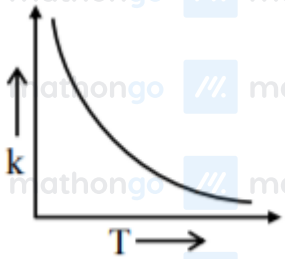
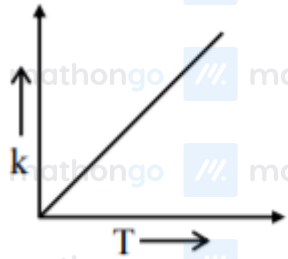
Q1 2021 (01 Sep Shift 2)

Which one of the following given graphs represents the variation of rate constant (k) with temperature (T) for an endothermic reaction ?

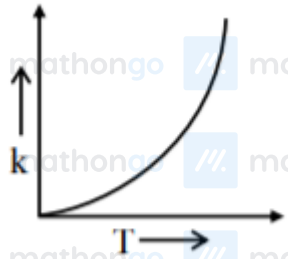
(1)



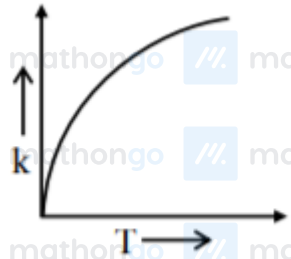
(2)



(3)



(4)



Q2 2021 (31 Aug Shift 2)

For the reaction $A \rightarrow B$, the rate constant $k\left(ins^{-1}\right)$ is given by

$$\log_{10} k = 20.35 - \frac{\left(2.47 \times 10^{3}\right)}{T}$$

The energy of activation in kJ mol^{-1} is ____.

(Nearest integer)

[Given : $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$]

Q3 2021 (31 Aug Shift 1)

For a first order reaction, the ratio of the time for 75% completion of a reaction to the time for 50% completion is ____. (Integer answer)

Q4 2021 (27 Aug Shift 2)

The first order rate constant for the decomposition of $CaCO_3$ at 700 K is $6.36 \times 10^{-3} \text{ s}^{-1}$ and activation energy is 209 kJ mol^{-1}. Its rate constant (in s^{-1}) at 600 K is $x \times 10^{-6}$. The value of x is ____.

(Nearest integer)

[Given $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}; \log 6.36 \times 10^{-3} = -2.19$,
$10^{-4.79} = 1.62 \times 10^{-5}$]

Q5 2021 (27 Aug Shift 1)

The reaction that occurs in a breath analyser, a device used to determine the alcohol level in a person's blood stream is

$2 \text{ K}_2\text{Cr}_2\text{O}_7 + 8\text{H}_2\text{SO}_4 + 3\text{C}_2\text{H}_6\text{O} \rightarrow 2\text{Cr}_2(\text{SO}_4)_3 +$
$3\text{C}_2\text{H}_4\text{O}_2 + 2 \text{ K}_2\text{SO}_4 + 11\text{H}_2\text{O}$

If the rate of appearance of $\text{Cr}_2(\text{SO}_4)_3$ is 2.67 mol min^{-1} at a particular time, the rate of disappearance of $\text{C}_2\text{H}_6\text{O}$ at the same time is ____ mol min^{-1}. (Nearest integer)

Q6 2021 (26 Aug Shift 1)

The following data was obtained for chemical reaction given below at 975 K.

$2\text{NO}_{(g)} + 2\text{H}_{2(g)} \rightarrow \text{N}_{2(g)} + 2\text{H}_2\text{O}_{(g)}$

	[NO] mol L^{-1}	$[H_2]$ mol L^{-1}	Rate mol $L^{-1}s^{-1}$
(A)	8×10^{-5}	8×10^{-5}	7×10^{-9}
(B)	24×10^{-5}	8×10^{-5}	2.1×10^{-8}
(C)	24×10^{-5}	32×10^{-5}	8.4×10^{-8}

The order of the reaction with respect to NO is ____. [Integer answer]

Answer Key

Q1 (3) **Q2** (47) **Q3** (2) **Q4** (16)

Q5 (4) **Q6** (1)

Q1 (3)

By observation we get this plot during measurable temperatures

Ans. 3^{rd} Option.

Q2 (47)

Given $\log \mathrm{K}=20.35-\frac{2.47\times10^{3}}{\mathrm{T}}$

We know $\log \mathrm{K}=\log A-\frac{E_a}{2.303RT}$

$\Rightarrow \quad \frac{\mathrm{E_a}}{2.303\mathrm{RT}}=2.47\times10^{3}$

$\mathrm{E_a}=2.47\times10^{3}\times2.303\times\frac{8.314}{1000}\mathrm{KJ/mole}$

$=47.29=47$ (Nearest integer)

Q3 (2)

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

$\frac{2.303}{\mathrm{t_{50\%}}}\log\frac{100}{100-50}=\frac{2.303}{\mathrm{t_{75\%}}}\log\frac{100}{100-75}$

$t_{75\%}=2t_{50\%}$

Q4 (16)

$\mathrm{K_{700}}=6.36\times10^{-3}\ \mathrm{s^{-1}};$

$\mathrm{K_{600}}=x\times10^{-6}\ \mathrm{s^{-1}}$

$\mathrm{E_a}=209\ \mathrm{kJ/mol}$

Applying ;

$\log\left(\frac{\mathrm{K_{T_2}}}{\mathrm{K_{T_1}}}\right)=\frac{-\mathrm{E_a}}{2.303\mathrm{R}}\left(\frac{1}{\mathrm{T_2}}-\frac{1}{\mathrm{T_1}}\right)$

$\log\left(\frac{\mathrm{K_{700}}}{\mathrm{K_{600}}}\right)=\frac{-\mathrm{E_a}}{2.303\mathrm{R}}\left(\frac{1}{700}-\frac{1}{600}\right)$

$\log\left(\frac{6.36\times10^{-3}}{\mathrm{K_{600}}}\right)=\frac{+209\times1000}{2.303\times8.31}\left(\frac{100}{700\times600}\right)$

$\log\left(6.36\times10^{-3}\right)-\log K_{600}=2.6$

$\Rightarrow \log\mathrm{K_{600}}=-2.19-2.6=-4.79$

$$\Rightarrow K_{600} = 10^{-4.79} = 1.62 \times 10^{-5}$$
$$= 16.2 \times 10^{-6}$$
$$= x \times 10^{-6}$$
$$\Rightarrow \mathrm{x} = 16$$

Q5 (4)

$$\left(\frac{\text{Rate of disappearance of } C_2H_6O}{3}\right)$$
$$= \left(\frac{\text{Rate of appearance of } Cr_2(SO_4)_3}{2}\right)$$
$$\Rightarrow \left(\frac{2.67 \text{ mol/ min} \times 3}{2}\right) = \text{rate of disappearance of } C_2H_6O.$$
$$\Rightarrow \text{Rate of disappearance of } C_2H_6O = 4.005 \text{ mol/min}$$

Q6 (1)

$$7 \times 10^{-9} = \mathrm{K} \times \left(8 \times 10^{-5}\right)^x \left(8 \times 10^{-5}\right)^y \ldots (1)$$
$$2.1 \times 10^{-8} = \mathrm{K} \times \left(24 \times 10^{-5}\right)^x \left(8 \times 10^{-5}\right)^y \ldots (2)$$
$$\frac{1}{3} = \left(\frac{1}{3}\right)^x \Rightarrow x = 1$$