DPP - Daily Practice Problems

Name : ______ **Date :** ______

Start Time : ______ **End Time :** ______

CHEMISTRY

36

SYLLABUS : Chemical Kinetics-II : Collision Theory, Energy of Activation and Arrhenius Equation, Photochemical Reactions

Max. Marks : 120 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids youself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE choice is correct.

Q.1 A large increase in the rate of a reaction for a rise in temperature is due to
(a) The decrease in the number of collisions
(b) The increase in the number of activated molecules
(c) The shortening of the mean free path
(d) The lowering of the activation energy

Q.2 According to the collision theory of chemical reactions
(a) A chemical reaction occurs with every molecular collision
(b) Rate is directly proportional to the number of collisions per second
(c) Reactions in the gas phase are always of zero order
(d) Reaction rates are of the order of molecular speeds

Q.3 According to Arrhenius theory, the activation energy is
(a) The energy it should possess so that it can enter into an effective collision
(b) The energy which the molecule should possess in order to undergo reaction
(c) The energy it has to acquire further so that it can enter into effective collision
(d) The energy gained by the molecules on colliding with another molecule

Q.4 Which one of the following does not represent Arrhenius equation
(a) $k = Ae^{-E/RT}$
(b) $\log_e k = \log_e A - \frac{E}{RT}$
(c) $\log_{10} k = \log_{10} A - \frac{E}{2.303RT}$
(d) $k = AE^{-RT}$

RESPONSE GRID 1. ⓐⓑⓒⓓ 2. ⓐⓑⓒⓓ 3. ⓐⓑⓒⓓ 4. ⓐⓑⓒⓓ

Space for Rough Work

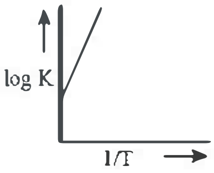
Get More Learning Materials Here : CLICK HERE www.studentbro.in

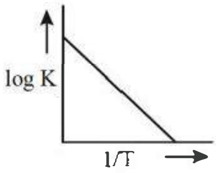
Q.5 Energy of activation of a reactant is reduced by
(a) Increased temperature (b) Reduced temperature
(c) Reduced pressure (d) Increased pressure

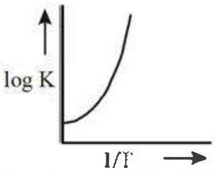
Q.6 Activation energy is
(a) The amount of energy to be added to the actual energy of a molecule so that the threshold energy is reached.
(b) The amount of energy the molecule must contain so that it reacts
(c) the energy which a molecule should have in order to enter into an effective collision
(d) The average kinetic energy of the molecule

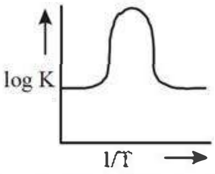
Q.7 The activation energy for a simple chemical reaction $A \rightarrow B$ is E_a in forward direction. The activation energy for reverse reaction
(a) Is always double of E_a
(b) Is negative of E_a
(c) Is always less than E_a
(d) Can be less than or more than E_a

Q.8 A graph plotted between log K vs 1/T for calculating activation energy is shown by

(a)


(b)


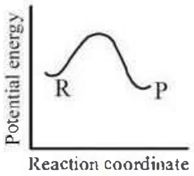
(c)


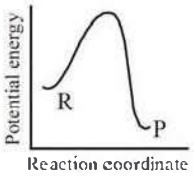
(d)


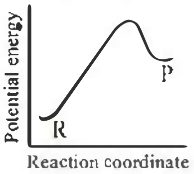
Q.9 The rate constant is doubled when temperature increases from 27°C to37°C. Activation energy in kJ is
(a) 34 (b) 54 (c) 100 (d) 50

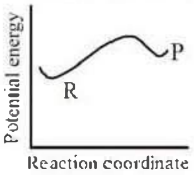
Q.10 The activation energyofa reaction is zero. the rate constant of this reaction
(a) Increases with increase of temperature
(b) Decreases with an increase of temperature
(c) Decreases with decrease of temperature
(d) Is independent of temperature

Q.11 An endothermic reaction with high activation energy for the forward reaction is given by the diagram.

(a)


(b)


(c)


(d)


Q.12 Temperature dependent equation can be written as
(a) $\ln k = \ln A - e^{Ea/RT}$ (b) $\ln k = \ln A + e^{Ea/RT}$
(c) $\ln k = \ln A - e^{RT/E_a}$ (d) All of these

Q.13 The reaction rate at a given temperature becomes slower, then
(a) The free energy of activation is higher
(b) The free energy of activation is lower
(c) The entropy changes
(d) The concentration of the reactants remains constant

Q.14 Arrhenius equation is
(a) $\frac{d \ln K}{dT} = \Delta E^* / RT$ (b) $\frac{d \ln K}{dT} = \Delta E^* / RT^2$
(c) $\frac{d \ln K}{dT} = -\Delta E^* / RT^2$ (d) $\frac{d \ln K}{dT} = -\Delta E^* / RT$

Q.15 If E_f and E_r are the activation energies of forward and reverse reactions and the reaction is known to be exothermic, then
(a) $E_f > E_r$
(b) $E_f < E_r$
(c) $E_f = E_r$
(d) No relation can be given between E_f and E_r as data are not sufficient

Q.16 For a reaction, activation energy $(E_a) = 0$ and rate constant $(K) = 3.2 \times 10^6 s^{-1}$ at 300 K. What is the value of the rate constant at 310 K
(a) $3.2 \times 10^{-12} s^{-1}$ (b) $3.2 \times 10^6 s^{-1}$
(c) $6.4 \times 10^{12} s^{-1}$ (d) $6.4 \times 10^6 s^{-1}$

RESPONSE GRID

5. ⓐⓑⓒⓓ 6. ⓐⓑⓒⓓ 7. ⓐⓑⓒⓓ 8. ⓐⓑⓒⓓ 9. ⓐⓑⓒⓓ
10. ⓐⓑⓒⓓ 11. ⓐⓑⓒⓓ 12. ⓐⓑⓒⓓ 13. ⓐⓑⓒⓓ 14. ⓐⓑⓒⓓ
15. ⓐⓑⓒⓓ 16. ⓐⓑⓒⓓ

Space for Rough Work

Get More Learning Materials Here : CLICK HERE www.studentbro.in

Q.17 The number of collisions depend upon
(a) Pressure (b) Concentration
(c) Temperature (d) All the above

Q.18 The photolysis of water gives the substance
(a) $OH^- + H^+$ (b) $H_2 + OH^-$
(c) $H_2 + O_2$ (d) $H_2O + H_2O_2$

Q.19 The law of photochemical equivalence was given by
(a) Drapper (b) Grauths
(c) Einstein (d) Lambert

Q.20 If 'I' is the intensity of absorbed light and C is the concentration of AB for the photochemical process $AB + h\nu \rightarrow AB^*$, the rate of formation AB^* is directly proportional to
(a) C (b) I
(c) I^2 (d) C.I

Q.21 A rise in temperature increases the velocity of a reaction. It is because it results in
(a) An increased number of molecular collisions
(b) An increased momentum of collinding molecules
(c) An increase in the activation energy
(d) A decrease in the activation energy

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :
(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct
(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 Which of the following statements are true according to collision theory of reaction rates?
(1) Collision of molecules is a precondition for any reaction to occur
(2) Molecules which have acquired the energy of activation can collide effectively
(3) Only activated collisions result in the formation of the products
(4) All collisions result in the formation of the products

Q.23 Regarding the equation $k = Ae^{-E_a/RT}$ in chemical kinetics, which one of the following statement are incorrect?
(1) k is equilibrium constant
(2) A is absorption factor
(3) R is Rydberg's constant
(4) E_a is energy of activation

Q.24 Activation energy of a chemical reaction cannot be determined by-
(1) Changing concentration of reactants
(2) Evaluating rate constant at standard temperature
(3) Evaluating velocities of reaction at two different temperatures.
(4) Evaluating rate constant at two different temperatures

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

In case of photochemical reactions the Einstein's law of equivalence is strictly applicable to primary processes, whereas for secondary processes some complicating factors step in. Hence, a simple one to one relationship between number of quanta absorbed and the number of new molecules is seldom realized. The over all result of photochemical reaction is thus expressed in terms of Quantum efficiency or Quantum yield (ϕ).

$$\phi = \frac{\text{moles of substance reacted in a given time}}{\text{moles of photons absorbed in the same time}}$$

Q.25 A certain system absorbed 3.0×10^{16} quanta of light per second. On irradiations for 10 minutes, 0.002 moles of the reactants was found to have reacted. The quantum efficiency of the process is
(a) 50 (b) 60 (c) 67 (d) 76

Q.26 Acetone decomposes as follows :

$$(CH_3)_2CO \xrightarrow{h\nu} C_2H_6 + CO$$

If ϕ for above reaction at 330 nm is 0.3 and a sample of acetone absorbs monochromatic radiations at 330 nm at the rate of $7.2 \times 10^{-3}\ Js^{-1}$, the rate of formation of CO is
(a) 6×10^{-10} mol/s (b) 6×10^{-9} mol/s
(c) 6×10^{-8} mol/s (d) 6×10^{-7} mol/s

RESPONSE GRID					
	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ
	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ

Space for Rough Work

Get More Learning Materials Here : CLICK HERE www.studentbro.in

Q.27 If the quantum yield is 0.6, then rate of formation of C_2H_6 (mol/s) is
(a) 1×10^{-8} (b) 1.2×10^{-9}
(c) 1.8×10^{-9} (d) 12×10^{-9}

DIRECTIONS (Q. 28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(c) Statement -1 is False, Statement-2 is True.
(d) Statement -1 is True, Statement-2 is False.

Q.28 Statement-1: If the activation energy of a reaction is zero, temperature will have no effect on the rate constant.
Statement-2: Lower the activation energy, faster is the reaction.

Q.29 Statement-1: The photochemical reaction $H_2 + Cl_2 \rightarrow 2HCl$ has much higher quantum efficiency than $H_2 + Br_2 \rightarrow 2HBr$
Statement-2: Both the reactions proceed by similar mechanism.

Q.30 Statement-1: Vision is not a photochemical reaction
Statement-2: Halogenation of alkenes is a photochemical reaction.

RESPONSE GRID	27.ⓐⓑⓒⓓ	28.ⓐⓑⓒⓓ	29.ⓐⓑⓒⓓ	30.ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 36 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	40	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

Get More Learning Materials Here : CLICK HERE www.studentbro.in

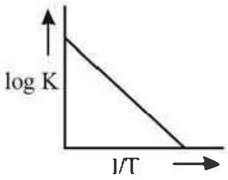
DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS

36

1. **(b)** The increase in collision frequency brings in an increase in effective collisions and thus rate of reaction increases.
2. **(b)** The increase in collision frequency brings in an increase in effective collisions and thus rate of reaction increases.
3. **(c)** The definition of activation energy.
4. **(d)** All other are different forms of Arrhenius equation.
5. **(a)** Energy of activation reduced by increasing temperature.
6. **(a)** The definition of activation energy.
7. **(d)** In exothermic and endothermic reactions E_a for reversible reaction will be more than or less than E_a respectively.
8. **(b)** A graph plotted between log k Vs $\frac{1}{T}$ for calculating activation energy is shown as from Arrhenius equation

   $$\log k = \log A - \frac{E_A}{2.303RT}$$

9. **(b)** $\log\frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$; If $\frac{K_2}{K_1} = 2$

   $$\log 2 = \frac{E_a}{2.303 \times 8.314}\left[\frac{1}{300} - \frac{1}{310}\right]$$

   $$E_a = .3010 \times 2.303 \times 8.314\left(\frac{300 \times 310}{10}\right)$$

   $= 53598.59\ \text{Jmol}^{-1} = 54\ \text{kJ}$
10. **(d)** When $E_a = 0$, the rate of reaction becomes independent of temperature. (E_a = Energy of activation).
11. **(c)** Endothermic reactions are those which involve absorption of heat. High activation energy means potential energy of product must be much greater than reactants.
12. **(a)** Arrhenius suggested an equation which describes rate constant (K) as a finction of temperature.

    $K = Ae^{-Ea/RT}$

    $\ln k = \ln A - c^{Ea/RT}$
13. **(a)** Slower reaction rate indicates higher energy of activation.
14. **(b)**
15. **(b)**
16. **(b)** When $E_a = 0$ rate constant is independent of temperature.
17. **(d)** Number of collision depend upon pressure, concentration and temperature.
18. **(a)** $H_2O \xrightarrow{\text{Photolysis}} OH^- + H^+$
19. **(c)** Stark – Einstein was given the law of photochemical equivalence.
20. **(b)** In photochemical reaction the rate of formation of product is directly proportional to the intensity of absorbed light.
21. **(d)** Energy of activation decreases, rate of reaction will increases.
22. **(a)** All collisions are not effective and does not result in the formation of the products
23. **(a)** E_a represents energy of activation in Arhenius equation.
24. **(a)** $\log\frac{k_f}{k_b} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1T_2}\right]$
25. **(c)** Amount of energy absorbed in 10 min

    $= 3.0 \times 10^{16} \times 60 \times 10$ Quanta

    Number of molecules reacted in 10 min

    $= 0.002 \times 6.023 \times 10^{23}$

    $$\therefore\ \phi = \frac{0.002 \times 6.023 \times 10^{23}}{3.0 \times 10^{16} \times 60 \times 10} = 67$$
26. **(b)** Energy of 1 mole of photon = Nhν

    $$= \frac{6.02 \times 10^{23} \times 6.6 \times 10^{-34} \times 3 \times 10^{8}}{330 \times 10^{-9}}\text{J.} = 3.6 \times 10^5\text{J.}$$

    Energy absorbed/sec = 7.2×10^{-3} J (given)

    ∴ Number of moles of photons absorbed/sec

    $$= \frac{7.2 \times 10^{-3}}{3.6 \times 10^5} = 2 \times 10^{-8}$$

    $$\text{Now, } \phi = \frac{\text{mole of substance reacted in given time}}{\text{moles of photons absorbed in same time}}$$

    $$0.3 = \frac{\text{mole of substance reacted}}{2 \times 10^{-8}}$$

    or moles of substance reacted/sec

    $= 0.3 \times 2 \times 10^{-8} = 0.6 \times 10^{-8} = 6 \times 10^{-9}$

    ∴ Moles of CO formed/sec

    = moles of $(CH_3)_2CO$ reacting/sec $= 6 \times 10^{-9}$
27. **(d)** Proceeding as in question 26

    $$\therefore\ 0.6 = \frac{\text{moles of substance reacted}}{2 \times 10^{-8}}$$

    Moles of acetone reacted

    $= 0.6 \times 2 \times 10^{-8} = 1.2 \times 10^{-8} = 12 \times 10^{-9}$

    Moles of C_2H_6 formed/sec

    = moles of acetone reacting/sec

    Moles of C_2H_6 formed/sec $= 12 \times 10^{-9}$
28. **(b)** According to Arrhenius equation, $K = Ae^{-Ea/RT}$ When $E_a = 0$, $K = A$.
29. **(d)** $H_2 + Cl_2 \rightarrow 2HCl$ has much higher quantum efficiency than $H_2 + Br_2 \rightarrow 2HBr$. The first step of secondary process of $H_2 + Cl_2 \rightarrow 2HCl$ is exothermic while the same for $H_2 + Br_2 \rightarrow 2HBr$ is endothermic.
30. **(c)** Vision is a fast photochemical reaction in which the compound, retinal, present in the eye undergoes isomerisation by absorbing a photon of light. Halogenation of alkanes is a photochemical reaction.

Get More Learning Materials Here : CLICK HERE www.studentbro.in