DPP –8 [Arrhenius Equation]

Chapter: Chemical Kinetics

"Un logon ke liye padh lo… Jinhone apni life sacrifice ki taaki tumhe chance mile… Unke sapne tumhari mehnat ke bina adhure hain."

TYPE–1 : Arrhenius Plots & Graphical Analysis

1. **According to the arrhenius equation a straight line is to be obtained by plotting the logarithm of the rate constant of chemical reaction (log k) against.**

(1) (T) (2) log T

(3) $\frac{1}{T}$ (4) log $\frac{1}{T}$

2. **The plot of ℓn k versus 1/T is linear with slope of**

(1) $-\frac{E_a}{R}$ (2) $\frac{E_a}{R}$

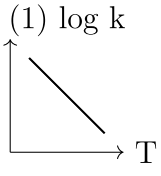
(3) $\frac{E_a}{2.303R}$ (4) $-\frac{E_a}{2.303R}$

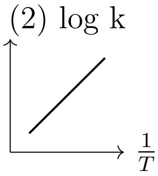
3. **Which plot will give the value of activation energy.**

(1) k v/s T (2) $\frac{1}{k}$ v/s T

(3) lnk v/s T (4) lnk v/s $\frac{1}{T}$

4. **Which of the following plot is in accordance with the arrhenius equation :–**

(1)


(2)


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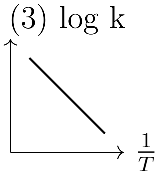
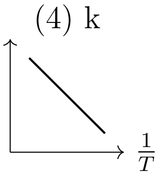
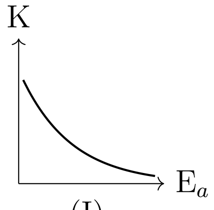
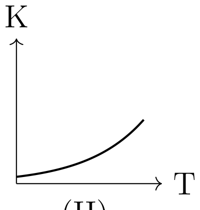


(4)


5. **Consider the given plots for a reaction obeying Arrhenius equation (0°C $<$ T $<$ 300°C) : (k and E_a are rate constant and activation energy, respectively)**



(I)



(II)

Choose the correct option :

[JEE(Main) 2019 Online (10-01-19), 4/120]

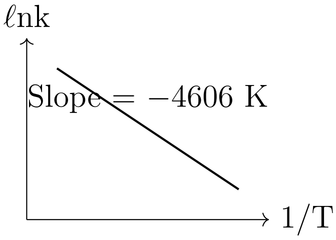
(1) I is right but II is wrong

(2) Both I and II are wrong

(3) I is wrong but II is right
(4) Both I and II are correct

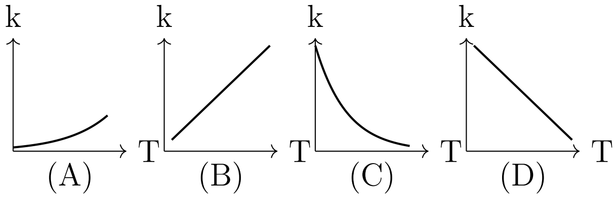
6. **If a reaction follows the Arrhenius equation the plot lnk vs 1/(RT) gives straight line with a gradient (−y) unit. The energy required to activate the reactant is :**
[JEE(Main) 2019 Online (11-01-19), 4/120]
(1) −y unit (2) y unit
(3) y/R unit (4) yR unit

7. **For a reaction, consider the plot of ln k versus 1/T given in the figure. If the rate constant of this reaction at 400 K is 10^{-5} s^{-1}, then the rate constant at 500 K is:**
[JEE(Main) 2019 Online (12-01-19), 4/120]



(1) 10^{-4} s^{-1} (2) 4×10^{-4} s^{-1}
(3) 2×10^{-4} s^{-1} (4) 10^{-6} s^{-1}

8. **Plots showing the variation of the rate constant (k) with temperature (T) are given below. The plot that follows Arrhenius equation is :**
[JEE-2010, 3/163]



TYPE–2 : Rate Constant at a given temperature

9. **The rate of reaction increases to 2.3 times when the temperature is raised from 300 K to 310 K. If K is the rate constant at 300 K then the rate constant at 310 K will be equal to –**
(1) 2 k (2) k
(3) 2.3 k (4) $3\ k^2$

10. **Given that k is the rate constant for some order of any reaction at temp T then the value of**
$\lim_{T\to\infty}$ **log k ____________.**
(1) A/2.303 (2) A
(3) 2.303 A (4) log A

11. **The rate constant, the activation energy and the arrhenius parameter of a chemical reaction at 25°C are 3×10^{-4} s^{-1}; 104.4 kJ mol^{-1} and 6.0 $\times 10^{14}$ s^{-1} respectively, the value of the rate constant as T→ ∞ is.**
(1) 2×10^{5} s^{-1} (2) 6×10^{14} s^{-1}

(3) Infinity (4) 3.6×10^{30} s^{-1}

12. **The rate of a reaction A doubles on increasing the temperature from 300 to 310 K. By how much, the temperature of reaction B should be increased from 300 K so that rate doubles if activation energy of the reaction B is twice to that of reaction A.**

[JEE(Main) 2017 Online (08-04-17), 4/120]

(1) 9.84 K (2) 19.67 K
(3) 2.45 K (4) 4.92 K

TYPE–3 : Activation Energy Calculations from Data

13. **For a certain gaseous reaction rise of temperature from 25° C to 35° C doubles the rate of reaction. What is the value of activation energy :–**

(1) $\dfrac{10}{2.303R \times 298 \times 308}$

(2) $\dfrac{2.303 \times 10}{298 \times 308R}$

(3) $\dfrac{0.693R \times 10}{290 \times 308}$

(4) $\dfrac{0.693R \times 298 \times 308}{10}$

14. **The rate coefficient (k) for a particular reactions is 1.3×10^{-4} $M^{-1}s^{-1}$ at 100°C, and 1.3×10^{-3} $M^{-1}s^{-1}$ at 150°C. What is the energy of activation (E_A) (in kJ) for this reaction ?**

(R = molar gas constant = 8.314 JK^{-1} mol^{-1})

[JEE(Main) 2014 Online (12-04-14), 4/120]

(1) 16 (2) 60
(3) 99 (4) 132

15. **The rate of a reaction quadruples when the temperature changes from 300 to 310 K. The activation energy of this reaction is :**

(Assume activation energy and pre-exponential factor are independent of temperature; ln2 = 0.693; R = 8.314 J mol^{-1} K^{-1})

[JEE(Main) 2017 Online (09-04-17), 4/120]

(1) 53.6 kJ mol^{-1} (2) 26.8 kJ mol^{-1}
(3) 107.2 kJ mol^{-1} (4) 214.4 kJ mol^{-1}

16. **From the following data; the activation energy for the reaction (Cal/mol) $H_2 + I_2 \rightarrow 2HI$**

T (in K)	1/T(in K^{-1})	$\log_{10}k$
769	1.3×10^{-3}	2.9
667	1.5×10^{-3}	1.1

(1) 4×10^4 (2) 2×10^4
(3) 8×10^4 (4) 3×10^4

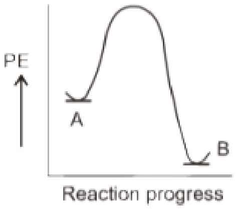
17. **For a first order reaction A → P, the temperature (T) dependent rate constant (k) was found to follow the equation log k = – (2000) $\dfrac{1}{T}$ + 6.0. The pre-exponential factor A and the activation energy E_a, respectively, are :**

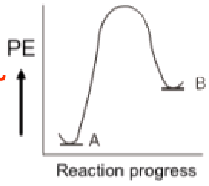
[JEE-2009, 3/160]

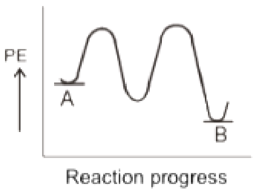
(A) 1.0×10^6 s^{-1} and 9.2 kJ mol^{-1}
(B) 6.0 s^{-1} and 16.6 kJ mol^{-1}
(C) 1.0×10^6 s^{-1} and 16.6 kJ mol^{-1}
(D) 1.0×10^6 s^{-1} and 38.3 kJ mol^{-1}

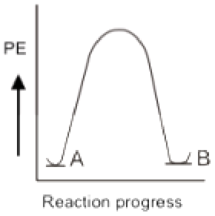
18. **The rate constant k_1 of a reaction is found to be double that of rate constant k_2 of another reaction. The relationship between corresponding activation energies of the two reactions at same temperature (E_1 and E_2) will be represented as :**
(A) $E_1 > E_2$ (B) $E_1 < E_2$
(C) $E_1 = E_2$ (D) None of these

19. **For a reaction A → B, $E_a = 10$ kJ mol^{-1}, $\Delta H = 5$ kJ mol^{-1}. Thus, potential energy profile for this reaction is :**

(A)


[✓ (B)]


(C)


(D)


[JEE(Main) 2019 Online (10-01-19), 4/120]

20. **For the equilibrium, $A(g) \rightleftharpoons B(g)$, ΔH is -40 kJ/mol. If the ratio of the activation energies of the forward (E_f) and reverse (E_b) reactions is $\frac{2}{3}$ then :**

[JEE(Main) 2015 Online (11-04-15), 4/120]

(1) $E_f = 80$ kJ/mol; $E_b = 120$ kJ/mol
(2) $E_f = 60$ kJ/mol; $E_b = 100$ kJ/mol
(3) $E_f = 30$ kJ/mol; $E_b = 70$ kJ/mol
(4) $E_f = 70$ kJ/mol; $E_b = 30$ kJ/mol

TYPE–4 : Activation Energy and enthaply of reaction relationship

1. **Activation energy of a reaction is –**
(1) The energy released during the reaction
(2) The energy evolved when activated complex is formed
(3) Minimum extra amount of energy needed to overcome the potential barrier of reaction
(4) The energy needed to form one mole of the product

2. **The minimum energy for molecules to enter into chemical reaction is called.**
(1) Kinetic energy (2) Potential energy
(3) Threshold energy (4) Activation energy

3. **For an endothermic reaction where ΔH represents the enthalpy of reaction in kJ mol^{-1}, the minimum value for the energy of activation will be**
(1) less than ΔH (2) more than ΔH
(3) equal to ΔH (4) zero

4. **The activation energy of the reaction, A + B → C + D + 38 kcal is 20 kCal, what would be the activation energy of the reaction, C + D → A + B**
(1) 20 kCal (2) −20 kCal
(3) 18 kCal (4) 58 kCal

5. **An endothermic reac on A → B have an activation energy 15 kCal/mol and the heat of the reaction is 5 k cal/mol. The actvation energy of the reaction B → A is –**
(1) 20 kCal/mol (2) 15 kCal/mol
(3) 10 kCal/mol (4) Zero

6. **For a reaction in which case the activation energies of forward and reverse reactions are equal :–**
(1) ΔH = 0 (2) ΔS = 0
(3) The order is zero (4) There is no catalyst

7. **The energy of activation of a forward reaction is 50 kCal. The energy of activation of its backward reaction is:–**
(1) Equal to 50 kCal.
(2) Greater than 50 kCal.
(3) Less than 50 kCal.
(4) Either greater or less than 50 kCal.

8. **An exothermic reaction X → Y has an activation energy 30 kJ mol^{-1}. If energy change (ΔE) during the reaction is −20 kJ, then the activation energy for the reverse reaction is :–**
(1) 10 kJ (2) 20 kJ
(3) 50 kJ (4) −30 kJ

9. **For the decomposition of $N_2O_5(g)$ it is given that–**
$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ activation energy = Ea
$N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2} O_2(g)$ activation energy = Ea'
then
(1) Ea = 2Ea' (2) Ea > Ea'
(3) Ea < Ea' (4) Ea = Ea'

10. **The activation energy for a chemical reaction depends upon :–**
(1) Temperature
(2) Nature of reacting species
(3) Concentration of the reacting species
(4) Collision frequency

TYPE–5 : Miscellaneous problems

11. **If concentration of reactants is increased by 'x' then the k becomes –**
(1) $\ln \frac{k}{x}$ (2) $\frac{k}{x}$
(3) k + x (4) k

12. **The rate constant of a first order reaction depends on the :–**
    (1) Concentration of the reactant
    (2) Concentration of the product
    (3) Time
    (4) Temperature
13. **The half life for a reaction is ———of temperature:–**
    (1) Independent
    (2) Increased with increase
    (3) Decreased with increase
    (4) Increased or decreased with increase
14. $\frac{k_{30^\circ}}{k_{24^\circ}}$ **>1 , this means that**
    (1) Rate increases with the rise in temperature
    (2) Rate decreases with rise in temperature
    (3) rate does not change with rise in temperature
    (4) None of the above
15. **The rate of a chemical reaction doubles for every 10^0C rise in temperature. If the temp is increased by 60^0C the rate of reaction increases by :**
    (1) 20 times (2) 32 times
    (3) 64 times (4) 128 times
16. **If the concentration units are reduced by n times then the value of rate constant of first order will**
    (1) Increases by n times
    (2) Decreases by factor of n
    (3) Remain constant
    (4) Decrease 1/n times
17. **Which is used in the determination of reaction rates.**
    (1) Reaction Temperature
    (2) Reaction Concentration
    (3) Specific rate constant
    (4) All of these
18. **At room temperature the reaction between NO and O_2 to give NO_2 is fast while that between CO and O_2 is slow it is due to –**
    (1) CO is smaller in size than that of NO
    (2) CO is poisonous
    (3) The activation energy for the reaction $2NO + O_2 \rightarrow 2NO_2$ is less than $2CO + O_2 \rightarrow 2CO_2$
    (4) NO_2 is poisonous
19. **Rate of which reactions increases with temperature**
    (1) Of any reaction
    (2) Of exothermic reaction
    (3) Of endothermic reaction
    (4) Can't be predicted
20. **According to collision theory of reaction rates –**
    (1) Every collision between reactants leads to chemical reaction
    (2) Rate of reaction is proportional to velocity of molecules

(3) All reactions which occur in gaseous phase are zero order reaction
(4) Rate of reaction is directly proportional to collision frequency.

21. **Chemical reaction occurs as a result of collision between reacting molecules. Therefore the reaction rate is given by**
(1) Total number of collisions occuring in a unit volume per second
(2) Fraction of molecules which possess energy less than the threshold energy.
(3) Total number of effective collisions
(4) Temperature

22. **A large increase in the rate of a reaction for a rise in temperature is due –**
(1) Increase in the nui ar of collisions
(2) Increase in the numbe r of activated molecules
(3) Lowering of activation energy
(4) Shortening of the mean free path

23. **The rate of reaction increases by the increase of temperature because :–**
(1) Collision is increased
(2) Energy of products decreases
(3) Fraction of molecules possessing energy $\geq E_T$ (Threshold energy) increases
(4) Mechanism of a reaction is changed

24. **For producing the effective collisions, the colloiding molecules must posses:–**
(1) A certain minimum amount of energy
(2) Energy equal to or greater than threshold energy
(3) Proper orientation
(4) Threshold energy as well as proper orientation of collision

25. **Consider the following reversible reaction,**
$A(g) + B(g) \rightleftharpoons AB(g)$
The activation energy of the backward reaction exceeds that of the forward reaction by 2 RT (in J mol^{-1}). If the pre-exponential factor of the forward reaction is 4 times that of the reverse reaction, the absolute value of ΔG^0 (in J $mole^{-1}$) for the reaction at 300 K is __________.
(Given : $\ln(2) = 0.7$, RT = 2500 J mol^{-1} at 300 K and G is the Gibbs energy)
[JEE(Advanced)-2018, 3/120]