Q1 - 24 January - Shift 1

The number of correct statement/s from the following is _____.

A. Larger the activation energy, smaller is the value of the rate constant.

B. The higher is the activation energy, higher is the value of the temperature coefficient.

C. At lower temperatures, increase in temperature causes more change in the value of k than at higher temperature.

D. A plot of ln k vs $\frac{1}{T}$ is a straight line with slope equal to $-\frac{Ea}{R}$

Space for your notes:

Q2 - 24 January - Shift 2

A student has studied the decomposition of a gas AB_3 at 25°C. He obtained the following data.

p (mm Hg)	50	100	200	400
Relative $t_{1/2}$ (s)	4	2	1	0.5

The order of the reaction is

(1) 0.5 (2) 2

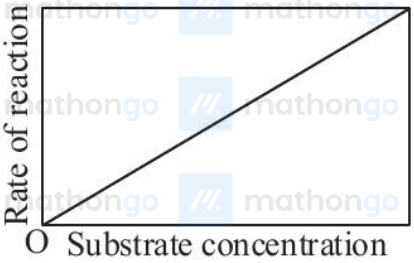
(3) 1 (4) 0 (zero)

Space for your notes:

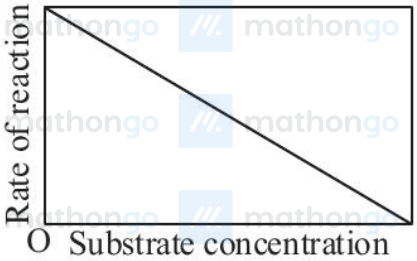
Q3 - 25 January - Shift 1

The variation of the rate of an enzyme catalyzed reaction with substrate concentration is correctly represented by graph

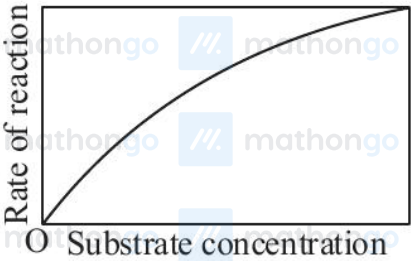
(a)



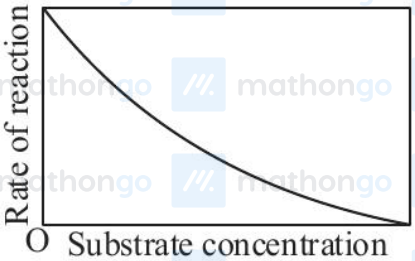
(b)



(c)



(d)



(1) b (2) c (3) d (4) a

Space for your notes:

Q4 - 25 January - Shift 1

For the first order reaction A → B Br the half life is 30 mm. The time taken for 75% completion of the reaction is_____mm. (Nearest mteger)

Given : log 2 = 0.3010

log 3 = 0.4771

log 5 = 0.6989

Space for your notes:

Q5 - 25 January - Shift 2

A first order reaction has the rate constant, k = 4.6 × 10^{-3} s^{-1}. The number of correct statement/s from the following is/are _____.

Given : log 3 = 0.48

A. Reaction completes in 1000 s.

B. The reaction has a half-life of 500 s.

C. The time required for 10% completion is 25 times the time required for 90% completion.

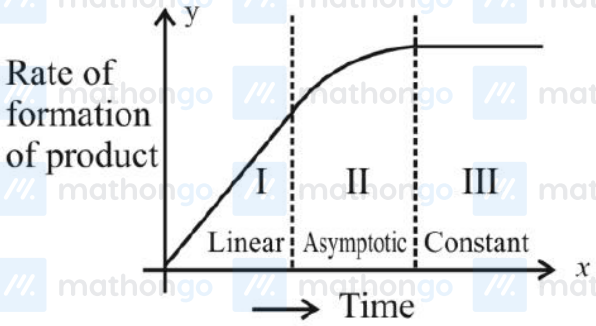
D. The degree of dissociation is equal to $(1 - e^{-kt})$.

E. The rate and the rate constant have the same unit.

Space for your notes:

Q6 - 29 January - Shift 1

For certain chemical reaction $X \rightarrow Y$, the rate of formation of product is plotted against the time as shown in the figure. The number of **Correct** statement/s from the following is _____



(A) Over all order of this reaction is one

(B) Order of this reaction can't be determined

(C) In region-I and III, the reaction is of first and zero order respectively

(D) In region-II, the reaction is of first order

(E) In region-II, the order of reaction is in the range of 0.1 to 0.9.

Space for your notes:

Q7 - 29 January - Shift 2

For conversion of compound A $\rightarrow$ B, the rate constant of the reaction was found to be 4.6×10^{-5} L mol^{-1} s^{-1}. The order of the reaction is _____ .

Space for your notes:

Q8 - 30 January - Shift 1

If compound A reacts with B following first order kinetics with rate constant $2.011\times10^{-3}s^{-1}$. The time taken by A (in seconds) to reduce from 7 g to 2 g will be _____. (Nearest Integer)

$[\log 5 = 0.698, \log 7 = 0.845, \log 2 = 0.301]$

Space for your notes:

Q9 - 30 January - Shift 2

An organic compound undergoes first order decomposition. If the time taken for the 60% decomposition is 540 s, then the time required for 90% decomposition will be is _____ s. (Nearest integer).

Given : ln 10 = 2.3; log 2 = 0.3

Space for your notes:

Q10 - 31 January - Shift 1

$A \rightarrow B$

The rate constants of the above reaction at 200 K and 300K are 0.03 min^{-1} and 0.05 min^{-1} respectively. The activation energy for the reaction is _____ J (Nearest integer)

(Given : In 10 = 2.3

$R = 8.3\ J\ K^{-1}\ mol^{-1}$

log5 = 0.70

log3=0.48

log2 = 0.30

Space for your notes:

Q11 - 31 January - Shift 2

Match **List-I** with **List-II**

List-I		List-II	
(A)	Physisorption	I	Single layer adsorption
(B)	Chemisorption	II	20-40 kJ mol^{-1}
(C)	$N_2(g)+3H_2(g)\xrightarrow{Fe(s)}2NH_3(g)$	III	Chromatography
(D)	Analytical Application or Adsorption	IV	Heterogeneous catalysis

Choose the correct answer from the options given below :

(1) A – II, B – III, C – I, D – IV

(2) A – III, B – IV, C – I, D - II

(3) A – IV, B – II, C – III, D - I

(4) A – II, B – I, C – IV, D – III

Space for your notes:

Q12 - 31 January - Shift 2

The rate constant for a first order reaction is $20\ min^{-1}$. The time required for the initial concentration of the reactant to reduce to its $\frac{1}{32}$ level is _____ $\times 10^{-2}$ min . (Nearest integer)

(Given : $\ln 10 = 2.303$

$\log 2 = 0.3010$)

Space for your notes:

Q13 - 01 February - Shift 1

A and B are two substances undergoing radioactive decay in a container. The half life of A is 15 min and that of B is 5 min. If the initial concentration of B is 4 times that of A and they both start decaying at the same time, how much time will it take for the concentration of both of them to be same? _____ min.

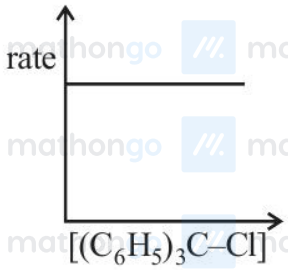
Space for your notes:

Q14 - 01 February - Shift 2

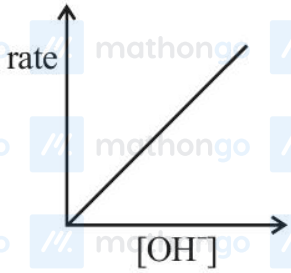
The graph which represents the following reaction is :

$$(C_6H_5)_3C-Cl \xrightarrow[\text{Pyridine}]{OH^-} (C_6H_5)_3C-OH$$

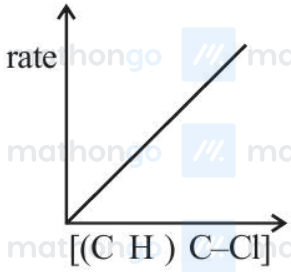
(1)



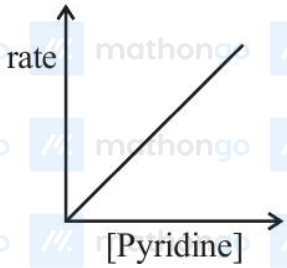
(2)



(3)



(4)



Space for your notes:

Q15 - 01 February - Shift 2

$A \rightarrow B$

The above reaction is of zero order. Half life of this reaction is 50 min. The time taken for the concentration of A to reduce to one-fourth of its initial value is_____min.

(Nearest integer)

Space for your notes:

Answer Key

(As per Official NTA Key released on 2 Feb)

Q1 (3)	**Q2** (2)	**Q3** (2)	**Q4** (60)
Q5 (2)	**Q6** (2)	**Q7** (2)	**Q8** (623)
Q9 (1350)	**Q10** (2520)	**Q11** (4)	**Q12** (17)
Q13 (15)	**Q14** (3)	**Q15** (75)	

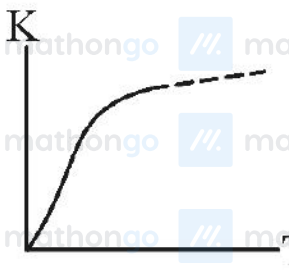
Q1 (3)

A : $k = Ae^{-\frac{}{RT}}$

As Ea increases k decreases

B : Temperature coefficient $= \frac{k_{T+10}}{k_T}$

C :



Option (C) is wrong. Δk may be greater or lesser depending on temperature.

D : $\ln k = \ln A - \frac{Ea}{RT}$

Q2 (2)

$$t_{1/2} \propto (P_o)^{1-n}$$

$$\frac{(t_{1/2})_1}{(t_{1/2})_2} = \frac{(P_0)_1^{1-n}}{(P_{0_2})_2^{1-n}}$$

$$\Rightarrow \left(\frac{4}{2}\right) = \left(\frac{50}{100}\right)^{1-n}$$

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

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

$$\Rightarrow n - 1 = 1$$

$$\Rightarrow n = 2$$

Q3 (2)

Fact base

Q4 (60)

$$t_{1/2} = T_{50} = 30 \text{ min}$$

$$T_{75} = 2t_{1/2} = 30 \times 2 = 60 \text{ min}$$

Q5 (2)

$$t_{10\%}=\frac{1}{K}\ln\left(\frac{a}{a-x}\right)=\frac{1}{K}\ln\left(\frac{100}{90}\right)$$

$$t_{10\%}=\frac{2.303}{K}(\log 10-\log 9)$$

$$t_{10\%}=\frac{2.093}{K}\times(0.04)$$

Similarly

$$t_{90\%}=\frac{1}{K}\ln\left(\frac{100}{10}\right)$$

$$t_{90\%}=\frac{2.303}{K}$$

$$\frac{t_{90\%}}{t_{10\%}}=\frac{1}{0.04}=25$$

$$e^{kt}=\frac{a}{a-x}$$

$$\frac{a-x}{a}=e^{-kt}$$

$$1-\frac{x}{a}=e^{-kt}$$

$$x=a(1-e^{-kt})$$

$$\alpha=\frac{x}{a}=\left(1-e^{-kt}\right)$$

Q6 (2)

Only option (B) is correct as order cannot be determined

Q7 (2)

As unit of rate constant is $(\text{conc.})^{1-n}\ \text{time}^{-1}$

$\Rightarrow (\text{L mol}^{-1}) \Rightarrow 1-n=-1$

$n=2$

Q8 (623)

$$A+B\rightarrow P$$

$t=0 \quad 7g$

$t=t \quad 2g$

at constant volume

$$t=\frac{2.303}{K}\log\frac{[A]_0}{[A]_t}$$

$$=\frac{2\cdot303}{2\cdot011\times10^{-3}}\log\frac{7}{2}$$

$$=\frac{2\cdot303\times0\cdot544}{2\cdot011\times10^{-3}}$$

$$=622.989$$

$$\approx623$$

Q9 (1350)

$$\frac{t_1}{t_2}=\frac{\frac{1}{K}\ln\frac{a_0}{0.4a_0}}{\frac{1}{K}\ln\frac{a_0}{0.1a_0}}$$

$$\frac{540}{t_2}=\frac{\ln\frac{10}{4}}{\ln 10}$$

$$\frac{540}{t_2}=\frac{\log 10-\log 4}{\log 10}$$

$$\frac{540}{t_2}=\frac{1-0.6}{1}$$

$$\Rightarrow \frac{540}{t_2}=0.4$$

$$\Rightarrow t_2=\frac{540}{0.4}=1350\ \text{sec}$$

Q10 (2520)

$$\log\frac{K_{300}}{K_{200}}=\frac{E_a}{2.3\times 8.314}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$$

$$\log\frac{0.05}{0.03}=\frac{Ea}{2.305\times 8.314}\times\left[\frac{1}{200}-\frac{1}{300}\right]$$

$$E_a=2519.88\ \text{J}\Rightarrow E_a=2520\ \text{J}$$

Q11 (4)

(A) Physisorption = 20 – 40 kJ/mol and Chemisorption = 80 – 240 kJ/mol

(B) Physisorption is multi-layered and chemisorption is unimolecular layered.

(C) In heterogeneous catalysis, medium and catalyst are in different phases.

(D) Chromatography uses adsorption to purify/separate mixtures.

Q12 (17)

$$C = \frac{C_o}{2^n} = \frac{C_o}{32}$$

$$n = 5$$

$$t = 5t_{1/2}$$

$$= \frac{5 \times 0.693}{20} = \frac{0.693}{4}$$

$$= 0.17325 \text{ min} = 17.325 \times 10^{-2} \text{ min.}$$

Q13 (15)

$[A]_t = [A]_0 e^{-kt}$

For A : Let $[A]_t$ be y and $[A]_0$ be x ; $k = \frac{\ln 2}{t_{1/2}} =$

$\frac{\ln 2}{15 \text{ min}}$

$y = xe^{-kt}$

$= xe^{-\left(\frac{\ln 2}{15}\right)t}$

For B : $[B]_t = [B]_0 e^{-kt}$

Let $[B]_t = y$; $[B]_0 = 4x$; $k = \frac{\ln 2}{t_{1/2}} = \frac{\ln 2}{5 \text{ min}}$

$y = 4xe^{-\left(\frac{\ln 2}{5}\right)t}$

$xe^{-\left(\frac{\ln 2}{15}\right)t} = 4xe^{-\left(\frac{\ln 2}{5}\right)t}$

$e^{t\left(\frac{\ln 2}{5} - \frac{\ln 2}{15}\right)} = 4$

$t \times \left[\frac{\ln 2}{5} - \frac{\ln 2}{15}\right] = \ln 4$

$t \times \ln 2 \left[\frac{1}{5} - \frac{1}{15}\right] = 2 \ln 2$

$t = 15 \text{ min}$

Q14 (3)

(It is SN1 reaction so rate of reaction depends on the concentration of alkyl halide only.

Q15 (75)

Assume reaction starts with 1 mole A

$$\left(t_{1/2}=\frac{a}{2k}, K=\frac{1}{2\times 50}\right.$$

For 75% completion

$$a-\frac{a}{4}=kt$$

$$t=\frac{3}{4}\frac{a}{k}=\frac{3}{4}\times\frac{100}{a}=75$$