Q1 (20 July 2021 Shift 1)

The inactivation rate of a viral preparation is proportional to the amount of virus. In the first minute after preparation, 10% of the virus is inactivated. The rate constant for viral inactivation is ___ $\times 10^{-3}$ min^{-1}. (Nearest integer)

[Use: $\ln 10 = 2.303; \log_{10} 3 = 0.477$ property of logarithm : $\log x^y = y \log x$]

Q2 (20 July 2021 Shift 2)

$\mathrm{PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)}$ In the above first order reaction the concentration of $\mathrm{PCl_5}$ reduces from initial concentration 50 mol L^{-1} to 10 mol L^{-1} in 120 minutes at 300 K. The rate constant for the reaction at 300 K is x $\times 10^{-2}$ min^{-1}. The value of x is ___

[Given $\log 5 = 0.6989$]

Q3 (22 July 2021 Shift 1)

Isotope(s) of hydrogen which emits low energy β^- particles with $t_{1/2}$ value > 12 years is/are

(1) Protium

(2) Tritium

(3) Deuterium

(4) Deuterium and Tritium

Q4 (22 July 2021 Shift 1)

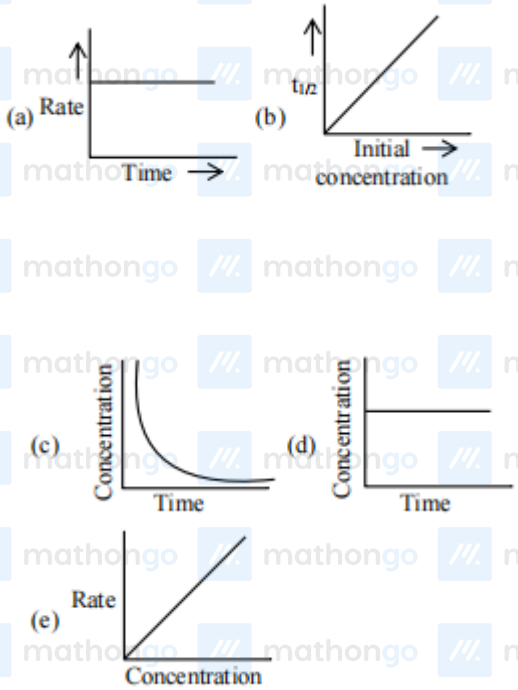
$\mathrm{N_2O_{5(g)} \rightarrow 2NO_{2(g)} + \frac{1}{2}O_{2(g)}}$

In the above first order reaction the initial concentration of $\mathrm{N_2O_5}$ is 2.40×10^{-2} mol L^{-1} at 318 K. The concentration of $\mathrm{N_2O_5}$ after 1 hour was 1.60×10^{-2} mol L^{-1}. The rate constant of the reaction at 318 K is $\times 10^{-3}$ min^{-1}. (Nearest integer)

[Given : $\log 3 = 0.477, \log 5 = 0.699$]

Q5 (25 July 2021 Shift 1)

For the following graphs,



Choose from the options given below, the correct one regarding order of reaction is:

(1) (b) zero order (c) and (e) First order (b) Zero order

(2) (a) and (e) First order

(3) (b) and (d) Zero order (e) First order

(4) (a) and (b) Zero order (c) and (e) First order

Q6 (25 July 2021 Shift 2)

For a chemical reaction $A \rightarrow B$, it was found that concentration of B is increased by 0.2 mol L^{-1} in 30 min. The average rate of the reaction is $\times 10^{-1}$ mol L^{-1} h^{-1}. (in nearest integer)

Q7 (27 July 2021 Shift 1)

For a reaction of order n, the unit of the rate

constant is:

(1) $\mathrm{mol}^{1-n}\mathrm{L}^{1-n}\mathrm{s}$

(2) $\mathrm{mol}^{1-n}\mathrm{L}^{2n}\mathrm{s}^{-1}$

(3) $\mathrm{mol}^{1-n}\mathrm{L}^{n-1}\,\mathrm{s}^{-1}$

(4) $\mathrm{mol}^{1-n}\mathrm{L}^{1-n}\mathrm{s}^{-1}$

Q8 (27 July 2021 Shift 2)

For the first order reaction $\mathrm{A} \rightarrow 2\ \mathrm{B}$, 1 mole of reactant A gives 0.2 moles of B after 100 minutes. The half life of the reaction is ..... min. (Round off to the nearest integer).

[Use : $\ln 2 = 0.69, \ln 10 = 2.3$

Properties of logarithms : $\ln \mathrm{x}^{\mathrm{y}} = \mathrm{y} \ln \mathrm{x}$

$$\ln\left(\frac{x}{y}\right) = \ln x - \ln y\Big]$$

(Round off to the nearest integer)

Answer Key

Q1 (106) **Q2** (1) **Q3** (2) **Q4** (7)

Q5 (1) **Q6** (4) **Q7** (3) **Q8** (300)

Q1

As the unit of rate constant is $\min^{-1}$ so it must be a

first order reaction $\mathrm{K} \times \mathrm{t} = 2.303 \log \mathrm{A}_0/\mathrm{A}_\mathrm{t}$

in 1 min10% is in activated so tabing

$\mathrm{A}_0 = 100 \quad \mathrm{A}_1 = 90$ in 1 min

So

$$K \times 1 = 2.303 \times \log \frac{100}{90}$$
$$= 2.303 \times (\log 10 - 2\log 3)$$
$$= 2.303 \times (1 - 2 \times 0.477)$$
$$= 0.10593$$
$$= 105.93 \times 10^{-3}$$
$$\approx = 106$$

Q2

$$\mathrm{PCl}_{5(g)} \xrightarrow[300\mathrm{K}]{1 \text{ order}} \mathrm{PCl}_{3(g)} + \mathrm{Cl}_{2(g)}$$

$\mathrm{t} = 0 \quad 50\mathrm{M}$

$\mathrm{t} = 120 \text{ min} \quad 10\mathrm{M}$

$$\Rightarrow \mathrm{K} = \frac{2.303}{\mathrm{t}} \log \frac{[\mathrm{A}_0]}{[\mathrm{A}_t]}$$
$$\Rightarrow \mathrm{K} = \frac{2.303}{120} \log \frac{50}{10}$$
$$\Rightarrow \mathrm{K} = \frac{2.303}{120} \times 0.6989 = 0.013413 \text{ min}^{-1}$$
$$= 1.3413 \times 10^{-2} \text{ min}^{-1}$$
$$1.34 \Rightarrow \text{Nearest integer} = 1$$

Q3

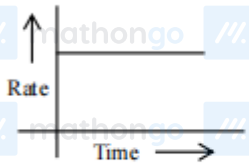
$^1_1\mathrm{H}$ and $^2_1\mathrm{H}$ are stable while $^3_1\mathrm{H}$ is radioactive.

Q4

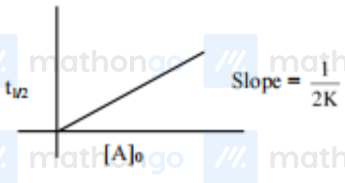
$$\mathrm{K} = \frac{2.303}{\mathrm{t}} \log \frac{[\mathrm{N_2O_5}]_0}{[\mathrm{N_2O_5}]_t}$$
$$= \frac{2.303}{60} \log \frac{2.4}{1.6} = 6.76 \times 10^{-3} \text{ min}^{-1} \approx 7 \times 10^{-3} \text{ min}^{-1}$$

Q5

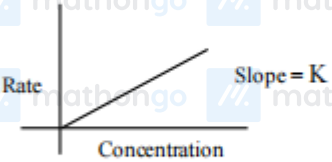
For zero order reaction's
rate = K [Reactant]^0
$\Rightarrow r = k$



$t_{1/2} = \frac{[A]_0}{2K}$ for zero order



For first order reaction →
r = K [Concentration]



Reactant concentration after time t →
$C_t = C_0\ e^{-kt}$

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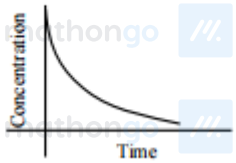

Q6

$$\begin{array}{ccc} & A \longrightarrow & B \\ t = 0 & & 0 \\ t = 30\ \text{min} & & 0.2M \end{array}$$

$$\text{Av. rate of reaction} = -\frac{\Delta[A]}{\Delta t} = \frac{\Delta[B]}{\Delta t} = \frac{(0.2-0)}{\frac{1}{2}}$$

$$= 0.4 = 4 \times 10^{-1}\ \text{mol/L} \times \text{hr}$$

Q7

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

comparing units

$\frac{(\text{mol}/\ell)}{\text{sec}} = k\left(\frac{\text{mol}}{\ell}\right)^n$

$\Rightarrow k = \text{mol}^{(1-n)}\ell^{(n-1)}s^{-1}$

Q8

$A \longrightarrow 2B$

$t = 0$	1 mole	0
$t = 100$ min	$1 - x$	$2x$
$= 0.9$ mol	$= 0.2$ mol	

Now, $t = \frac{t_{1/2}}{\ln 2} \times \frac{[A_0]}{[A_t]}$

$100 = \frac{t_{1/2}}{\ln 2} \times \ln \frac{1}{0.9} \Rightarrow t_{1/2} = 690$ min.

(taking $\ln 3 = 1.11$)

Ans. 600 to 700