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CHEMISTRY

DAILY PRACTICE PAPER

(DPP) – 2

For JEE/NEET

CHEMICAL KINETICS – For Effect of Temp.

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CHEMICAL KINETICS – For Effect of Temperature

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Unit - Chemical Kinetics **Topic - Effect Of Temp.**

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Objective Problems

01. Temperature coefficient of the rate of a reaction is 3. How many times the rate of reaction would increase if temperature is raised by 30 K

(A) 3 (B) 9 (C) 27 (D) 81

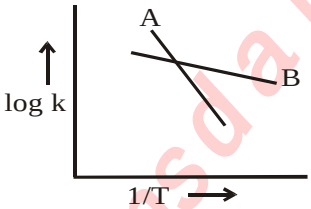
02. Collision theory sometimes gives the rate in the form rate = $\rho Z \exp(-E_a/RT)$ where Z is the collision frequency and the exponential is the probability that the energy of collision is equal to or greater than E_a. The steric factor, ρ, account for

(A) Molecular collisions
(B) Collisions with insufficient energy
(C) Collision with sufficient energy
(D) Collisions with unfavourable orientation

03. The decomposition of N_2O into N_2 & O_2 in presence of gaseous argon follow second order kinetic with $k = (5.0 \times 10^2 \text{ L mol}^{-1} \text{ s}^{-1})\ e^{\frac{41570\text{ K}}{1}}$ (K stands for Kelvin units). The energy of activation of the reaction is

(A) 5.0×10^{11} J (B) 41570 J
(C) 41570 J (D) 5000 J

04. The Arrhenius relationship of two different reactions is shown below. Which reaction is faster at a lower temperature and which is more sensitive to changes of temperature?



(A) B faster, A more sensitive
(B) B in both cases
(C) A in both cases
(D) A faster, B more sensitive

05. The rate of a reaction gets doubled when the temperature changes from 7ºC to 17ºC. By what factor will it change for the temperature change from 17ºC to 27ºC?

(A) 1.81 (B) 1.71 (C) 1.91 (D) 1.76

06. $A \rightarrow B$, $K_A = 10^{15}\ e^{-2000/T}$;
$C \rightarrow D$, $K_C = 10^{14}\ e^{-1000/T}$. Temperature **T** K at which ($K_A = K_C$) is

(A) 1000 K (B) 2000 K
(C) (2000/2.303) K (D) (1000/2.303) K

07. Temperature coefficient of the rate of a reaction is 3. How many times the rate of reaction would increase if temperature is raised by 30 K

(A) 3 (B) 9 (C) 27 (D) 81

08. The plot of log k versus 1/T is linear with slope of

(A) E_a/R (B) $-E_a/R$
(C) $E_a/2.303\ R$ (D) $-E_a/2.303$

09. Trimolecular reactions are uncommon because

(A) the probability of three molecules colliding at an instant is low.
(B) the probability of three molecules colliding at an instant is high.
(C) the probability of three molecules colliding at an instant is almost zero.
(D) the probability of many molecules colliding at an instant is high.

10. The rate constant for two parallel reactions were found to be 1.0×10^{-2} dm^3 mol^{-1} s^{-1} and 3.0×10^{-2} dm^3 mol^{-1} s^{-1}. If the corresponding energies of activation of the parallel reactions are 60.0 kJ mol^{-1} respectively. What is the apparent overall energy of activation?

(A) 130.0kJ mol^{-1} (B) 67.5kJ mol^{-1}
(C) 100.0kJ mol^{-1} (D) 65.0kJ mol^{-1}

11. Consider the following reactions at 300 K.
$A \longrightarrow B$ (uncatalysed reaction)
$A \xrightarrow{\text{catalyst}} B$ (catalyst reaction)
The activation energy is lowered by 8.314 KJ mol^{-1} for the catalysed reaction. The rate of this reaction is.....that of the uncatalyzed reaction

(A) 15 times (B) 38 times
(C) 22 times (D) 28 times

12. For a zero order reaction. Which of the following statement is false

(A) the rate is independent of the temp. of the reaction.
(B) the rate is independent of the conc. of the reactants.
(C) the half life depends as the conc. of the reactants.
(D) the rate const. has the unit mol. lit.$^{-1}$ sec^{-1}

13. The equation for the rate constant is : $k = Ae^{-E_a/RT}$. A chemical reaction will proceed more rapidly if there is a decrease in

(A) k (B) A (C) E_a (D) T

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14. An exothermic reaction A ⟶ B has an activation energy of 17 kJ per mole of A. The heat of reaction is –40 kJ/mole. The activation energy for the reverse reaction B ⟶ A is
(A) 75 KJ/mole (B) 67 KJ/mole
(C) 57 KJ/mole (D) 17 KJ/mole

15. The first order rate constant k is related to temperature as log K = 15.0 – (10^6/T). Which of the following pair of value is correct?
(A) A = 10^{15} and E = 1.9 × 10^4 KJ
(B) A = 10^{-15} and E = 40 KJ
(C) A = 10^{15} & E = 40 KJ
(D) A = 10^{-15} & E = 1.9 × 10^4 KJ

16. For an endothermic reaction where ΔH represents the enthalpy of the reaction in KJ/mole, the minimum value of the energy of activation will be
(A) less than ΔH (B) Zero
(C) More than ΔH (D) Equal to ΔH

17. When a graph between log k (on y-axis) and 1/T (on x-axis) is drawn a straight line is obtained. The point at which line cuts y-axis and x-axis respectively correspond to the temperature
(A) 0, E_a / 2.303 R log A
(B) ∞, E_a / (R /n A)
(C) 0, log A
(D) None of these

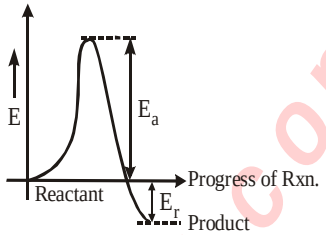
18. At room temperature the reaction between NO and O_2 to give NO_2 is fast, while that between CO and O_2 is slow. It is due to
(A) CO is smaller in size than that of NO.
(B) CO is poisonous.
(C) The activation energy for the reaction, $2NO + O_2 \longrightarrow 2NO_2$ is less than $2CO + O_2 \longrightarrow 2CO_2$
(D) None

19. Effective collision are those in which molecules must
(A) Have energy equal to or greater than required to form the transition state.
(B) Have proper crientation.
(C) Acquire the energy of activation.
(D) All

20. Large increase in the rate of reaction due to rise in temperature is due to
(A) Increase in collision frequency.
(B) Lowering of activation energy.
(C) Increase in number of effective collisions.
(D) None.

21. Rate of which reactions increases with temperature
(A) Of any (B) Of exothermic
(C) Of endothermic (D) Of none

22. From the figure, the activation energy for the reverse reaction would be : (Given E_a = 1640 KJ/mole, E_r = –120 KJ/mole)



(A) –120 KJ/mole (B) +152 KJ/mole
(C) +120 KJ/mole (D) 1760 KJ/mole

23. The rate constant, the activation energy and the frequency factor a chemical reaction at 25ºC are 3.0×10^{-4} s^{-1} 104.4 kJ mol^{-1} and 6.0×10^{14} s^{-1} respectively. The value of the rate constant as T → ∞ is
(A) 2.0 × $10^{18}s^{-1}$ (B) 6.0 × $10^{14}s^{-1}$
(C) Infinity (D) 3.6 × $10^{30}s^{-1}$

24. Half-time for first order reaction is $t^{1/2}$. The half-life period will
(A) Increase with increase in temperature.
(B) Decrease with increase in temperature.
(C) Be unaffected by the change in temperature.
(D) None of the above.

25. The activation energy of a first order reaction is zero. The rate constant of the reaction
(A) rapidly increases with rise of temperature.
(B) can not be increased by any amount on raising temperature.
(C) can be increased by adding a catalyst.
(D) can be decreased by adding a negative catalyst.

26. The rate constant is given by the equation $k = PZe^{-E/RT}$. Which factor should register a decrease for the reaction to proceed more rapidly?
(A) T (B) Z (C) E (D) P

27. Given that K is the rate constant for some order of any reaction at temperature. T, then the value of $\lim_{T\to\infty}$ log K, (where A is the Arrhenius constant) is
(A) A/2.303 (B) A (C) 2.303 A (D) log A

28. Which of the following statement is correct?
(A) Rate of reaction ∝ (1/E_a)
(B) At lower temperature increase in temperature causes more change in the value of K.
(C) Both
(D) None

29. The activation energy for a reaction is 9 kcal/mol. The increase in rate constant when the temperature of the reaction is increased from 298 K to 308 K is
(A) 10% (B) 100% (C) 50% (D) 63%

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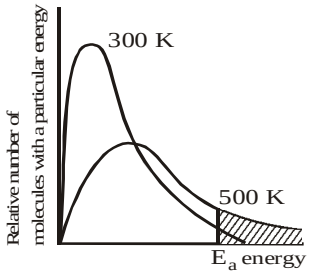
30. Identify the statement which is true
(A) the order of reaction is determined by inspection of the stoichiometry of the process.
(B) the catalyst changes the ΔG of the reaction.
(C) the value of the activation energy for an endothermic reaction is ΔH.
(D) diffusion controlled reactions are very rapid and consequently it is difficult to measure their rates.

31. The distribution of molecular kinetic energy at two temperature is as shown in the following graph.



Which of the following conclusions are correct?
(A) The number of molecules with energy E_a or greater is proportional to the shaded area for each temperature.
(B) The number of molecules with energy E_a or less is proportional to the shaded area for each temperature.
(C) The number of molecules with energy E_a is the mean of all temperatures.
(D) The graph follows the Maxwell–Boltzmann energy distribution law.

32. Given that k is the rate constant for some order of a reaction at temperature T, the value of $\lim_{T\to\infty}$ log A (where A is Arrhenius constant)
(A) A/2.303 (B) A (C) 2.303 A (D) log A

33. In gaseious reactions important for understanding the upper atmosphere, H_2O and O react bimolecularly to form two OH radicals. ΔH for this reaction is 72 kJ at 500 K and E_a = 77 kJ mol^{-1}, then E_a for the bimolecular recombination of 2OH radicals to form H_2O & O 500 K is
(A) 3 kJ mol^{-1} (B) 4 kJ mol^{-1}
(C) 5 kJ mol^{-1} (D) 7 kJ mol^{-1}

34. The rate of a reaction gets doubled when the temperature changes from 7C to 17C. By what factor will it change when the temperature change from 17C to 27C?
(A) 2 (B) 2.1 (C) 1.91 (D) 2.3

35. The activation energy for a reaction, which doubles the rate when the temperature is raised from 300 K to 310 K is
(A) 50.6 kJ mol^{-1} (B) 53.6 kJ mol^{-1}
(C) 56.6 kJ mol^{-1} (D) 59.6 kJ mol^{-1}

36. A catalyst lowers the activation energy of the forward reaction by 20 kJ mol^{-1}. It also changes the activation energy of the reverse reaction by an amount
(A) equal to that of the forward reaction
(B) equal to twice that of the forward reaction.
(C) which is determined only by the average energy of products
(D) which is determined by the average energy of products relative to that of reactants.

37. Reactions of higher order are rare because
(A) the number of effective collisions go on decreasing with increase in the number of molecules colliding at the same time.
(B) activation energy of molecules increases.
(C) kinetic energy of molecules increases.
(D) none of these

38. An endothermic reaction, A $\rightarrow$ B have an activation energy of 15 kcal/mol and the heat of the reaction is 5 kcal/mol. The activation energy of the reaction, B $\rightarrow$ A is
(A) 20 kcal/mol (B) 15 kcal/mol
(C) 10 kcal/mol (D) zero

39. The activation energies of two reactions are E_{a1} and E_{a2} with $E_{a1} > E_{a2}$. if the temperature of the reacting systems is increased from T_1 to T_2 predict which of the following alternatives is correct? (Where k_1 & k'_1 are the rate constant at temperature T_1 & T_2 K for one reaction and k_2 & k'_2 are the rate constants at temperature T_1 & T_2 K for another reaction.)
(A) $\frac{k'_1}{k_1} = \frac{k'_2}{k_2}$ (B) $\frac{k'_1}{k_1} > \frac{k'_2}{k_2}$
(C) $\frac{k'_1}{k_1} < \frac{k'_2}{k_2}$ (D) $\frac{k'_1}{k_1} < 2\frac{k'_2}{k_2}$

40. The rate constant k_1 of a reaction is found to be double the rate constant k_2 of another reaction. The realitonship between corresponding activation energies of the two reactions at same temperature (E_{a1} and E_{a2}) can be represented as
(A) $E_{a1} > E_{a2}$ (B) $E_{a1} < E_{a2}$
(C) $E_{a1} = E_{a2}$ (D) none of these

41. The rate constant of a reaction is 1.5×10^{-3} at 25°C and 2.1×10^{-2} at 60°C. The activation energy is-
(A) $\frac{35}{333} R \log_e \frac{2.1\times10^{-2}}{1.5\times10^{-2}}$
(B) $\frac{298\times333}{35} R \log_e \frac{21}{1.5}$
(C) $\frac{298\times333}{35} R \log_e 2.1$
(D) $\frac{298\times333}{35} R \log_e \frac{2.1}{1.5}$

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42. The rate of a certain reaction increase by 2.3 times when the temperature is raised from 300 K to 310K. If k is the rate constant at 300K then the rate constant at 310 K will be
(A) k (B) $3k^2$ (C) 2k (D) 2.3k

43. In a reaction, the threshold energy is equal to
(A) Activation energy
(B) Activation energy - normal energy of reactants
(C) Activation energy + normal energy of reactants
(D) Normal energy of reactants

44. In Arrehenius equation if a graph is plotted between log k and $\frac{1}{T}$, the slope of the curve will be
(A) $-\frac{E_a}{R}$ (B) $-\frac{E_a}{2.303\ R}$
(C) $\frac{E_a}{R}$ (D) $\frac{E_a}{2.303\ R}$

45. The slope of the line for the graph of log k versus $\frac{1}{T}$ for the reaction, $N_2O_5 \rightarrow 2NO_2 + \frac{1}{2}O_2$ is – 5000. Calculate the energy of activation of the reaction - (kJ $K^{-1}mol^{-1}$)
(A) 95.7 (B) 9.57 (C) 957 (D) None

46. For a reaction, the rate constant is expressed as, $k = A.e^{-40000/T}$. The energy of the activation is
(A) 40000 cal (B) 88000 cal
(C) 80000 cal (D) 8000 cal

47. In respect of the equation $k = Ae^{-Ea/RT}$ in chemical kinetics, which one of the following statement is correct ?
(A) E_a is energy of activation
(B) R is Rydberg's constant
(C) k is equilibrium constant
(D) A is adsorption factor

48. The energies of activation for forward and reverse reactions for $A_2 + B_2 \rightleftharpoons 2AB$ are 180 kJ mol^{-1} and 200kJ mol^{-1} respectively. The presence of a catalyst lowers the activation energy of both (forward and reverse) reactions by 100 kJ mol^{-1}. The enthalpy change of the reaction :
$A_2 + B_2 \rightarrow 2AB$) in the presence of catalyst will be (in kJ/mol) -
(A) 300 (B) 120 (C) 280 (D) –20

49. A reactant (A) forms two products :
$A \xrightarrow{k_1} B$, Activation Energy Ea_1
$A \xrightarrow{k_1} C$, Activation Energy Ea_2
If $Ea_2 = 2\ Ea_1$, then k_1 and k_2 are related as :-
(A) $k_1 = 2k_2e^{Ea_2/RT}$ (B) $k_1 = k_1e^{Ea_1/RT}$
(C) $k_2 = k_1e^{Ea_2/RT}$ (D) $k_1 = A\,k_2e^{Ea_1/RT}$

50. Rate of reaction can be expressed by Arhenius equation as $k = Ae^{-E/RT}$. In this equation, E represents
(A) the energy below which colliding molecules will not react
(B) the total energy of the reacting molecule at a temperature, T
(C) The fraction of molecules with energy greater than the activation energy of the reaction
(D) None of these

51. The rate of a chemical reaction doubles for every 10°C rise of temperature. If the temperature is raised by 50°C, the rate of the reaction increases by about
(A) 32 times (B) 64 times
(C) 10 times (D) 24 times

Subjective Problems

01. In gaseous reactions important for understanding the upper atmosphere, H_2O and O react bimolecularly to form two OH radicals. DH for this reaction is 72 kJ at 500 K and E_a = 77 kJ mol^{-1}, then calculate E_a for the biolecular recombination of 2OH radicals to form H_2O & O at 500 K

Ans. 5 kJ mol^{-1}

02. The energy of activation of a first order reaction is 104.5 kJ $mole^{-1}$ and pre – exponential factor (A) is 5×10^{13} sec^{-1}. At what temperature, will the reaction have a half life of 1 minute?

Ans. 349.1 k

03. The specific rate constant for a reaction increases by a factor of 4, if the temperature is changed from 27°C to 47°C. Find the activation energy for the reaction.

Ans. 55.33 kJ $mole^{-1}$

04. The energy of activation and specific rate constant for a first order reaction at 25°C are 100 kJ/ mole and 3.46×10^{-5} sec^{-1} respectively. Determine the temperature at which half life of the reaction is 2 hours.
$2N_2O_5(g) \longrightarrow 2N_2O_4(g) + O_2(g)$

Ans. 306 k

05. A first order reaction is 50% complete in 30 minutes at 27°C and in 10 minutes at 47°C. Calculate the
(a) rate constant for the reactiion at 27°C & 47°C and
(b) energy of activatioin for the reaction.

Ans. (a) 2.31×10^{-12} min^{-1}, 6.93×10^{-2} min^{-1},
(b) 43.85 kJ $mole^{-1}$

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06. A catalyst lowers the activation energy for a certain reaction from 75 kJ to 25 kJ mol^{-1}. What will be the effect on the rate of reaction at 25°C, after things being equal.

Ans. rate of reaction increases 5.81×10^8 times

07. Given that the temperature coefficient for the saponification of ethyl acetate by NaOH is 1.75. Calculate activation energy for the saponification of ethyl acetate.

Ans. 10.757 k cal mol^{-1}

08. A flask containing a solution a solution of N_2O_5 in CCl_4 was placed in a thermostat at 40^0C. The N_2O_5 began to decompose by a first-order reaction, forming NO_2 and N_2O_4, which remained in the solution, and oxygen, which defined pressure. The measurements were started (t = 0) when 10.75ml gas had collected. At t = 2400 sec., 29.65ml was measured. After a very long time, (t = ∞) 45.50ml was measured. Find the :
(a) Rate constant,
(b) Half-life time for reaction at 40^0C in CCl_4 solution.
(c) What volume of gas should have collected after 4800 sec?

Ans. (a) $3.27 \bullet 10^{-4}sec^{-1}$ (b) 2120 sec
(c) 38.27 (measured : 55.00ml)

09. At room temperature (20^0C) orange juice gets spoilt in about 64 hours. In a referigerator at 3^0C juice can be stored three times as long before it gets spoilt. Estimate :
(a) the activation energy of the reaction that causes the spoiling of juice.
(b) How long should it take for juice to get spoilt at 40^0C?

Ans. (a) 43.46kJmol^{-1}, (b) 20.47 hour

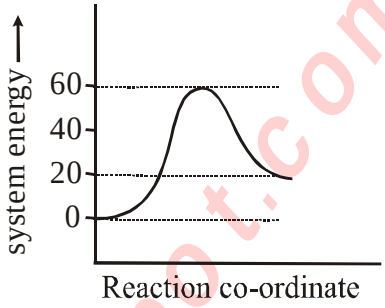
10. A first order reaction, A → B, requires activation energy of 70 kJ mol^{-1}. When a 20% solution of A was kept at 25^0C for 20 minutes, 25% decomposition took place. What will be the percent decomposition in the same time in a 30% solution maintianed at 40^0C? Assume that activation energy remains constant in this range of temperature.

Ans. % Decomposition = 67.21%

11. Two reations : (i) A → P ; (ii) B → P, follow first order kinetics. The rate of the reaction (i) is doubled when the temperature is raised from 300 K to 310K. The half life for this reaction at 310K is 30 minutes. At the same temperature B decomposes twice as fast as A. If the energy of activation for the reaction (ii) is half that of reaction (i), calculate the rate constant of the reaction (ii) at 300K.

Ans. k = 0.0327 min^{-1}

12. Use the diagram below to answer the following questions.



(a) Is the reaction exothermic or endothermic?
(b) What is the approximate value of DE for the forward reaction?
(c) What is activation energy in each direction?
(d) A catalyst is found that lowers the activation energy of the reaction by about 10kJ/mol. How will this catalyst affect the rate of the reverse reaction?

Ans. (a) endothermic,
(b) ΔE = 20 kJ/mol
(c) E_a = 60 kJ/mol, Ea' = 40 kJ/mol
(d) increases

13. **(A)** In the Arrhenius equation K = Aexp (–E/RT), A may be termed as the rate constant at .....
(B) The rate constant for the first order decomposition of a certain reaction is described by the equation

$$\log K(s^{-1}) = 14.34 - \frac{1.25\times 10^4 K}{T}$$

(i) What is the energy of activation for this reaction.
(ii) The rate constant at 500 K.
(iii) At what temperature will its half life period be 256 minutes.
(C) The time required for 10% completion of a first order reaction at 298 K is equal to that required for its 25% completion at 308 K. If the pre-exponential factor for the reaction is : 3.56×10^9 s^{-1}, calculate the rate constant at 318 K and also the energy of activation.

Ans. (a) Infinite temperature
(b) (i) 2.50×10^4 cal mol^{-1},
(ii) 2.35×10^{-5} sec^{-1}, (iii) 513

14. A hydrogenation reaction is carried out at 500 K. If the same reaction is carried out in the presence of a catalyst at the same rate, the temperature required is 400 K. Calculate the activation energy of the reaction if the catalyst lowers the activation barrier by 20 kJ mol^{-1}.

Ans. 100 kJ mol^{-1}

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ANSWER KEYS

Chapter – Chemical Kinetics

Topic – Effect of Temp

DPP – 2

Level – 1

Q.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Ans.	C	D	D	D	C	D	C	D	C	B	D	A	C	C	A
Q.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	D	B	C	D	C	A	D	D	B	B	C	D	B	D	D
Q.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	AD	D	C	C	B	A	A	C	B	D	B	D	C	B	A
Q.	46	47	48	49	50	51									
Ans.	C	A	D	D	A	A									

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