_0}{A_0 - A_0 \times \frac{90}{100}}$$

$$\frac{\ln 2}{t_{1/2}} = \frac{\ln 10}{xt_{1/2}}$$

$$x = \frac{\ln 10}{\ln 2} = \frac{2.303}{2.303 \times 0.3010} = 3.32$$

Q3 (1)

$$\gamma_1 A + \gamma_2 B \longrightarrow \gamma_3 C + \gamma_4 D$$

$$\text{Given}: +\frac{d[D]}{dt} = \frac{-3}{2}\frac{d[B]}{dt}$$

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

$$-\frac{d[B]}{dt} = -2\frac{d[A]}{dt} \Rightarrow -\frac{1}{2}\frac{d[B]}{dt} = \frac{-d(A)}{dt}$$

$$+\frac{d[B]}{dt} = 9 \text{ mmol dm}^{-3}\text{s}^{-1}$$

$$\frac{+d[C]}{dt} = \frac{20-10}{10} = 1 \text{mmol dm}^{-3}\text{s}^{-1}$$

$$\frac{+d[C]}{dt} = \frac{1}{9} \times \frac{+d[D]}{dt}$$

$$1A + 2B \longrightarrow \frac{1}{3}C + 3D$$

$$\Rightarrow 3A + 6B \longrightarrow C + 9D$$

$$\text{Rate of reaction} = \frac{+d[C]}{dt} = 1 \text{ mmol dm}^{-3}\text{ s}^{-1}$$

Q4 (0)

$$t_{1/2} \times \frac{1}{[P_0]^{n-1}}$$

$$\frac{t_1}{t_2} = \frac{(P_2)^{n-1}}{(P_1)^{n-1}}$$

$$\frac{340}{170} = \left(\frac{27.8}{55.5}\right)^{n-1}$$

$$\Rightarrow \quad 2 = \frac{1}{(2)^{n-1}}$$

$$n = 0$$

Q5 (200)

$$k_A = \frac{\ln 2}{100} ; k_B = \frac{\ln 2}{50}$$

$$A_t = A_0 \times e^{-k_A t}$$

$$A_t = A_0 \times e^{\left(\frac{-\ln 2}{100} \times t\right)}$$

$$B_t = B_0 \times e^{\left(\frac{-\ln 2}{50} \times t\right)}$$

$$A_0 = B_0$$

$$\& \ At = 4B_t$$

$$e^{-\frac{\ln 2}{100} \times t} = 4 \times e^{-\frac{\ln 2}{50} \times t}$$

$$e^{\frac{\ln 2}{100} \times t} = 4$$

$$e^{\frac{\ln 2}{100} \times t} = 4$$

$$\frac{\ln 2}{100} \times t = \ln 4 = 2 \ln 2$$

$$t = 200 \text{ sec}$$

Q6 (4)

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

$$K_{cat} = Ae^{-\frac{E_a{}^1}{RT}}, \quad K_{uncat.} = Ae^{-\frac{Ea}{RT}}$$

$$\frac{K_{cat}}{K_{uncat.}} = e^{\frac{E_a - E_a{}^1}{RT}} = e^{\frac{10\times1000}{8.31\times300}} = e^{4.009} = e^x$$

$\therefore \quad x = 4$

Q7 (166)

$$\ln k = \ln A - \frac{E_A}{RT}$$

$$\text{Given: } \ln k = 33.24 - \frac{2.0\times10^4}{T}$$

$\therefore$ on comparing $\frac{E_A}{R} = 2.0 \times 10^4$

$\therefore E_A = 2.0 \times 10^4 \times R$

$\Rightarrow E_A = 2.0 \times 10^4 \times 8.3\ J$

$\Rightarrow E_A = 16.6 \times 10^4 J = 166\ kJ$

Q8 (59)

$$\log_{10}\frac{K_2}{K_1}=\frac{E_a}{2.303R}\left(\frac{1}{300}-\frac{1}{309}\right)$$

$$0.3=\frac{E_a}{2.303\times 8.3}\left(\frac{9}{300\times 309}\right)$$

$$E_a=\frac{0.3\times 2.303\times 8.3\times 300\times 309}{9}$$

$= 59065.04$ J

$E_a = 59.06$ kJ

Q9 (16)

$$t_{67\%}=\frac{1}{k}\ln\left(\frac{1}{1-0.67}\right)=\frac{t_{1/2}}{\ln 2}\times\ln\left(\frac{1}{1-\frac{2}{3}}\right)$$

$$t_{67\%}=\frac{t_{1/2}}{\log 2}\times\log 3=\frac{t_{1/2}\times 0.4771}{0.301}$$

$\Rightarrow t_{67\%} = 1.585 \times t_{1/2}$

$X \times 10^{-1} = 1.585$

$\Rightarrow X = 15.85$

Ans. 16

Q10 (75)

$$t=\frac{t_{1/2}}{0.3}\log\frac{[A]_0}{[A]_t}$$

$$83=\frac{200}{0.3}\log\frac{[A]_0}{[A]_t}$$

$$0.125=\log\frac{[A]_0}{[A]_t}$$

$$\frac{[A]_0}{[A]_t}=1.333\cong\frac{4}{3}$$

$$\therefore\frac{[A]_t}{[A]_0}\times100=\frac{3}{4}\times100=75\%$$

75

Q11 (1)

$$\ell n\left(\frac{K_2}{K_1}\right)=\frac{E_a}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$$

$$\ell n\left(\frac{K_2}{K_1}\right)=\frac{532611}{8.3}\times\left(\frac{10}{310\times 300}\right)$$

where K_2 is at 310 K & K_1 is at 300 K

$$\ell n\left(\frac{K_2}{K_1}\right)=6.9$$

$$=3\times\ell n10$$

$$\ell n\frac{K_2}{K_1}=\ell n10^3$$

$K_2 = K_1 \times 10^3$

$K_1 = K_2 \times 10^3$

So K = 1

Q12 (216)

$K = Ae^{-Ea/RT} = (6.5 \times 10^{12}\ s^{-1})\ e^{-26000K/T}$

$$\frac{Ea}{8.314}=26000$$

Ea = 216.164 kJ/mol.