Master Math for JEE Main & JEE Advanced

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JEE Mains 2020 Jan Chapter wise Question Bank

Chemical Kinetics

Q1

Half life of $_{90}Sr$ is 6.93 years. In a child body 1 μg of $_{90}Sr$ dopped in place of calcium, how many years will it take to reduce its concentration by 90% (Assume no involvement of Sr in metabolism).

7th Jan Morning

Sol

23.03

$$\frac{t_{90\%}}{t_{50\%}} = \frac{\ell n\frac{100}{10}}{\ell n2} = \frac{\ell n10}{0.693}$$

$$t_{90\%} = \frac{6.93}{0.693} \times \ell n10 = 10\ell n10 = 23.03\,\text{Years}$$

Q2

Rate of a reaction increases by 10^6 times when a reaction is carried out in presence of enzyme catalyst at same temperature. Determine change in activation energy.
अभिक्रिया को समान ताप पर एन्जाइम की उपस्थित में सम्पन्न कराने पर अभिक्रिया के वेग में 10^6 से वृद्धि हो जाती है तब सक्रियण ऊर्जा में परिवर्तन का निर्धारण कीजिये।
(1) –6 × 2.303 RT (2) +6×2.303RT (3) + 6RT (4) –6RT

8th Jan Morning

Sol

(1)

$K = Ae^{-E/RT}$ .....(1)

$10^6k = Ae^{-E_c/RT}$ .....(2)

$\frac{\text{equation } 2}{\text{equation } 1} \Rightarrow 10^6 = e^{(E-E_c)/RT}$

or या

$6 \ln 10 = (E-E_c)/RT$

or या

$$\frac{(E - E_c)}{RT} = 2.303 \times 6$$

or या, $E–E_C = 2.303 \times 6RT$

or या, $\Delta E_a = E_c - E = \boxed{-2.303 \times 6RT}$

Q3

Which of the following exhibit both Frenkel & Schottky defect?
निम्न में से कौन फ्रेंकल तथा शॉट्की दोनों त्रुटि प्रदर्शित करता है?
(1) AgBr (2) KCl (3) CsCl (4) ZnS

8th Jan Evening

Sol

(1)
Only AgBr can exhibit both Schottky and Frenkel defect.

Q4

$A \longrightarrow B$ 700 K

$A \xrightarrow{C} B$ 500 K

Rate of reaction in absence of catalyst at 700 K is same as in presence of catalyst at 500 K. If catalyst decreases activation energy barrier by 30 kJ/mole, determine activation energy in presence of catalyst. (Assume 'A' factor to be same in both cases)
700 K पर उत्प्रेरक की अनुपस्थिति में अभिक्रिया का वेग 500 K पर उत्प्रेरक की उपस्थिति में अभिक्रिया के वेग के समान है यदि उत्प्रेरक सक्रियण ऊर्जा अवरोध में 30 kJ/mole से कमी करता है। तब उत्प्रेरक की उपस्थिति में सक्रियण ऊर्जा का निर्धारण कीजिऐ। (माना कि 'A' कारक दोनो परिस्थितियों में समान है।)
(1) 75 kJ (2) 135 kJ (3) 105 kJ (4) 125 kJ

9th Jan Morning

Sol

(1)

$K_{cat} = K$

$Ae^{-\frac{Ea_1}{RT_1}} = Ae^{-\frac{Ea_2}{RT_2}}$

$\frac{Ea_1}{T_1} = \frac{Ea_2}{T_2}$ $\quad Ea_1 = Ea_2 - 30$

$\frac{Ea_2 - 30}{500} = \frac{Ea_2}{700}$

$5Ea_2 = 7Ea_2 - 210$

$Ea_2 = \frac{210}{2} = 105$ kJ/mole

Activation energy of the catalysed reaction = 105 – 30 = 75 kJ/mole

Q5

Lacto bacillus has generation time 60 min. at 300 K and 40 min. at 400 K. Determine activation energy in $\frac{kJ}{mol}$. ($R = 8.3\ J\ K^{-1}mol^{-1}$) $\left[\ln\left(\frac{2}{3}\right) = -0.4\right]$ (given wrong in paper)

Sol

03.98

$$\ln \frac{K_2}{K_1} = \frac{Ea}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\ln\left(\frac{60}{40}\right) = \frac{E_a}{8.3} \times \frac{100}{400 \times 300}$$

$\ln(3/2) \times 8.3 \times 1200 = E_a$

$\Rightarrow \quad E_a = 0.4 \times 8.3 \times 1200$

$\Rightarrow \quad E_a = 3984$ J/mol.

$\Rightarrow \quad E_a = 3.984$ kJ/mol.

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