

JEE MAIN CHEMICAL KINETICS — TEMPERATURE DEPENDENCE OF THE RATE OF A REACTION AND ARRHENIUS EQUATION — PYQS

Max. Marks: 56

Questions: 14

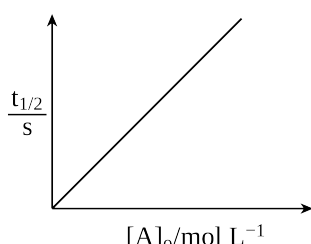
Section A (MCQ) — 4 questions

Q.1 Given below are two statements :

$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ and $1 \text{ cal} = 4.2 \text{ J}$

Statement-I: When $E_a = 12.6 \text{ kcal/mol}$, the room temperature rate constant is doubled by a 10°C increase in temperature (298 K to 308 K)

Statement-II: For a first order reaction $A \longrightarrow B$,



Here $[A]_0$ is the initial concentration of A and $t_{1/2}$ is half life of reaction.

In the light of the above statements, choose the correct answer from the options given below :

[JEE Main 2026 (Online) 8th April Evening Shift]

- (1) Both Statement-I and Statement-II are true
- (2) Both Statement-I and Statement-II are false
- (3) Statement-I is true but Statement-II is false
- (4) Statement-I is false but Statement-II is true

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Q.2 Correct statements regarding Arrhenius equation among the following are :

- A. Factor $e^{-E_a/RT}$ corresponds to fraction of molecules having kinetic energy less than E_a .
- B. At a given temperature, lower the E_a , faster is the reaction.
- C. Increase in temperature by about 10°C doubles the rate of reaction.

D. Plot of $\log k$ vs $\frac{1}{T}$ gives a straight line with

$$\text{slope} = -\frac{E_a}{R}.$$

Choose the correct answer from the options given below :

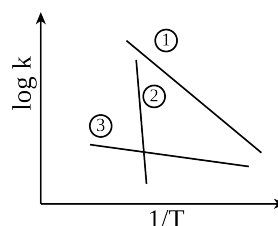
[JEE Main 2026 (Online) 22nd January Evening Shift]

- (1) A and B Only
- (2) B and D Only
- (3) B and C Only
- (4) A and C Only

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Q.3 Consider the following plots of $\log$ of rate constant k ($\log k$) vs $\frac{1}{T}$ for three different reactions. The correct order of activation energies of these reactions is :

[JEE Main 2025 (Online) 4th April Evening Shift]



- (1) $E_{a2} > E_{a1} > E_{a3}$
- (2) $E_{a1} > E_{a3} > E_{a2}$
- (3) $E_{a3} > E_{a2} > E_{a1}$
- (4) $E_{a1} > E_{a2} > E_{a3}$

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Q.4 Consider the following statements related to temperature dependence of rate constants.

- A. The Arrhenius equation holds true only for an elementary homogeneous reaction.
- B. The unit of A is same as that of k in Arrhenius equation.
- C. At a given temperature, a low activation energy means a fast reaction.
- D. A and E_a as used in Arrhenius equation depend on temperature.
- E. When $E_a \gg RT$, A and E_a become interdependent.

Identify the correct statements.

Choose the correct answer from the options given below:

[JEE Main 2025 (Online) 3rd April Evening Shift]

- (1) A, C and D Only
- (2) B, D and E Only
- (3) B and C Only
- (4) A and B Only

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Section B (Numerical) — 10 questions

Q.5 Decomposition of a hydrocarbon follows the equation $k = (5.5 \times 10^{11} \text{ s}^{-1}) e^{-28000 \text{ K}/T}$. The activation energy of reaction is _____ kJ mol^{-1} . (Nearest Integer)

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

[JEE Main 2026 (Online) 6th April Evening Shift]

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- Q.6** For reaction $A \longrightarrow P$, rate constant $k = 1.5 \times 10^3 \text{ s}^{-1}$ at 27°C . If activation energy for the above reaction is 60 kJ mol^{-1} , then the temperature (in $^\circ\text{C}$) at which rate constant, $k = 4.5 \times 10^3 \text{ s}^{-1}$ is _____. (Nearest integer)
- Given : $\log 2 = 0.30$, $\log 3 = 0.48$, $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$, $\ln 10 = 2.3$

[JEE Main 2026 (Online) 2nd April Morning Shift]

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- Q.7** $A \rightarrow B$ (first reaction)
 $C \rightarrow D$ (second reaction)
- Consider the above two first-order reactions. The rate constant for first reaction at 500 K is double of the same at 300 K . At 500 K , 50% of the reaction becomes complete in 2 hours. The activation energy of the second reaction is half of that of first reaction. If the rate constant at 500 K of the second reaction becomes double of the rate constant of first reaction at the same temperature; then rate constant for the second reaction at 300 K is _____ $\times 10^{-1} \text{ hour}^{-1}$ (nearest integer).

[JEE Main 2026 (Online) 28th January Evening Shift]

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- Q.8** The temperature at which the rate constants of the given below two gaseous reactions become equal is _____ K . (Nearest integer)
- $X \longrightarrow Y, \quad k_1 = 10^6 e^{\frac{-30000}{T}}$
 $P \longrightarrow Q, \quad k_2 = 10^4 e^{\frac{-24000}{T}}$
- Given : $\ln 10 = 2.303$

[JEE Main 2026 (Online) 22nd January Morning Shift]

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- Q.9** Consider $A \xrightarrow{k_1} B$ and $C \xrightarrow{k_2} D$ are two reactions. If the rate constant (k_1) of the $A \longrightarrow B$ reaction can be expressed by the following equation
- $$\log_{10} k = 14.34 - \frac{1.5 \times 10^4}{T/K}$$
- and activation energy of $C \longrightarrow D$ reaction (E_{a_2}) is $\frac{1}{5}$ th of the $A \longrightarrow B$ reaction (E_{a_1}), then the value of (E_{a_2}) is _____ kJ mol^{-1} . (Nearest Integer)

[JEE Main 2026 (Online) 22nd January Evening Shift]

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- Q.10** Pre-exponential factors of two different reactions of same order are identical. Let activation energy of first reaction exceed the activation energy of second reaction by 20 kJ mol^{-1} . If k_1 and k_2 are the rate constants of first and second reaction respectively at 300 K , then $\ln \frac{k_2}{k_1}$ will be _____. (nearest integer)
- [$R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$]

[JEE Main 2026 (Online) 21st January Morning Shift]

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- Q.11** Consider a complex reaction taking place in three steps with rate constants k_1 , k_2 and k_3 respectively. The overall rate constant k is given by the expression $k = \sqrt{\frac{k_1 k_3}{k_2}}$. If the activation energies of the three steps are 60 , 30 and 10 kJ mol^{-1} respectively, then the overall energy of activation in kJ mol^{-1} is _____. (Nearest integer)

[JEE Main 2025 (Online) 24th January Evening Shift]

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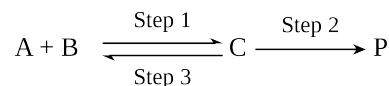
- Q.12** $A \longrightarrow B$
- The molecule A changes into its isomeric form B by following a first order kinetics at a temperature of 1000 K . If the energy barrier with respect to reactant energy for such isomeric transformation is $191.48 \text{ kJ mol}^{-1}$ and the frequency factor is 10^{20} , the time required for 50% molecules of A to become B is _____ picoseconds (nearest integer).
- [$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$]

[JEE Main 2025 (Online) 22nd January Morning Shift]

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- Q.13** Consider the following transformation involving first order elementary reaction in each step at constant temperature as shown below.



Some details of the above reactions are listed below.

Step	Rate constant (sec^{-1})	Activation energy (kJ mol^{-1})
1	k_1	300
2	k_2	200
3	k_3	E_{a_3}

If the overall rate constant of the above transformation (k) is given as $k = \frac{k_1 k_2}{k_3}$ and the overall activation energy (E_a) is 400 kJ mol^{-1} , then the value of E_{a3} is _____ kJ mol^{-1} (nearest integer) [JEE Main 2024 (Online) 4th April Morning Shift]

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Q.14 For a reaction taking place in three steps at same temperature, overall rate constant $K = \frac{K_1 K_2}{K_3}$. If E_{a1} , E_{a2} and E_{a3} are 40, 50 and 60 kJ/mol respectively, the overall E_a is _____ kJ/mol .

[JEE Main 2024 (Online) 29th January Morning Shift]

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ANSWER KEY

Section A (MCQ) — 4 questions

Ques.	1	2	3	4							
Ans.	3	3	1	3							

Section B (Numerical) — 10 questions

Ques.	5	6	7	8	9	10	11
Ans.	232	41	5	1303	57	8	20
Ques.	12	13	14				
Ans.	69	100	30				