

JEE Main 2025 (April)
Chapter-wise Qs Bank

Chemistry

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- Q1.** 20 mL of 2 M NaOH solution is added to 400 mL of 0.5 M NaOH solution. The final concentration of the solution is _____ $\times 10^{-2}$ M. (Nearest integer)
- Q2.** The hydrocarbon (X) with molar mass 80 g mol^{-1} and 90% carbon has degree of unsaturation.
- Q3.** The elemental composition of a compound is 54.2% C, 9.2% H and 36.6% O.
If the molar mass of the compound is 132 g mol^{-1} , the molecular formula of the compound is :
[Given : The relative atomic mass of C : H : O = 12 : 1 : 16]
- (1) $\text{C}_4\text{H}_9\text{O}_3$
- (2) $\text{C}_6\text{H}_{12}\text{O}_6$
- (3) $\text{C}_4\text{H}_8\text{O}_2$
- (4) $\text{C}_6\text{H}_{12}\text{O}_3$
- Q4.** 2.8×10^{-3} mol of CO_2 is left after removing 10^{21} molecules from its 'x' mg sample. The mass of CO_2 taken initially is
Given: $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
- (1) 98.3 mg
- (2) 48.2 mg
- (3) 196.2 mg
- (4) 150.4 mg
- Q5.** 0.01 mole of an organic compound (X) containing 10% hydrogen, on complete combustion produced 0.9 g H_2O .
Molar mass of (X) is _____ g mol^{-1} .
- Q6.** When 81.0 g of aluminium is allowed to react with 128.0 g of oxygen gas, the mass of aluminium oxide produced in grams is _____ - (Nearest integer)
Given :
Molar mass of Al is 27.0 g mol^{-1}
Molar mass of O is 16.0 g mol^{-1}
- Q7.** Xg of benzoic acid on reaction with aq NaHCO_3 released CO_2 that occupied 11.2 L volume at STP.
X is _____ g.
- Q8.** Density of 3 M NaCl solution is 1.25 g/mL. The molality of the solution is :
- (1) 1.79 m
- (2) 2.79 m

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(3) 2 m

(4) 3 m

Q9. The molarity of a 70% (mass / mass) aqueous solution of a monobasic acid (X) is _____ $\times 10^{-1}$ M (Nearest integer)

[Given: Density of aqueous solution of (X) is 1.25 g mL^{-1}

Molar mass of the acid is 70 g mol^{-1}]

Q10. Concentrated nitric acid is labelled as 75% by mass. The volume in mL of the solution which contains 30 g of nitric acid is _____.

Given : Density of nitric acid solution is 1.25 g/mL .

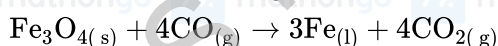
(1) 40

(2) 32

(3) 45

(4) 55

Q11. Consider the following reaction occurring in the blast furnace:



'x' kg of iron is produced when $2.32 \times 10^3 \text{ kg Fe}_3\text{O}_4$ and $2.8 \times 10^2 \text{ kg CO}$ are brought together in the furnace.

The value of 'x' is _____. (nearest integer)

Given:

molar mass of $\text{Fe}_3\text{O}_4 = 232 \text{ g mol}^{-1}$

molar mass of $\text{CO} = 28 \text{ g mol}^{-1}$

molar mass of $\text{Fe} = 56 \text{ g mol}^{-1}$ }

Q12. Quantitative analysis of an organic compound (X) shows following % composition.

C : 14.5%

Cl : 64.46 %

H: 1.8 %

(Empirical formula mass of the compound (X) is _____ $\times 10^{-1}$

(Given molar mass in g mol^{-1} of C : 12, H : 1, O : 16, Cl : 35.5)

Q13. Choose the correct statements.

(A) Weight of a substance is the amount of matter present in it.

(B) Mass is the force exerted by gravity on an object.

(C) Volume is the amount of space occupied by a substance.

(D) Temperatures below 0°C are possible in Celsius scale, but in Kelvin scale negative temperature is not possible.

(E) Precision refers to the closeness of various measurements for the same quantity.

Choose the correct answer from the options given below :

(1) (A), (D) and (E) Only

(2) (C), (D) and (E) Only

(3) (A), (B) and (C) Only

(4) (B), (C) and (D) Only

Q1. Radius of the first excited state of Helium ion is given as :

$a_0 \rightarrow$ radius of first stationary state of hydrogen atom.

(1) $r = 4a_0$

(2) $r = 2a_0$

(3) $r = \frac{a_0}{2}$

(4) $r = \frac{a_0}{4}$

Q2. In a multielectron atom, which of the following orbitals described by three quantum numbers will have same energy in absence of electric and magnetic fields?

A. $n = 1, l = 0, m_l = 0$

B. $n = 2, l = 0, m_l = 0$

C. $n = 2, l = 1, m_l = 1$

D. $n = 3, l = 2, m_l = 1$

E. $n = 3, l = 2, m_l = 0$

Choose the correct answer from the options given below:

(1) B and C Only

(2) A and B Only

(3) C and D Only

(4) D and E Only

Q3. Given below are two statements about X-ray spectra of elements :

Statement (I) : A plot of $\sqrt{\nu}$ (ν = frequency of X-rays emitted) vs atomic mass is a straight line.

Statement (II) : A plot of ν (ν = frequency of X-rays emitted) vs atomic number is a straight line.

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

(1) Both Statement I and Statement II are true

(2) Statement I is false but Statement II is true

(3) Both Statement I and Statement II are false

(4) Statement I is true but Statement II is false

Q4. Given below are two statements :

Statement (I): The radii of isoelectronic species increases in the order.



Statement (II): The magnitude of electron gain enthalpy of halogen decreases in the order.



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

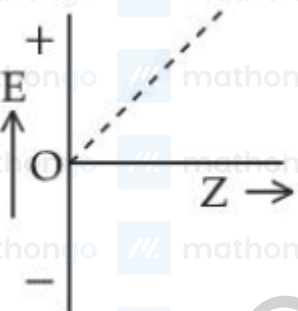
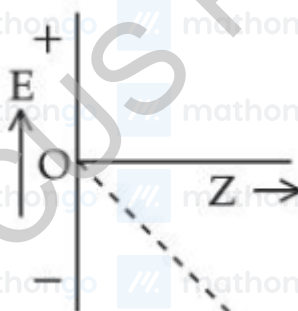
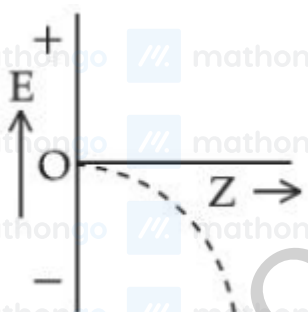
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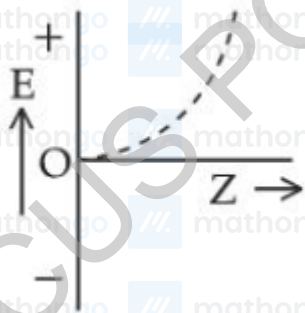
- (1) Statement I is incorrect but Statement II is correct
- (2) Statement I is correct but Statement II is incorrect
- (3) Both Statement I and Statement II are incorrect
- (4) Both Statement I and Statement II are correct

Q5. For hydrogen like species, which of the following graphs provides the most appropriate representation of E vs Z plot for a constant n ?

[E : Energy of the stationary state,

Z : atomic number, n = principal quantum number]





(4)

Q6. Heat treatment of muscular pain involves radiation of wavelength of about 900 nm. Which spectral line of H atom is suitable for this?

Given : Rydberg constant $R_H = 10^5 \text{ cm}^{-1}$, $h = 6.6 \times 10^{-34} \text{ J s}$, $c = 3 \times 10^8 \text{ m/s}$

(1) Balmer series, $\infty \rightarrow 2$

(2) Lyman series, $\infty \rightarrow 1$

(3) Paschen series, $\infty \rightarrow 3$

(4) Paschen series, $5 \rightarrow 3$

Q7. If a_0 is denoted as the Bohr radius of hydrogen atom, then what is the de-Broglie wavelength (λ) of the electron present in the second orbit of hydrogen atom? [n : any integer]

(1) $\frac{8\pi a_0}{n}$

(2) $\frac{2a_0}{n\pi}$

(3) $\frac{4n}{\pi a_0}$

(4) $\frac{4\pi a_0}{n}$

Q8. Given below are two statements :

Statement (I) : It is impossible to specify simultaneously with arbitrary precision, both the linear momentum and the position of a particle.

Statement (II) : If the uncertainty in the measurement of position and uncertainty in measurement of momentum are equal for an electron, then the uncertainty in the measurement of velocity is $\geq \sqrt{\frac{h}{\pi}} \times \frac{1}{2m}$.

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

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are false

(3) Both Statement I and Statement II are true

(4) Statement I is true but Statement II is false

Q9. Given below are two statements :

Statement (I) : For a given shell, the total number of allowed orbitals is given by n^2 .

Statement (II) : For any subshell, the spatial orientation of the orbitals is given by $-l$ to $+l$ values including zero.

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

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

Q10. For hydrogen atom, the orbital/s with lowest energy is/are:

(A) 4 s

(B) $3p_x$

(C) $3d_{x^2-y^2}$

(D) $3d_{z^2}$

(E) $4p_z$

Choose the correct answer from the options given below :

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

Q11. Given below are two statements :

Statement (I) : A spectral line will be observed for a $2p_x \rightarrow 2p_y$ transition.

Statement (II) : $2P_x$ and $2p_y$ are degenerate orbitals.

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

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

Q12. Which of the following is/are not correct with respect to energy of atomic orbitals of hydrogen atom?

(A) $1s < 2p < 3d < 4s$

(B) $1s < 2s = 2p < 3s = 3p$

(C) $1s < 2s < 2p < 3s < 3p$

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(D) $1s < 2s < 4s < 3d$

Choose the correct answer from the options given below :

(1) (A) and (C) only

(2) (B) and (D) only

(3) (C) and (D) only

(4) (A) and (B) only

Q1. For a reaction, $\text{N}_2\text{O}_{5(g)} \rightarrow 2\text{NO}_{2(g)} + \frac{1}{2}\text{O}_{2(g)}$ in a constant volume container, no products were present initially. The final pressure of the system when 50% of reaction gets completed is

(1) 5 times of initial pressure

(2) $5/2$ times of initial pressure

(3) $7/2$ times of initial pressure

(4) $7/4$ times of initial pressure

Q1. A liquid when kept inside a thermally insulated closed vessel at 25°C was mechanically stirred from outside. What will be the correct option for the following thermodynamic parameters ?

(1) $\Delta U < 0, q = 0, w > 0$

(2) $\Delta U = 0, q = 0, w = 0$

(3) $\Delta U > 0, q = 0, w > 0$

(4) $\Delta U = 0, q < 0, w > 0$

Q2. Standard entropies of X_2, Y_2 and XY_5 are 70, 50 and $110 \text{ J K}^{-1} \text{ mol}^{-1}$ respectively. The temperature in Kelvin at which the reaction



will be at equilibrium is _____. (Nearest integer)

Q3. The effect of temperature on spontaneity of reactions are represented as :

	ΔH	ΔS	Temperature	Spontaneity
(A)	+	-	any T	Non spontaneous
(B)	+	+	low T	spontaneous
(C)	-	-	low T	Non spontaneous
(D)	-	+	any T	spontaneous

The incorrect combinations are :

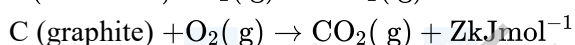
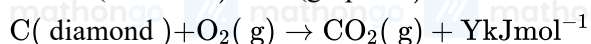
(1) (B) and (C) only

(2) (B) and (D) only

(3) (A) and (D) only

(4) (A) and (C) only

Q4. If $C(\text{diamond}) \rightarrow C(\text{graphite}) + X \text{ kJ mol}^{-1}$



at constant temperature. Then

(1) $X = -Y + Z$

(2) $-X = Y + Z$

(3) $X = Y + Z$

(4) $X = Y - Z$

Q5. Ice and water are placed in a closed container at a pressure of 1 atm and temperature 273.15 K .

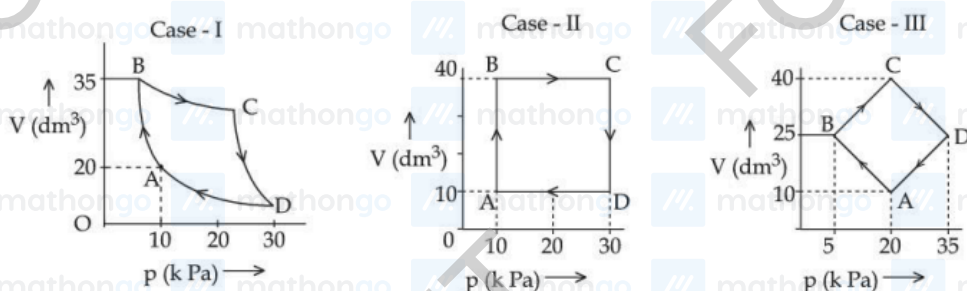
If pressure of the system is increased 2 times, keeping temperature constant, then identify correct observation

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from following

- (1) Volume of system increases.
- (2) The solid phase (ice) disappears completely.
- (3) Liquid phase disappears completely.
- (4) The amount of ice decreases.

Q6.



An ideal gas undergoes a cyclic transformation starting from the point A and coming back to the same point by tracing the path $A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$ as shown in the three cases above.

Choose the correct option regarding ΔU :

- (1) ΔU (Case-I) = ΔU (Case-II) = ΔU (Case-III)
- (2) ΔU (Case-I) > ΔU (Case-III) > ΔU (Case-II)
- (3) ΔU (Case-III) > ΔU (Case-II) > ΔU (Case-I)
- (4) ΔU (Case-I) > ΔU (Case-II) > ΔU (Case-III)

Q7. 500 J of energy is transferred as heat to 0.5 mol of Argon gas at 298 K and 1.00 atm. The final temperature and the change in internal energy respectively are:

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

- (1) 378 K and 500 J
- (2) 368 K and 500 J
- (3) 348 K and 300 J
- (4) 378 K and 300 J

Q8. Match List - I with List - II.

List - I

(Partial Derivatives)

(A) $\left(\frac{\partial G}{\partial T}\right)_P$

(B) $\left(\frac{\partial H}{\partial T}\right)_P$

(C) $\left(\frac{\partial G}{\partial P}\right)_T$

(D) $\left(\frac{\partial U}{\partial T}\right)_V$

List - II

(Thermodynamic Quantity)

(I) C_p

(II) $-S$

(III) C_v

(IV) V

Choose the correct answer from the options given below :

(1) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

(2) (A)-(I), (B)-(II), (C)-(IV), (D)-(III)

(3) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

(4) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Q9. Which of the following mixing of 1 M base and 1 M acid leads to the largest increase in temperature?

(1) 30 mL CH_3COOH and 30 mL NaOH

(2) 45 mL CH_3COOH and 25 mL NaOH

(3) 30 mL HCl and 30 mL NaOH

(4) 50 mL HCl and 20 mL NaOH

Q10. The standard enthalpy and standard entropy of decomposition of N_2O_4 to NO_2 are 55.0 kJ mol^{-1} and 175.0 J/K/mol respectively. The standard free energy change for this reaction at 25°C in J mol^{-1} is _____ (Nearest integer)

Q11. Let us consider an endothermic reaction which is non-spontaneous at the freezing point of water. However, the reaction is spontaneous at boiling point of water. Choose the correct option.

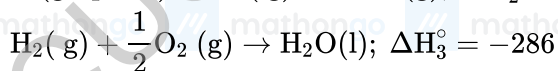
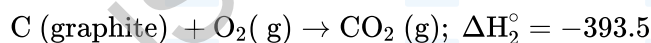
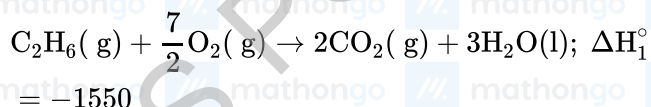
(1) Both ΔH and ΔS are (-ve)

(2) ΔH is (-ve) but ΔS is (+ve)

(3) ΔH is (+ve) but ΔS is (-ve)

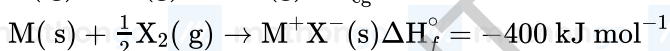
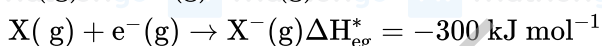
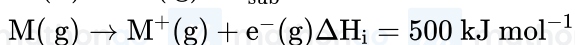
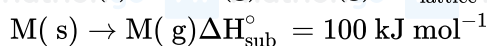
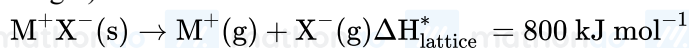
(4) Both ΔH and ΔS are (+ve)

Q12. Consider the following cases of standard enthalpy of reaction (ΔH_r° in kJ mol^{-1})



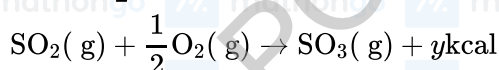
The magnitude of $\Delta H_{f\text{C}_2\text{H}_6(\text{g})}^\circ$ is _____ kJ mol^{-1} (Nearest integer).

Q13. The bond dissociation enthalpy of X_2 , ΔH_{bond} calculated from the given data is _____ kJ mol^{-1} . (Nearest integer)



[Given : M^+X^- is a pure ionic compound and X forms a diatomic molecule X_2 in gaseous state]

Q14. $\text{S}(\text{g}) + \frac{3}{2}\text{O}_2(\text{g}) \rightarrow \text{SO}_3(\text{g}) + 2x \text{ kcal}$



The heat of formation of $\text{SO}_2(\text{g})$ is given by :

(1) $x + y \text{ kcal}$

(2) $y - 2x \text{ kcal}$

(3) $\frac{2x}{y} \text{ kcal}$

(4) $2x + y \text{ kcal}$

Q15. Consider the following data :

Heat of formation of $\text{CO}_2(\text{g}) = -393.5 \text{ kJ mol}^{-1}$

Heat of formation of $\text{H}_2\text{O}(\text{l}) = -286.0 \text{ kJ mol}^{-1}$

Heat of combustion of benzene = $-3267.0 \text{ kJ mol}^{-1}$

The heat of formation of benzene is _____ kJ mol^{-1} . (Nearest integer)

Q16. Ice at -5°C is heated to become vapor with temperature of 110°C at atmospheric pressure. The entropy change associated with this process can be obtained from

(1)
$$\int_{268\text{K}}^{273\text{K}} C_{p,m} dT + \frac{\Delta H_{m,\text{fusion}}}{T_f} + \frac{\Delta H_{m,\text{vaporisation}}}{T_b} + \int_{273\text{K}}^{373\text{K}} C_{p,m} dT + \int_{373\text{K}}^{383\text{K}} C_{p,m} dT$$

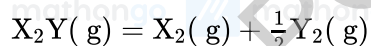
$$(2) \int_{268\text{K}}^{273\text{K}} \frac{C_{p,m}}{T} dT + \frac{\Delta H_{m,\text{fusion}}}{T_f} + \frac{\Delta H_{m,\text{vaporisation}}}{T_b} + \int_{273\text{K}}^{373\text{K}} \frac{C_{p,m}}{T} dT + \int_{373\text{K}}^{383\text{K}} \frac{C_{p,m}}{T} dT$$

$$(3) \int_{268\text{K}}^{383\text{K}} C_p dT + \frac{q_{\text{rev}}}{T}$$

$$(4) \int_{268\text{K}}^{383\text{K}} C_p dT + \frac{\Delta H_{\text{melting}}}{273} + \frac{\Delta H_{\text{boiling}}}{373}$$

Q17. The formation enthalpies, ΔH_f^\ominus for $\text{H}_{(g)}$ and $\text{O}_{(g)}$ are 220.0 and $250.0 \text{ kJ mol}^{-1}$, respectively, at 298.15 K , and ΔH_f^\ominus for $\text{H}_2\text{O}_{(g)}$ is $-242.0 \text{ kJ mol}^{-1}$ at the same temperature. The average bond enthalpy of the $\text{O} - \text{H}$ bond in water at 298.15 K is _____ kJ mol^{-1} (nearest integer).

Q1. Consider the reaction



The equation representing correct relationship between the degree of dissociation (x) of $X_2Y(g)$ with its equilibrium constant K_p is _____.

Assume x to be very very small.

(1) $x = \sqrt[3]{\frac{2K_p}{p}}$

(2) $x = \sqrt[3]{\frac{2K_p^2}{p}}$

(3) $x = \sqrt[3]{\frac{K_p}{p}}$

(4) $x = \sqrt[3]{\frac{K_p}{2p}}$

Q2. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of CO_2 is converted into CO on addition of graphite. If total pressure at equilibrium is 0.8 atm, then K_p is :

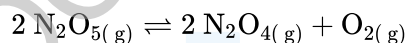
(1) 1.8 atm

(2) 0.3 atm

(3) 3 atm

(4) 0.18 atm

Q3. 37.8 g N_2O_5 was taken in a 1 L reaction vessel and allowed to undergo the following reaction at 500 K



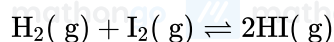
The total pressure at equilibrium was found to be 18.65 bar.

Then, $K_p = \text{_____} \times 10^{-2}$ [nearest integer]

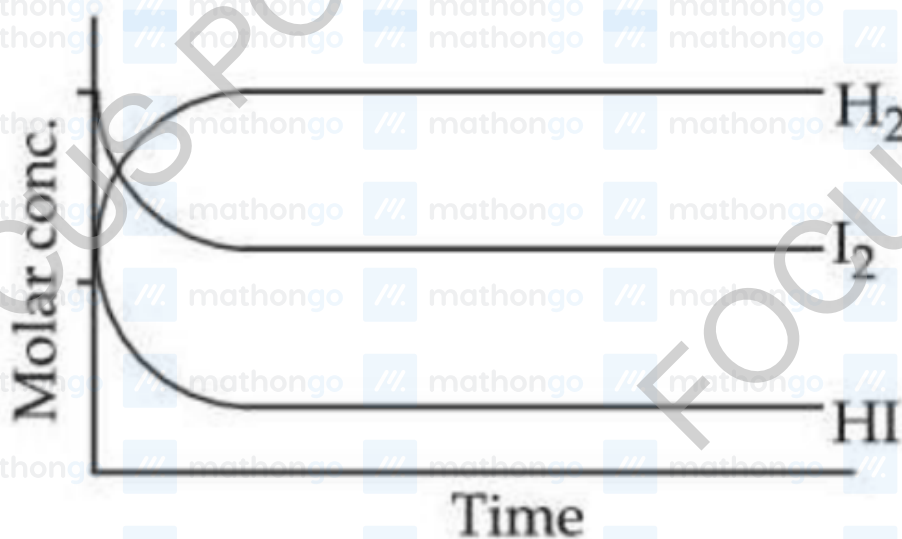
Assume N_2O_5 to behave ideally under these conditions.

Given: $R = 0.082 \text{ bar L mol}^{-1} \text{ K}^{-1}$

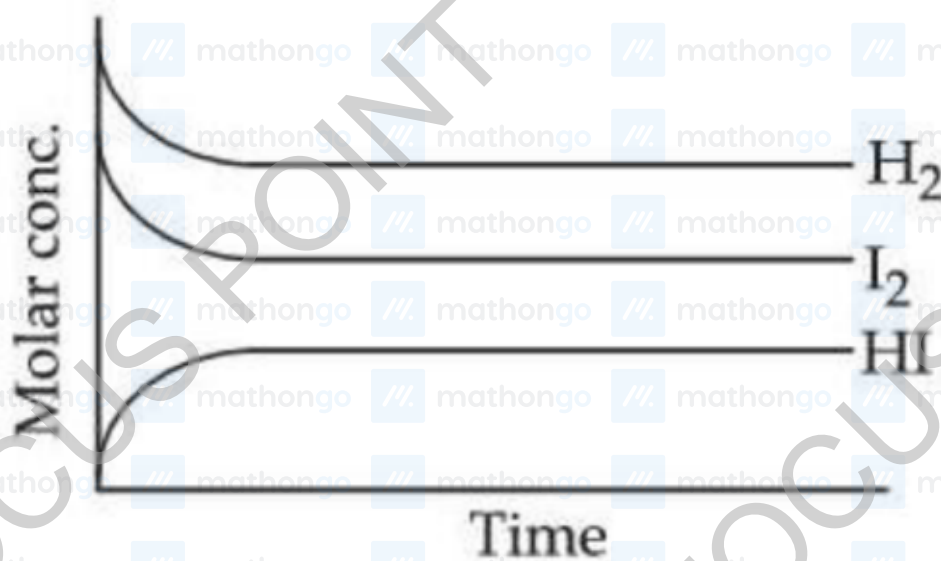
Q4. For the reaction,



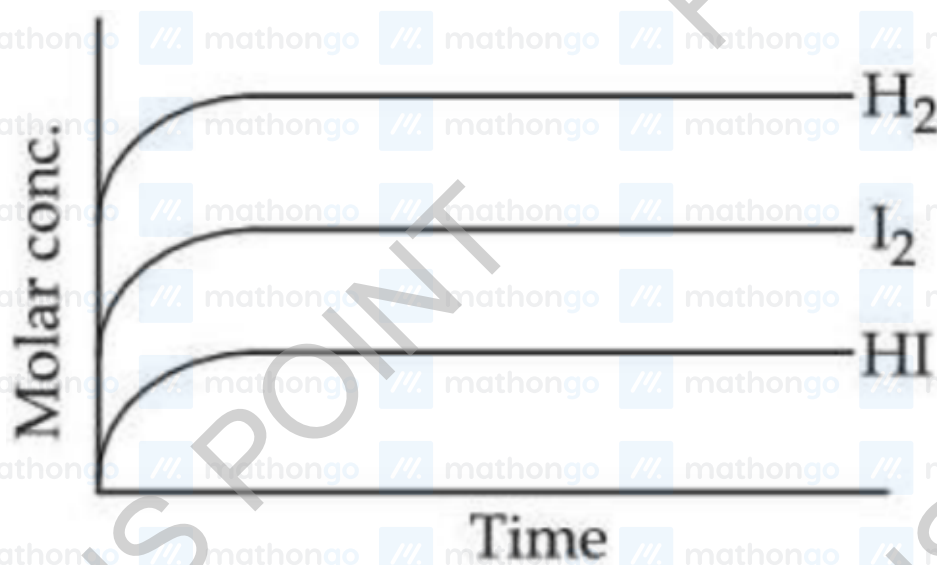
Attainment of equilibrium is predicted correctly by :



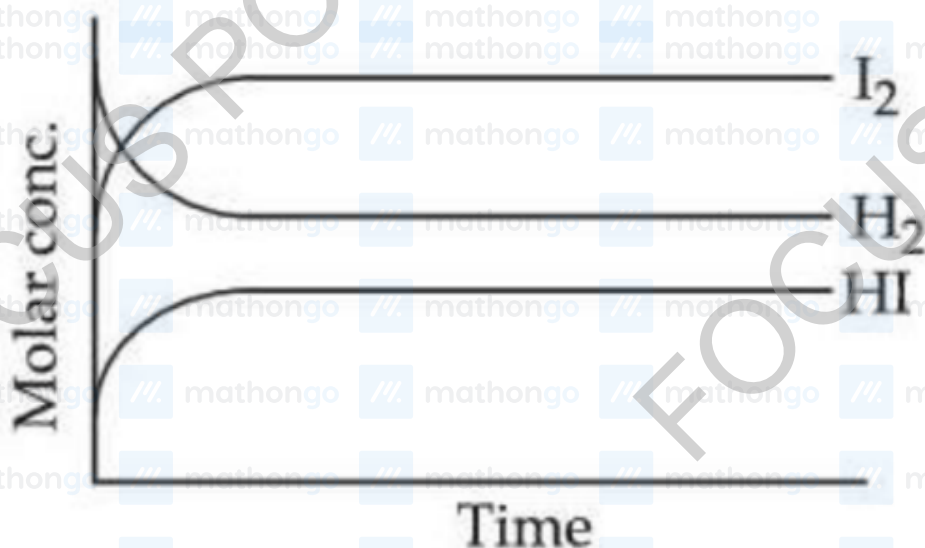
(1)



(2)



(3)



(4)

Q5. At temperature T , compound $AB_{2(g)}$ dissociates as $AB_{2(g)} \rightleftharpoons AB_{(g)} + \frac{1}{2} B_{2(g)}$ having degree of dissociation x (small compared to unity). The correct expression for x in terms of K_p and p is

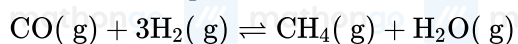
(1) $\sqrt[4]{\frac{2K_p}{p}}$

(2) $\sqrt[3]{\frac{2K_p}{p}}$

(3) $\sqrt[3]{\frac{2K_p^2}{p}}$

(4) $\sqrt{K_p}$

Q6. Consider the equilibrium



If the pressure applied over the system increases by two fold at constant temperature then

(A) Concentration of reactants and products increases.

(B) Equilibrium will shift in forward direction.

(C) Equilibrium constant increases since concentration of products increases.

(D) Equilibrium constant remains unchanged as concentration of reactants and products remain same.

Choose the correct answer from the options given below :

(1) (A), (B) and (C) only

(2) (A) and (B) only

(3) (A), (B) and (D) only

(4) (B) and (C) only

Q1. Total number of non bonded electrons present in NO_2^- ion based on Lewis theory is _____.

Q2. A weak acid HA has degree of dissociation x . Which option gives the correct expression of $(\text{pH}-\text{pK}_a)$?

(1) 0

(2) $\log(1 + 2x)$

(3) $\log\left(\frac{1-x}{x}\right)$

(4) $\log\left(\frac{x}{1-x}\right)$

Q3. If 1 mM solution of ethylamine produces $\text{pH} = 9$, then the ionization constant (K_b) of ethylamine is 10^{-x} . The value of x is _____ (nearest integer).

[The degree of ionization of ethylamine can be neglected with respect to unity.]

Q4. pH of water is 7 at 25°C . If water is heated to 80°C ., its pH will :

(1) Decrease

(2) H^+ concentration increases, OH^- concentration decreases

(3) Remains the same

(4) Increase

Q5. The molar solubility(s) of zirconium phosphate with molecular formula $(\text{Zr}^{4+})_3(\text{PO}_4^{3-})_4$ is given by relation :

(1) $\left(\frac{K_{\text{sp}}}{9612}\right)^{\frac{1}{3}}$

(2) $\left(\frac{K_{\text{sp}}}{6912}\right)^{\frac{1}{7}}$

(3) $\left(\frac{K_{\text{sp}}}{8435}\right)^{\frac{1}{7}}$

(4) $\left(\frac{K_{\text{sp}}}{5348}\right)^{\frac{1}{6}}$

Q6. Which of the following happens when NH_4OH is added gradually to the solution containing 1 M A^{2+} and 1 M B^{3+} ions?

Given : $K_{\text{sp}}[\text{A}(\text{OH})_2] = 9 \times 10^{-10}$ and $K_{\text{sp}}[\text{B}(\text{OH})_3] = 27 \times 10^{-18}$ at 298 K .

(1) Both $\text{A}(\text{OH})_2$ and $\text{B}(\text{OH})_3$ do not show precipitation with NH_4OH

(2) $\text{A}(\text{OH})_2$ will precipitate before $\text{B}(\text{OH})_3$

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(3) $B(OH)_3$ will precipitate before $A(OH)_2$

(4) $A(OH)_2$ and $B(OH)_3$ will precipitate together

Q7. K_{sp} for $Cr(OH)_3$ is 1.6×10^{-30} . What is the molar solubility of this salt in water?

(1) $\frac{1.8 \times 10^{-30}}{27}$

(2) $\sqrt[5]{1.8 \times 10^{-30}}$

(3) $\sqrt[4]{\frac{1.6 \times 10^{-30}}{27}}$

(4) $\sqrt[2]{1.6 \times 10^{-30}}$

Q8. Arrange the following in increasing order of solubility product :

$Ca(OH)_2, AgBr, PbS, HgS$

(1) $HgS < AgBr < PbS < Ca(OH)_2$

(2) $Ca(OH)_2 < AgBr < HgS < PbS$

(3) $PbS < HgS < Ca(OH)_2 < AgBr$

(4) $HgS < PbS < AgBr < Ca(OH)_2$

Q1. Match the LIST-I with LIST-II

LIST-I (Redox Reaction)		LIST-II (Type of Redox Reaction)	
A.	$\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \xrightarrow{\Delta} \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$	I.	Disproportionation reaction
B.	$2\text{NaH}(\text{s}) \xrightarrow{\Delta} 2\text{Na}(\text{s}) + \text{H}_2(\text{g})$	II.	Combination reaction
C.	$\text{V}_2\text{O}_5(\text{s}) + 5\text{Ca}(\text{s}) \xrightarrow{\Delta} 2\text{V}(\text{s}) + 5\text{CaO}(\text{s})$	III.	Decomposition reaction
D.	$2\text{H}_2\text{O}_2(\text{aq}) \xrightarrow{\Delta} 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$	IV.	Displacement reaction

Choose the correct answer from the options given below:

- (1) A-II, B-III, C-I, D-IV
- (2) A-III, B-IV, C-I, D-II
- (3) A-IV, B-I, C-II, D-III
- (4) A-II, B-III, C-IV, D-I

Q2. The species which does not undergo disproportionation reaction is :

- (1) ClO_3^-
- (2) ClO^-
- (3) ClO_2^-
- (4) ClO_4^-

Q3. Given below are two statements:

Statement I: In the oxalic acid vs KMnO_4 (in the presence of dil H_2SO_4) titration the solution needs to be heated initially to 60°C , but no heating is required in Ferrous ammonium sulphate (FAS) vs KMnO_4 titration (in the presence of dil H_2SO_4)

Statement II: In oxalic acid vs KMnO_4 titration, the initial formation of MnSO_4 takes place at high temperature, which then acts as catalyst for further reaction. In the case of FAS vs KMnO_4 , heating oxidizes Fe^{2+} into Fe^{3+} by oxygen of air and error may be introduced in the experiment.

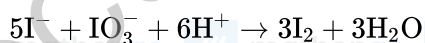
In the light of the above statements, choose the correct answer from the options given below

- (1) Both Statement I and Statement II are false

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

Q4. 0.1 M solution of KI reacts with excess of H_2SO_4 and KIO_3 solutions. According to equation



Identify the correct statements :

- (A) 200 mL of KI solution reacts with 0.004 mol of KIO_3
(B) 200 mL of KI solution reacts with 0.006 mol of H_2SO_4
(C) 0.5 L of KI solution produced 0.005 mol of I_2
(D) Equivalent weight of KIO_3 is equal to $\left(\frac{\text{Molecular weight}}{5}\right)$

Choose the correct answer from the options given below :

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

Q5. Some CO_2 gas was kept in a sealed container at a pressure of 1 atm and at 273 K. This entire amount of CO_2 gas was later passed through an aqueous solution of $\text{Ca}(\text{OH})_2$. The excess unreacted $\text{Ca}(\text{OH})_2$ was later neutralized with 0.1 M of 40 mL HCl. If the volume of the sealed container of CO_2 was x , then x is _____ cm^3 (nearest integer).

[Given : The entire amount of $\text{CO}_2(\text{g})$ reacted with exactly half the initial amount of $\text{Ca}(\text{OH})_2$ present in the aqueous solution.]

Q1. The observed and normal molar masses of compound MX_2 are 65.6 and 164 respectively. The percent degree of ionisation of MX_2 is %. (Nearest integer)

Q2. If A_2B is 30% ionised in an aqueous solution, then the value of van't Hoff factor (i) is _____ $\times 10^{-1}$.

Q3. Given below are two statements :

Statement (I) : NaCl is added to the ice at 0°C , present in the ice cream box to prevent the melting of ice cream.

Statement (II) : On addition of NaCl to ice at 0°C , there is a depression in freezing point.

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

(1) Both Statement I and Statement II are false

(2) Statement I is false but Statement II is true

(3) Statement I is true but Statement II is false

(4) Both Statement I and Statement II are true

Q4. Assume a living cell with 0.9% (w/w) of glucose solution (aqueous). This cell is immersed in another solution having equal mole fraction of glucose and water. (Consider the data upto first decimal place only)

The cell will :

(1) shrink since solution is 0.45% (w/w) as a result of association of glucose molecules (due to hydrogen bonding)

(2) Show no change in volume since solution is 0.9% (w/w)

(3) swell up since solution is 1% (w/w)

(4) shrink since solution is 0.5% (w/w)

Q5. Consider a binary solution of two volatile liquid components 1 and 2. x_1 and y_1 are the mole fractions of component 1 in liquid and vapour phase, respectively. The slope and intercept of the linear plot of $\frac{1}{x_1}$ vs $\frac{1}{y_1}$ are given respectively as:

(1) $\frac{P_2^0}{P_1^0}$, $\frac{P_2^0 - P_1^0}{P_2^0}$

(2) $\frac{P_1^0}{P_2^0}$, $\frac{P_2^0 - P_1^0}{P_2^0}$

(3) $\frac{P_1^0}{P_2^0}$, $\frac{P_1^0 - P_2^0}{P_2^0}$

(4) $\frac{P_2^0}{P_1^0}$, $\frac{P_1^0 - P_2^0}{P_2^0}$

Q6. When a non-volatile solute is added to the solvent, the vapour pressure of the solvent decreases by 10 mm of Hg. The mole fraction of the solute in the solution is 0.2. What would be the mole fraction of the solvent if decrease in vapour pressure is 20 mm of Hg ?

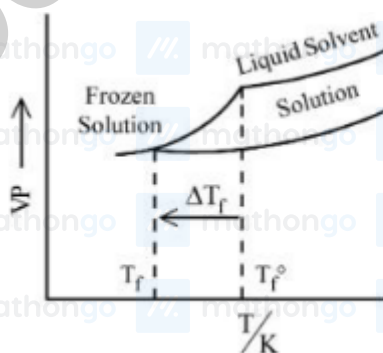
- (1) 0.8
- (2) 0.4
- (3) 0.2
- (4) 0.6

Q7. Arrange the following solutions in order of their increasing boiling points.

- (i) 10^{-4} M NaCl
- (ii) 10^{-4} M Urea
- (iii) 10^{-3} M NaCl
- (iv) 10^{-2} M NaCl

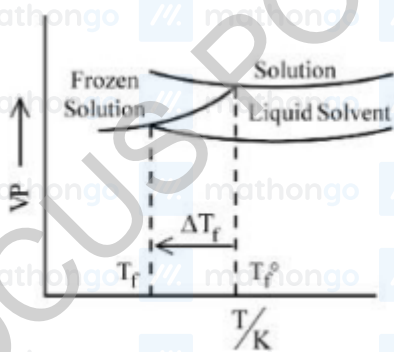
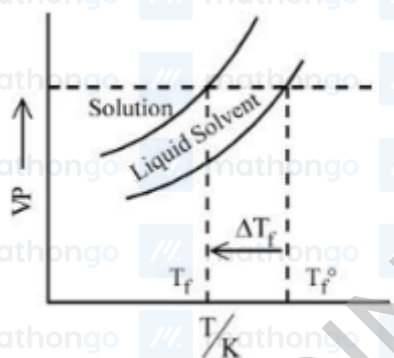
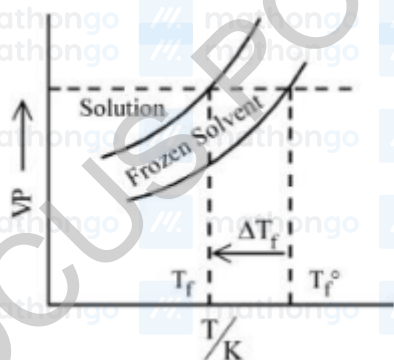
- (1) (i) < (ii) < (iii) < (iv)
- (2) (iv) < (iii) < (i) < (ii)
- (3) (ii) < (i) \equiv (iii) < (iv)
- (4) (ii) < (i) < (iii) < (iv)

Q8. Consider the given plots of vapour pressure (VP) vs temperature (T/K). Which amongst the following options is correct graphical representation showing ΔT_f , depression in the freezing point of a solvent in a solution?



(1)

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Q9. What is the freezing point depression constant of a solvent, 50 g of which contain 1 g non volatile solute (molar mass 256 g mol^{-1}) and the decrease in freezing point is 0.40 K ?

- (1) $3.72 \text{ K kg mol}^{-1}$
- (2) $1.86 \text{ K kg mol}^{-1}$
- (3) $4.43 \text{ K kg mol}^{-1}$
- (4) $5.12 \text{ K kg mol}^{-1}$

Q10. 1.24 g of AX_2 (molar mass 124 g mol^{-1}) is dissolved in 1 kg of water to form a solution with boiling point of 100.0156°C , while 25.4 g of AY_2 (molar mass 250 g mol^{-1}) in 2 kg of water constitutes a solution with a boiling point of 100.0260°C .

$$K_b (\text{H}_2\text{O}) = 0.52 \text{ K kg mol}^{-1}$$

Which of the following is correct ?

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(1) AX_2 is fully ionised while AY_2 is completely unionised.

(2) AX_2 is completely unionised while AY_2 is fully ionised.

(3) AX_2 and AY_2 (both) are completely unionised.

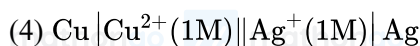
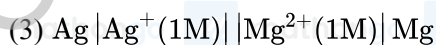
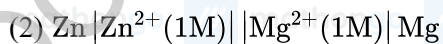
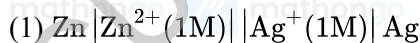
(4) AX_2 and AY_2 (both) are fully ionised.

Q1. Standard electrode potentials for a few half cells are mentioned below :

$$E_{\text{Cu}^{2+}/\text{Cu}}^{\circ} = 0.34 \text{ V}, E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = -0.76 \text{ V}$$

$$E_{\text{Ag}^{+}/\text{Ag}}^{\circ} = 0.80 \text{ V}, E_{\text{Mg}^{2+}/\text{Mg}}^{\circ} = -2.37 \text{ V}$$

Which one of the following cells gives the most negative value of ΔG° ?



Q2. For a $\text{Mg} | \text{Mg}^{2+}(\text{aq}) || \text{Ag}^{+}(\text{aq}) | \text{Ag}$ the correct Nernst Equation is :

(1) $E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{RT}{2F} \ln \frac{[\text{Ag}^{+}]}{[\text{Mg}^{2+}]}$

(2) $E_{\text{cell}} = E_{\text{cell}}^{\circ} + \frac{RT}{2F} \ln \frac{[\text{Ag}^{+}]^2}{[\text{Mg}^{2+}]}$

(3) $E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{RT}{2F} \ln \frac{[\text{Ag}^{+}]^2}{[\text{Mg}^{2+}]}$

(4) $E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{RT}{2F} \ln \frac{[\text{Mg}^{2+}]}{[\text{Ag}^{+}]}$

Q3. Given below are two statements :

Statement (I) : Corrosion is an electrochemical phenomenon in which pure metal acts as an anode and impure metal as a cathode.

Statement (II) : The rate of corrosion is more in alkaline medium than in acidic medium.

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

(1) Both Statement I and Statement II are true

(2) Statement I is false but Statement II is true

(3) Statement I is true but Statement II is false

(4) Both Statement I and Statement II are false

Q4. A solution of aluminium chloride is electrolysed for 30 minutes using a current of 2 A. The amount of the aluminium deposited at the cathode is

[Given : molar mass of aluminium and chlorine are 27 g mol^{-1} and 35.5 g mol^{-1} respectively. Faraday constant $= 96500 \text{ C mol}^{-1}$]

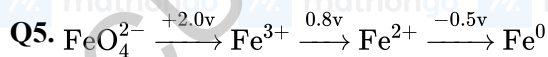
(1) 1.660 g

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(2) 0.336 g

(3) 0.441 g

(4) 1.007 g



In the above diagram, the standard electrode potentials are given in volts (over the arrow).

The value of $E^\circ_{\text{FeO}_4^{2-}/\text{Fe}^{2+}}$ is

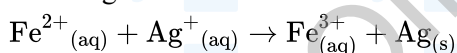
(1) 2.1 V

(2) 1.7 V

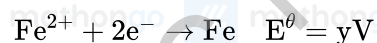
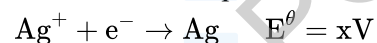
(3) 1.4 V

(4) 1.2 V

Q6. For the given cell



The standard cell potential of the above reaction is Given:

(1) $x + y - z$ (2) $x + 2y$ (3) $x + 2y - 3z$ (4) $y - 2x$

Q7. Based on the data given below :



the strongest reducing agent is :

(1) Cr

(2) Cl^- (3) MnO_4^- (4) Mn^{2+}

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Q8. Electrolysis of 600 mL aqueous solution of NaCl for 5 min changes the pH of the solution to 12. The current in Amperes used for the given electrolysis is _____. (Nearest integer).

Q9. The standard reduction potential values of some of the p-block ions are given below. Predict the one with the strongest oxidising capacity.

$$(1) E_{\text{Pb}^{4+}/\text{Pb}^{2+}}^{\ominus} = +1.67 \text{ V}$$

$$(2) E_{\text{Sn}^{4+}/\text{Sn}^{2+}}^{\ominus} = +1.15 \text{ V}$$

$$(3) E_{\text{Al}^{3+}/\text{Al}}^{\ominus} = -1.66 \text{ V}$$

$$(4) E_{\text{Tl}^{3+}/\text{Tl}}^{\circ} = +1.26 \text{ V}$$

Q10. O₂ gas will be evolved as a product of electrolysis of :

- (A) an aqueous solution of AgNO₃ using silver electrodes.
- (B) an aqueous solution of AgNO₃ using platinum electrodes.
- (C) a dilute solution of H₂SO₄ using platinum electrodes.
- (D) a high concentration solution of H₂SO₄ using platinum electrodes.

Choose the correct answer from the options given below :

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

Q11. Match List - I with List - II :

List - I

Applications

- (A) Transistors
- (B) Hearing aids
- (C) Invertors
- (D) Apollo space ship

List - II

Batteries/Cell

- (I) Anode - Zn/Hg ; Cathode - HgO + C
- (II) Hydrogen fuel cell
- (III) Anode - Zn ; Cathode - Carbon
- (IV) Anode - Pb ; Cathode - Pb | PbO₂

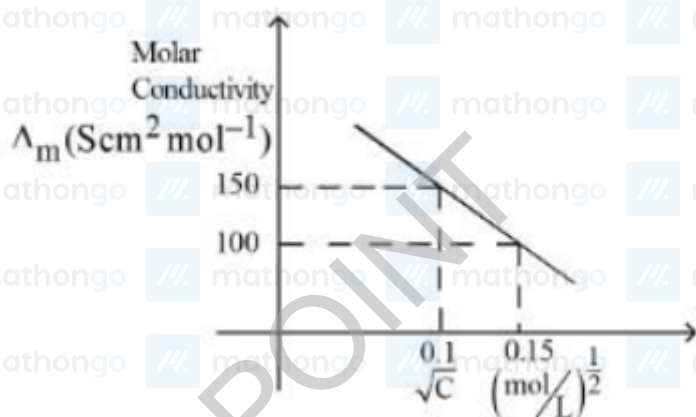
Choose the correct answer from the options given below :

- (1) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
- (2) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
- (3) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
- (4) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

Q12. The molar conductivity of a weak electrolyte when plotted against the square root of its concentration, which of the following is expected to be observed ?

- (1) A small decrease in molar conductivity is observed at infinite dilution.
- (2) Molar conductivity decreases sharply with increase in concentration.
- (3) A small increase in molar conductivity is observed at infinite dilution.
- (4) Molar conductivity increases sharply with increase in concentration.

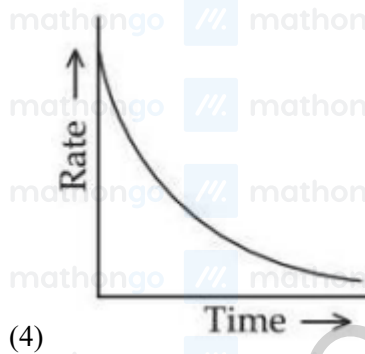
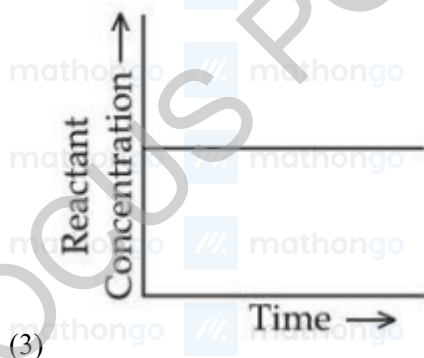
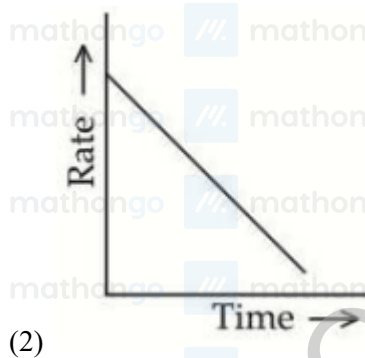
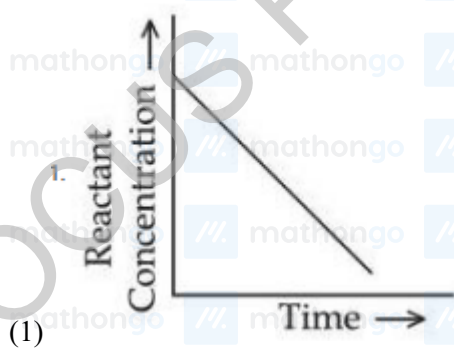
Q13. Given below is the plot of the molar conductivity vs $\sqrt{\text{concentration}}$ for KCl in aqueous solution.



If, for the higher concentration of KCl solution, the resistance of the conductivity cell is 100Ω , then the resistance of the same cell with the dilute solution is ' x ' Ω

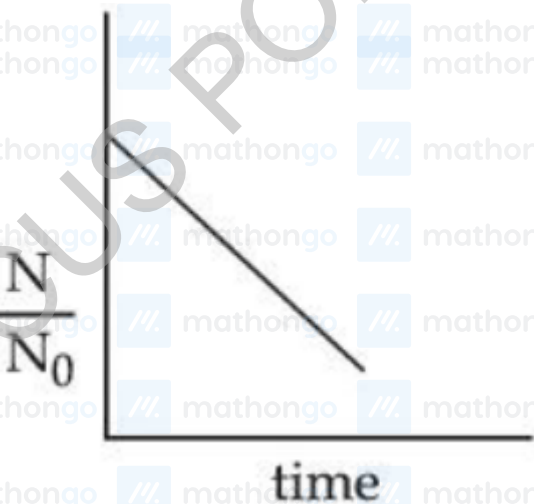
The value of x is _____ (Nearest integer)

Q1. Which of the following graphs most appropriately represents a zero order reaction ?

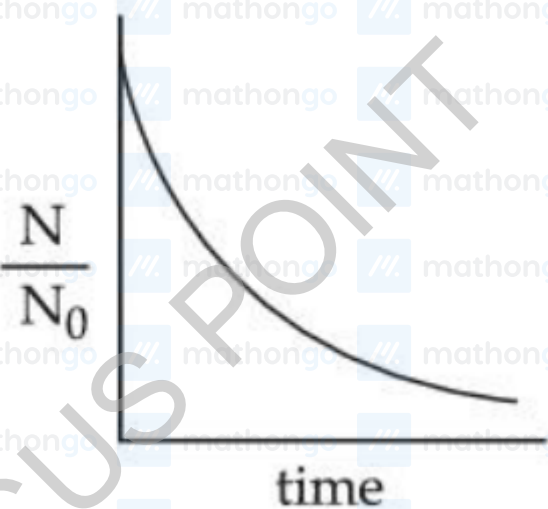


Q2. For bacterial growth in a cell culture, growth law is very similar to the law of radioactive decay. Which of the following graphs is most suitable to represent bacterial colony growth ?

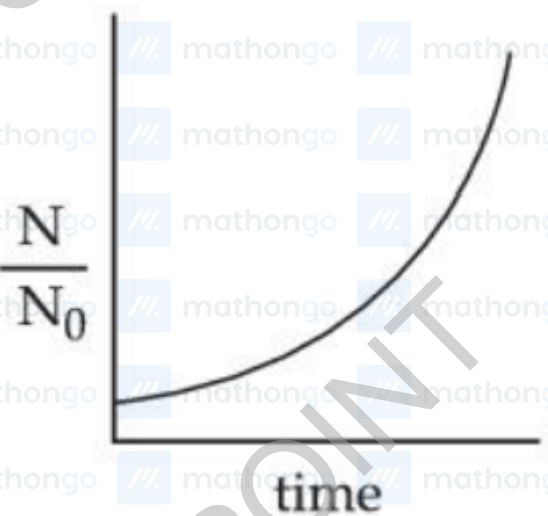
Where N - Number of Bacteria at any time, N_0 - Initial number of Bacteria.



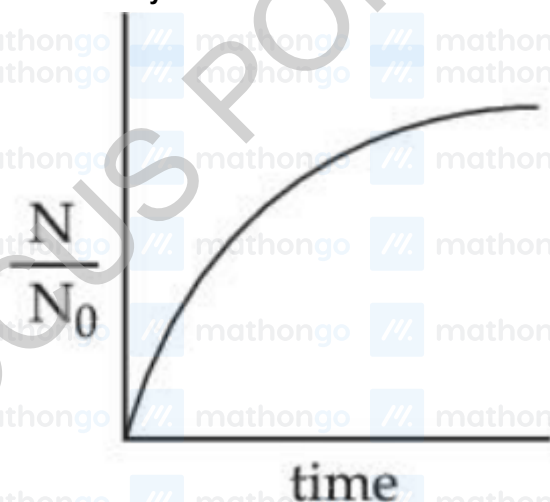
(1)



(2)

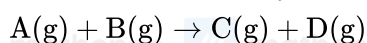


(3)



(4)

Q3. Consider an elementary reaction



If the volume of reaction mixture is suddenly reduced to $\frac{1}{3}$ of its initial volume, the reaction rate will become 'x' times of the original reaction rate. The value of x is :

(1) 3

(2) $\frac{1}{9}$

(3) 9

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

Q4. Which of the following statement is not true for radioactive decay?

(1) Decay constant increases with increase in temperature.

(2) Amount of radioactive substance remained after three half lives is $\frac{1}{8}$ th of original amount.

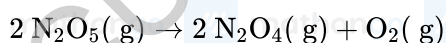
(3) Decay constant does not depend upon temperature.

(4) Half life is $\ln 2$ times of $\frac{1}{\text{rate constant}}$

Q5. $A \rightarrow B$

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). $[R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}]$

Q6. For the thermal decomposition of $\text{N}_2\text{O}_5(g)$ at constant volume, the following table can be formed, for the reaction mentioned below.



Sr.No	Time/s	Total pressure/(atm)
1	0	0.6
2	100	x^2

$x = \dots \times 10^{-3}$ atm [nearest integer]

Given : Rate constant for the reaction is $4.606 \times 10^{-2} \text{ s}^{-1}$.

Q7.

$[A]_0 / \text{molL}^{-1}$	$t_{1/2} / \text{min}$
0.100	200
0.025	100

For a given reaction $R \rightarrow P$, $t_{1/2}$ is related to $[A]_0$ as given in table.

Given: $\log 2 = 0.30$

Which of the following is true?

A. The order of the reaction is $1/2$.

B. If $[A]_0$ is 1 M, then $t_{1/2}$ is $200\sqrt{10}$ min

C. The order of the reaction changes to 1 if the concentration of reactant changes from 0.100 M to 0.500 M.

D. $t_{1/2}$ is 800 min for $[A]_0 = 1.6\text{M}$

Choose the correct answer from the options given below:

Options

(1) A and C Only

(2) A, B and D Only

(3) C and D Only

(4) A and B Only

Q8. Drug X becomes ineffective after 50% decomposition. The original concentration of drug in a bottle was 16mg/mL which becomes 4mg/mL in 12 months. The expiry time of the drug in months is

Assume that the decomposition of the drug follows first order kinetics.

(1) 2

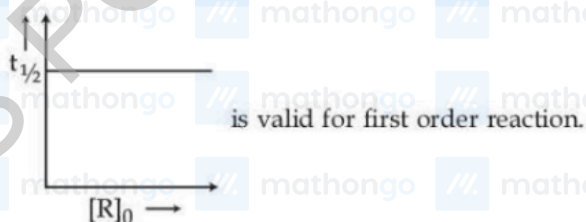
(2) 6

(3) 12

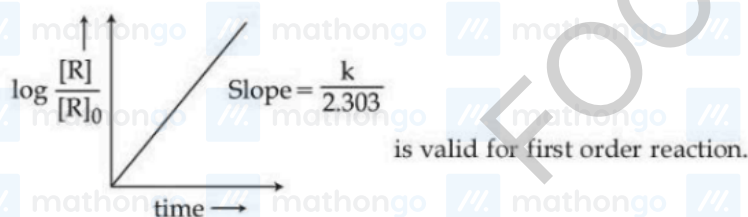
(4) 3

Q9. Given below are two statements :

Statement (I) :



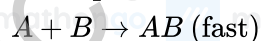
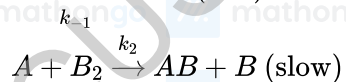
Statement (II) :



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

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

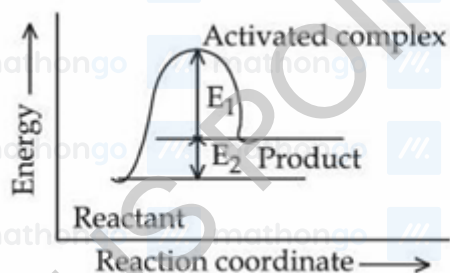
Q10. The reaction $A_2 + B_2 \rightarrow 2AB$ follows the mechanism



The overall order of the reaction is :

- (1) 2
- (2) 2.5
- (3) 3
- (4) 1.5

Q11. Consider the given figure and choose the correct option :



- (1) Activation energy of both forward and backward reaction is $E_1 + E_2$ and reactant is more stable than product.
- (2) Activation energy of forward reaction is $E_1 + E_2$ and product is less stable than reactant.
- (3) Activation energy of backward reaction is E_1 and product is more stable than reactant.
- (4) Activation energy of forward reaction is $E_1 + E_2$ and product is more stable than reactant.

Q12. 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)

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Q1. Given below are two statements :

Statement (I) : An element in the extreme left of the periodic table forms acidic oxides.

Statement (II) : Acid is formed during the reaction between water and oxide of a reactive element present in the extreme right of the periodic table.

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

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

Q2. The incorrect decreasing order of atomic radii is

- (1) $\text{Si} > \text{P} > \text{Cl} > \text{F}$
- (2) $\text{Be} > \text{Mg} > \text{Al} > \text{Si}$
- (3) $\text{Al} > \text{B} > \text{N} > \text{F}$
- (4) $\text{Mg} > \text{Al} > \text{C} > \text{O}$

Q3. Given below are two statements :

Statement (I): According to the Law of Octaves, the elements were arranged in the increasing order of their atomic number. **Statement (II):** Meyer observed a periodically repeated pattern upon plotting physical properties of certain elements against their respective atomic numbers.

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

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

Q4. The element that does not belong to the same period of the remaining elements (modern periodic table) is:

- (1) Iridium
- (2) Platinum
- (3) Osmium
- (4) Palladium

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Q5. Which of the following statements are NOT true about the periodic table?

- A. The properties of elements are function of atomic weights.
- B. The properties of elements are function of atomic numbers.
- C. Elements having similar outer electronic configurations are arranged in same period.
- D. An element's location reflects the quantum numbers of the last filled orbital.
- E. The number of elements in a period is same as the number of atomic orbitals available in energy level that is being filled.

Choose the correct answer from the options given below:

(1) A, C and E Only

(2) A and E Only

(3) B, C and E Only

(4) D and E Only

Q6. Which of the following electronegativity order is incorrect?

(1) $\text{Mg} < \text{Be} < \text{B} < \text{N}$

(2) $\text{S} < \text{Cl} < \text{O} < \text{F}$

(3) $\text{Al} < \text{Si} < \text{C} < \text{N}$

(4) $\text{Al} < \text{Mg} < \text{B} < \text{N}$

Q7. Match List-I with List-II.

List-I

(A) $\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{F}^-$ (I)

(B) $\text{B} < \text{C} < \text{O} < \text{N}$ (II)

(C) $\text{B} < \text{Al} < \text{Mg} < \text{K}$ (III)

(D) $\text{Si} < \text{P} < \text{S} < \text{Cl}$ (IV)

List-II

(I) Ionisation Enthalpy

(II) Metallic character

(III) Electronegativity

(IV) Ionic radii

Choose the correct answer from the options given below :

(1) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

(2) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

(3) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

(4) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

Q8. The successive 5 ionisation energies of an element are 800, 2427, 3658, 25024 and 32824 kJ/mol, respectively.

By using the above values predict the group in which the above element is present :

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- (1) Group 13
- (2) Group 14
- (3) Group 2
- (4) Group 4

Q9. An element 'E' has the ionisation enthalpy value of 374 kJ mol^{-1} . 'E' reacts with elements A, B, C and D with electron gain enthalpy values of -328 , -349 , -325 and -295 kJ mol^{-1} , respectively. The correct order of the products EA, EB, EC and ED in terms of ionic character is :

- (1) $ED > EC > EB > EA$
- (2) $EA > EB > EC > ED$
- (3) $EB > EA > EC > ED$
- (4) $ED > EC > EA > EB$

Q10. The type of oxide formed by the element among Li, Na, Be, Mg, B and Al that has the least atomic radius is :

- (1) A_2O
- (2) A_2O_3
- (3) AO_2
- (4) AO

Q11. First ionisation enthalpy values of first four group 15 elements are given below. Choose the correct value for the element that is a main component of apatite family :

- (1) 1402 kJ mol^{-1}
- (2) 834 kJ mol^{-1}
- (3) 1012 kJ mol^{-1}
- (4) 947 kJ mol^{-1}

Q1. Total number of sigma (σ) _____ and pi(π) _____ bonds respectively present in hex-1-en-4-yne are :

- (1) 3 and 13
- (2) 11 and 3
- (3) 13 and 3
- (4) 14 and 3

Q2. The number of molecules/ions that show linear geometry among the following is _____

$\text{SO}_2, \text{BeCl}_2, \text{CO}_2, \text{N}_3^-, \text{NO}_2, \text{F}_2\text{O}, \text{XeF}_2, \text{NO}_2^+, \text{I}_3^-, \text{O}_3$

Q3. In the given structure, number of sp and sp^2 hybridized carbon atoms present respectively are :



- (1) 4 and 5
- (2) 3 and 5
- (3) 3 and 6
- (4) 4 and 6

Q4. Match the LIST-I with LIST-II

LIST-I (Classification of molecules based on octet rule)		LIST-II (Example)	
A.	Molecules obeying octet rule	I.	NO, NO_2
B.	Molecules with incomplete octet	II.	$\text{BCl}_3, \text{AlCl}_3$
C.	Molecules with incomplete octet with odd electron	III.	$\text{H}_2\text{SO}_4, \text{PCl}_5$
D.	Molecules with expanded octet	IV.	$\text{CCl}_4, \text{CO}_2$

Choose the correct answer from the options given below:

- (1) A-IV, B-I, C-III, D-II
- (2) A-IV, B-II, C-I, D-III
- (3) A-II, B-IV, C-III, D-I
- (4) A-III, B-II, C-I, D-IV

Q5. The sum of sigma (σ) and pi (π) bonds in Hex-1,3-dien-5-yne is _____.

Q6. Given below are two statements :

Statement (I) : The first ionization energy of Pb is greater than that of Sn.

Statement (II) : The first ionization energy of Ge is greater than that of Si.

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

(1) Statement I is false but Statement II is true

(2) Statement I is true but Statement II is false

(3) Both Statement I and Statement II are true

(4) Both Statement I and Statement II are false

Q7. Which of the following statement is true with respect to H_2O , NH_3 and CH_4 ?

A. The central atoms of all the molecules are sp^3 hybridized.

B. The $\text{H}-\text{O}-\text{H}$, $\text{H}-\text{N}-\text{H}$ and $\text{H}-\text{C}-\text{H}$ angles in the above molecules are 104.5° , 107.5° and 109.5° , respectively.

C. The increasing order of dipole moment is $\text{CH}_4 < \text{NH}_3 < \text{H}_2\text{O}$.

D. Both H_2O and NH_3 are Lewis acids and CH_4 is a Lewis base.

E. A solution of NH_3 in H_2O is basic. In this solution NH_3 and H_2O act as Lowry-Bronsted acid and base respectively.

Choose the correct answer from the options given below:

(1) A, B and C Only

(2) A, D and E Only

(3) C, D and E Only

(4) A, B, C and E Only

Q8. Given below are two statements :

Statement (I): Experimentally determined oxygen-oxygen bond lengths in the O_3 are found to be same and the bond length is greater than that of a $\text{O}=\text{O}$ (double bond) but less than that of a single ($\text{O}-\text{O}$) bond.

Statement (II) : The strong lone pair-lone pair repulsion between oxygen atoms is solely responsible for the fact that the bond length in ozone is smaller than that of a double bond ($\text{O}=\text{O}$) but more than that of a single bond ($\text{O}-\text{O}$).

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

(1) Both Statement I and Statement II are false

(2) Statement I is false but Statement II is true

(3) Statement I is true but Statement II is false

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(4) Both Statement I and Statement II are true

Q9. The molecules having square pyramidal geometry are

(1) BrF_5 & PCl_5

(2) SbF_5 & PCl_5

(3) SbF_5 & XeOF_4

(4) BrF_5 & XeOF_4

Q10. Which of the following linear combination of atomic orbitals will lead to formation of molecular orbitals in homonuclear diatomic molecules [internuclear axis in z -direction] ?

A. $2p_z$ and $2p_x$

B. $2s$ and $2p_x$

C. $3d_{xy}$ and $3d_{x^2-y^2}$

D. $2s$ and $2p_z$

E. $2p_z$ and $3d_{x^2-y^2}$

Choose the correct answer from the options given below:

(1) A and B Only

(2) D Only

(3) E Only

(4) C and D Only

Q11. Total number of molecules/species from following which will be paramagnetic is _____

O_2 , O_2^+ , O_2^- , NO , NO_2 , CO , $\text{K}_2[\text{NiCl}_4]$, $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$, $\text{K}_2[\text{Ni}(\text{CN})_4]$

Q12. Arrange the following compounds in increasing order of their dipole moment : HBr , H_2S , NF_3 and CHCl_3

(1) $\text{H}_2\text{S} < \text{HBr} < \text{NF}_3 < \text{CHCl}_3$

(2) $\text{NF}_3 < \text{HBr} < \text{H}_2\text{S} < \text{CHCl}_3$

(3) $\text{HBr} < \text{H}_2\text{S} < \text{NF}_3 < \text{CHCl}_3$

(4) $\text{CHCl}_3 < \text{NF}_3 < \text{HBr} < \text{H}_2\text{S}$

Q13. The correct option with order of melting points of the pairs (Mn, Fe) , (Tc, Ru) and (Re, Os) is :

(1) $\text{Fe} < \text{Mn}$, $\text{Ru} < \text{Tc}$ and $\text{Re} < \text{Os}$

(2) $\text{Mn} < \text{Fe}$, $\text{Tc} < \text{Ru}$ and $\text{Os} < \text{Re}$

(3) $\text{Mn} < \text{Fe}$, $\text{Tc} < \text{Ru}$ and $\text{Re} < \text{Os}$

(4) $\text{Fe} < \text{Mn}$, $\text{Ru} < \text{Tc}$ and $\text{Os} < \text{Re}$

Q1. Consider the following elements In, Tl, Al, Pb, Sn and Ge.

The most stable oxidation states of elements with highest and lowest first ionisation enthalpies, respectively, are

(1) +4 and +1

(2) +1 and +4

(3) +4 and +3

(4) +2 and +3

Q2. Given below are the atomic numbers of some group 14 elements. The atomic number of the element with lowest melting point is :

(1) 6

(2) 82

(3) 14

(4) 50

Q1. The incorrect statement among the following is

- (1) PH_3 shows lower proton affinity than NH_3 .
- (2) SO_2 can act as an oxidizing agent, but not as a reducing agent.
- (3) PF_3 exists but NF_5 does not.
- (4) NO_2 can dimerise easily.

Q2. A group 15 element forms $d\pi - d\pi$ bond with transition metals. It also forms hydride, which is a strongest base among the hydrides of other group members that form $d\pi - d\pi$ bond. The atomic number of the element is ____.

Q3. The maximum covalency of a non-metallic group 15 element 'E' with weakest E - E bond is :

- (1) 4
- (2) 6
- (3) 3
- (4) 5

Q4. The large difference between the melting and boiling points of oxygen and sulphur may be explained on the basis of

- (1) Atomicity
- (2) Electron gain enthalpy
- (3) Electronegativity
- (4) Atomic size

Q5. Which of the following electrolyte can be used to obtain H_2 S_2O_8 by the process of electrolysis?

- (1) Dilute solution of sodium sulphate.
- (2) Acidified dilute solution of sodium sulphate.
- (3) Dilute solution of sulphuric acid
- (4) Concentrated solution of sulphuric acid

Q1. Match List - I with List - II.

List - I

List - II

- | | |
|---------------------|--------------------|
| (A) Bronze | (I) Cu, Ni |
| (B) Brass | (II) Fe, Cr, Ni, C |
| (C) UK silver coin | (III) Cu, Zn |
| (D) Stainless steel | (IV) Cu, Sn |

Choose the correct answer from the options given below :

- (1) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
- (2) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
- (3) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
- (4) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

Q2. Preparation of potassium permanganate from MnO_2 involves two step process in which the 1st step is a reaction with KOH and KNO_3 to produce

- (1) K_3MnO_4
- (2) $\text{K}_4[\text{Mn}(\text{OH})_6]$
- (3) KMnO_4
- (4) K_2MnO_4

Q3. Niobium (Nb) and ruthenium (Ru) have " x " and " y " number of electrons in their respective 4 d orbitals. The value of $x + y$ is _____.

Q4. The correct set of ions (aqueous solution) with same colour from the following is:

- (1) Sc^{3+} , Ti^{3+} , Cr^{2+}
- (2) V^{2+} , Cr^{3+} , Mn^{3+}
- (3) Ti^{4+} , V^{4+} , Mn^{2+}
- (4) Zn^{2+} , V^{3+} , Fe^{3+}

Q5. Consider ' n ' is the number of lone pair of electrons present in the equatorial position of the most stable structure of ClF_3 . The ions from the following with ' n ' number of unpaired electrons are

- A. V^{3+}
- B. Ti^{3+}
- C. Cu^{2+}
- D. Ni^{2+}

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E. Ti^{2+}

Choose the correct answer from the options given below:

(1) A and C Only

(2) A, D and E Only

(3) B and D Only

(4) B and C Only

Q6. The amphoteric oxide among V_2O_3 , V_2O_4 and V_2O_5 , upon reaction with alkali leads to formation of an oxide anion. The oxidation state of V in the oxide anion is :

(1) +3

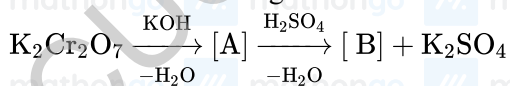
(2) +4

(3) +7

(4) +5

Q7. The spin only magnetic moment (μ) value (B.M.) of the compound with strongest oxidising power among Mn_2O_3 , TiO and VO is ____ B.M. (Nearest integer).

Q8. Consider the following reactions



The products [A] and [B], respectively are :

(1) K_2CrO_4 and CrO (2) K_2CrO_4 and Cr_2O_3 (3) K_2CrO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (4) $\text{K}_2\text{Cr}(\text{OH})_6$ and Cr_2O_3

Q9. Which of the following oxidation reactions are carried out by both $\text{K}_2\text{Cr}_2\text{O}_7$ and KMnO_4 in acidic medium?

A. $\text{I}^- \rightarrow \text{I}_2$ B. $\text{S}^{2-} \rightarrow \text{S}$ C. $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+}$ D. $\text{I}^- \rightarrow \text{IO}_3^-$ E. $\text{S}_2\text{O}_3^{2-} \rightarrow \text{SO}_4^{2-}$

Choose the correct answer from the options given below:

(1) C, D and E Only

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

Q10. Identify the inorganic sulphides that are yellow in colour :

- (A) $(\text{NH}_4)_2\text{S}$
- (B) Pbs
- (C) Cus
- (D) As_2S_3
- (E) As_2S_5

Choose the correct answer from the options given below :

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

Q11. The molar mass of the water insoluble product formed from the fusion of chromite ore (FeCr_2O_4) with Na_2CO_3 in presence of O_2 is _____ gmol^{-1} .

Q12. Lanthanoid ions with $4f^7$ configuration are :

- (A) Eu^{2+}
- (B) Gd^{3+}
- (C) Eu^{3+}
- (D) Tb^{3+}
- (E) Sm^{2+}

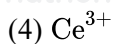
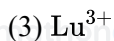
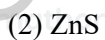
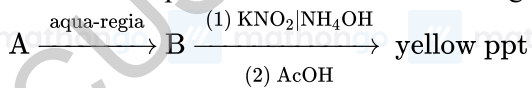
Choose the correct answer from the options given below :

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

Q13. Which of the following ions is the strongest oxidizing agent? (Atomic Number of Ce = 58, Eu = 63, Tb = 65, Lu = 71)

- (1) Eu^{2+}
- (2) Tb^{4+}

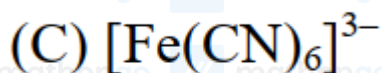
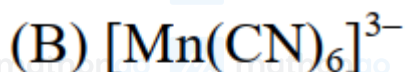
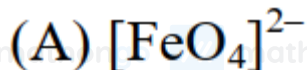
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**Q14.** Find the compound 'A' from the following reaction sequences.

Q1. The calculated spin-only magnetic moments of $K_3 [Fe(OH)_6]$ and $K_4 [Fe(OH)_6]$ respectively are :

- (1) 3.87 and 4.90 B.M.
- (2) 4.90 and 5.92 B.M.
- (3) 4.90 and 4.90 B.M.
- (4) 5.92 and 4.90 B.M.

Q2. Identify the coordination complexes in which the central metal ion has d^4 configuration.

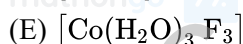
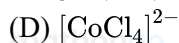
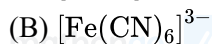


Choose the correct answer from the options given below :

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

Q3. The complex of Ni^{2+} ion and dimethyl glyoxime contains _____ number of Hydrogen (H) atoms.

Q4. Identify the homoleptic complexes with odd number of d electrons in the central metal :



Choose the correct answer from the options given below :

- (1) (A), (B) and (D) only

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(2) (C) and (E) only

(3) (B) and (D) only

(4) (A), (C) and (E) only

Q5. The complex that shows Facial - Meridional isomerism is:(1) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (2) $[\text{Co}(\text{en})_3]^{3+}$ (3) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ (4) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ **Q6.** From the magnetic behaviour of $[\text{NiCl}_4]^{2-}$ (paramagnetic) and $[\text{Ni}(\text{CO})_4]$ (diamagnetic), choose the correct geometry and oxidation state.(1) $[\text{NiCl}_4]^{2-} : \text{Ni}^{\text{II}}$, tetrahedral
 $[\text{Ni}(\text{CO})_4] : \text{Ni}^{\text{II}}$, square planar(2) $[\text{NiCl}_4]^{2-} : \text{Ni}^{\text{II}}$, square planar
 $[\text{Ni}(\text{CO})_4] : \text{Ni}(0)$, square planar(3) $[\text{NiCl}_4]^{2-} : \text{Ni}^{\text{II}}$, tetrahedral
 $[\text{Ni}(\text{CO})_4] : \text{Ni}(0)$, tetrahedral(4) $[\text{NiCl}_4]^{2-} : \text{Ni}(0)$, tetrahedral
 $[\text{Ni}(\text{CO})_4] : \text{Ni}(0)$, square planar**Q7.** Identify the homoleptic complex(es) that is/are low spin.(A) $[\text{Fe}(\text{CN})_5\text{NO}]^{2-}$ (B) $[\text{CoF}_6]^{3-}$ (C) $[\text{Fe}(\text{CN})_6]^{4-}$ (D) $[\text{Co}(\text{NH}_3)_6]^{3+}$ (E) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$

Choose the correct answer from the options given below :

(1) (C) only

(2) (C) and (D) only

(3) (A) and (C) only

(4) (B) and (E) only

Q8. One mole of the octahedral complex compound $\text{Co}(\text{NH}_3)_5\text{Cl}_3$ gives 3 moles of ions on dissolution in water. One mole of the same complex reacts with excess of AgNO_3 solution to yield two moles of $\text{AgCl}_{(s)}$. The structure of the complex is:

- (1) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2] \cdot \text{Cl} \cdot \text{NH}_3$
- (2) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3] \cdot 2\text{NH}_3$
- (3) $[\text{Co}(\text{NH}_3)_5\text{Cl}] \text{Cl}_2$
- (4) $[\text{Co}(\text{NH}_3)_4\text{Cl}] \cdot \text{Cl}_2 \cdot \text{NH}_3$

Q9. Match List - I with List - II.

List - I

(Transition metal ion)

- (A) Ti^{3+}
- (B) V^{2+}
- (C) Ni^{2+}
- (D) Sc^{3+}

List - II

(Spin only magnetic moment (B.M.))

- (I) 3.87
- (II) 0.00
- (III) 1.73
- (IV) 2.84

Choose the correct answer from the options given below :

- (1) (A) – (III), (B) – (I), (C) – (IV), (D) – (II)
- (2) (A) – (III), (B) – (I), (C) – (II), (D) – (IV)
- (3) (A) – (IV), (B) – (II), (C) – (III), (D) – (I)
- (4) (A) – (II), (B) – (IV), (C) – (I), (D) – (III)

Q10. Match List - I with List - II.

List - I

(Complex)

- (A) $[\text{CoF}_6]^{3-}$
- (B) $[\text{NiCl}_4]^{2-}$
- (C) $[\text{Co}(\text{NH}_3)_6]^{3+}$
- (D) $[\text{Ni}(\text{CN})_4]^{2-}$

List - II

(Hybridisation of central metal ion)

- (I) d^2sp^3
- (II) sp^3
- (III) sp^3d^2
- (IV) dsp^2

Choose the correct answer from the options given below :

- (1) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)
- (2) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
- (3) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
- (4) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

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Q11. Match List - I with List - II.

List - I

List - II

(Complex)

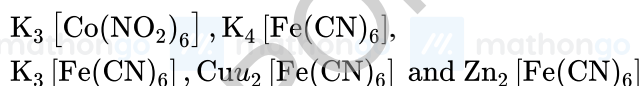
(Hybridisation &
Magnetic characters)

- | | |
|--|--------------------------------|
| (A) $[\text{MnBr}_4]^{2-}$ | (I) $d^2 sp^3$ & diamagnetic |
| (B) $[\text{FeF}_6]^{3-}$ | (II) $sp^3 d^2$ & paramagnetic |
| (C) $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$ | (III) sp^3 & diamagnetic |
| (D) $[\text{Ni}(\text{CO})_4]$ | (IV) sp^3 & paramagnetic |

Choose the correct answer from the options given below :

- (1) (A) – (IV), (B) – (II), (C) – (I), (D) – (III)
- (2) (A) – (III), (B) – (I), (C) – (II), (D) – (IV)
- (3) (A) – (IV), (B) – (I), (C) – (II), (D) – (III)
- (4) (A) – (III), (B) – (II), (C) – (I), (D) – (IV)

Q12. Consider the following low-spin complexes



The sum of the spin-only magnetic moment values of complexes having yellow colour is _____ B.M. (answer in nearest integer)

Q13. In which of the following complexes the CFSE, Δ_o will be equal to zero?

- (1) $[\text{Fe}(\text{en})_3] \text{Cl}_3$
- (2) $\text{K}_4[\text{Fe}(\text{CN})_6]$
- (3) $[\text{Fe}(\text{NH}_3)_6] \text{Br}_2$
- (4) $\text{K}_3[\text{Fe}(\text{SCN})_6]$

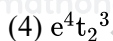
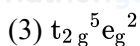
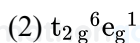
Q14. The correct order of the following complexes in terms of their crystal field stabilization energies is :

- (1) $[\text{Co}(\text{NH}_3)_4]^{2+} < [\text{Co}(\text{NH}_3)_6]^{2+} < [\text{Co}(\text{en})_3]^{3+} < [\text{Co}(\text{NH}_3)_6]^{3+}$
- (2) $[\text{Co}(\text{NH}_3)_6]^{2+} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Co}(\text{NH}_3)_4]^{2+} < [\text{Co}(\text{en})_3]^{3+}$
- (3) $[\text{Co}(\text{en})_3]^{3+} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Co}(\text{NH}_3)_6]^{2+} < [\text{Co}(\text{NH}_3)_4]^{2+}$
- (4) $[\text{Co}(\text{NH}_3)_4]^{2+} < [\text{Co}(\text{NH}_3)_6]^{2+} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Co}(\text{en})_3]^{3+}$

Q15. The d- electronic configuration of an octahedral Co(II) complex having magnetic moment of 3.95 BM is:

- (1) $t_2g^3 e_g^0$

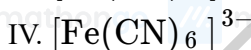
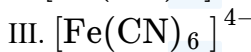
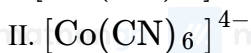
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Q16. The conditions and consequence that favours the $t_2g^3 e_g^1$ configuration in a metal complex are :

- (1) weak field ligand, low spin complex
- (2) weak field ligand, high spin complex
- (3) strong field ligand, high spin complex
- (4) strong field ligand, low spin complex

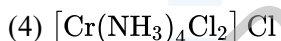
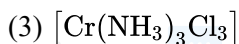
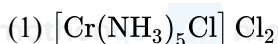
Q17. The correct increasing order of stability of the complexes based on Δ_o value is :



- (1) IV < III < II < I
- (2) I < II < IV < III
- (3) III < II < IV < I
- (4) II < III < I < IV

Q18. $\text{CrCl}_3 \cdot x\text{NH}_3$ can exist as a complex. 0.1 molal aqueous solution of this complex shows a depression in freezing point of 0.558°C . Assuming 100% ionisation of this complex and coordination number of Cr is 6, the complex will be

(Given $K_f = 1.86 \text{ K kg mol}^{-1}$)



Q19. When Ethane-1,2-diamine is added progressively to an aqueous solution of Nickel (II) chloride, the sequence of colour change observed will be :

- (1) Violet \rightarrow Blue \rightarrow Pale Blue \rightarrow Green

(2) Pale Blue → Blue → Green → Violet

(3) Green → Pale Blue → Blue → Violet

(4) Pale Blue → Blue → Violet → Green

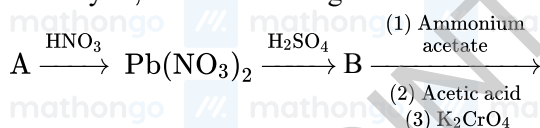
Q1. The metal ion whose electronic configuration is not affected by the nature of the ligand and which gives a violet colour in non-luminous flame under hot condition in borax bead test is

- (1) Mn^{2+}
- (2) Cr^{3+}
- (3) Ni^{2+}
- (4) Tl^{3+}

Q2. Among the following cations, the number of cations which will give characteristic precipitate in their identification tests with $\text{K}_4[\text{Fe}(\text{CN})_6]$ is _____.

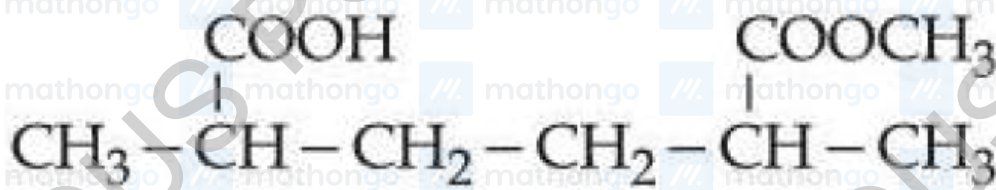
Cu^{2+} , Fe^{3+} , Ba^{2+} , Ca^{2+} , NH_4^+ , Mg^{2+} , Zn^{2+}

Q3. Identify A, B and C in the given below reaction sequence



- (1) PbCl_2 , PbSO_4 , PbCrO_4
- (2) PbS , PbSO_4 , $\text{Pb}(\text{CH}_3\text{COO})_2$
- (3) PbCl_2 , $\text{Pb}(\text{SO}_4)_2$, PbCrO_4
- (4) PbS , PbSO_4 , PbCrO_4

Q1. The IUPAC name of the following compound is :



(1) Methyl-6-carboxy-2,5-dimethylhexanoate.

(2) 2-Carboxy-5-methoxycarbonylhexane.

(3) 6-Methoxycarbonyl-2,5-dimethylhexanoic acid.

(4) Methyl-5-carboxy-2-methylhexanoate.

Q2. Given below are two statements :



Statement (I) :

are isomeric compounds. Statement (II) :  and 

are functional group isomers.

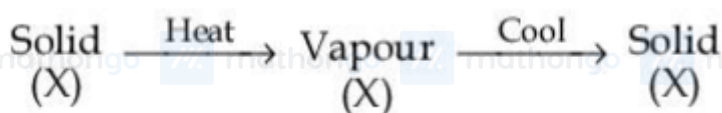
(1) Both Statement (I) and Statement (II) are false.

(2) Both Statement (I) and Statement (II) are true.

(3) Statement (I) is false but Statement (II) is true.

(4) Statement (I) is true but Statement (II) is false.

Q3. The purification method based on the following physical transformation is :



(1) Distillation

(2) Extraction

(3) Sublimation

(4) Crystallization

Q4. Given below are two statements :

Statement (I): In partition chromatography, stationary phase is thin film of liquid present in the inert support.

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Statement (II) : In paper chromatography, the material of paper acts as a stationary phase.

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

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

Q5. Given below are two statements I and II.

Statement I: Dumas method is used for estimation of "Nitrogen" in an organic compound.

Statement II: Dumas method involves the formation of ammonium sulphate by heating the organic compound with conc H_2SO_4 .

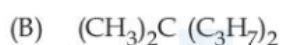
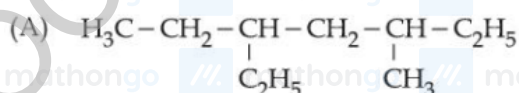
In the light of the above statements, choose the correct answer from the options given below

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

Q6. Match List - I with List - II.

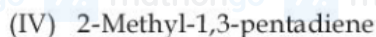
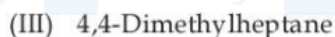
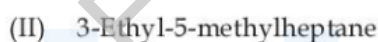
List - I

(Structure)



List - II

(IUPAC Name)

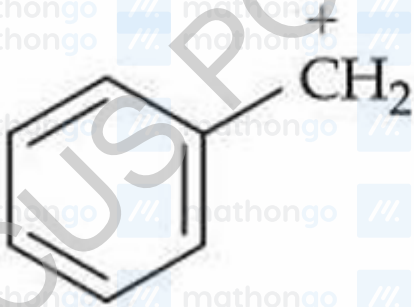


Choose the correct answer from the options given below :

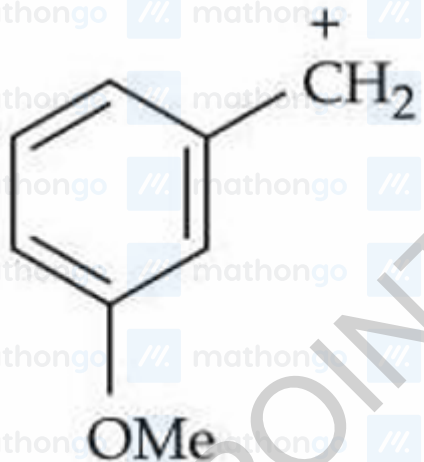
- (1) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
- (2) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
- (3) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
- (4) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

Q7. The most stable carbocation from the following is :

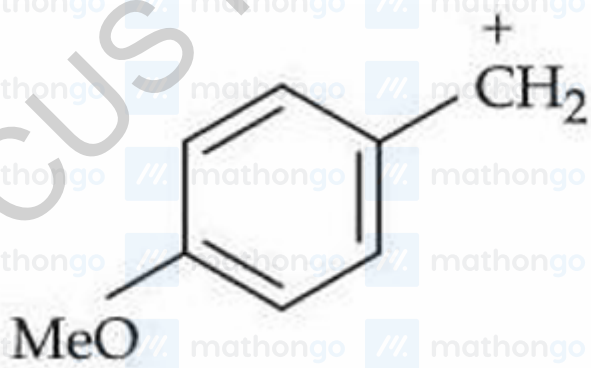
(1)



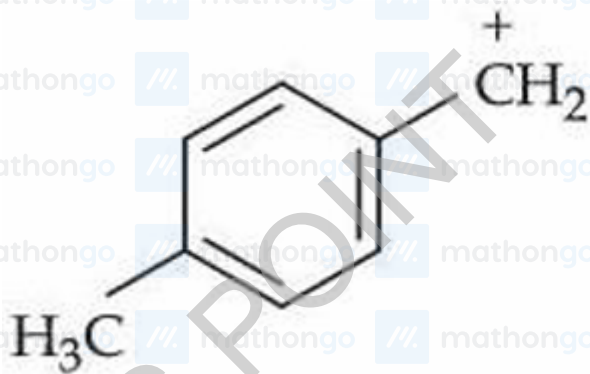
(2)



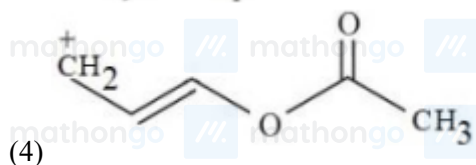
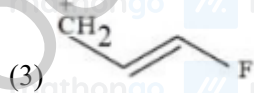
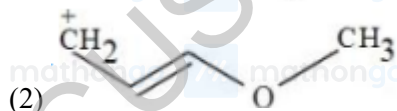
(3)



(4)



Q8. Which one of the carbocations from the following is most stable?



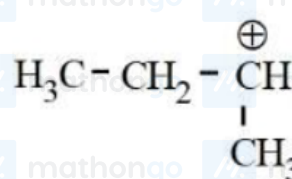
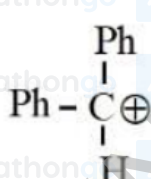
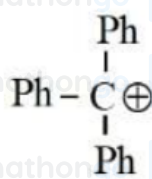
Q9. Identify correct statement/s :

- (A) $-\text{OCH}_3$ and $-\text{NHCOCH}_3$ are activating group.
 (B) $-\text{CN}$ and $-\text{OH}$ are meta directing group.
 (C) $-\text{CN}$ and $-\text{SO}_3\text{H}$ are meta directing group.
 (D) Activating groups act as ortho - and para directing groups.
 (E) Halides are activating groups.

Choose the correct answer from the options given below :

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

Q10. The correct order of stability of following carbocations is :

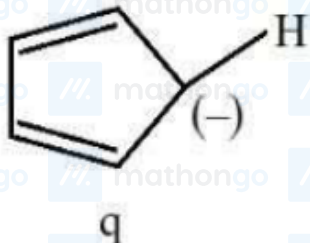


- (1) $\text{C} > \text{B} > \text{A} > \text{D}$
 (2) $\text{A} > \text{B} > \text{C} > \text{D}$
 (3) $\text{B} > \text{C} > \text{A} > \text{D}$

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(4) $C > A > B > D$

Q11. The correct stability order of the following species/molecules is:

(1) $q > r > p$ (2) $r > q > p$ (3) $q > p > r$ (4) $p > q > r$

Q12. Total number of nucleophiles from the following is :

 $\text{NH}_3, \text{PhSH}, (\text{H}_3\text{C})_2\text{S}, \text{H}_2\text{C}=\text{CH}_2, \overset{\ominus}{\text{O}}\text{H}, \text{H}_3\text{O}^{\oplus}, (\text{CH}_3)_2\text{CO}, \text{>NCH}_3$

(1) 7

(2) 4

(3) 6

(4) 5

Q13. The incorrect statements regarding geometrical isomerism are :

(A) Propene shows geometrical isomerism.

(B) Trans isomer has identical atoms/groups on the opposite sides of the double bond.

(C) Cis-but-2-ene has higher dipole moment than trans-but-2-ene.

(D) 2-methylbut-2-ene shows two geometrical isomers.

(E) Trans-isomer has lower melting point than cis isomer.

Choose the correct answer from the options given below :

(1) (A) and (E) Only

(2) (A), (D) and (E) Only

(3) (B) and (C) Only

(4) (C), (D) and (E) Only

Q14. How many different stereoisomers are possible for the given molecule?



(1) 2

(2) 1

(3) 4

(4) 3

Q15. Propane molecule on chlorination under photochemical condition gives two di-chloro products, "x" and "y".

Amongst "x" and "y", "x" is an optically active molecule. How many tri-chloro products (consider only structural isomers) will be obtained from "x" when it is further treated with chlorine under the photochemical condition?

(1) 2

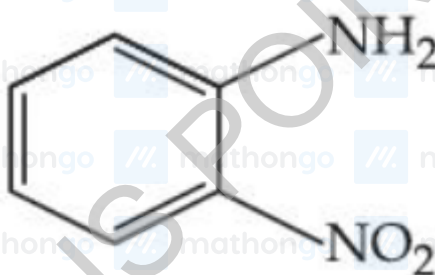
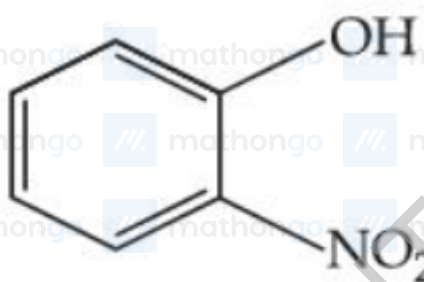
(2) 5

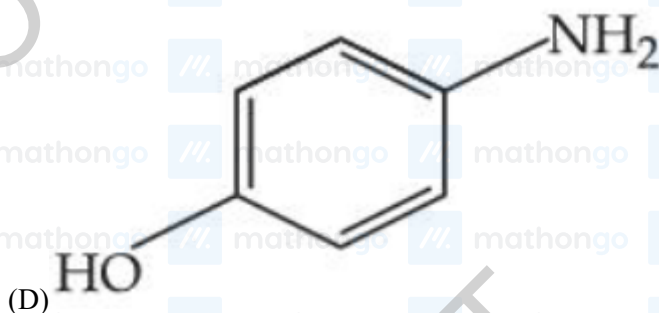
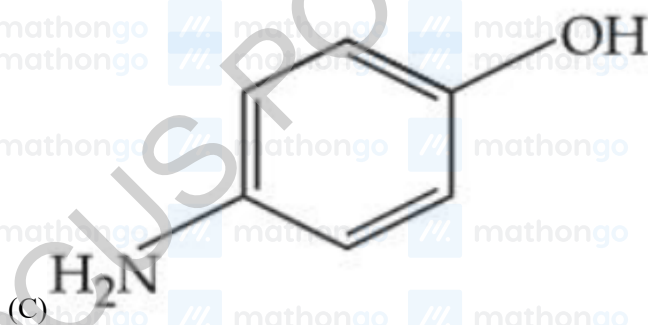
(3) 4

(4) 3

Q16. The possible number of stereoisomers for 5-phenylpent-4-en-2-ol is

Q17. The steam volatile compounds among the following are :





Choose the correct answer from the options given below :

(1) (B) and (D) Only

(2) (A) and (C) Only

(3) (A), (B) and (C) Only

(4) (A) and (B) Only

Q18. Given below are two statements :

Statement (I) : Nitrogen, sulphur, halogen and phosphorus present in an organic compound are detected by Lassaigne's Test.

Statement (II) : The elements present in the compound are converted from covalent form into ionic form by fusing the compound with Magnesium in Lassaigne's test.

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

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II are false

(4) Statement I is true but Statement II is false

Q19. Given below are two statements:

Statement I: In Lassaigne's test, the covalent organic molecules are transformed into ionic compounds.

Statement II: The sodium fusion extract of an organic compound having N and S gives prussian blue colour with FeSO_4 and $\text{Na}_4[\text{Fe}(\text{CN})_6]$

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

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

Q20. In Carius method for estimation of halogens, 180 mg of an organic compound produced 143.5 mg of AgCl. The percentage composition of chlorine in the compound is _____ %.
(Given : molar mass in g mol^{-1} of Ag : 108, Cl : 35.5)

Q21. During " S " estimation, 160 mg of an organic compound gives 466 mg of barium sulphate. The percentage of Sulphur in the given compound is _____ %.
(Given molar mass in g mol^{-1} of Ba : 137, S : 32, O : 16)

Q22. In Carius method of estimation of halogen, 0.25 g of an organic compound gave 0.15 g of silver bromide (AgBr). The percentage of Bromine in the organic compound is $\dots \times 10^{-1}\%$ (Nearest integer).
(Given : Molar mass of Ag is 108 and Br is 80 g mol^{-1})

Q23. In the sulphur estimation, 0.20 g of a pure organic compound gave 0.40 g of barium sulphate. The percentage of sulphur in the compound is _____ $\times 10^{-1}\%$.
(Molar mass : O = 16, S = 32, Ba = 137 in g mol^{-1})

Q1. The alkane from below having two secondary hydrogens is :

- (1) 4 - Ethyl-3,4-dimethyloctane
- (2) 2,2,4,4-Tetramethylhexane
- (3) 2, 2, 3, 3-Tetramethylpentane
- (4) 2, 2, 4, 5-Tetramethylheptane

Q2. Match the LIST-I with LIST-II

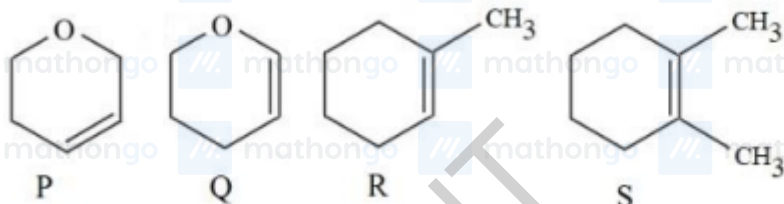
LIST-I Name reaction		LIST-II Product obtainable	
A.	Swarts reaction	I.	Ethyl benzene
B.	Sandmeyer's reaction	II.	Ethyl iodide
C.	Wurtz Fittig reaction	III.	Cyanobenzene
D.	Finkelstein reaction	IV.	Ethyl fluoride

Choose the correct answer from the options given below:

- (1) A-II, B-I, C-III, D-IV
- (2) A-II, B-III, C-I, D-IV
- (3) A-IV, B-I, C-III, D-II
- (4) A-IV, B-III, C-I, D-II

Q3. Following are the four molecules "P", "Q", "R" and "S".

Which one among the four molecules will react with $\text{H} - \text{Br}_{(\text{aq})}$ at the fastest rate?



- (1) R
- (2) P
- (3) Q
- (4) S

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Q4. Given below are two statements :

Statement (I) : On nitration of m-xylene with HNO_3 , H_2SO_4 followed by oxidation, 4-nitrobenzene-1,3-dicarboxylic acid is obtained as the major product.

Statement (II) : $-\text{CH}_3$ group is o/p-directing while $-\text{NO}_2$ group is m-directing group.

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

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

Q5. Given below are two statements :

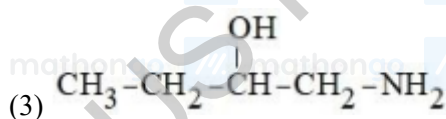
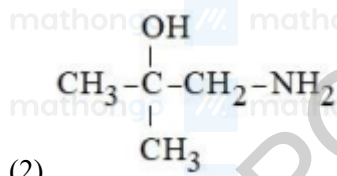
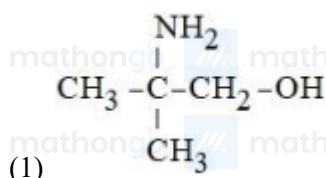
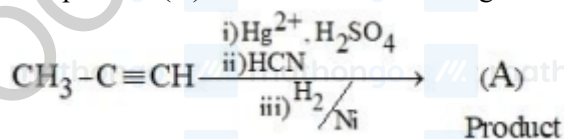
Statement I : One mole of propyne reacts with excess of sodium to liberate half a mole of H_2 gas.

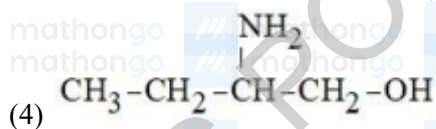
Statement II : Four g of propyne reacts with NaNH_2 to liberate NH_3 gas which occupies 224 mL at STP.

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

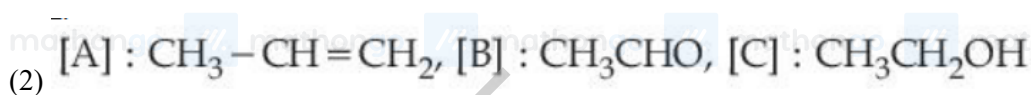
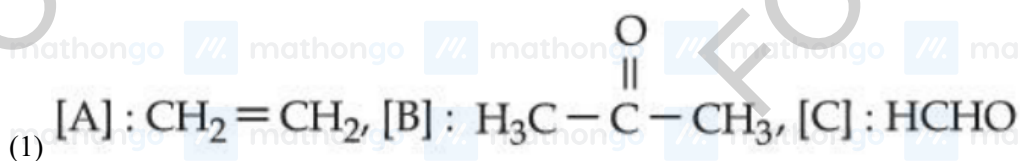
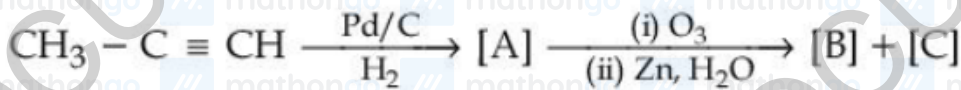
- (1) Statement I is incorrect but Statement II is correct
- (2) Both Statement I and Statement II are correct
- (3) Statement I is correct but Statement II is incorrect
- (4) Both Statement I and Statement II are incorrect

Q6. The product (A) formed in the following reaction sequence is

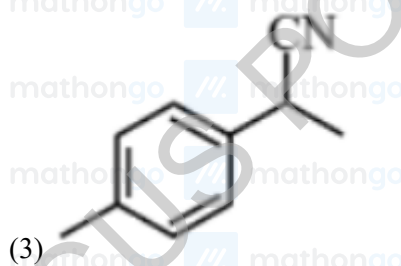
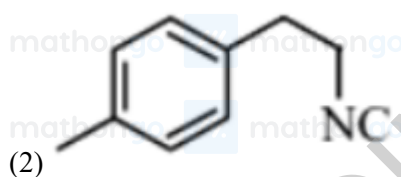
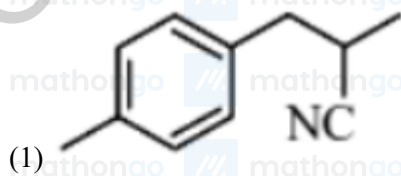
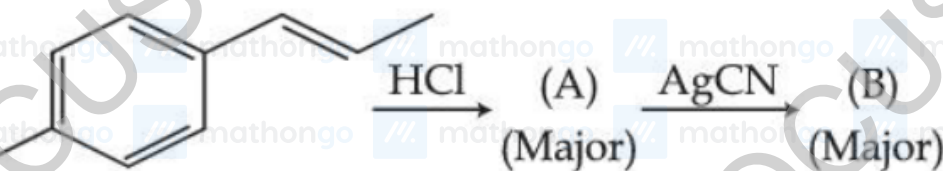


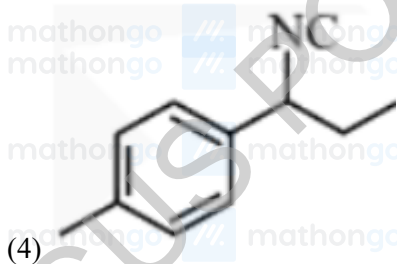


Q7. Identify product [A], [B] and [C] in the following reaction sequence.

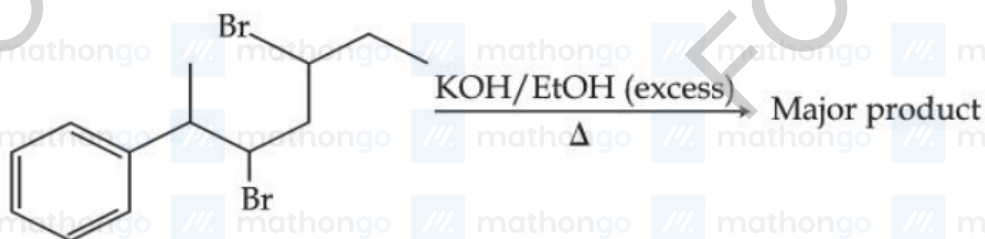


Q8. The product B formed in the following reaction sequence is :



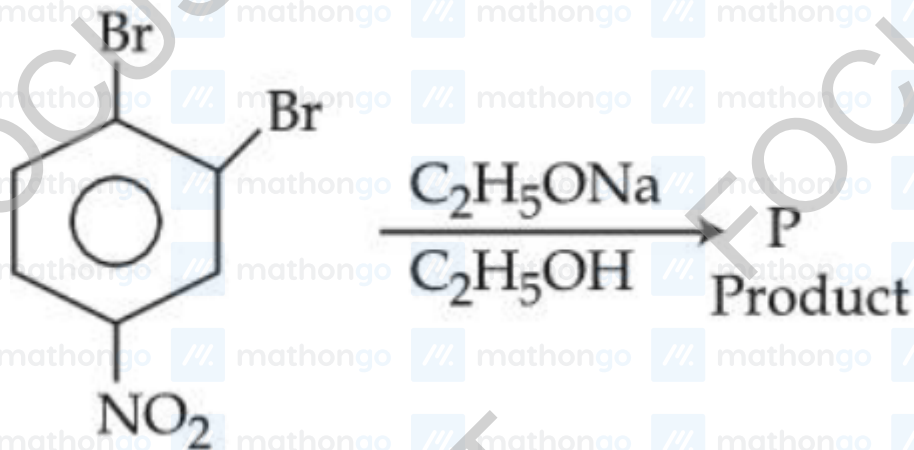


Q9. The major product of the following reaction is :

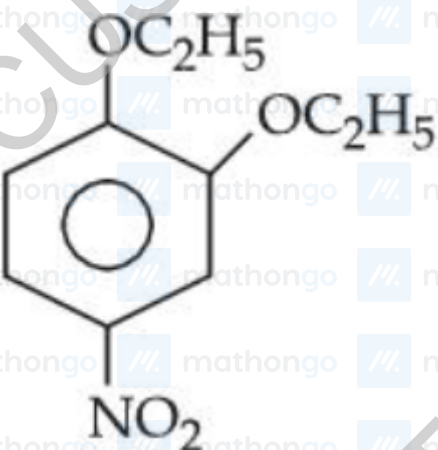
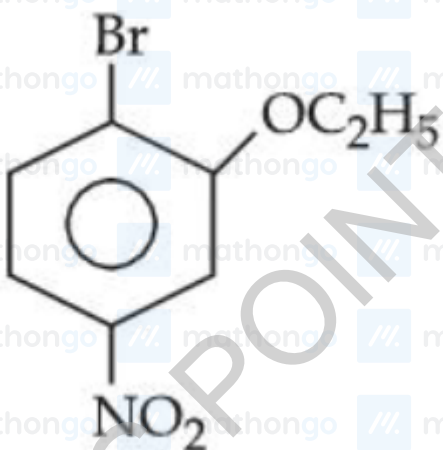
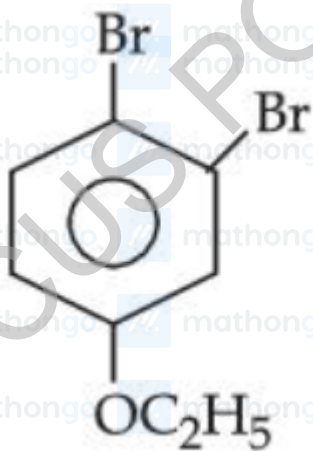


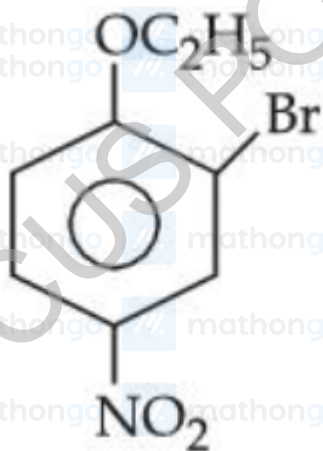
- (1) 2-Phenylhepta-2,5-diene
- (2) 6-Phenylhepta-2,4-diene
- (3) 6-Phenylhepta-3,5-diene
- (4) 2-Phenylhepta-2,4-diene

Q10. In the following substitution reaction:



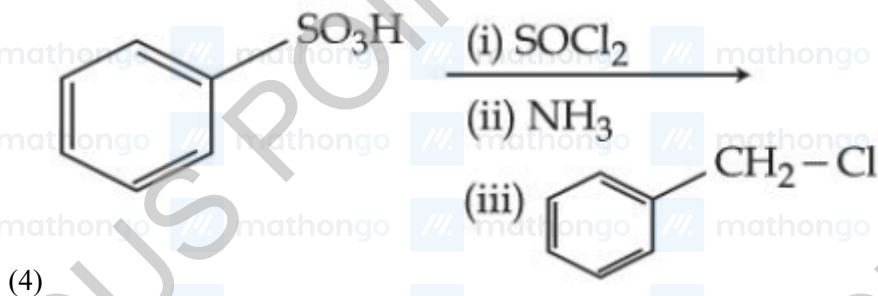
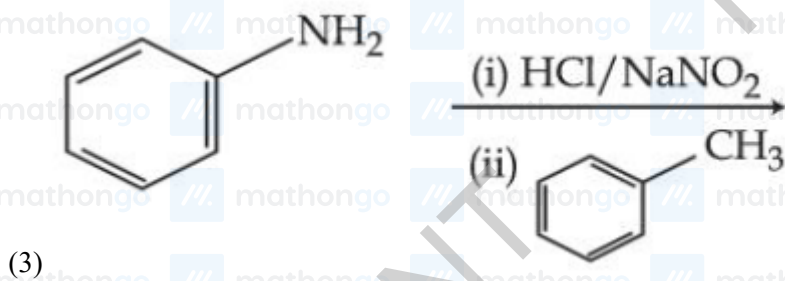
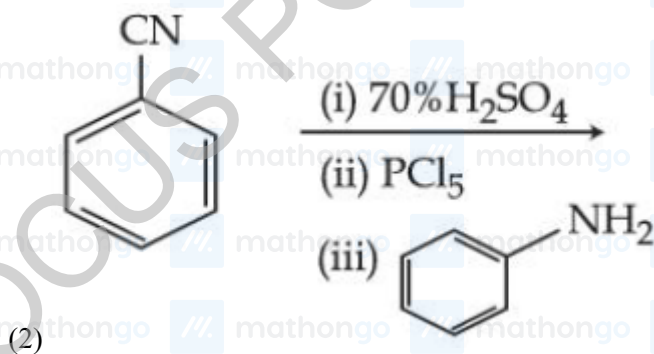
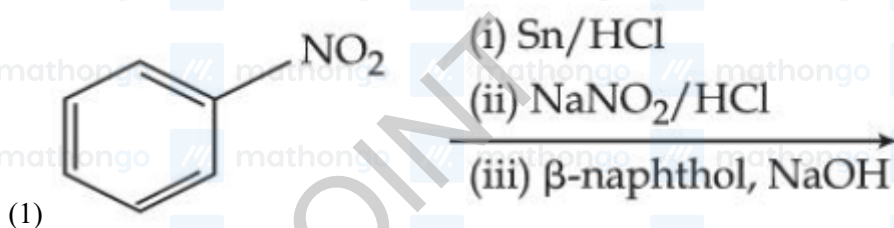
product 'P' formed is :



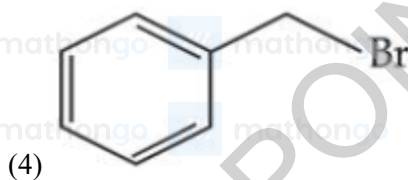
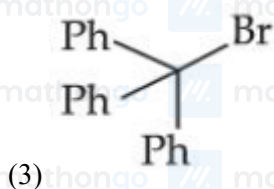
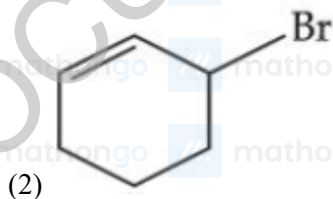


(4)

Q11. Which one of the following reaction sequences will give an azo dye?



Q12. Which among the following halides will generate the most stable carbocation in the nucleophilic substitution reaction?



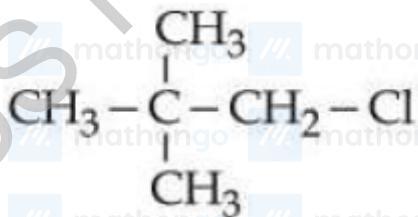
Q13. Isomeric hydrocarbons \rightarrow negative Baeyer's test

(Molecular formula C_9H_{12})

The total number of isomers from above with four different non-aliphatic substitution sites is -

Q1. Given below are two statements :

Statement I : $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{Cl}$ will undergo $\text{S}_{\text{N}}1$ reaction though it is a primary halide.



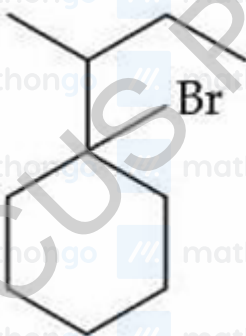
Statement II :

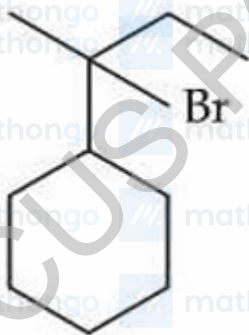
will not undergo $\text{S}_{\text{N}}2$ reaction very easily though it is a primary halide.

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

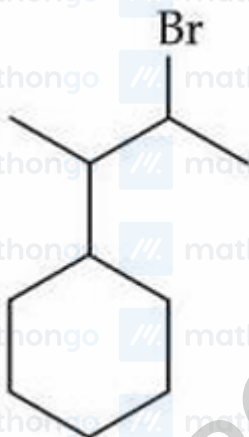
- (1) Both Statement I and Statement II are incorrect
- (2) Both Statement I and Statement II are correct
- (3) Statement I is incorrect but Statement II is correct
- (4) Statement I is correct but Statement II is incorrect

Q2. When sec-butylcyclohexane reacts with bromine in the presence of sunlight, the major product is :





(3)

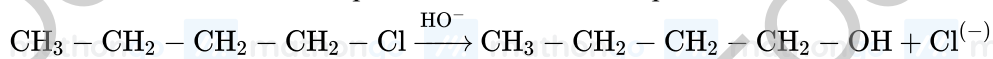


(4)

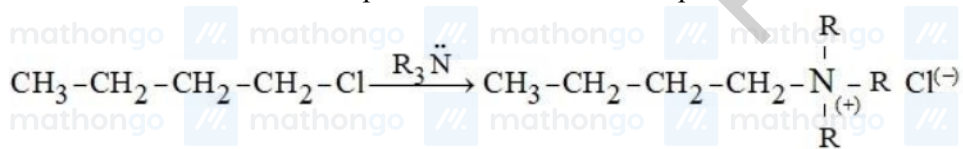
Q3. The compound with molecular formula C_6H_6 , which gives only one monobromo derivative and takes up four moles of hydrogen per mole for complete hydrogenation has _____ π electrons.

Q4. Given below are two statements:

Statement I: The conversion proceeds well in the less polar medium.



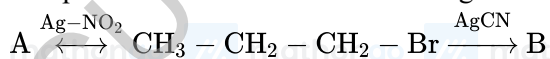
Statement II: The conversion proceeds well in the more polar medium.



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

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

Q5. The products *A* and *B* in the following reactions, respectively are

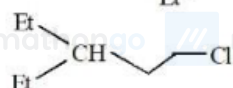


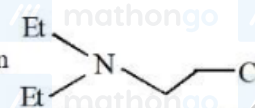
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- (1) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{NO}_2$, $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CN}$
 (2) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{ONO}$, $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{NC}$
 (3) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{ONO}$, $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CN}$
 (4) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{NO}_2$, $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{NC}$

Q6. Given below are two statements:

Statement I:  will undergo alkaline hydrolysis at a faster rate than

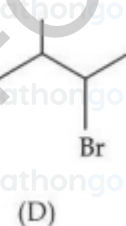
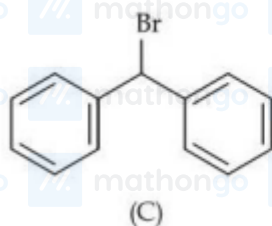
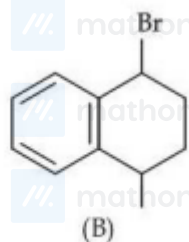


Statement II: In , intramolecular substitution takes place first by involving lone pair of electrons on nitrogen.

In the light of the above statements, choose the most appropriate answer from the options given below

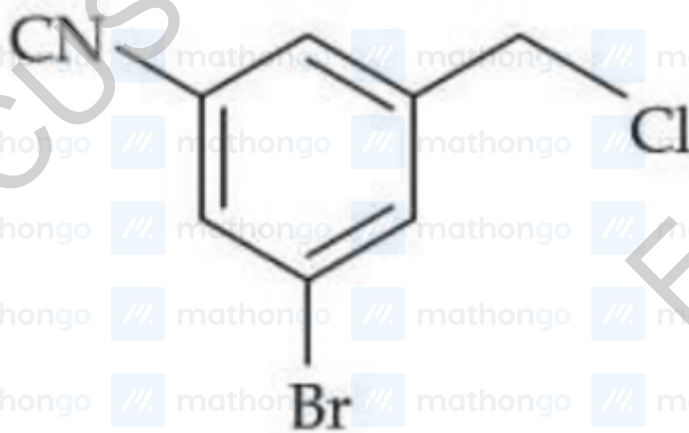
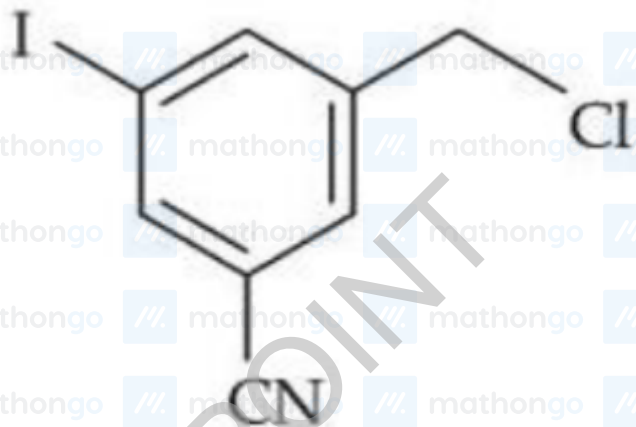
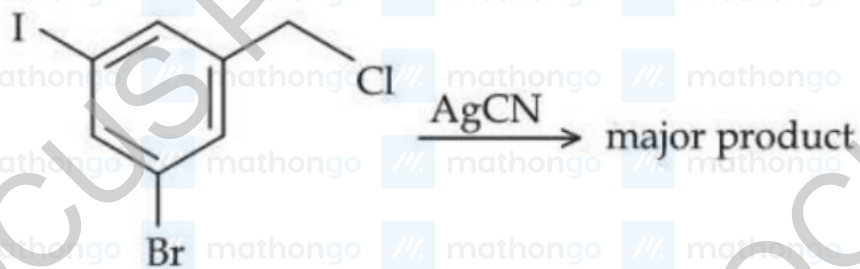
- (1) Statement I is incorrect but Statement II is correct
 (2) Statement I is correct but Statement II is incorrect
 (3) Both Statement I and Statement II are correct
 (4) Both Statement I and Statement II are incorrect

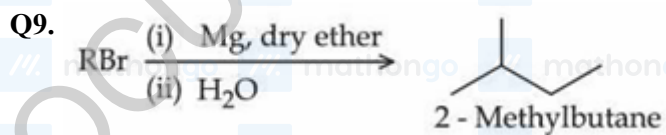
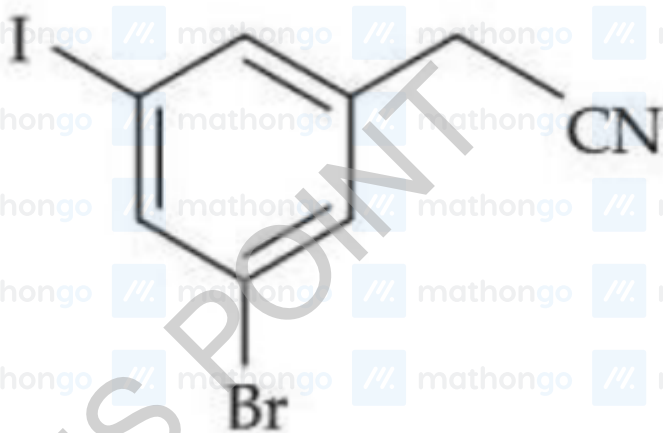
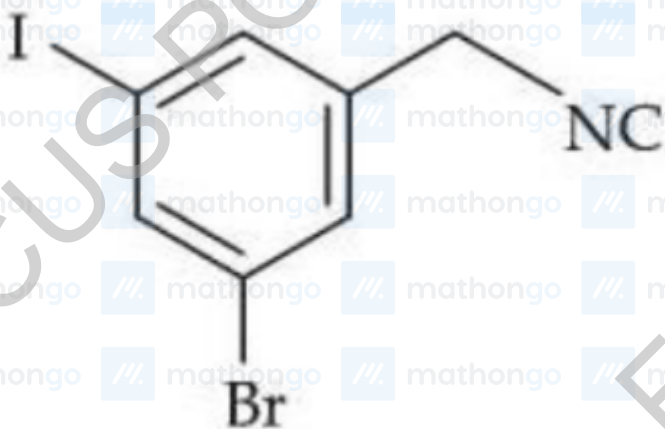
Q7. The ascending order of relative rate of solvolysis of following compounds is :



- (1) (C) < (B) < (A) < (D)
 (2) (D) < (A) < (B) < (C)
 (3) (D) < (B) < (A) < (C)
 (4) (C) < (D) < (B) < (A)

Q8. The structure of the major product formed in the following reaction is :

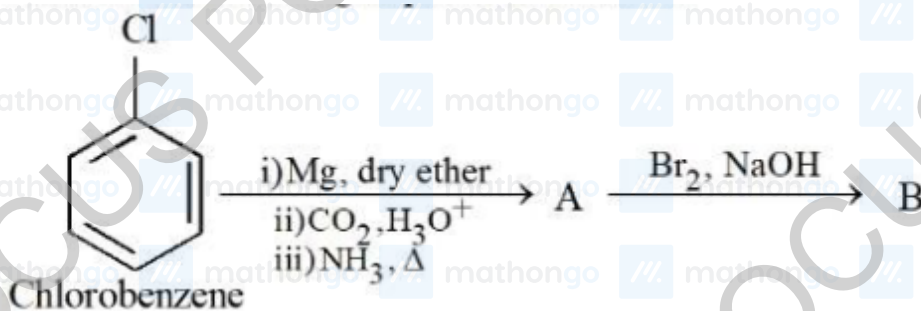




The maximum number of RBr producing 2-methylbutane by above sequence of reactions is _____ - (Consider the structural isomers only)

- (1) 5
 (2) 4
 (3) 3
 (4) 1

Q10. Consider the following sequence of reactions:



11.25 mg of chlorobenzene will produce $\underline{\hspace{2cm}}$ $\times 10^{-1}$ mg of product B.

(Consider the reactions result in complete conversion.)

[Given molar mass of C, H, O, N and Cl as 12, 1, 16, 14 and 35.5 g mol^{-1} respectively]

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Q1. What amount of bromine will be required to convert 2 g of phenol into 2,4,6-tribromophenol? (Given molar mass in gmol^{-1} of C, H, O, Br are 12, 1, 16, 80 respectively)

- (1) 20.44 g
- (2) 4.0 g
- (3) 6.0 g
- (4) 10.22

Q2. Given below are two statements :

Statement (I) : The boiling points of alcohols and phenols increase with increase in the number of C-atoms.


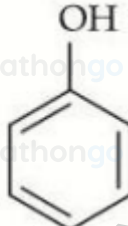
Statement (II) : The boiling points of alcohols and phenols are higher in comparison to other class of compounds such as ethers, haloalkanes.

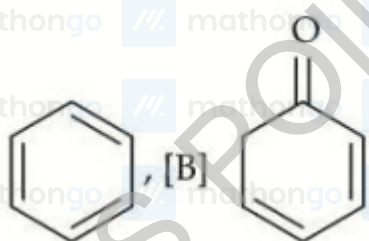
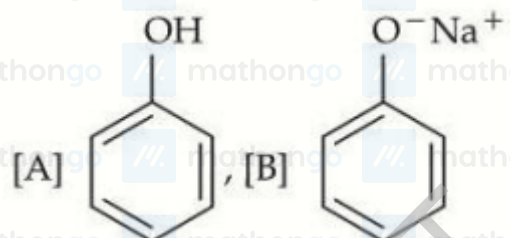
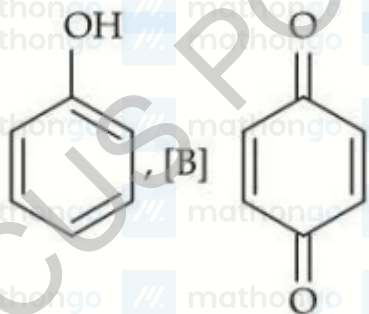
In the light of the above statements, choose the correct answer from the options given below :

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

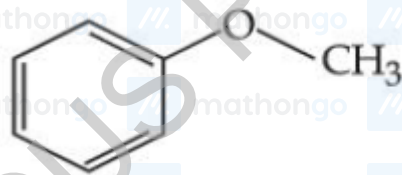
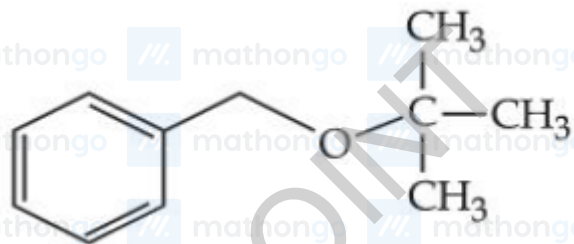
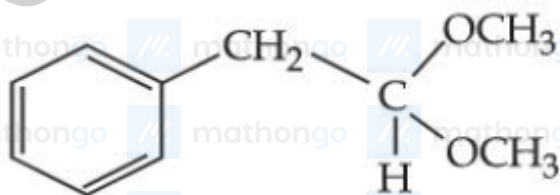
Q3. Identify the products [A] and [B], respectively in the following reaction :

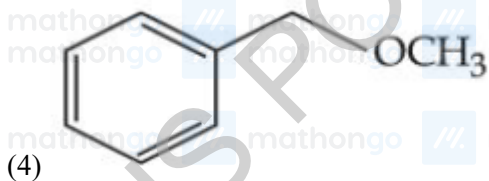


- (1)  , [B] 



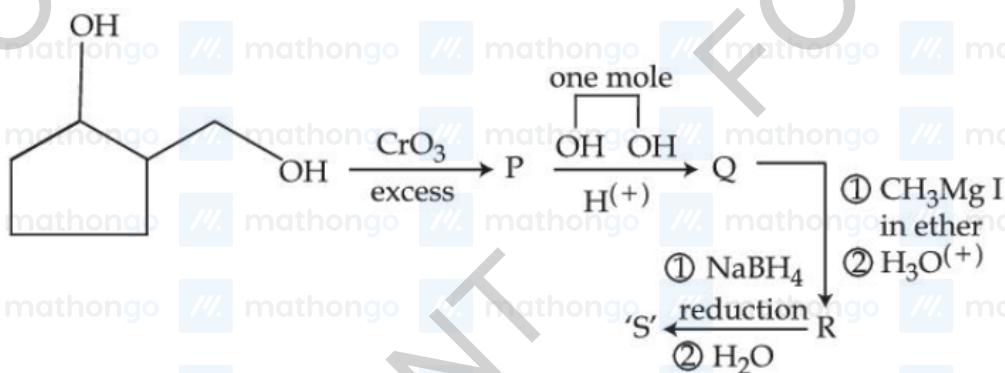
Q4. Which one of the following, with HBr will give a phenol?





Q5. In the Claisen-Schmidt reaction to prepare, dibenzalacetone from 5.3 g of benzaldehyde, a total of 3.51 g of product was obtained. The percentage yield in this reaction was _____ %.

Q6.



0.1 mole of compound 'S' will weigh _____ g. (Given molar mass in gmol^{-1} C : 12, H : 1, O : 16)

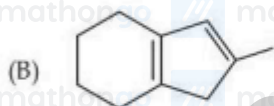
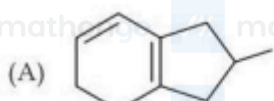
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Q1. Which of the following arrangements with respect to their reactivity in nucleophilic addition reaction is correct?

- (1) acetophenone < benzaldehyde < p-tolualdehyde < p-nitrobenzaldehyde
- (2) benzaldehyde < acetophenone < p-nitrobenzaldehyde < p-tolualdehyde
- (3) p-nitrobenzaldehyde < benzaldehyde < p-tolualdehyde < acetophenone
- (4) acetophenone < p-tolualdehyde < benzaldehyde < p-nitrobenzaldehyde

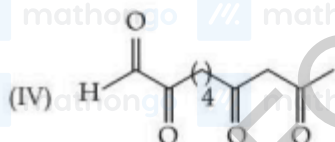
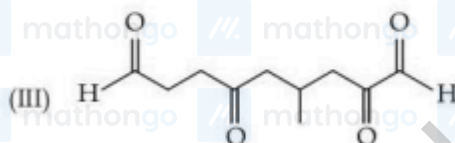
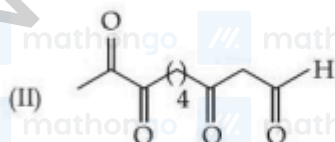
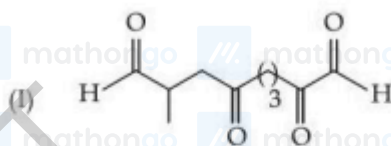
Q2. Match List - I with List - II.

List - I

(Isomers of $C_{10}H_{14}$)

List - II

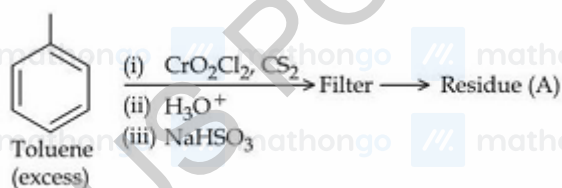
(Ozonolysis product)



Choose the correct answer from the options given below :

- (1) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)
- (2) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
- (3) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
- (4) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Q3.



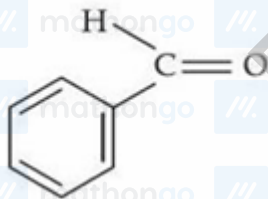
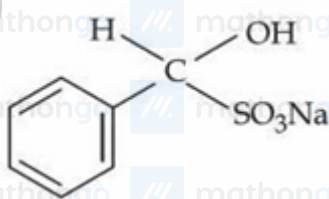
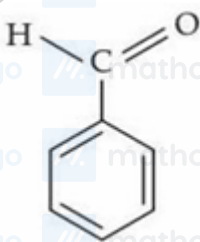
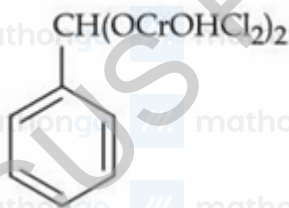
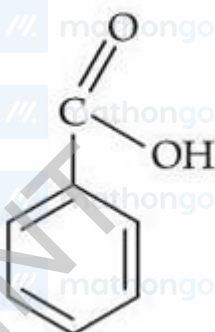
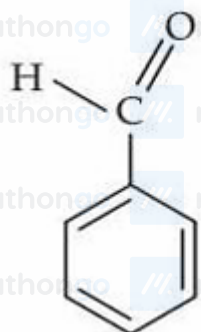
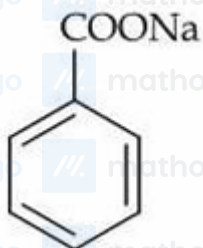
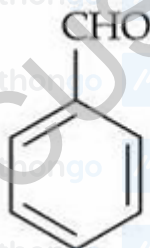
Residue (A) + HCl (dil) → Compound (B)

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Structure of residue (A) and compound (B) formed respectively is :

[A]

[B]

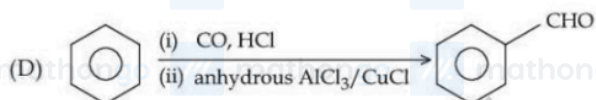
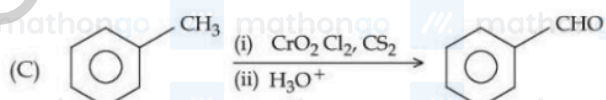
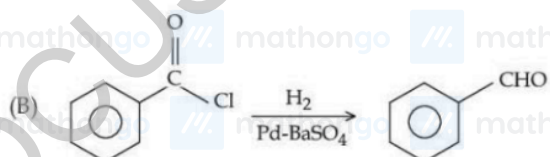
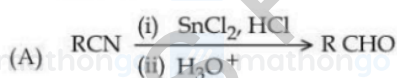


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Q4. Match List - I with List - II.

List - I

List - II



(I) Etard reaction

(II) Gatterman-Koch reaction

(III) Rosenmund reduction

(IV) Stephen reaction

Choose the correct answer from the options given below :

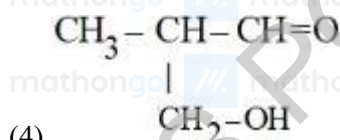
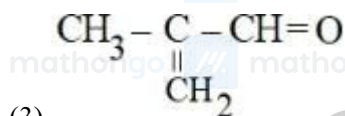
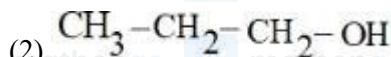
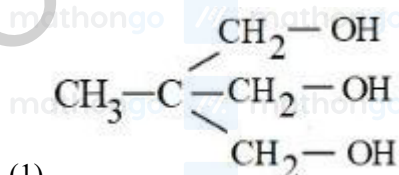
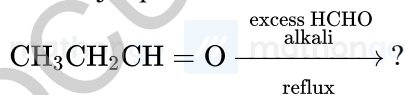
(1) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

(2) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)

(3) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

(4) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

Q5. The major product of the following reaction is:



Q6. Both acetaldehyde and acetone (individually) undergo which of the following reactions?

A. Iodoform Reaction

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B. Cannizaro Reaction

C. Aldol Condensation

D. Tollen's Test

E. Clemmensen Reduction

Choose the correct answer from the options given below:

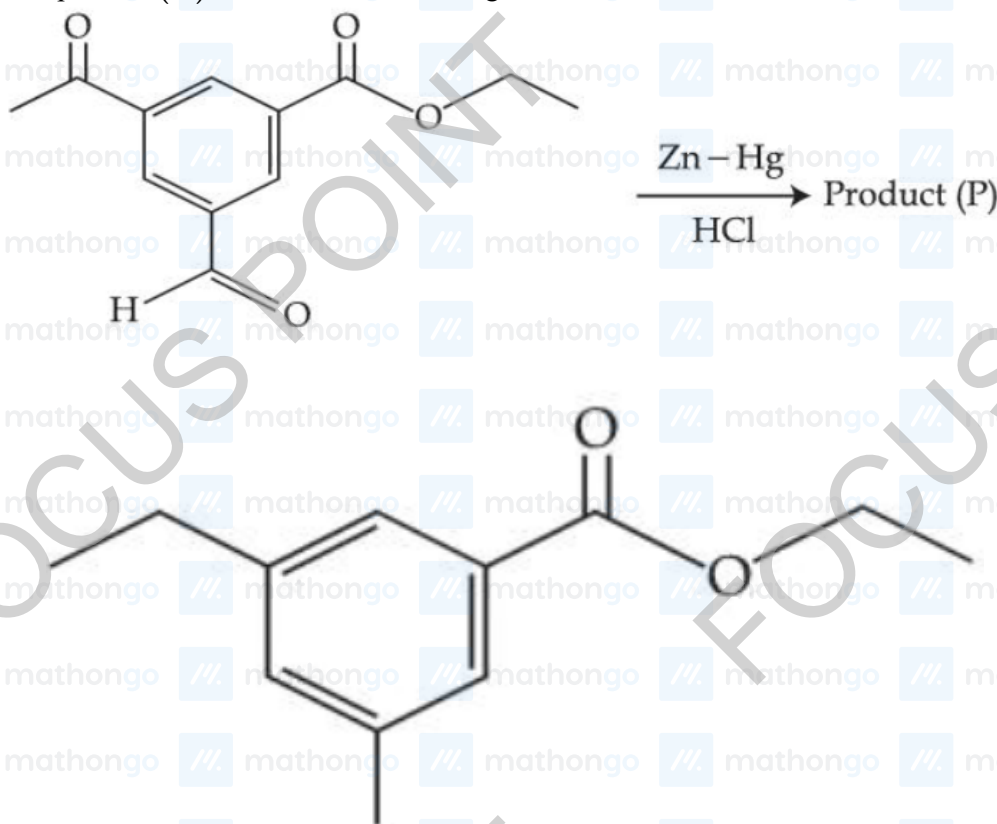
(1) A, B and D Only

(2) C and E Only

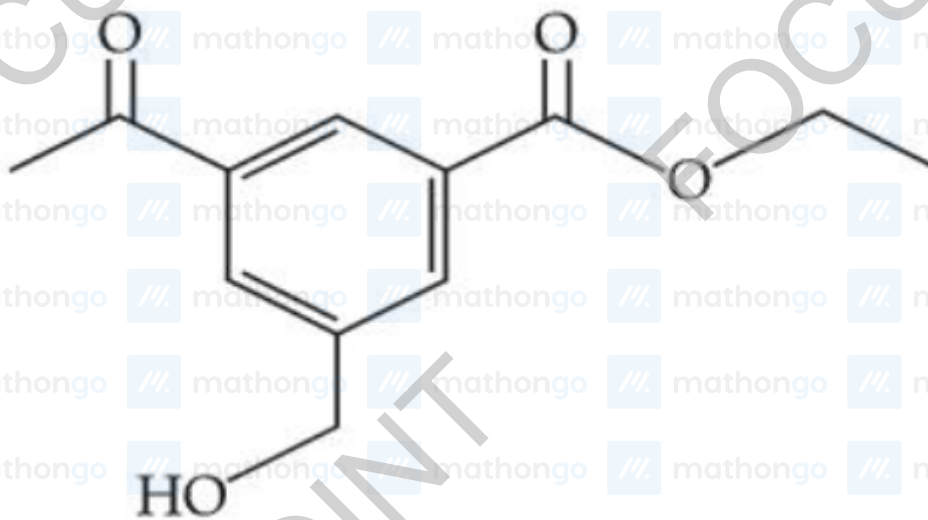
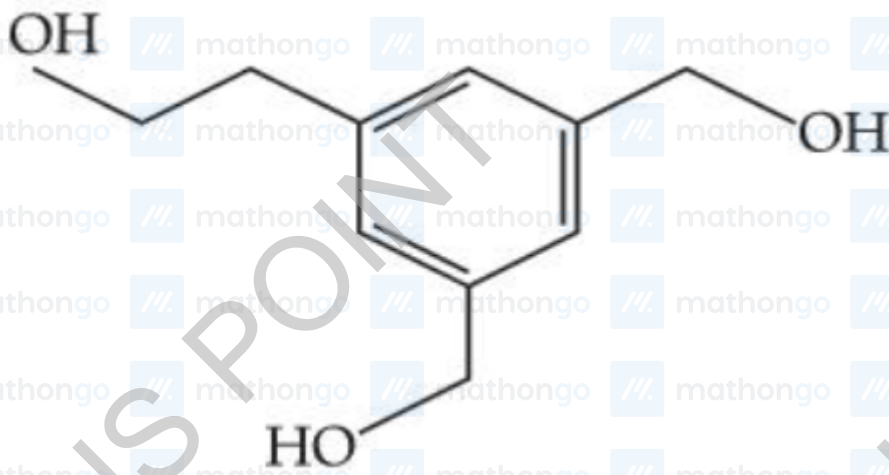
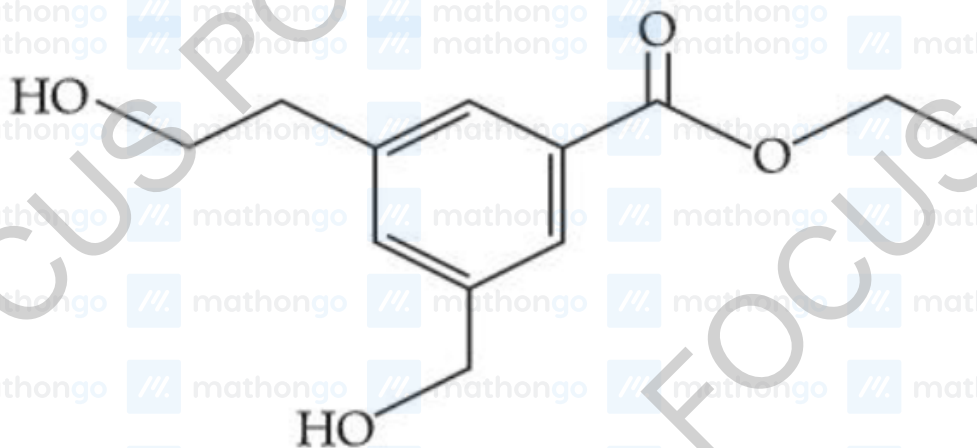
(3) A, C and E Only

(4) B, C and D Only

Q7. The product (P) formed in the following reaction is :

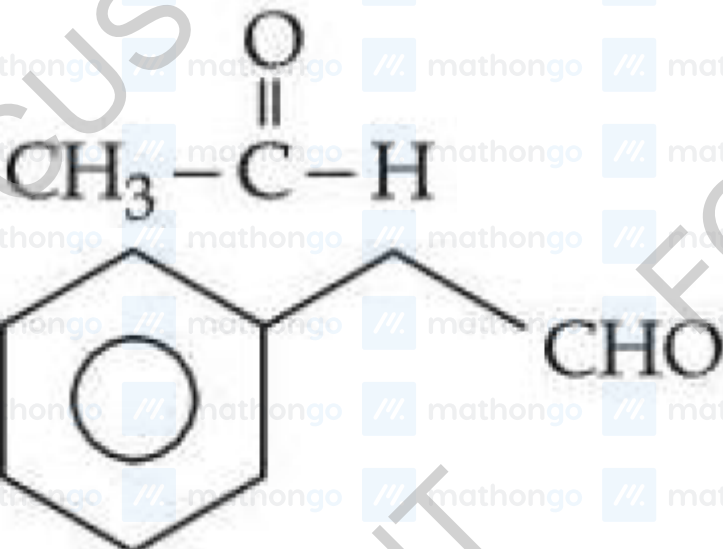
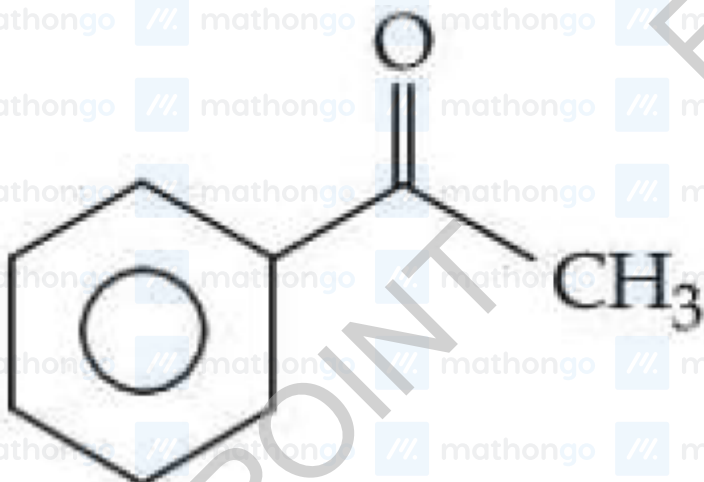
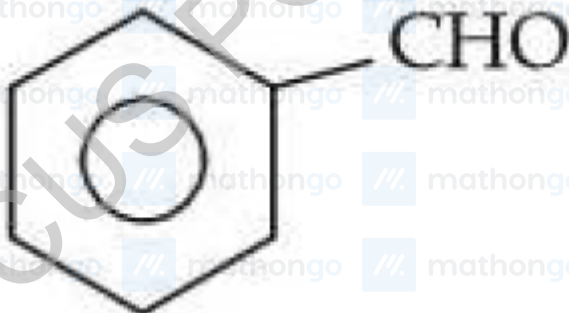


(1)



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Q8. The compounds which give positive Fehling's test are :



(E)

Choose the correct answer from the options given below :

(1) (A), (D) and (E) Only

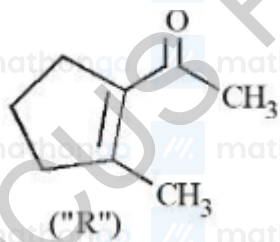
(2) (C), (D) and (E) Only

(3) (A), (C) and (D) Only

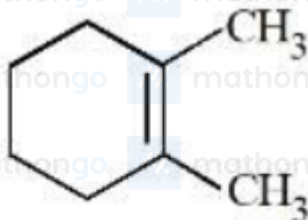
(4) (A), (B) and (C) Only

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Q9. A molecule ("P") on treatment with acid undergoes rearrangement and gives ("Q"). ("Q") on ozonolysis followed by reflux under alkaline condition gives ("R"). The structure of ("R") is given below.



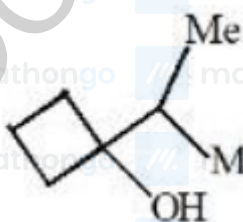
The structure of ("P") is



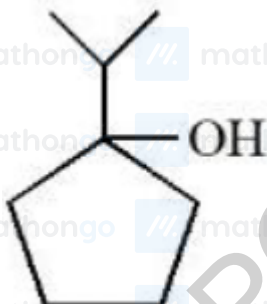
(1)



(2)



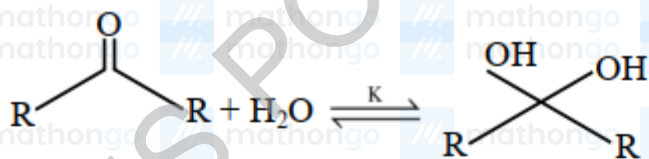
(3)



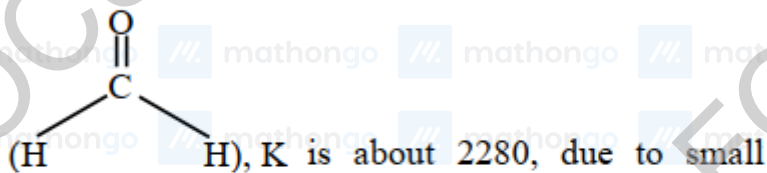
(4)

Q10. Given below are two statements :

Consider the following reaction

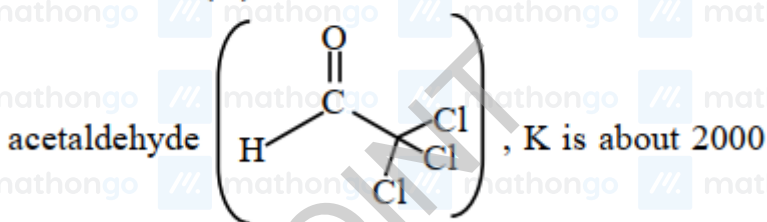


Statement (I) : In the case of formaldehyde



substituents, hydration is faster.

Statement (II) : In the case of trichloro

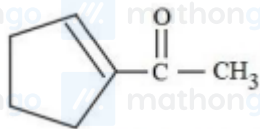


due to $-I$ effect of $-\text{Cl}$.

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

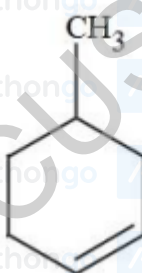
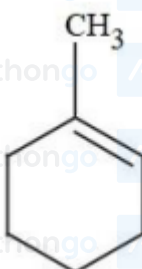
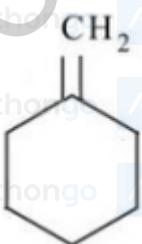
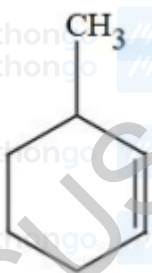
- (1) Both Statement I and Statement II are false
- (2) Statement I is true but Statement II is false
- (3) Statement I is false but Statement II is true
- (4) Both Statement I and Statement II are true

Q11.

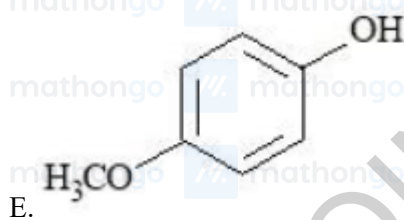
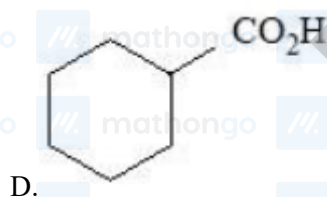
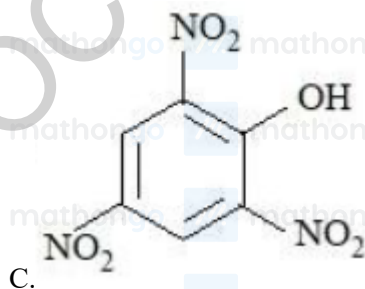
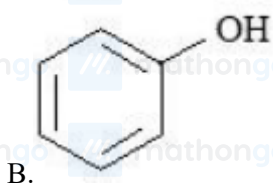
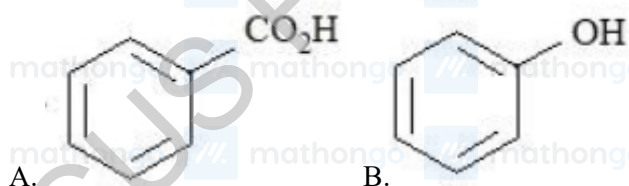


Aman has been asked to synthesise the molecule

(x). He thought of preparing the molecule using an aldol condensation reaction. He found a few cyclic alkenes in his laboratory. He thought of performing ozonolysis reaction on alkene to produce a dicarbonyl compound followed by aldol reaction to prepare "x". Predict the suitable alkene that can lead to the formation of "x".



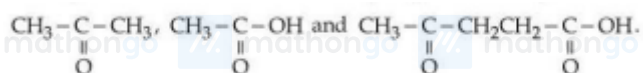
Q1. The compounds that produce CO_2 with aqueous NaHCO_3 solution are:



Choose the correct answer from the options given below:

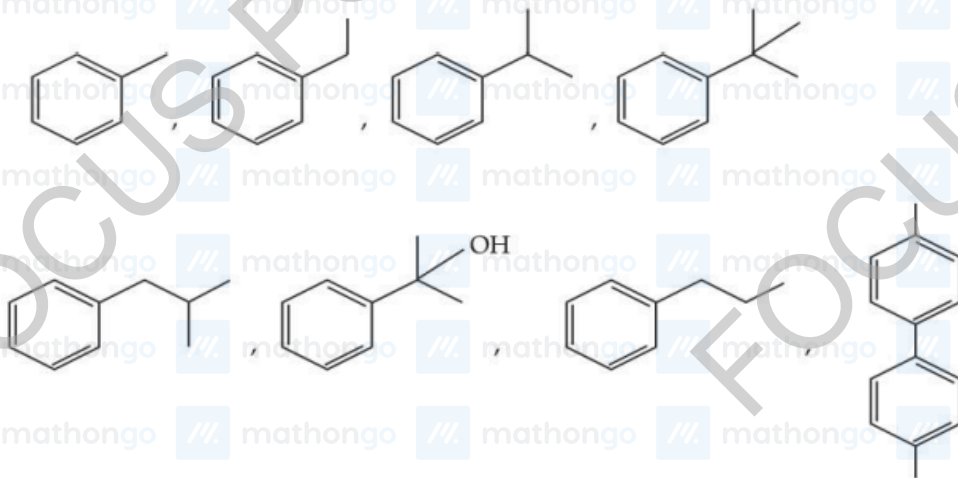
- (1) A, C and D Only
- (2) A, B and E Only
- (3) A and C Only
- (4) A and B Only

Q2. A compound 'X' absorbs 2 moles of hydrogen and 'X' upon oxidation with $\text{KMnO}_4 \mid \text{H}^+$ gives



The total number of σ bonds present in the compound 'X' is _____

Q3. The total number of compounds from below when treated with hot KMnO_4 giving benzoic acid is :



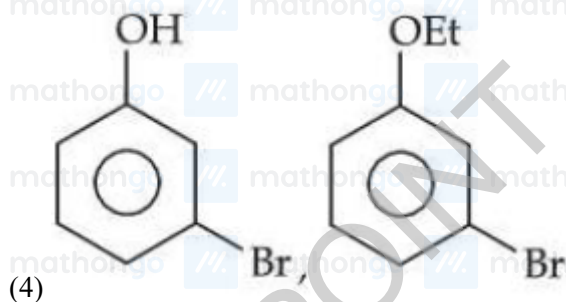
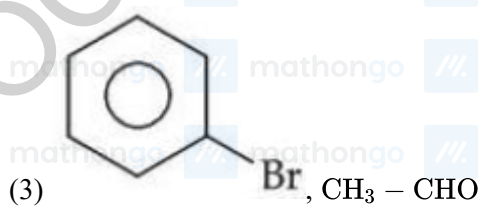
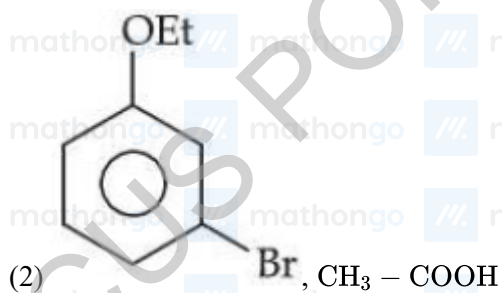
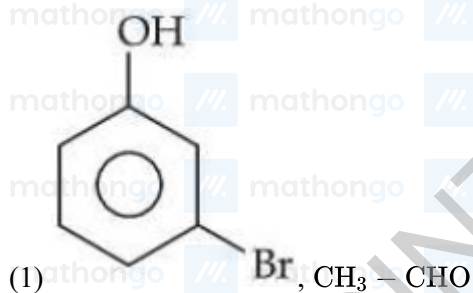
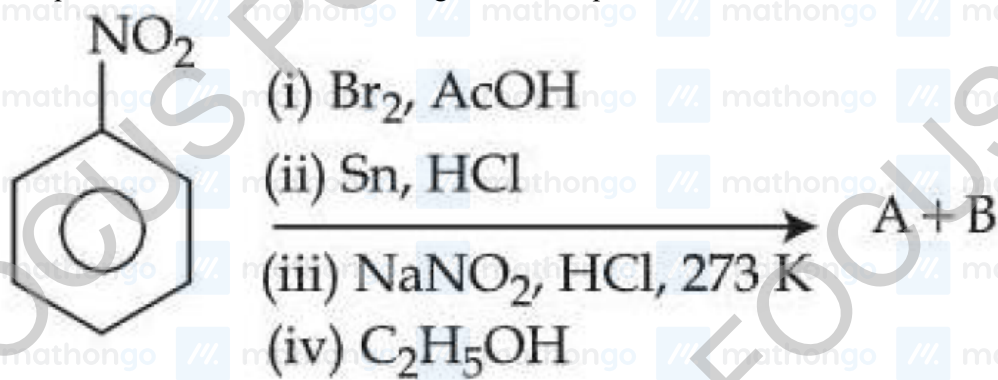
(1) 6

(2) 3

(3) 5

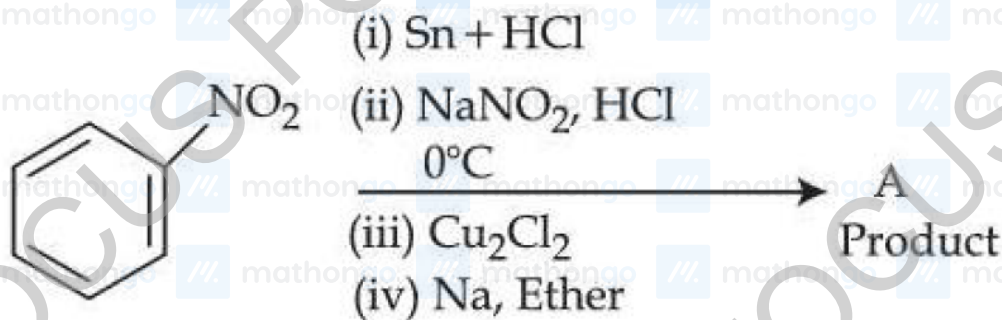
(4) 4

Q1. The products formed in the following reaction sequence are :

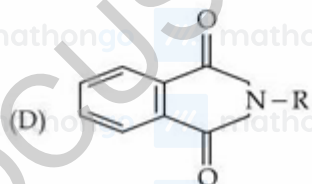
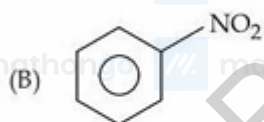
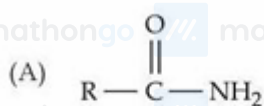


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Q2. Consider the following sequence of reactions :

Molar mass of the product formed (A) is _____ gmol⁻¹.

Q3. Match the Compounds (List - I) with the appropriate Catalyst/Reagents (List - II) for their reduction into corresponding amines.

List - I
(Compounds)List - II
(Catalyst/Reagents)

Choose the correct answer from the options given below :

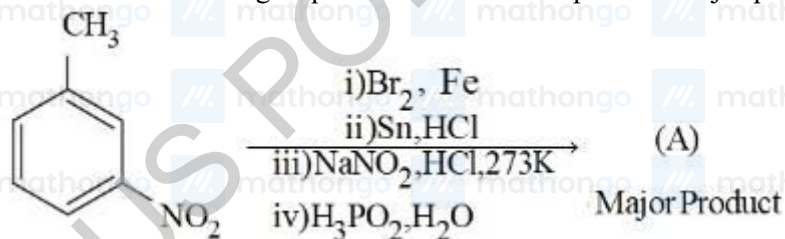
(1) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

(2) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

(3) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

(4) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

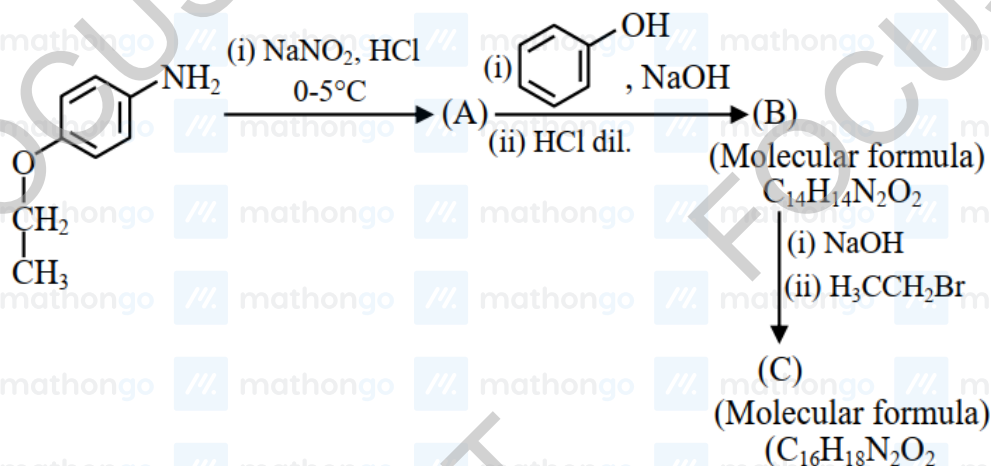
Q4. Consider the following sequence of reactions to produce major product (A)



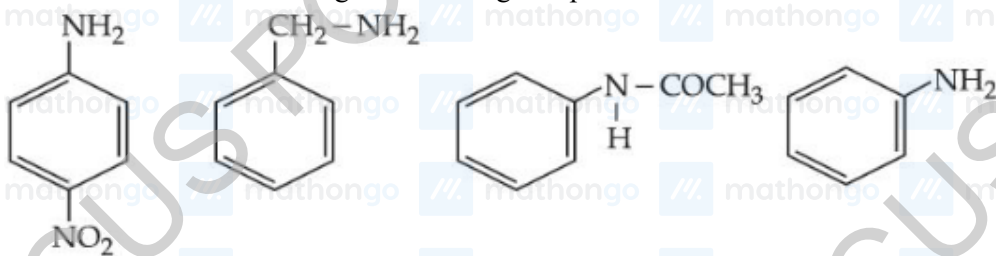
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Molar mass of product (A) is _____ g mol^{-1} .(Given molar mass in g mol^{-1} of C : 12, H : 1, O : 16, Br : 80, N : 14, P : 31)

Q5. Consider the following sequence of reactions.

Total number of sp^3 hybridised carbon atoms in the major product C formed is _____

Q6. Given below are some nitrogen containing compounds

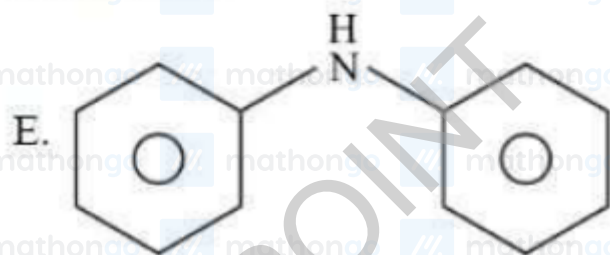
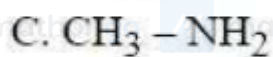
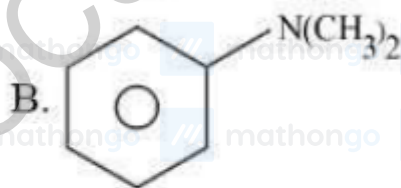


Each of them is treated with HCl separately. 1.0 g of the most basic compound will consume _____ mg of HCl.

(Given molar mass in g mol^{-1} C : 12, H : 1, O : 16, Cl : 35.5)

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Q7. Which among the following react with Hinsberg's reagent?



Choose the correct answer from the options given below:

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

Q8. Identify correct statements :

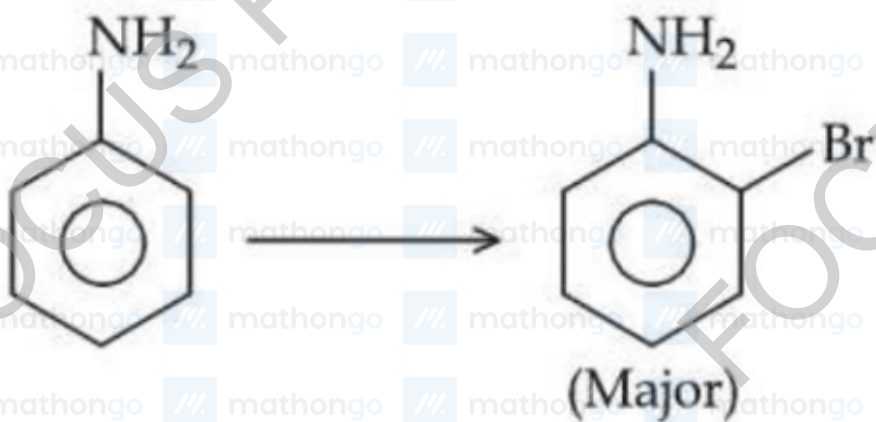
- (A) Primary amines do not give diazonium salts when treated with NaNO_2 in acidic condition.
- (B) Aliphatic and aromatic primary amines on heating with CHCl_3 and ethanolic KOH form carbylamines.
- (C) Secondary and tertiary amines also give carbylamine test.
- (D) Benzenesulfonyl chloride is known as Hinsberg's reagent.
- (E) Tertiary amines reacts with benzenesulfonyl chloride very easily.

Choose the correct answer from the options given below :

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

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Q9. For reaction



The correct order of set of reagents for the above conversion is :

(1) $\text{Br}_2 \mid \text{FeBr}_3, \text{H}_2\text{O}(\Delta), \text{NaOH}$

(2) $\text{H}_2\text{SO}_4, \text{Ac}_2\text{O}, \text{Br}_2, \text{H}_2\text{O}(\Delta), \text{NaOH}$

(3) $\text{Ac}_2\text{O}, \text{Br}_2, \text{H}_2\text{O}(\Delta), \text{NaOH}$

(4) $\text{Ac}_2\text{O}, \text{H}_2\text{SO}_4, \text{Br}_2, \text{NaOH}$

Q1. Identify the essential amino acids from below :

- (A) Valine
- (B) Proline
- (C) Lysine
- (D) Threonine
- (E) Tyrosine

Choose the correct answer from the options given below :

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

Q2. The α -Helix and β - Pleated sheet structures of protein are associated with its :

- (1) tertiary structure
- (2) quaternary structure
- (3) secondary structure
- (4) primary structure

Q3. Which of the following acids is a vitamin?

- (1) Adipic acid
- (2) Ascorbic acid
- (3) Saccharic acid
- (4) Aspartic acid

Q4. Given below are two statements:

Statement I: Fructose does not contain an aldehydic group but still reduces Tollen's reagent

Statement II: In the presence of base, fructose undergoes rearrangement to give glucose.

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

- (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 true but Statement II is false

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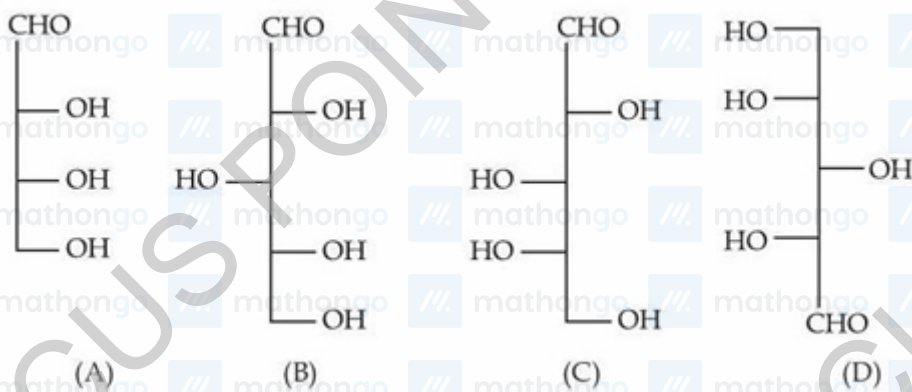
Q5. The carbohydrate "Ribose" present in DNA, is

- A. A pentose sugar
- B. present in pyranose form
- C. in "D" configuration
- D. a reducing sugar, when free
- E. in α -anomeric form

Choose the correct answer from the options given below:

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

Q6. Identify the number of structure/s from the following which can be correlated to D-glyceraldehyde.



- (1) four
- (2) one
- (3) two
- (4) three

Q7. Given below are two statements:

Statement I : D-glucose pentaacetate reacts with 2, 4-dinitrophenylhydrazine

Statement II : Starch, on heating with concentrated sulfuric acid at 100°C and 2-3 atmosphere pressure produces glucose.

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

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

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(4) Statement I is true but Statement II is false

Q8. Match List - I with List - II.

List - I

(Saccharides)

- (A) Sucrose
(B) Maltose
(C) Lactose
(D) Amylopectin

List - II

(Glycosidic-linkages found)

- (I) α 1-4
(II) α 1-4 and α 1-6
(III) α 1- β 2
(IV) β 1-4

Choose the correct answer from the options given below :

- (1) (A)-(IV), (B)-(II), (C)-(I), (D)-(III)
(2) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(3) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
(4) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

Q9. Match List - I with List - II.

List - I

(Carbohydrate)

- (A) Amylose
(B) Cellulose
(C) Glycogen
(D) Amylopectin

List - II

(Linkage Source)

- (I) β - C₁ - C₄, plant
(II) α - C₁ - C₄, animal
(III) α - C₁ - C₄,
 α - C₁ - C₆, plant
(IV) α - C₁ - C₄, plant

Choose the correct answer from the options given below :

- (1) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)
(2) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
(3) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
(4) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

Q10. Identify correct conversion during acidic hydrolysis from the following :

- (A) starch gives galactose.
(B) cane sugar gives equal amount of glucose and fructose.
(C) milk sugar gives glucose and galactose.
(D) amylopectin gives glucose and fructose.
(E) amylose gives only glucose.

Choose the correct answer from the options given below :

(1) (A), (B) and (C) only

(2) (B), (C) and (E) only

(3) (C), (D) and (E) only

(4) (B), (C) and (D) only

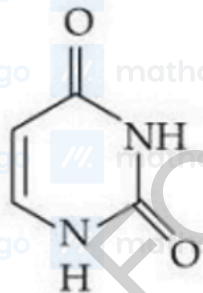
Q11. Match List - I with List - II.

List - I

List - II

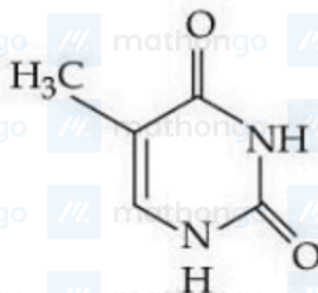
(A) Adenine

(I)



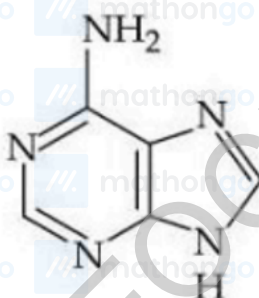
(B) Cytosine

(II)



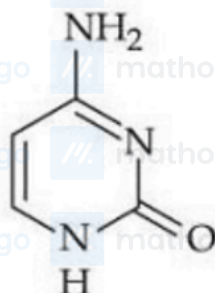
(C) Thymine

(III)



(D) Uracil

(IV)



Choose the correct answer from the options given below :

(1) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

(2) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

(3) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

(4) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

Some Basic Concepts of Chemistry

1. (57) 2. (3) 3. (4) 4. (3) 5. (100) 6. (153) 7. (61) 8. (2)
9. (125) 10. (2) 11. (420) 12. (1655) 13. (2)

Structure of Atom

1. (2) 2. (4) 3. (3) 4. (4) 5. (1) 6. (3) 7. (1) 8. (3)
9. (3) 10. (1) 11. (2) 12. (3)

States of Matter

1. (4)

Thermodynamics (C)

1. (3) 2. (700) 3. (1) 4. (4) 5. (2) 6. (1) 7. (3) 8. (3)
9. (3) 10. (2850) 11. (4) 12. (95) 13. (200) 14. (2) 15. (48) 16. (2)
17. (466)

Chemical Equilibrium

1. (2) 2. (1) 3. (962) 4. (2) 5. (3) 6. (2)

Ionic Equilibrium

1. (12) 2. (4) 3. (7) 4. (1) 5. (2) 6. (3) 7. (3) 8. (4)

Redox Reactions

1. (4) 2. (4) 3. (2) 4. (1) 5. (45)

Solutions

1. (75) 2. (16) 3. (4) 4. (4) 5. (2) 6. (4) 7. (4) 8. (1)
9. (4) 10. (1)

Electrochemistry

1. (1) 2. (2) 3. (3) 4. (2) 5. (2) 6. (3) 7. (1) 8. (2)
9. (1) 10. (2) 11. (3) 12. (2) 13. (150)

Chemical Kinetics

1. (1) 2. (3) 3. (3) 4. (1) 5. (69) 6. (897) 7. (2) 8. (2)
9. (1) 10. (4) 11. (2) 12. (20)

Classification of Elements and Periodicity in Properties

1. (4) 2. (2) 3. (1) 4. (4) 5. (1) 6. (4) 7. (1) 8. (1)
9. (3) 10. (2) 11. (3)

Chemical Bonding and Molecular Structure

1. (3) 2. (6) 3. (2) 4. (2) 5. (15) 6. (2) 7. (1) 8. (3)
9. (4) 10. (2) 11. (6) 12. (2) 13. (2)

p Block Elements (Group 13 & 14)

1. (3) 2. (4)

p Block Elements (Group 15, 16, 17 & 18)

1. (2) 2. (15) 3. (1) 4. (1) 5. (4)

d and f Block Elements

1. (2) 2. (4) 3. (11) 4. (2) 5. (2) 6. (4) 7. (5) 8. (3)
 9. (4) 10. (2) 11. (160) 12. (3) 13. (2) 14. (1)

Coordination Compounds

1. (4) 2. (3) 3. (14) 4. (3) 5. (3) 6. (3) 7. (2) 8. (3)
 9. (1) 10. (4) 11. (1) 12. (0) 13. (4) 14. (4) 15. (3) 16. (2)
 17. (2) 18. (1) 19. (3)

Practical Chemistry

1. (3) 2. (4) 3. (4)

General Organic Chemistry

1. (3) 2. (2) 3. (3) 4. (1) 5. (1) 6. (1) 7. (3) 8. (2)
 9. (4) 10. (4) 11. (1) 12. (4) 13. (2) 14. (3) 15. (4) 16. (4)
 17. (4) 18. (4) 19. (1) 20. (20) 21. (40) 22. (255) 23. (275)

Hydrocarbons

1. (2) 2. (4) 3. (3) 4. (4) 5. (3) 6. (2) 7. (3) 8. (4)
 9. (4) 10. (4) 11. (1) 12. (3) 13. (2)

Haloalkanes and Haloarenes

1. (2) 2. (3) 3. (8) 4. (1) 5. (4) 6. (3) 7. (2) 8. (3)
 9. (2) 10. (93)

Alcohols Phenols and Ethers

1. (4) 2. (2) 3. (2) 4. (3) 5. (60) 6. (13)

Aldehydes and Ketones

1. (4) 2. (3) 3. (4) 4. (4) 5. (1) 6. (3) 7. (1) 8. (2)
 9. (4) 10. (4) 11. (3)

Carboxylic Acid Derivatives

1. (1) 2. (27) 3. (3)

Amines

1. (3) 2. (154) 3. (4) 4. (171) 5. (4) 6. (341) 7. (2) 8. (3)
 9. (2)

Biomolecules

1. (2) 2. (3) 3. (2) 4. (1) 5. (2) 6. (4) 7. (1) 8. (3)
 9. (4) 10. (2) 11. (2)

Q1. $M_F = \frac{M_1 V_1 + M_2 V_2}{V_1 + V_2}$
 (57) $= \frac{2 \times 20 + 0.5 \times 400}{420} = 0.571M$
 $= 57.1 \times 10^{-2}M$
 $= 57$

Q2. (3)

Element	Mass %	Mole %	Molar ratio
C	90	7.5	1
H	10	10	1.33

\therefore Empirical formula is C_3H_4

Molecular mass = 80 g mol^{-1} .

Molecular formula = $(C_3H_4)_n$

$$n = \frac{\text{Molecular mass}}{\text{EF mass}} = \frac{80}{40} = 2$$

\therefore Molecular formula is C_6H_8

$$\text{Degree of unsaturation} = \frac{2 \times 6 + 2 - 8}{2} = 3$$

Q3. (4)

Element	Mass %	Mole %	Molar ratio
C	54.2	4.52	2
H	9.2	9.2	4
O	36.6	2.28	1

Empirical formula of compound is C_2H_4O

Molecular mass of compound = 132 g mol^{-1} Molecular formula of compound is $(C_2H_4O)_n$

$$n = \frac{\text{Molecular mass}}{\text{EF mass}} = \frac{132}{44} = 3$$

\therefore Molecular formula of compound is $C_6H_{12}O_3$

Q4. (3) Moles of removed $CO_2 = \frac{10^{21}}{6.02 \times 10^{23}} \text{ mol}$

$$= 1.66 \times 10^{-3} \text{ mol}$$

mole of CO_2 left = 2.8×10^{-3} moles total moles of CO_2 taken initially

$$= (2.8 + 1.66) \times 10^{-3} \text{ mol}$$

mass of CO_2 taken initially

$$= 4.46 \times 10^{-3} \times 44$$

$$= 196.24 \times 10^{-3} \text{ g}$$

$$= 196.24 \text{ mg}$$



$$\therefore \text{mole of } H_2O = \frac{0.9}{18} = 0.05 \text{ mole}$$

$$\therefore \text{mole of H in } H_2O = 0.05 \times 2 = 0.1 \text{ mole}$$

∴ = mole of H in 0.01 mole

Organic compound

∴ wt of H atom in 0.01 mole compound = $0.1 \times 1 = 0.1\text{gm}$

∴ wt of H atom in one mole compound

$$= \frac{0.1}{0.01} = 10\text{gm}$$

$$\therefore \text{wt. \% of H} = \frac{\text{wt. of H in one mole compound}}{\text{Molar mass of compound}} \times 100$$

$$10 = \frac{10}{M} \times 100$$

$$\therefore M = 100$$

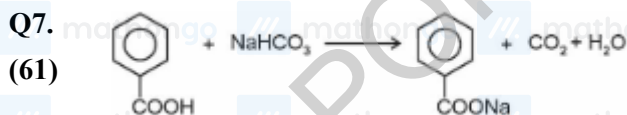


(153) $\frac{81}{27} = 3 \text{ mole}$ $\frac{128}{32} = 4 \text{ mole}$

Limiting reagent

$$\therefore \text{mole of Al}_2\text{O}_3 \text{ formed} = \frac{1}{2} \times 3 \text{ mole}$$

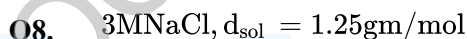
$$\therefore \text{wt. of Al}_2\text{O}_3 \text{ formed} = \frac{3}{2} \times 102 = 153\text{gm}$$



1 mole benzoic acid will release 1 mole CO_2

11.2 L CO_2 at STP is $\frac{1}{2}$ mole CO_2 which will be released by reaction with $\frac{1}{2}$ mole benzoic acid

$$\text{Mass of benzoic acid} = \frac{1}{2} \times 122 = 61\text{gm}$$



(2)
$$\text{Molality} = \frac{M \times 1000}{1000 d - M \times M_w} = \frac{3000}{1250 - 175.5} = 2.79$$

Q9. Moles of solute = $\frac{70}{70} = 1$

(125) Volume of solution = $\frac{100}{1.25} = 80 \text{ mL}$

$$M = \frac{1}{80} \times 1000 = 12.5$$

$$M = 125 \times 10^{-1}$$

Q10. 75% by mass means :

(2) ∴ 75 g HNO_3 in 100 g solution.

∴ 30 g HNO_3 in $\frac{100}{75} \times 30$ g solution.

$$m_{\text{solution}} = \frac{100 \times 30}{75} \text{ g}$$

$$\therefore V_{\text{sol}} = \frac{m_{\text{sol}}}{d_{\text{sol}}} = \frac{100 \times 30}{75 \times 1.25} = 32 \text{ mL}$$

Q11. moles of $\text{Fe}_3\text{O}_4 = \frac{2.32 \times 10^3 \times 10^3}{232} = 10000 \text{ mol}$

(420)

moles of $\text{CO} = \frac{2.8 \times 10^2 \times 10^3}{28} = 10000 \text{ mol}$



$$10^4 \text{ mol} \quad 10^4 \text{ mol}$$

CO is L.R.

$$\text{mole of Fe} = \frac{3}{4} \times 10^4$$

$$\text{mass of Fe} = \frac{3}{4} \times \frac{10^4 \times 56}{1000} \text{ kg} = 420 \text{ kg}$$

Q12.

(1655) \ %mass

	C	Cl	H	O
\ %mass	14.5	64.46	1.8	19.24
Molar ratio	$\frac{14.5}{12}$	$\frac{64.46}{35.5}$	$\frac{1.8}{1}$	$\frac{19.24}{16}$
	1.2	1.8	1.8	1.2

Minimum

2

3

3

2

integral ratio

$$\text{Empirical formula} = \text{C}_2\text{H}_3\text{Cl}_3\text{O}_2$$

$$\text{Mass} = 165.5$$

$$\text{Mass} = 1655 \times 10^{-1}$$

Q13. Mass of substance is amount of matter present in it. Weight is force exerted by gravity on object.

(2)

Q1. $r = a_0 \left(\frac{n^2}{z} \right)$

(2) $r = \frac{a_0(2)^2}{(2)}$

$r = 2a_0$

Q2. A : $n = 1, \ell = 0, m_\ell = 0$ orbital

(4) B : $n = 2, \ell = 0, m_\ell = 0$ 1 s

C : $n = 3, \ell = 1, m_\ell = 1$ 2 s

D : $n = 3, \ell = 2, m_\ell = 1$ 3p

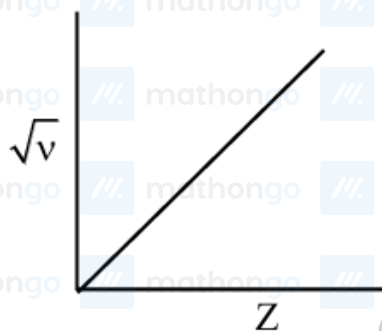
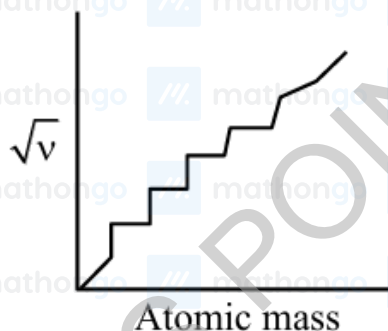
E : $n = 3, \ell = 2, m_\ell = 0$ 3 d

3 d

In absence of electric and magnetic fields, all orbitals of 3d are degenerate

Q3.

(3)



Q4. $r \propto q^-$ (for isoelectronic species)

(4) $\propto \frac{1}{q^+}$

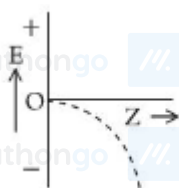
\therefore Statement I is correct

Magnitude of electron gain enthalpy

$\text{Cl} > \text{F} > \text{Br} > \text{I}$

Q5. $E_n = -13.6 \frac{z^2}{n^2}$

(1) $E_n \propto -z^2$
 $y = kx^2$



Q6. $\lambda = 900 \text{ nm}$ H-atom ($Z = 1$)

(3) $= 9 \times 10^{-5} \text{ cm}$

$$R_H = 10^5 \text{ cm}^{-1}$$

$$\text{Rydberg eq.} = \frac{1}{\lambda} = R_H Z^2 \times \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$\Rightarrow \frac{1}{\lambda \times R_H} = \frac{1}{n_1^2} - \frac{1}{n_2^2}$$

$$\Rightarrow \frac{1}{9 \times 10^{-5} \text{ cm} \times 10^5 \text{ cm}^{-1}} = \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$\Rightarrow \frac{1}{n_1^2} - \frac{1}{n_2^2} = \frac{1}{9}$$

It is possible when $n_1 = 3, n_2 = \infty$

Possible series : $\infty \rightarrow 3$

Q7. Bohr radius of hydrogen atom $\rightarrow a_0$

(1) According to Bohr, the equation used to calculate the angular momentum of an electron in a hydrogen atom is

$$mvr = n \frac{h}{2\pi} \dots (i)$$

$m \rightarrow$ mass of electron

$v \rightarrow$ velocity of electron

$r \rightarrow$ radius of the orbit

$n \rightarrow$ orbit. number. in. which electron is present.

Given that; electron is present in second orbit, $n = 2$

The radius of the second orbit $r_2 = a_0 \times 2^2 = 4a_0$

General formula for radius of n^{th} orbit,

$$r_n = a_0 \times n^2 \text{ From (1)}$$

$$mvr = n \frac{h}{2\pi}$$

$$2\pi r = n \frac{h}{mv}$$

$$\frac{h}{mv} = \lambda \text{ (de Broglie relation ship, } \lambda \rightarrow \text{ de Broglie Wavelength)}$$

$$\text{So, } 2\pi r = n\lambda$$

For the electron in the second orbit, $2\pi r_2 = n\lambda$

Substitute for r_2

$$2\pi \times 4a_0 = n\lambda$$

$$8\pi a_0 = n\lambda$$

$$\therefore \lambda = \frac{8\pi a_0}{n}$$

Q8. According to Heisenberg's uncertainty principle, it is impossible to determine simultaneously the exact position

(3) and momentum of particle like electron

If

$$\Delta p = \Delta x$$

$$\Delta p \cdot \Delta x \geq \frac{h}{4\pi}$$

$$(\Delta p)^2 \geq \frac{h}{4\pi}$$

$$\Delta p \geq \sqrt{\frac{h}{\pi}} \times \frac{1}{2}$$

$$m\Delta v \geq \sqrt{\frac{h}{\pi}} \times \frac{1}{2}$$

$$\Delta v \geq \sqrt{\frac{h}{\pi}} \times \frac{1}{2m}$$

Q9. For a shell total number of orbitals = n^2

(3) Magnetic quantum number have values $(-\ell \text{ to } +\ell)$ including 0.

Q10. For hydrogen atom and one electron species, the energy of orbitals is decided by the value of principal quantum

(1) number. Higher the value of principal quantum number, higher will be the energy of orbital.

(A) 4s $n = 4$

(B) 3p_x $n = 3$

(C) 3d_{x²-y²} $n = 3$

(D) 3d_{z²} $n = 3$

(E) 4p_z $n = 4$

\therefore (B), (C) and (D) have orbitals with the lowest energy.

Q11. 2p_x and 2p_y are degenerated orbitals hence having equal energy and therefore no spectral line will be observed

(2) for 2p_x \rightarrow 2p_y transition.

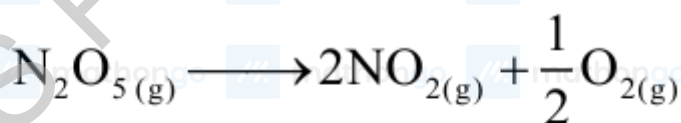
Q12. For single electron species energy only depends on 'n' (principal quantum number)

(3) So energy of 2s = 2p

and energy of 3d < 4s

Q1.

(4)



$$t=0 \quad P_0$$

$$t=t \quad P_0 - x$$

$$2x$$

$$\frac{x}{2}$$

$$x = \frac{P_0}{2}$$

$$P_{\text{total}} = P_0 - \frac{P_0}{2} + P_0 + \frac{P_0}{4} = \frac{7}{4}P_0$$

Q1. Thermally insulated $\Rightarrow q = 0$ from Ist law

(3) $\Delta U = q + w$

$$\Delta U = w$$

$$w > 0, \Delta U > 0$$

Q2. $\frac{1}{2}X_2 + \frac{5}{2}Y_2 \rightleftharpoons XY_5$

(700) $\Delta S_{Rxn}^0 = 110 - \left[\left(\frac{1}{2} \times 70 \right) + \left(\frac{5}{2} \times 50 \right) \right]$

$$= 110 - 160 = -50 \text{JK}^{-1} \text{mol}^{-1}$$

$$\Delta G^0 = 0 \text{ at eqb}$$

$$\Delta G^0 = \Delta H^0 - T\Delta S^0$$

$$0 = -35000 - T(-50)$$

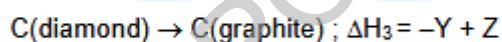
$$T = 700 \text{ Kelvin}$$

Q3. $\therefore \Delta G = \Delta H - T\Delta S$

(1) For spontaneity of reaction: $\Delta G = -ve$

Q4. $C(\text{diamond}) + O_2(g) \rightarrow CO_2(g); \Delta H_1 = -Y \text{ kJ mol}^{-1}$

(4) $CO_2(g) \rightarrow C(\text{graphite}) + O_2(g); \Delta H_2 = Z \text{ kJ mol}^{-1}$

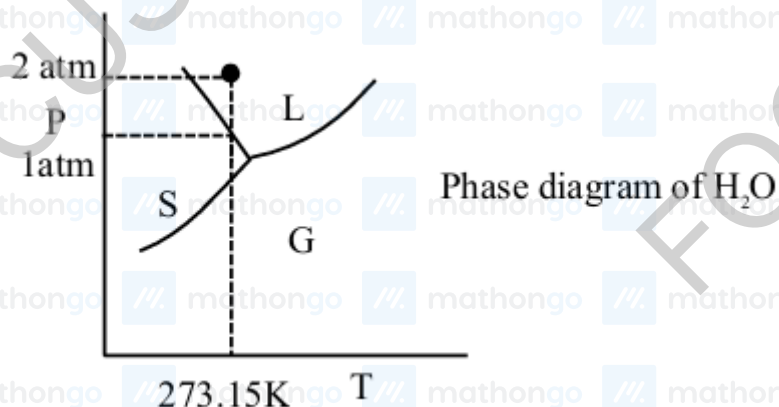


$$-X = -Y + Z$$

$$X = Y - Z$$

Q5.

(2)



If pressure is made two time then mixture of ice and water will completely convert into water (liquid) form.

Q6. As internal energy 'U' is a state function, its cyclic integral must be zero in a cyclic process

(1) $\therefore \Delta U \text{ case (I)} = \Delta U \text{ case (II)} = \Delta U \text{ case (III)}$

Q7. $q_p = n \times c_p \times \Delta T$

(3) $\Rightarrow 500 = 0.5 \times \frac{5}{2} \times 8.3 (T_f - 298)$

$\Rightarrow T_f \approx 346.2 \text{ K}$

$\frac{\Delta H}{\Delta U} = \frac{C_p}{C_v} = \left(\frac{5}{3}\right)$

$\Rightarrow \Delta U = \frac{3}{5} \times 500 = 300 \text{ J}$

Q8. $\therefore dH = dq$ (at $P = \text{constant}$)

(3) $dH = C_p dT$

$\left(\frac{dH}{dT}\right)_P = C_p$

$dU = dq$ (at $V = \text{constant}$)

$dU = C_v dT$

$\left(\frac{dU}{dT}\right)_V = C_v$

$\therefore dG = VdP - SdT$

at $P = \text{constant}$, $dP = 0$

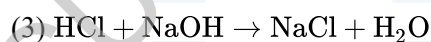
$\left(\frac{dG}{dT}\right)_P = -S$

at $T = \text{constant}$

$\left(\frac{dG}{dP}\right)_T = V$

Q9. The rise in temperature of neutralization reaction will be maximum for maximum number of moles of strong

(3) acid and strong base neutralized and lower volume of final solution.



mmol 30 30

Final volume of solution = 60 mL

Option (1) and (2) have weak acids and in option

(4) only 20 mmol of HCl will be neutralized with 70 mL final volume.

Q10. $\Delta H_{\text{rxn}}^\circ = 55 \text{ kJ/mol}$, $T = 298 \text{ K}$

(2850) $\Delta S_{\text{rxn}}^\circ = 175 \text{ J/mol}$

$\Delta G_{\text{rxn}}^\circ = \Delta H_{\text{rxn}}^\circ - T\Delta S_{\text{rxn}}^\circ$

$\Rightarrow \Delta G_{\text{rxn}}^\circ = 55000 \text{ J/mol} - 298 \times 175 \text{ J/mol}$

$\Rightarrow \Delta G_{\text{rxn}}^\circ = 55000 - 52150$

$\Rightarrow \Delta G_{\text{rxn}}^\circ = 2850 \text{ J/mol}$

Q11. On increasing temperature, the given endothermic reaction becomes spontaneous.

(4) $\Delta G = \Delta H - T\Delta S$

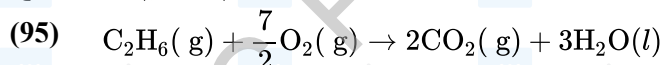
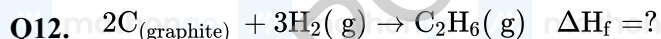
For spontaneity,

$\Delta G < 0$

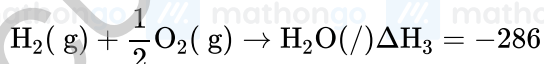
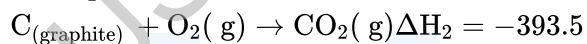
Given,

$\Delta H > 0$

So, ΔS should be +ve.



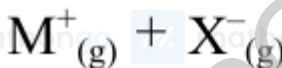
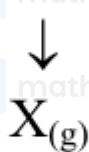
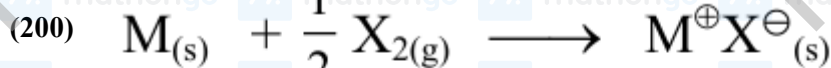
$$\Delta H_1 = -1550$$



$$\Delta H_f = 2\Delta H_2 + 3\Delta H_3 - \Delta H_1$$

$$= 95 \text{ kJ/mole}^2$$

Q13.



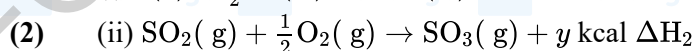
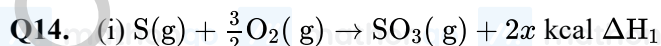
$$\therefore \Delta H_f(MX) =$$

$$\Delta H_{\text{sub}}(M) + \text{I.E.}(M) + \frac{1}{2}[\text{B.E.}(X - X)]$$

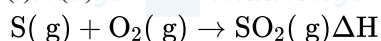
$$+ \text{E.G.}(X) + \text{L.E.}(MX)$$

$$-400 = (100) + (500) + \frac{1}{2}(\text{B.E.}) + (-300) + (-800)$$

$$\therefore \text{B.E.} = 200 \text{ kJ mole}^{-1}$$

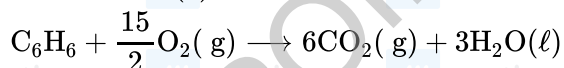
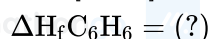
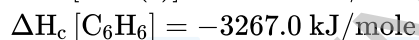
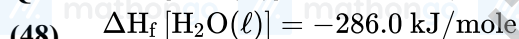
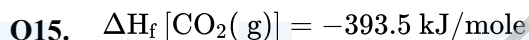


(i) - (ii)



$$\Delta H = \Delta H_1 - \Delta H_2$$

$$= -2x - (-y) = (y - 2x) \text{ kcal}$$



$$\Delta H_R = \Delta H_C = \Sigma \Delta H_f(P) - \Sigma \Delta H_f(R)$$

$$-3267 = 6 \times (-393.5) + 3(-286) - \Delta H_f(C_6H_6)$$

$$\Delta H_f(C_6H_6) = 48 \text{ kJ/mole}$$

Q16.
$$\text{H}_2\text{O}(s) \rightarrow \text{H}_2\text{O}(s); \Delta S_1 = \int_{268\text{ K}}^{273\text{ K}} \frac{C_{p, \text{mdT}}}{T}$$

(2)
$$\text{H}_2\text{O}(s) \rightleftharpoons \text{H}_2\text{O}(l); \Delta S_2 = \frac{\Delta H_{\text{m, fus}}}{273}$$

$$\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(l); \Delta S_3 = \int_{273}^{373} \frac{C_{p, \text{mdt}}}{T}$$

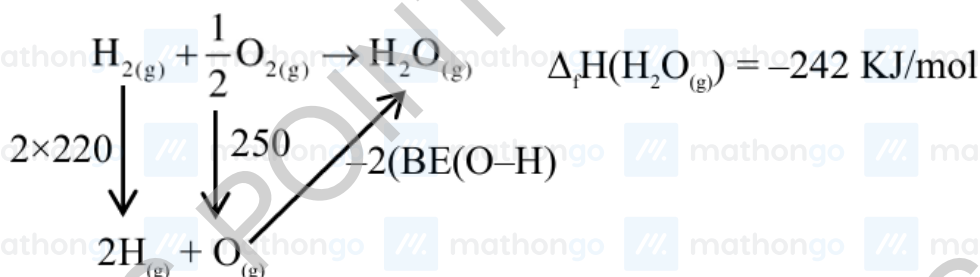
$$\text{H}_2\text{O}(l) \rightleftharpoons \text{H}_2\text{O}(g); \Delta S_4 = \frac{\Delta H_{\text{m, vap}}}{373}$$

$$\text{H}_2\text{O}(g) \rightarrow \text{H}_2\text{O}(g); \Delta S_5 = \int_{373}^{383} \frac{C_{p, \text{mdT}}}{T}$$

$$\Delta S_{\text{total}} = \Delta S_1 + \Delta S_2 + \Delta S_3 + \Delta S_4 + \Delta S_5$$

Q17.
$$\frac{1}{2}\text{H}_2(g) \rightarrow \text{H}(g) ; \Delta_f H(\text{H}(g)) = 220\text{KJ/mol}$$

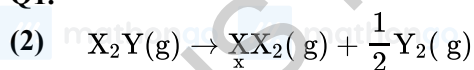
(466)
$$\frac{1}{2}\text{O}_2(g) \rightarrow \text{O}(g) ; \Delta_f H(\text{O}(g)) = 250\text{KJ/mol}$$



$$\Delta H_f(\text{H}_2\text{O}(l)) = -242 = 440 + 250 - 2(\text{B.E.}(\text{O}-\text{H}))$$

$$\text{B.E.}(\text{O}-\text{H}) = 466\text{KJ/mol}$$

Q1. 1 mol



$$\begin{aligned} \therefore P_{x_2Y} &= \frac{1-x}{1+\frac{x}{2}} \times p \\ P_{x_2} &= \frac{x}{1+\frac{x}{2}} \times p \\ P_{y_2} &= \frac{x/2}{1+\frac{x}{2}} \times p \end{aligned}$$

$$\therefore K_p = \frac{\left(\frac{x}{1+\frac{x}{2}}p\right) \left(\frac{x/2}{2\left(1+\frac{x}{2}\right)}p\right)^{1/2}}{\left(\frac{1-x}{1+\frac{x}{2}}\right) \times p}$$

$$\therefore K_p = \left(\frac{x}{1-x}\right) \left(\frac{x}{2\left(1+\frac{x}{2}\right)}\right)^{1/2} \times p^{1/2}$$

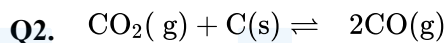
\therefore x to be very small

$$\therefore K_p = \frac{x^{3/2}}{2^{(1/2)}} \times p^{1/2}$$

$$\therefore x^{3/2} = \frac{K_p \times 2^{1/2}}{p^{1/2}}$$

$$x^3 = \frac{K_p^2 \times 2}{p}$$

$$x = \left(\frac{K_p^2 \times 2}{p}\right)^{1/3}$$



(1) 0.5

$$0.5 - x \qquad 2x$$

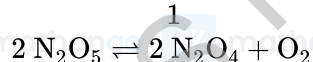
$$P_{total} = 0.5 + x = 0.8$$

$$x = 0.3$$

$$K_P = \frac{(0.6)^2}{0.2} = 1.8$$

Q3. Initial pressure of N_2O_5

$$(962) \quad = \frac{37.8}{108} \times 0.082 \times 500 = 14.35 \text{ bar}$$



$$t = 0 \quad 14.35$$

$$t = t_{eq} \quad 14.35 - 2P \quad 2P$$

$$P_{Total} \text{ at eqb} = 14.35 + P = 18.65$$

$$P = 4.3$$

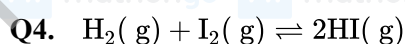
$$P_{N_2O_5} = 5.75 \text{ bar}$$

$$P_{N_2O_4} = 8.6 \text{ bar}$$

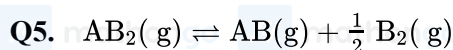
$$P_{O_2} = 4.3 \text{ bar}$$

$$K_p = \frac{(8.6)^2 \times (4.3)}{(5.75)^2} = 9.619 = x \times 10^{-2}$$

$$x = 961.9 \approx 962$$



(2) Concentrations of $H_2(g)$ and $I_2(g)$ decrease with time while concentration of $HI(g)$ increases with time. At equilibrium $H_2(g)$, $I_2(g)$ and $HI(g)$ attain constant values. Correct plot of molar concentration with time is



(3) $t = 0 \quad p_0$

$$t = t_{eq} \quad p_0(1-x) \quad p_0x \quad \frac{p_0x}{2}$$

$$p = p_0x - p_0x + p_0x + \frac{p_0x}{2}$$

$$p = p_0 \left(1 + \frac{x}{2} \right)$$

$$p_0 = \frac{p}{\left(1 + \frac{x}{2} \right)}$$

$$K_p = \frac{(p_{AB})(p_{B_2})^{1/2}}{(p_{AB_2})}$$

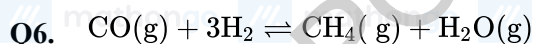
$$K_p = \frac{(p_0x) \left(\frac{p_0x}{2} \right)^{1/2}}{p_0(1-x)}$$

$$K_p = \frac{\frac{px}{\left(1+\frac{x}{2}\right)} \left(\frac{p}{1+\frac{x}{2}} \times \frac{x}{2} \right)^{1/2}}{\frac{p(1-x)}{\left(1+\frac{x}{2}\right)}}$$

Since $x \ll 1$

$$K_p = \frac{p^{1/2} x^{3/2}}{2^{1/2}}$$

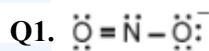
$$x = \sqrt[3]{\frac{2 K_p^2}{p}}$$



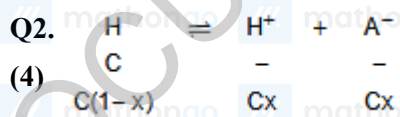
(2) $\Delta n_g = -2$

If pressure of system increases then according to Le-Chatelier's principle reaction will move in forward direction.

Concentration of reactant and products both increases but concentration of product increases more.



(12) Number of non-bonding electrons = 12



$$K_a = \frac{[\text{H}^+](x)}{\text{C}(1-x)}$$

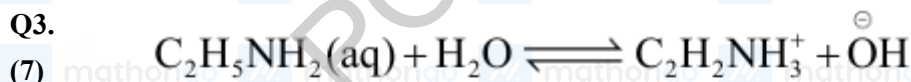
$$[\text{H}^+] = K_a \frac{(1-x)}{x}$$

$$\log \text{H}^+ = \log K_a + \log \left(\frac{1-x}{x} \right)$$

$$-\log \text{H}^+ = -\log K_a - \log \frac{1-x}{x}$$

$$\text{pH} = \text{p}K_a - \log \frac{1-x}{x}$$

$$\text{pH} - \text{p}K_a = \log \frac{x}{1-x}$$



$$\text{C} = 10^{-3} \text{ M}$$

$$\text{C}(1-\alpha)$$

$$\Rightarrow \text{C} = 10^{-3}$$

$$\text{C}\alpha = 10^{-5} \quad \text{C}\alpha = 10^{-5}$$

Given, $\text{pH} = 9 \Rightarrow \text{pOH} = 5 \Rightarrow [\text{OH}^-] = 10^{-5} \text{ M}$

Now, $K_b = \frac{[\text{C}_2\text{H}_5\text{NH}_3^+][\text{OH}^-]}{[\text{C}_2\text{H}_5\text{NH}_2]}$

$$\Rightarrow K_b = \frac{10^{-5} \times 10^{-5}}{10^{-3}} = 10^{-7}$$

Q4. At 25°C, pure water has pH = 7

(1) As temperature increased, water molecules dissociate more into hydrogen ions (H^+) and hydroxide ions (OH^-).

This increased dissociation leads to slightly decrease in pH.

At 80°C, pH \approx 6.93



(2)
$$\begin{array}{c} \text{---} \\ \text{3 s} \quad \text{4 s} \end{array}$$

$$K_{sp} = (3s)^3(4s)^4 = 6912s^7$$

$$s = \left(\frac{K_{sp}}{6912} \right)^{1/7}$$

Q6. Condition for precipitation $Q_{ip} > K_{sp}$

(3) For $[A(OH)_2]$

$$[A^{2+}] [OH^-]^2 > 9 \times 10^{-10}$$

$$[A^{2+}] = 1M$$

$$\Rightarrow [OH^-] > 3 \times 10^{-5}M$$

For $[B(OH)_3]$

$$[B^{3+}] [OH^-]^3 > 27 \times 10^{-18}$$

$$[B^{3+}] = 1M$$

$$\Rightarrow [OH^-] > 3 \times 10^{-6}M$$

So, $B(OH)_3$ will precipitate before $A(OH)_2$

Q7. $Cr(OH)_3 \rightleftharpoons Cr^{3+}(aq) + 3OH^-(aq)$

(3) $K_{sp} = s(3s)^3$

$$1.6 \times 10^{-30} = 27s^4$$

$$\sqrt[4]{\frac{1.6 \times 10^{-30}}{27}} = s$$

Q8. Based on the K_{sp} values and salt analysis cation identification, we can say that order of K_{sp} value is:

(4) $HgS < PbS < AgBr < Ca(OH)_2$

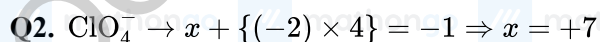
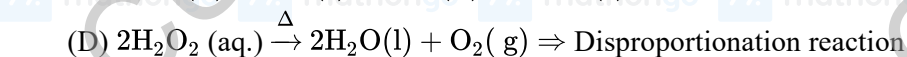
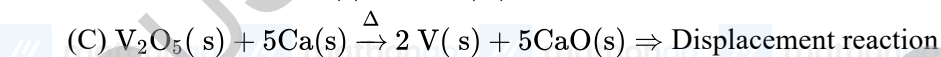
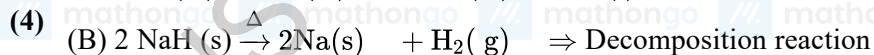
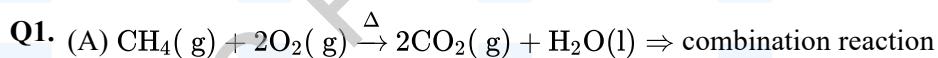
K_{sp} values

$$HgS \rightarrow 4 \times 10^{-53}$$

$$PbS \rightarrow 8 \times 10^{-28}$$

$$AgBr \rightarrow 5 \times 10^{-13}$$

$$Ca(OH)_2 \rightarrow 5.5 \times 10^{-6}$$



(4) Chlorine is in its maximum oxidation state, so disproportionation not possible in ClO_4^- .

Q3. Heating is required in oxalic acid filtration due to High activation energy.

(2) Heating is not required in FAS vs KMnO_4 titration because Fe^{2+} will get converted into Fe^{3+} by oxygen of air and error may be introduced in the experiment.

Both Statement-I and Statement-II are correct.

Q4. $E_{\text{KIO}_3} = \frac{\text{Molecular weight}}{n_f}$

(1) $n_{\text{ff}_f} = 5$

$E_{\text{KIO}_3} = \frac{\text{Molecular weight}}{5}$

(D) is correct meq of KI = $0.1 \times 200 = 20$ meq of $\text{KIO}_3 = 4 \times 5 = 20$

(A) is correct

Q5. Let moles of $\text{CO}_2 = n$ moles of $\text{Ca}(\text{OH})_2$ total initially = $2n$ excess $\text{Ca}(\text{OH})_2 = n$ gm equivalent of

(45) $\text{Ca}(\text{OH})_2 =$ gm equivalent of HCl

$n \times 2 = 0.1 \times \frac{40}{1000} \times 1$

$n = 2 \times 10^{-3}$

Volume of $\text{CO}_2 = 2 \times 10^{-3} \times 22400 = 44.8 \text{ cm}^3$

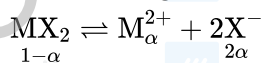
Q1. Normal molar mass of $\text{MX}_2 = 164.0 \text{ g mol}^{-1}$

(75) Observed molar mass of $\text{MX}_2 = 65.6 \text{ g mol}^{-1}$

$$\text{Van't Hoff factor (i)} = \frac{\text{Normal molar mass}}{\text{Observed molar mass}}$$

$$= \frac{164}{65.6} = 2.5$$

If α is the degree of ionisation, then



$$i = 1 - \alpha + \alpha + 2\alpha = 1 + 2\alpha$$

$$1 + 2\alpha = 2.5$$

$$\alpha = 0.75$$

\therefore Percent degree of ionisation = 75%

Q2. $\text{AB}_2 \rightleftharpoons \text{A}^{2+} + 2\text{B}^{-}$

(16) $\begin{matrix} 1 & 0 & 0 \\ 1-\alpha & \alpha & 2\alpha \end{matrix}$

$$i = 1 + 2\alpha$$

$$= 1 + 2 \times (0.3)$$

$$= 1.6$$

$$= 16 \times 10^{-1}$$

Q3. A mixture of salt and ice is known as freezing mixture. Freezing mixture decreases freezing point of ice. Both

(4) statements are true.

Q4. Living cell = 0.9gm in 100 gm of solution

(4) %w/w = 0.9

Solution is have equal moles of glucose and water = 0.5

$$\text{Weight of solution} = 0.5 \times 180 + 0.5 \times 18 = 99\text{gm} \quad \%w/w \simeq 90\%$$

Concentrated solution = Cell will shrink.

Q5. \therefore For liquid solution of two liquids '1' and '2'

(2) $P_1 = P_T y_1 = P_1^\circ x_1$

$$\therefore \frac{P_T}{x_1} = \frac{P_1^\circ}{y_1}$$

$$\therefore \frac{P_2^\circ + x_1 P_1^\circ - P_2^\circ}{x_1} = \frac{P_1^\circ}{y_1}$$

$$\therefore \frac{P_2^\circ}{x_1} + P_1^\circ - P_2^\circ = \frac{P_1^\circ}{y_1}$$

$$\therefore \frac{1}{x_1} = \frac{P_1^\circ}{P_2^\circ} \frac{1}{y_1} + \frac{P_2^\circ - P_1^\circ}{P_2^\circ}$$

$$\therefore \text{Slope} = \frac{P_1^\circ}{P_2^\circ}$$

$$\therefore \text{Intercept} = \frac{P_2^\circ - P_1^\circ}{P_2^\circ}$$

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Q6. $\therefore P^\circ - P \propto X_{\text{solute}}$

(4) and $\therefore 10 \propto 0.2$

$\therefore 20 \propto 0.4$

$\therefore X_{\text{solvent}} = 1 - X_{\text{solute}}$

$= 1 - 0.4$

$= 0.6$

Q7. For 10^{-4}MNaCl $i = 2$

(4) 10^{-4}M Urea $i = 1$

10^{-3}MMgCl_2 $i = 3$

10^{-2}MNaCl $i = 2$

More the value of i , C , more will be the elevation in boiling point hence increasing order of boiling point is

$10^{-4} \text{M Urea} <$

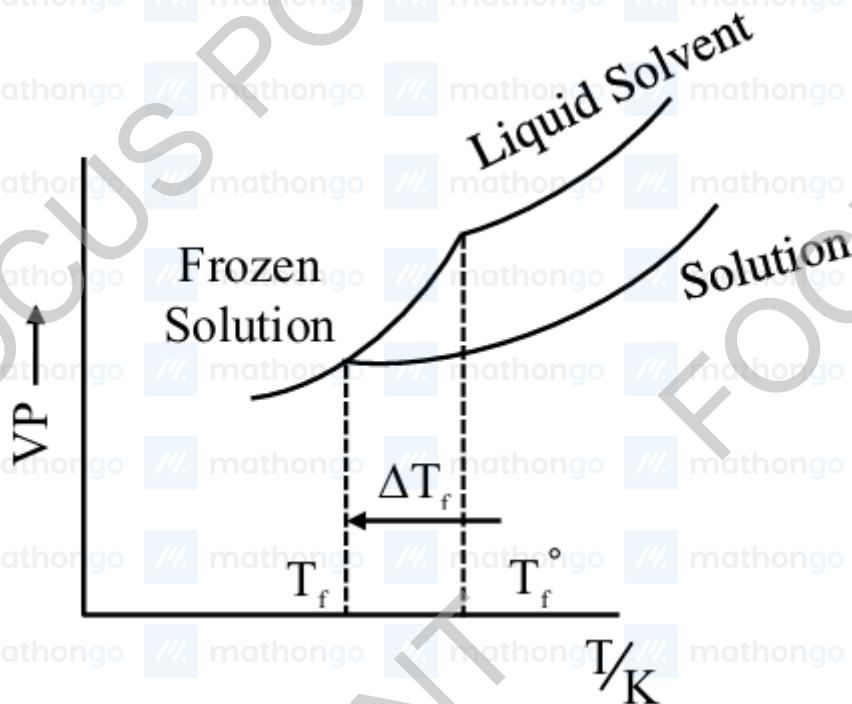
$10^{-4} \text{MNaCl} < 10^{-3} \text{MMgCl}_2 < 10^{-2} \text{MNaCl}$

Q8. On adding non-volatile solute in a solvent, the freezing point of solution decreases.

(1) $T_f < T_f^0$

F.P. of solution $<$ F.P. of pure solvent

Also V.P. of solution decreases on adding nonvolatile solute in a solvent.



Q9. $\Delta T_f = K_b \cdot m$

(4) $0.4 = K_b \frac{1}{50 \times 10^{-3}}$

$K_b = 5.12 \text{ K kg/mol}$

Q10. For AX_2

$$(1) \Delta T_b = i K_b m$$

$$0.0156 = i \times 0.52 \times \frac{1.24}{124 \times 1}$$

$$3 = i$$

$$3 = 1 + 2\alpha$$

$$1 = \alpha$$

For AY_2

$$\Delta T_b = i K_b m$$

$$0.0260 = i \times 0.52 \times \frac{25.4}{250 \times 2}$$

$$i \approx 1$$

$\therefore AX_2$ is completely ionised & AY_2 is completely unionised

Q1. $\therefore \Delta G^\circ = -nFE^\circ$
 (1) Option (1) $E^\circ = 0.8 + 0.76$
 $= 1.56 \text{ V}$

$$\therefore \Delta G^\circ = -2 \times F \times 1.56$$

$$= -3.12 \text{ V}$$

Option (2) $E^\circ = -2.37 + 0.76$
 $= -1.61 \text{ V}$

$$\therefore \Delta G^\circ = -2 \times F \times (-1.61)$$

$$= +3.22 \text{ V}$$

Option (3) $E^\circ = -2.37 - 0.8$
 $= -3.17 \text{ V}$

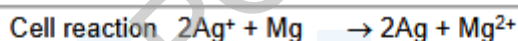
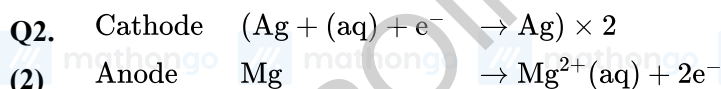
$$\Delta G^\circ = -2 \times F \times (-3.17)$$

$$= +6.34$$

Option (4) $E^\circ = 0.8 - 0.34$
 $= 0.46 \text{ V}$

$$\Delta G^\circ = -2 \times F \times 0.46$$

$$= -0.92 \text{ V}$$



$$Q = \frac{[\text{Mg}^{2+}]}{[\text{Ag}^+]^2}$$

By Nernst equation

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{RT}{nF} \ln Q$$

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{RT}{nF} \ln \frac{[\text{Mg}^{2+}]}{[\text{Ag}^+]^2}$$

$$= E_{\text{cell}}^\circ + \frac{RT}{2F} \ln \frac{[\text{Ag}^+]^2}{[\text{Mg}^{2+}]}$$

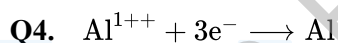
Q3. Statement I :

(3) Corrosion is an example of electrochemical phenomenon

In which pure metal act as anode and impure metal (rusted metal) act as cathode.

Statement II :

Corrosion is more favourable in acid medium than alkaline so rate of corrosion is high in acid medium than alkaline.



(2) Moles of electron $= \frac{2 \times 30 \times 60}{96500}$

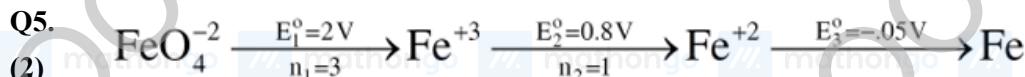
$$= \frac{36}{965}$$

$$\text{Moles of Al} = \frac{36}{3 \times 965}$$

$$= \frac{12}{965}$$

$$\text{Mass of Al} = \frac{12}{965} \times 27$$

$$= 0.336 \text{ gm}$$



$$E_4^{\circ} = ?$$

$$n_4 = 4$$

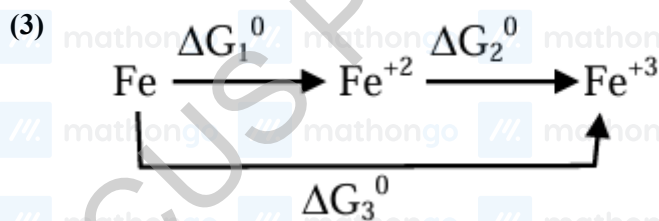
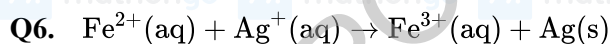
$$\Delta G_4^{\circ} = \Delta G_1^{\circ} + \Delta G_2^{\circ}$$

$$\Rightarrow -n_4 F E_4^{\circ} = -n_1 F E_1^{\circ} - n_2 F E_2^{\circ}$$

$$\Rightarrow +4E_4^{\circ} = 3 \times 2 + (1 \times 0.8)$$

$$\Rightarrow E_4^{\circ} = \frac{6.8}{4} \text{ V}$$

$$\Rightarrow E_4^{\circ} = 1.7 \text{ V}$$



$$\Delta G_3^{\circ} = \Delta G_1^{\circ} + \Delta G_2^{\circ}$$

$$-3F(-z) = -2F(-y) + \Delta G_2^{\circ}$$

$$\Delta G_2^{\circ} = 3Fz - 2Fy$$

$$\text{Also } \Delta G_2^{\circ} = -nF E_{\text{Fe}^{2+}/\text{Fe}^{3+}}^{\circ}$$

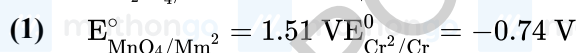
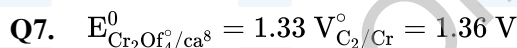
$$3Fz - 2Fy = -1F \left(E_{\text{Fe}^{2+}/\text{Fe}^{3+}}^{\circ} \right)$$

$$E_{\text{Fe}^{2+}/\text{Fe}^{3+}}^{\circ} = 2y - 3z$$

E_{Cell}° for reaction will be

$$E_{\text{Ag}^{+}/\text{Ag}}^{\circ} + E_{\text{Fe}^{2+}/\text{Fe}}^{\circ}$$

$$= x + 2y - 3z$$



The species which has the most negative value of standard reduction potential will be the strongest reducing agent. Since Cr^{3+}/Cr has SRP value of -0.74 V , Cr is the strongest reducing agent.

Q8. Electrolysis of NaCl is



Since during electrolysis pH changes to 12

So $[\text{OH}^\ominus] = 10^{-2}$ and $[\text{H}^+] = 10^{-12}$

So by Faraday law

Gram amount of substance deposited = Amount of electricity passed

$$10^{-2} \times \frac{600}{1000} \times 96500 = I \times t$$

$$\frac{10^{-2} \times 600}{1000} \times 96500 = I \times 5 \times 60$$

$$I = \frac{10^{-2} \times 600 \times 96500}{1000 \times 5 \times 60}$$

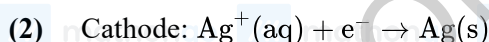
$$I = 1.93 \text{ ampere}$$

So, $I = 2$ ampere (nearest integer)

Q9. The element having strongest oxidising capacity will have highest value of standard reduction potential

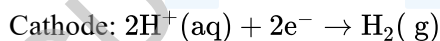
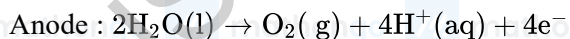
(1)

Q10. When an aqueous solution of AgNO_3 is electrolysed using Pt electrodes



⇒ When dilute H_2SO_4 is electrolysed using Pt electrodes

⇒ When dilute H_2SO_4 is electrolysed using Pt electrodes



Q11. In transistor, anode is Zn and cathode is carbon.

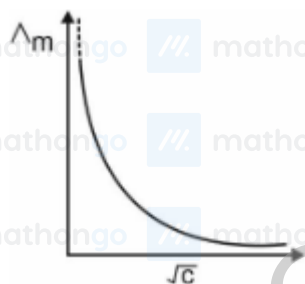
(3) In hearing, aids mercury battery are used.

In invertors, lead storage battery is used.

In apollo space ship, hydrogen fuel cell was used.

Q12. For weak electrolyte, variation of Λ_m with \sqrt{c} is

(2)



$$\text{Q13. } R = \rho \frac{\ell}{A}$$

(150)

$$\kappa = G \cdot G^* \quad G = \frac{1}{R}; \kappa = \frac{1}{\rho}$$

$$G^* = \frac{\ell}{A}$$

R = Resistance

 ρ = Resistivity $\frac{\ell}{A}$ = cell constant (G^*)

$$\frac{\kappa_c}{\kappa_d} = \frac{R_d}{R_c}; \lambda_m = \frac{\kappa \times 1000}{C}$$

$$\frac{\kappa_c}{\kappa_d} = \frac{(\lambda_m \cdot C)}{(\lambda_m \cdot C)_d} = \frac{R_d}{R_c}$$

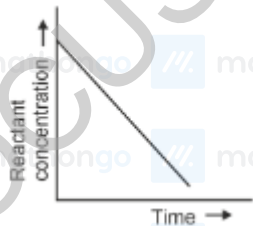
c = concentrated sol. d = diluted solution

$$\frac{100 \cdot (0.15)^2}{150 \cdot (0.1)^2} = \frac{R_d}{100}$$

$$R_d = 150\Omega$$

Q1. $[A]_t = [A]_0 - kt$

(1) Straight line with negative slope



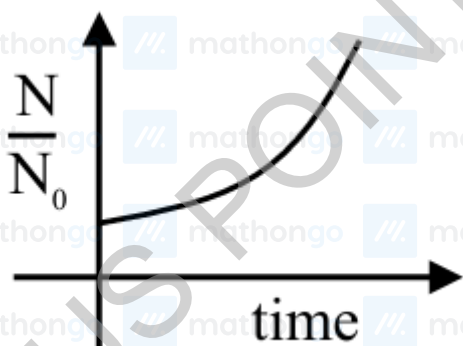
Graph of reactant concentration versus time for zero order reaction.

Q2. Because no. of bacteria initial = N_0 and No. of bacteria at any time $t = N$

(3) Since bacterial growth is given as

$$N = N_0 e^{Kt}$$

Where K = growth constant for bacterial growth



Q3. Since, the reaction is elementary

(3) Rate = $k[A]^1[B]^1$

When V is reduced to $\frac{1}{3} V$, concentration will be tripled.

Hence, rate = $9 \times (\text{rate})_{\text{initial}}$

$$x = 9$$

Q4. For radioactive decay, decay constant does not depend upon temperature because for radioactive decay

(1) activation energy is zero.

Q5. $t_{1/2} = \frac{0.693}{K}$

(69) $K = Ae^{-E_a/RT}$

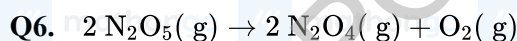
$$= 10^{20} \times e^{-\frac{191.48 \times 10^3}{8.314 \times 1000}}$$

$$= 10^{20} \times e^{-23.031} = 10^{20} \times e^{-\ln 10 \times 10}$$

$$= \frac{10^{20}}{10^{10}} = 10^{10} \text{ sec.}$$

$$t_{1/2} = \frac{0.693}{10^{10}} = 6.93 \times 10^{-11}$$

$$= 69.3 \times 10^{-12} \text{ sec.}$$



(897) $k = \frac{2.303}{t} \log \frac{0.9 - 0.6}{(0.9 - x)}$

$$2 \times 10^{-2} \times 100 = \log \frac{0.3}{(0.9 - x)}$$

$$100 = \frac{0.3}{(0.9 - x)}$$

$$= \frac{0.9 - x}{0.3} = 0.01$$

$$0.9 - X = 0.003$$

$$= 897 \times 10^{-3}$$

Q7. $\frac{t_1}{2} \propto (C_0)^{1-\eta}$

(2) $\frac{t_1}{t_2} = \left(\frac{C_1}{C_2}\right)^{1-\eta}$

$$\Rightarrow \frac{200}{100} = \left(\frac{0.100}{0.025}\right)^{1-\eta}$$

$$\Rightarrow 2 = (4)^{1-\eta}$$

$$(1 - \eta) = \frac{1}{2}$$

$$\eta = \frac{1}{2}$$

For $\eta = \frac{1}{2}$

$$\frac{-dA}{dt} = k(A)^{\frac{1}{2}}$$

$$\int_{C_0}^C \frac{dA}{(A)^{\frac{1}{2}}} = - \int_0^t k dt$$

$$\Rightarrow 2 A^{\frac{1}{2}} = -kt$$

$$\Rightarrow \sqrt{C} - \sqrt{C_0} = \frac{-kt}{2}$$

$$\sqrt{C} - \sqrt{C_0} = \frac{kt}{2}$$

For $C_0 = 0.1 \Rightarrow t_{\frac{1}{2}} = 200 \text{ min}$

$$\sqrt{\frac{C_0}{2}} = \sqrt{C_0} - \frac{kt}{2}$$

$$\frac{kt}{2} = \sqrt{C_0} - \sqrt{\frac{C_0}{2}}$$

$$\frac{kt}{2} = \sqrt{C_0} \left(\frac{\sqrt{2}-1}{\sqrt{2}} \right)$$

$$t_{\frac{1}{2}} = \frac{2\sqrt{C_0}}{k} \left(\frac{\sqrt{2}-1}{\sqrt{2}} \right)$$

$$200 = \frac{2\sqrt{0.1}}{k} \left(\frac{\sqrt{2}-1}{\sqrt{2}} \right)$$

$$k = \frac{\sqrt{0.1}}{100} \left(\frac{\sqrt{2}-1}{\sqrt{2}} \right)$$

For $C_0 = 1M$

$$t_{\frac{1}{2}} = \frac{2 \times 100(\sqrt{2})}{\sqrt{0.1}(\sqrt{2}-1)} \times \frac{(\sqrt{2}-1)}{\sqrt{2}}$$

$$\Rightarrow 200\sqrt{10} \text{ min.}$$

$\Rightarrow B$ is correct

C is incorrect

For $C_0 = 1.6M$

$$t_{\frac{1}{2}} = \frac{2\sqrt{1.6}(\sqrt{2})(\sqrt{2}-1) \times 100}{\sqrt{0.1}(\sqrt{2}-1)(\sqrt{2})}$$

$$t_{\frac{1}{2}} = 400 \times 2 \text{ min}$$

$$t_{\frac{1}{2}} = 800 \text{ min}$$

Q8. Drug X $\xrightarrow{\text{1st order}}$ Product

(2) Initial concentration of drug = 16mg/mL

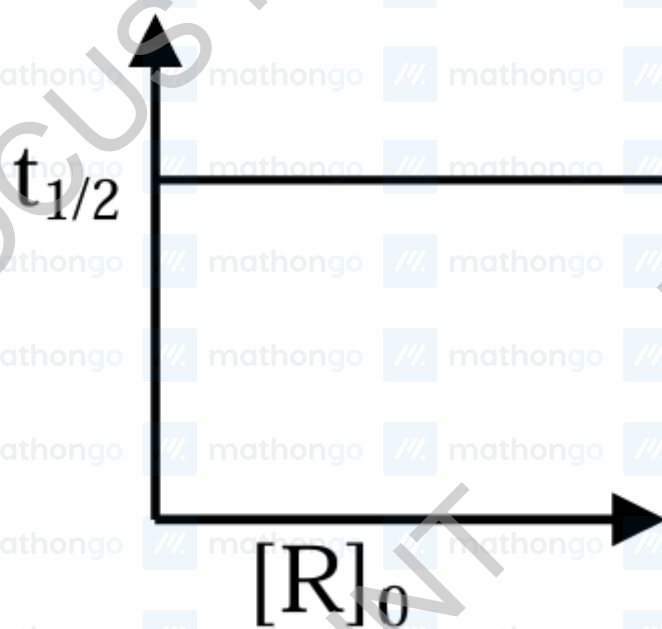
Concentration of drug after 12 months = 4mg/mL

Half life of drug = 6 months

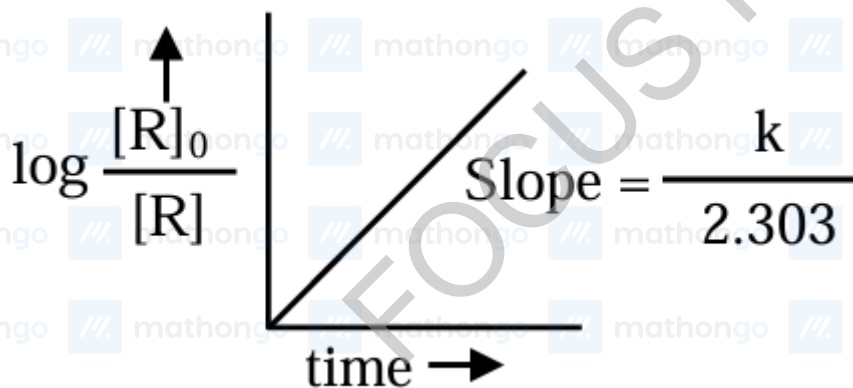
Drug become ineffective after 50% decomposition. The expiry time of drug = 6 months

Q9. For first order reaction $t_{1/2} = \frac{\ln 2}{k}$

(1)



For first order reaction



$$\log \frac{[R]_0}{[R]} = \frac{1}{2.303} kt$$

$$\log \frac{[R]_0}{[R]} = \left(\frac{k}{2.303} \right) \times t$$

Q10. rate = $k_2[A][B_2]$

$$(4) \left(\frac{k_1}{k_{-1}} \right) = \left(\frac{[A]^2}{[A_2]} \right)$$

$$\Rightarrow [A] = \sqrt{\frac{k_1}{k_{-1}}} \cdot \sqrt{[A_2]}$$

Substituting in (1); we get

$$\text{Rate} = k_2 \sqrt{\frac{k_1}{k_{-1}}} \cdot [A_2]^{\frac{1}{2}} \cdot [B_2]$$

$$\therefore \text{order} = \left(\frac{3}{2} \right) = 1.5$$

Q11. Activation energy of forward reaction = $E_1 + E_2$

(2) Energy of product > Energy of reactant

Stability

Reactant > Product

Q12. k_1, k_2 and k_3 are given as rate constants of three steps of a complex reaction. Rate constant (k) of the overall

(20) reaction is given as

$$k = \sqrt{\frac{k_1 k_3}{k_2}}$$

Activation energies of the three steps are given as

$$E_{a_1} = 60 \text{ kJ mol}^{-1}, E_{a_2} = 30 \text{ kJ mol}^{-1},$$

$$E_{a_3} = 10 \text{ kJ mol}^{-1}$$

From Arrhenius equation, we know that

$$k = A e^{-E_a/RT}$$

If E_a is the activation energy of the overall reaction, then

$$E_a = \frac{1}{2} [E_{a_1} + E_{a_3} - E_{a_2}]$$

$$= \frac{1}{2} [60 + 10 - 30] = 20 \text{ kJ mol}^{-1}$$

Q1. Analyzing Statement (I)

(4) The extreme left of the periodic table corresponds to the alkali metals (Group 1) and alkaline earth metals (Group 2).

These metals typically form basic (or occasionally amphoteric, in the case of some Group 2 elements) oxides, not acidic oxides.

For example, Na_2O , K_2O , MgO , CaO , etc., all form basic solutions (e.g., $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$).

Hence, Statement (I)-that an element in the extreme left forms acidic oxides-is false.

Analyzing Statement (II)

The extreme right of the periodic table corresponds to the nonmetals in Groups 15, 16, 17 (and noble gases in Group 18).

Nonmetal oxides (such as those of sulfur, phosphorus, chlorine) are generally acidic.

When these oxides dissolve in water, they typically form acids.

Example: $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$ (sulfuric acid)

Example: $\text{P}_2\text{O}_5 + 3\text{H}_2\text{O} \rightarrow 2\text{H}_3\text{PO}_4$ (phosphoric acid)

Example: $\text{Cl}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{HClO}_4$ (perchloric acid)

Thus, Statement (II)-that acid is formed when water reacts with an oxide of a reactive element in the extreme right-is true.

Conclusion

Statement (I) is false.

Statement (II) is true.

Q2. Correct order of atomic radii : Be < Mg > Al > Si

(2)

Q3. Law of octaves was arranged in the increasing order of their atomic weight.

(1) Lothar Meyer plotted the physical properties such as atomic volume, melting point and boiling point against atomic weight.

Q4. Palladium \Rightarrow 5th period

(4) Iridium, Osmium, Platinum \Rightarrow 6th Period

Q5. Properties of elements are function of atomic numbers.

(1) Elements having similar outer electronic configuration are arranged in same group.

Number of elements in a period is double of number of atomic orbitals available in energy level that is being filled.

Q6.	Li	Be	B	C	N	O	F
(4)	(E.N.)= 1	1.5	2	2.5	3	3.5	4.0

On
Pauling
scale

	Na	Mg	Al	Si	P	S	Cl
(E.N.)=	0.9	1.2	1.5	1.8	2.1	2.5	3.0

Correct order $Mg < Al < B < N$

Q7. Ionic radii $-Al^{3+} < Mg^{2+} < Na^{+} < F^{-}$

(1) Ionisation energy - $B < C < O < N$
Metallic character $-B < Al < Mg < K$

Electron negativity $-Si < P < S < Cl$

Q8. The successive 5 ionisation energies of an element are 800, 2427, 3658, 25024 and 32824 kJ/mol, respectively.

$$(1) \frac{IE_2}{IE_1} = \frac{2427}{800} = 3.03$$

$$\frac{IE_3}{IE_2} = \frac{3658}{2427} = 1.51$$

$$\frac{IE_4}{IE_3} = \frac{25024}{3658} = 6.84$$

$$\frac{IE_5}{IE_4} = \frac{32824}{25024} = 1.31$$

Since (IE_4/IE_3) value is maximum, the element belongs to group 13.

Q9. The element having high value of Electron gain enthalpy (magnitude) will form a compound having higher ionic character so order of ionic character



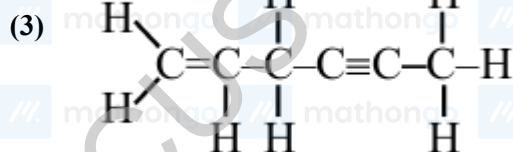
Q10. Among given atoms, Boron has least atomic radius oxide of Boron $= B_2O_3$

(2)

Q11. The main component of apatite family is phosphorus.

(3) Order of IE_1 of group 15 elements $N > P > As > Sb$ IE of phosphorus $= 1012 \text{ kJ mol}^{-1}$.

Q1.



σ bonds = 13

π bonds = 3

Q2. $Cl - Be - Cl$ $N \equiv N : \rightarrow O$

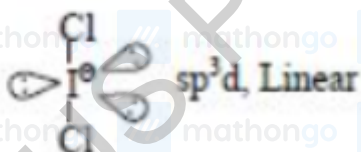
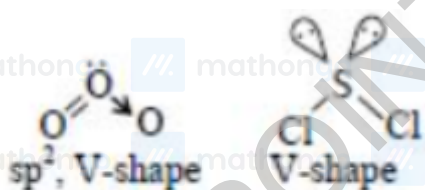
(6) sp , linear sp , linear

$N^- = N^+ = N^-$ $O = N^+ = O$

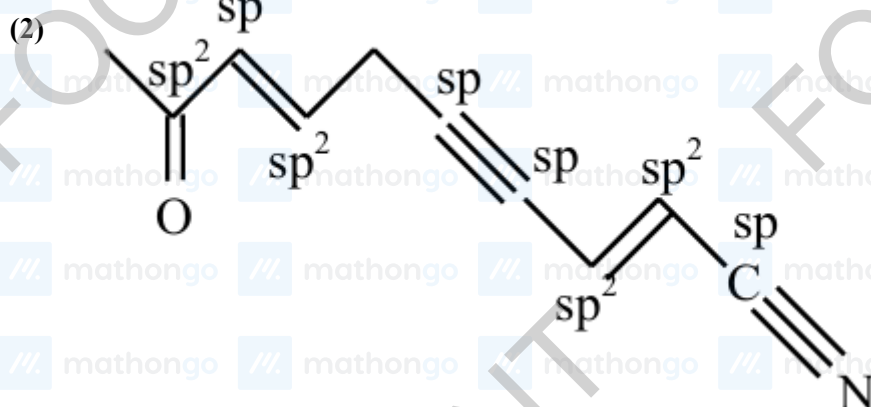
sp , linear sp , linear

like I_3^- , $XeF_2 \rightarrow sp^3d_1$, Linear

Ans. = 4



Q3.



Number of sp and sp^2 hybridised carbon atom are 3 and 5.

Q4. $NO = 7e^-$ Incomplete octet with

(2) $NO_2 = 7e^-$ } odd electron

$BCl_3 = 6e^-$ } Incomplete octet

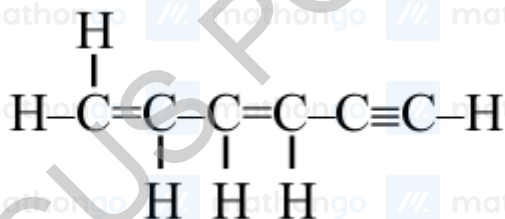
$AlCl_3 = 6e^-$ }

$H_2SO_4 = 12e^-$, $PCl_5 = 10e^- \Rightarrow$ molecules with expanded octet

$CCl_4 = 8e^-$, $CO_2 = 8e^- \Rightarrow$ molecules obeying octet rule

Q5.

(15)



Number of σ bond = 11

Number of π bond = 4

$\sigma + \pi = 11 + 4 = 15$

Q6. First ionization energy of Lead = 715 kJ mol^{-1}

(2) First ionization energy of Tin = 708 kJ mol^{-1}

(IE_1) of Lead is greater than that of Tin due to ineffective shielding of d - and f -electrons.

Therefore Statement-I is true.

First ionization energy of Germanium = 761 kJ mol^{-1}

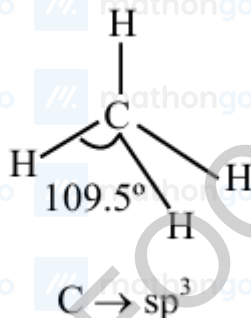
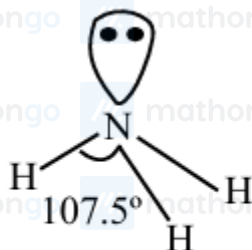
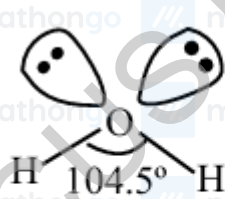
First ionization energy of Silicon = 786 kJ mol^{-1}

(IE_1) of Germanium is lower than that of Silicon as the effect of higher atomic radius of Ge outweighs the increase in nuclear charge from Si to Ge and effective shielding of inner electrons.

Therefore Statement-II is false.

Q7.

(1)



Dipole moment $\text{H}_2\text{O} > \text{NH}_3 > \text{CH}_4$

H_2O & NH_3 are Lewis Bases

NH_3 act as Lowry- Bronsted base

Hence, A, B & C are correct

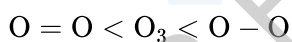
Q8.

(3)

Bond	(O - O) Bond order
(O - O)	1.0
	1.5
O = O	2.0

Bond length $\propto \frac{1}{\text{Bond order}}$

Order of O – O bond length



∴ Statement I is true.

Lone pair-lone pair repulsion between O-atoms is not solely responsible for the correct order of O-O bond length. Bond order also should be considered.

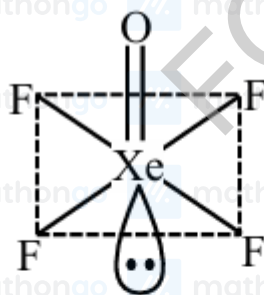
∴ Statement II is false.

Q9.

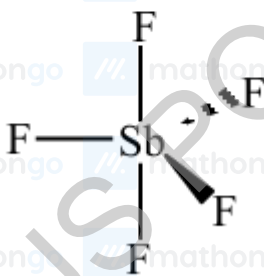
(4)



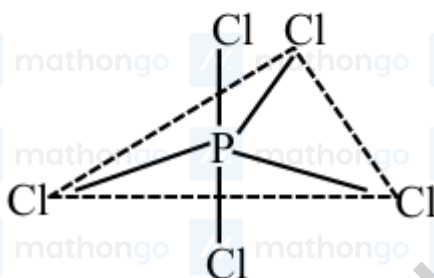
Square pyramidal



Square pyramidal



Trigonal Bipyramidal



Trigonal Bipyramidal

BrF_5 : Square pyramidal

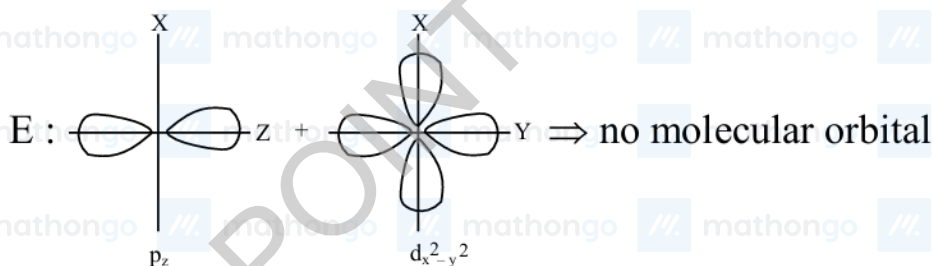
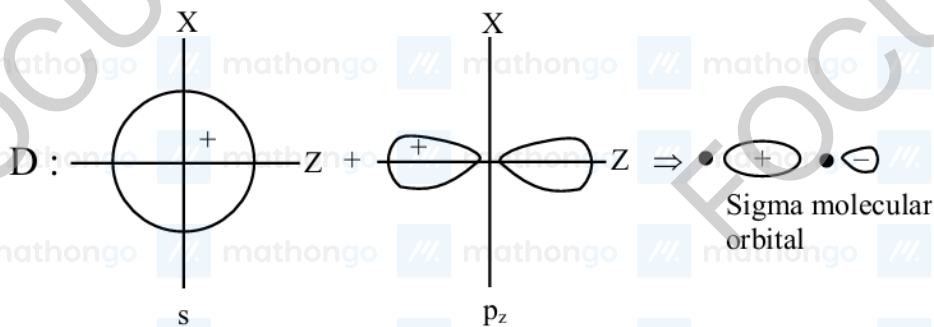
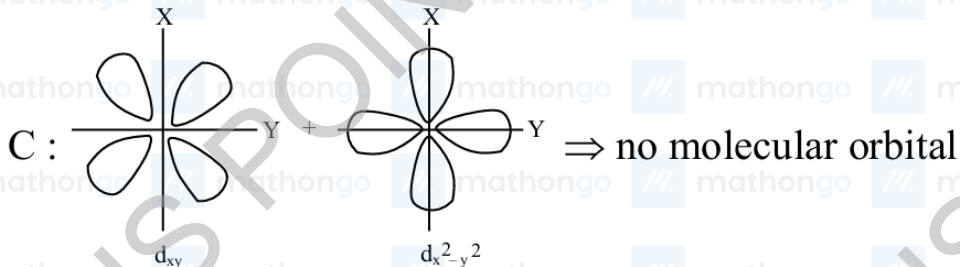
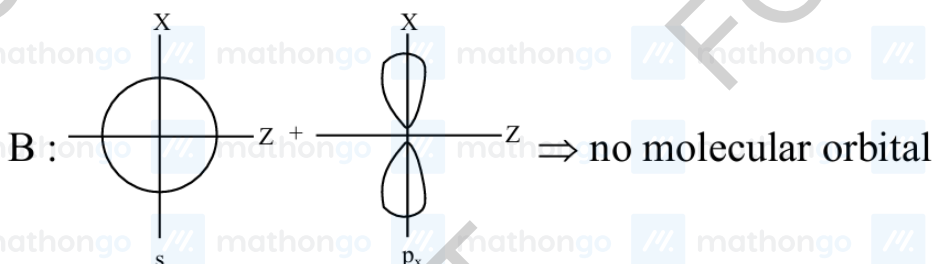
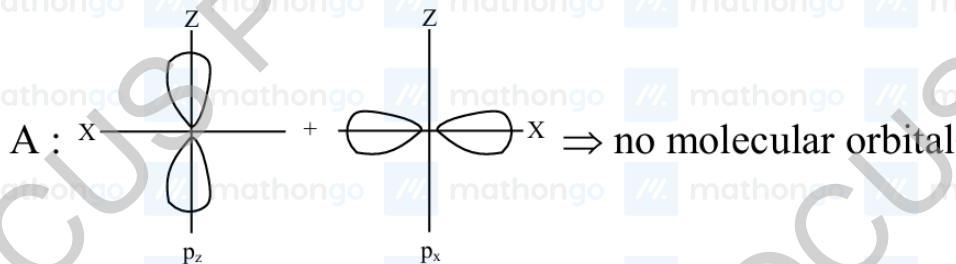
$XeOF_4$: Square pyramidal

SbF_5 : Trigonal bipyramidal

PCl_5 : Trigonal bipyramidal

Q10.

(2)



Q11. $O_2 \rightarrow$ 2 unpaired electrons according to MOT

(6) $O_2^+ \rightarrow$ 1 unpaired electrons according to MOT

$O_2^- \rightarrow$ 1 unpaired electrons according to MOT

NO \rightarrow odd electron species

NO₂ \rightarrow odd electron species

K₂ [NiCl₄] \rightarrow Ni²⁺ \Rightarrow 3 d⁸ weak Ligand, C.N. = 4

\Rightarrow Tetrahedral, Paramagnetic with 2 unpaired electrons

Q12. $\mu_{\text{HBr}} = 0.78\text{D}$

(2) $\mu_{\text{H}_2\text{S}} = 0.95\text{D}$

$\mu_{\text{NF}_3} = 0.24\text{D}$

$\mu_{\text{CHCl}_3} = 1.01\text{D}$

Hence dipole moment of

NF₃ < HBr < H₂S < CHCl₃

Q13. Melting point order

(2) Fe > Mn

Ru > Tc

Re > Os

Q1. Among Al, In, Tl, Ge, Sn, Pb, the metal having highest IE_1 is Ge and lowest IE_1 is In.

(3) Most stable oxidation state of Ge is +4 and In is +3.

Q2. Order of M.P. of group 14: C > Si > Ge > Pb > Sn

(4) element M.P. ($^{\circ}\text{C}$)

Z = 6 = C 3730

Z = 14 = Si 1410

Z = 32 = Ge 937

Z = 50 = Sn 232

Z = 82 = Pb 327

Q1. SO_2 can act as both oxidising agent as well as reducing agent because due to intermediate oxidation state, it can oxidise and reduce as well.

Q2. Phosphorus belongs to 15th group and forms $d\pi - d\pi$ bond with transition metal and PH_3 is strongest base (15) among the other group members except NH_3 .

Q3. $\text{N} - \text{N} < \text{P} - \text{P}$: single (σ) bond strength

(1) Due to L.P.-L.P. repulsion

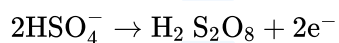
and maximum possible covalency of nitrogen is 4.

Q4. The large difference in the melting and boiling points of oxygen and sulphur is due to atomicity as oxygen exists

(1) as O_2 and sulphur exists as S_8 .

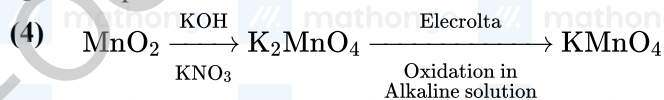
Q5. Theory based.

(4) At anode :



- Q1. - Bronze is an alloy of copper and Tin. (A-IV)
 (2) - Brass is an alloy of copper and Zinc. (B-III)
 - UK Silver coin is an alloy of copper and Nickel. (C-I)
 - Stainless steel is an alloy of Fe, Cr, Ni, C. (D-II)

Q2. Preparation of KMnO_4



Q3. $Z = 41 \rightarrow \text{Nb}$ (Niobium) : $[\text{Kr}]_{36} 4d^4 5s^1$

(11) Number of electron in $4d = 4 = x$

$Z = 44 \rightarrow \text{Ru}$ (Ruthenium) $[\text{Kr}]_{36} 4d^7 5s^1$

Number of electron in $4d = 7 = y$

$$x + y = 11$$

Q4. (1) V^{2+} (Violet), Cr^{3+} (Violet), Mn^{3+} (Violet)

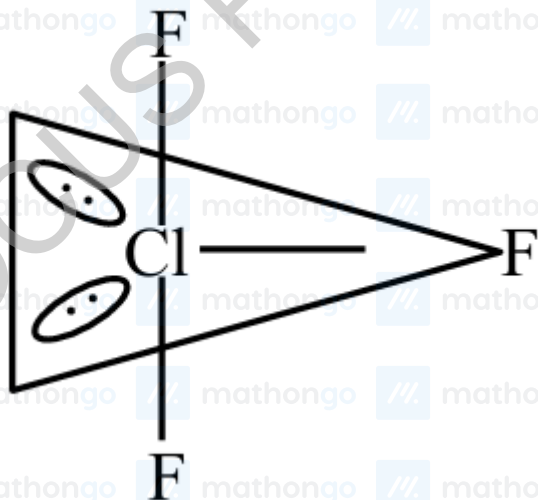
(2) (2) Zn^{2+} (Colourless), V^{3+} (Green), Fe^{3+} (Yellow)

(3) Ti^{4+} (Colourless), V^{4+} (Blue), Mn^{2+} (Pink)

(4) Sc^{3+} (Colourless), Ti^{3+} (Purple), Cr^{2+} (Blue)

Q5. ClF_3

(2)



$n = 2$ (No of lone pair present in equatorial plane) (Unpaired e^-)

(A) $\text{V}^{+3} : [\text{Ar}] 3d^2 \quad 2$

(B) $\text{Ti}^{3+} : [\text{Ar}] 3d^1 \quad 1$

(C) $\text{Cu}^{+2} : [\text{Ar}] 3d^9 \quad 1$

(D) $\text{Ni}^{+2} : [\text{Ar}] 3d^8 \quad 2$

(E) $\text{Ti}^{+2} : [\text{Ar}] 3d^2 \quad 2$

Q6. V_2O_5 is amphoteric oxide.

(4) V_2O_5 gives VO_4^{3-} on reaction with alkali oxidation state of V in $\text{VO}_4^{3-} = +5$

Q7. Strongest oxidising power among the option is Mn_2O_3 because of E° value

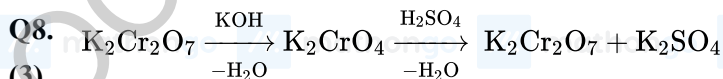
(5) $E^\circ_{\text{Mn}^{+3}/\text{Mn}^{+2}} = +1.57 \text{ V}$



$\mu = \sqrt{24\text{BM}}$

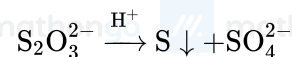
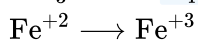
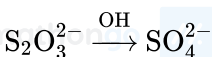
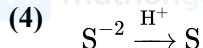
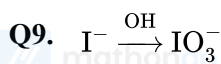
$= 4.89\text{BM}$

$\Rightarrow 5$



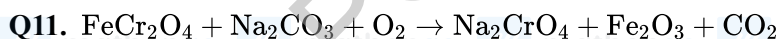
(3) [A]

[B]



Q10. As_2S_3 and As_2S_5 are yellow colour sulphides, $(\text{NH}_4)_2\text{S}$ is colourless, PbS is black, CuS is black in colour

(2)

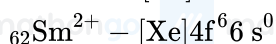
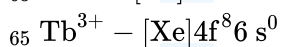
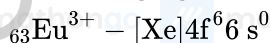
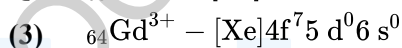
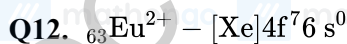


(160) Insoluble product will be Fe_2O_3

molar mass = $56 \times 2 + 16 \times 3$

$= 112 + 48$

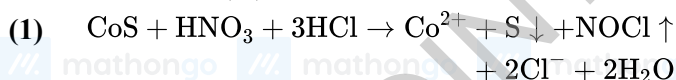
$= 160$



Q13. Tb^{4+} is strongest oxidising agent as it will reduce to Tb^{3+} (common O.S. of Ln)

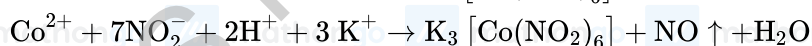
(2)

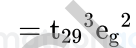
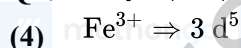
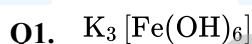
Q14. Compound (A) in the given reaction sequence is likely to be CoS .



The above solution is neutralised with NH_4OH .

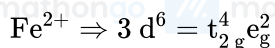
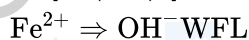
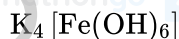
To a neutral solution of Co^{2+} , acetic acid and saturated solution of KNO_2 are added which results in the formation of yellow precipitate of $\text{K}_3[\text{Co}(\text{NO}_2)_6]$





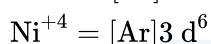
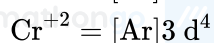
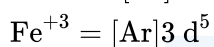
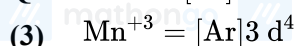
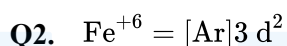
Number of unpaired electron (n) = 5

μ spin only = 5.92BM

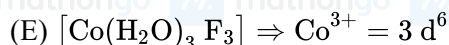
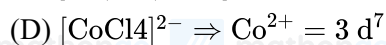
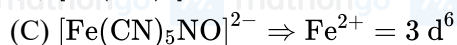
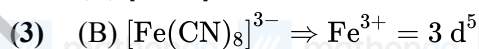
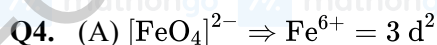
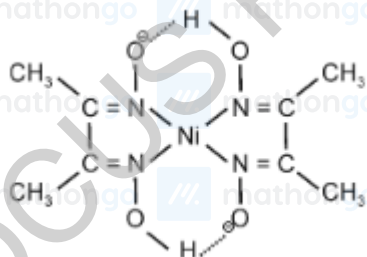


$n = 4$

$\mu_{spin\ only} = 4.90BM$

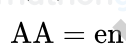
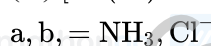
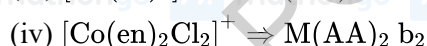
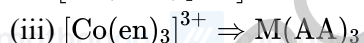
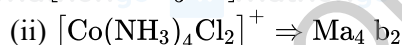
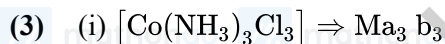


(14) The no. of H atoms = 14



(B) and (D) are homoleptic complex having odd no. of d electrons.

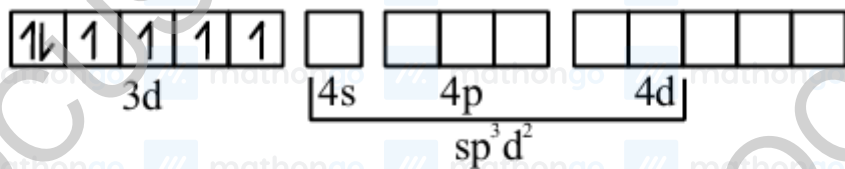
Q5. $Ma_3 b_3$ type complexes show Facial - Meridional isomerism



- Q6.** $[\text{NiCl}_4]^{2-}$
(3) $\text{Ni}^{+2} - [\text{Ar}]3d^8 4s^0 \rightarrow sp^3$, Tetrahedral
 Number of unpaired electron = 2 paramagnetic
 $[\text{Ni}(\text{CO})_4]$
 $\text{Ni}(0) \rightarrow [\text{Ar}]3d^{10} 4s^0$ (After rearrangement)
 No unpaired electron
 sp^3 , Tetrahedral, Diamagnetic
- Q7.** (A) $[\text{Fe}(\text{CN})_5\text{NO}]^{-2} \rightarrow$ Heteroleptic, Fe^{+2} , $3d^6$, $t_2g^6 e_g^0$, d^2sp^3 , Low spin (3 d series +SFL)
(2) (B) $[\text{CoF}_6]^{-3} \rightarrow$ Homoleptic, $sp^3 d^2$, High spin, Co^{+3} , $3d^6$ (3 d series + WFL)
 (C) $[\text{Fe}(\text{CN})_6]^{-4} \rightarrow$ Homoleptic
 Fe^{+2} , $3d^6$, d^2sp^3 , $t_2g^6 e_g^0$ Low spin
 (3 d series +SFL)
 (D) $[\text{Co}(\text{NH}_3)_6]^{+3} \rightarrow$ Homoleptic, Co^{+3} $3d^6$, d^2sp^3 ,
 $t_2g^6 e_g^0$, Low spin (3d series + SFL)
 (E) $[\text{Cr}(\text{H}_2\text{O})_6]^{+2} \rightarrow$ Homoleptic
 Cr^{+2} $3d^4$, d^2sp^3 , High spin $t_2g^3 e_g^1$
 (3d series + WFL)
- Q8.** $[\text{Co}(\text{NH}_3)_5\text{Cl}] \text{Cl}_2 \rightarrow \underbrace{[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}(\text{aq.}) + 2\text{Cl}^-(\text{aq.})}_{3 \text{ ions in water}}$
(3)
 $[\text{Co}(\text{NH}_3)_5\text{Cl}] \text{Cl}_2(\text{aq.}) + 2\text{AgNO}_3(\text{aq.}) \rightarrow$
 $[\text{Co}(\text{NH}_3)_5\text{Cl}](\text{NO}_3)_2(\text{aq.}) + 2\text{AgCl}(\text{s})$
- Q9.** $\text{Sc}^{+3} = 3d^0 \quad \therefore \mu_{\text{spin}} = 0$
(1) $\text{V}^{+2} = 3d^3 \quad \therefore \mu_{\text{spin}} = 3.87 \text{ B} \cdot \text{M.}$
 $\text{Ni}^{+2} = 3d^8 \quad \therefore \mu_{\text{spin}} = 2.84 \text{ B} \cdot \text{M.}$
 $\text{Ti}^{+3} = 3d^1 \quad \therefore \mu_{\text{spin}} = 1.73 \text{ B.M.}$

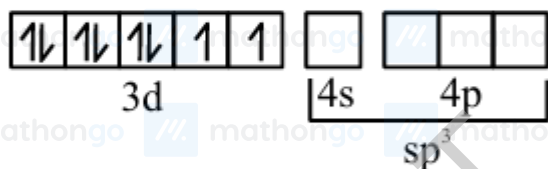
Q10. (A) $[\text{CoF}_6]^{-3}$

(4) $\text{Co}^{3+} \rightarrow 3d^6$



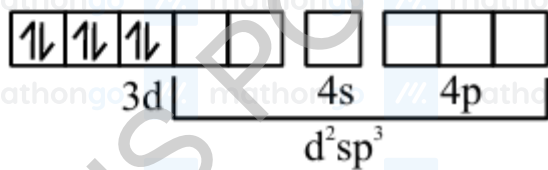
(B) $[\text{NiCl}_4]^{2-}$

$\text{Ni}^{2+} \rightarrow 3d^8$



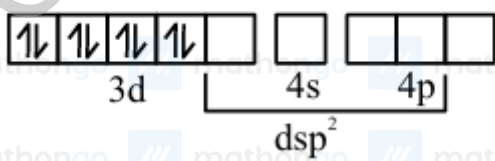
(C) $[\text{Co}(\text{NH}_3)_6]^{3+}$

$\text{Co}^{3+} \rightarrow 3d^6$



(D) $[\text{Ni}(\text{CN})_4]^{2-}$

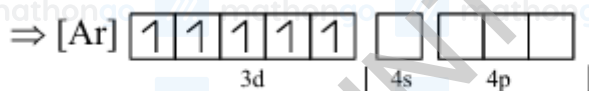
$\text{Ni}^{2+} \rightarrow 3d^8$



Q11. (A) $[\text{MnBr}_4]^{2-}$

(1) $\text{Mn}^{+2} \Rightarrow [\text{Ar}]3d^5$

In presence of ligand field



$\Rightarrow sp^3$ hybridization, paramagnetic in nature

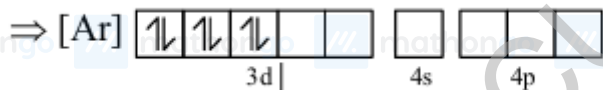
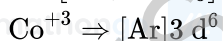
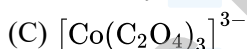
(B) $[\text{FeF}_6]^{3-}$

$\text{Fe}^{+3} \Rightarrow [\text{Ar}]3d^5$



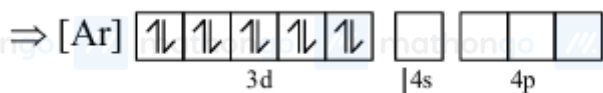
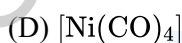
In presence of ligand field

$\Rightarrow sp^3 d^2$ hybridization, paramagnetic in nature



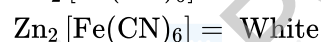
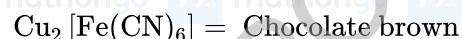
In presence of ligand field

$\Rightarrow d^2sp^3$ hybridization, diamagnetic in nature



In presence of ligand field

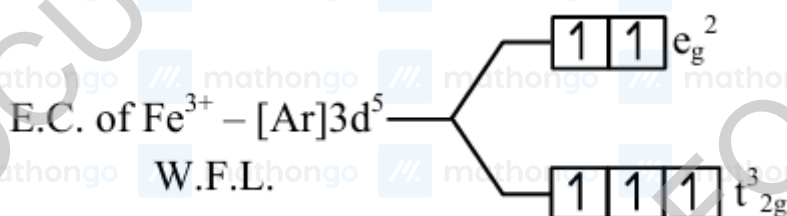
$\Rightarrow sp^3$ hybridization, diamagnetic in nature



Spin only magnetic moment of complex having Yellow colour is zero.



(4)



Calculation of CFSE

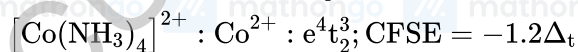
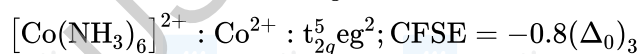
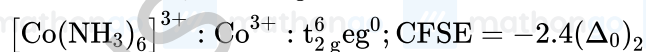
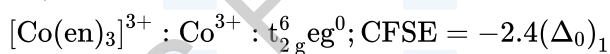
$$= (-0.4 \times 3 + 0.6 \times 2) \Delta_0$$

$$= 0 \Delta_0$$



Crystal field stabilisation energy (CFSE) = $[-0.4t_{2g} + 0.6 e_g] \Delta_0$ (for octahedral)

For,

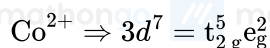


$$\left(\text{as } (\Delta_t) = \frac{4}{9}(\Delta_0)_3 \right)$$

$$\therefore \Delta_t < (\Delta_0)_3 < (\Delta_0)_2 < (\Delta_0)_1$$

Q15. Co^{2+} complex having $\mu = 3.95\text{BM}$

(3) Hence number of unpaired electron = 3



Q16. The conditions and consequence that favour $t_{2g}^3 e_g^1$ configuration in a metal complex are

(2) (i) weak field ligand, and

(ii) high spin complex

For weak field ligands, splitting energy (Δ_0) is lower than pairing energy (P). As a result distribution of electrons for $3d^4$ will be $t_{2g}^3 e_g^1$. It results in high spin complex due to maximum number of unpaired electrons.

Q17. Neglecting pairing energy

(2) I. $[\text{Mn}(\text{CN})\text{B}]^{3-} \Rightarrow \text{Mn}^{3+}, t_{2g}^4 e_g^0, \text{CFSE} = -0.4 \times 4\Delta_0 = -1.6\Delta_0$

II. $[\text{Co}(\text{CN})_8]^{4-} \Rightarrow \text{Co}^{2+}, t_{2g}^6 e_g^1, \text{CFSE} = -0.4 \times 6 + 0.6 \times 1 = -1.8\Delta_0$

III. $[\text{Fe}(\text{CN})_8]^{4-} \Rightarrow \text{Fe}^{2+}, t_{2g}^6 e_g^0, \text{CFSE} = -0.4 \times 6 = -2.4\Delta_0$

IV. $[\text{Fe}(\text{CN})_8]^{3-} \Rightarrow \text{Fe}^{3+}, t_{2g}^5 e_g^0, \text{CFSE} = -0.4 \times 5 = -2\Delta_0$

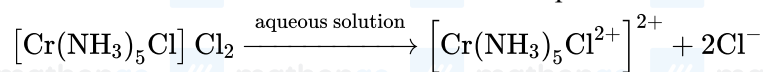
Order of stability III > IV > II > I

Q18. $\Delta T_f = iK_f m$

$$(1) 0.558 = i \times 1.86 \times 0.1$$

$$i = \frac{0.558}{0.186} = 3$$

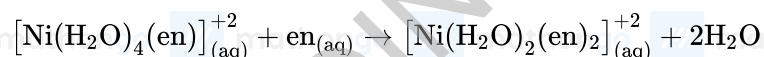
Number of ions when 100% ionisation takes place = 3



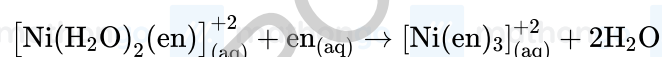
Number of ions = 3

Q19. $[\text{Ni}(\text{H}_2\text{O})_6]^{+2}_{(\text{aq})} + \text{en}_{(\text{aq})} \rightarrow [\text{Ni}(\text{H}_2\text{O})_4(\text{en})]^{+2}_{(\text{aq})} + 2\text{H}_2\text{O}$

(3) Green

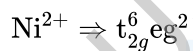


Pale Blue



Blue / purple

Q1. Ni^{2+} gives violet colour with borax bead test in nonluminous flame under hot conditions. Ni^{2+} has d^8 (3) configuration which does not depend on nature of ligand present in octahedral field.

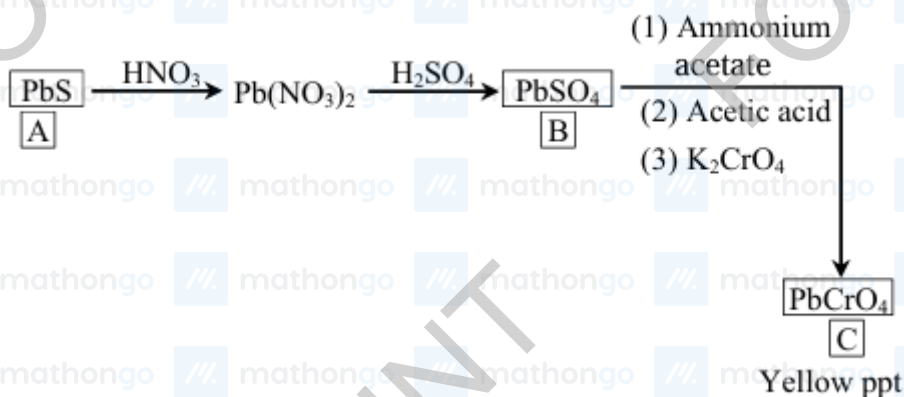


Q2. Only Cu^{2+} , Fe^{3+} , Ca^{2+} & Zn^{2+} form precipitate with $\text{K}_4[\text{Fe}(\text{CN})_6]$

(4)

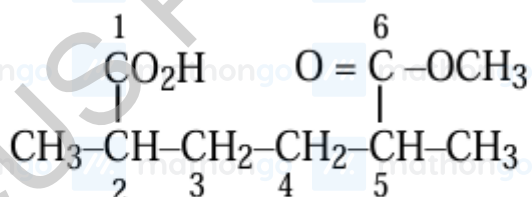
Q3.

(4)



Q1.

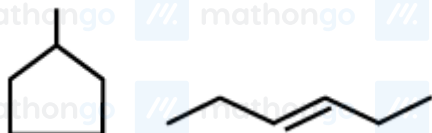
(3)



6-Methoxycarbonyl-2,5-dimethylhexanoic acid

Q2. Statement-I \rightarrow True

(2)



Both are ring chain isomers



Statement-II \rightarrow True

1° Amine and 2° Amine are different functional groups, hence both are functional group isomers.

Q3. Phase transfer from solid to vapour directly is known as sublimation.

(3)

Q4. Statement I is true.

(1) In partition chromatography, stationary phase is thin liquid film present in the inert support.

Statement II is false.

Because stationary phase in paper chromatography is water.

Q5. In Dumas method nitrogen present in organic compound is converted into N_2 gas whose volumetric analysis

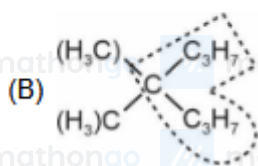
(1) gives the percentage of nitrogen atom in the organic compound.

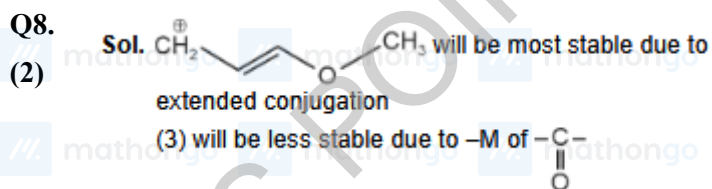
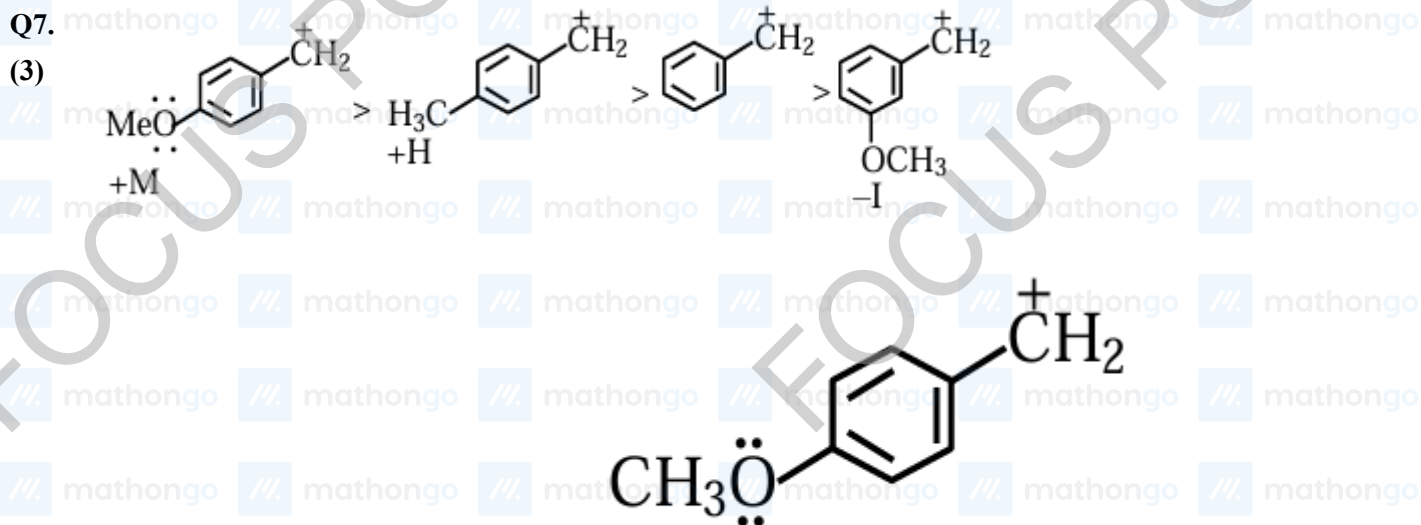
Q6. (A) $\text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH} - \text{C}_2\text{H}_5$

(1)

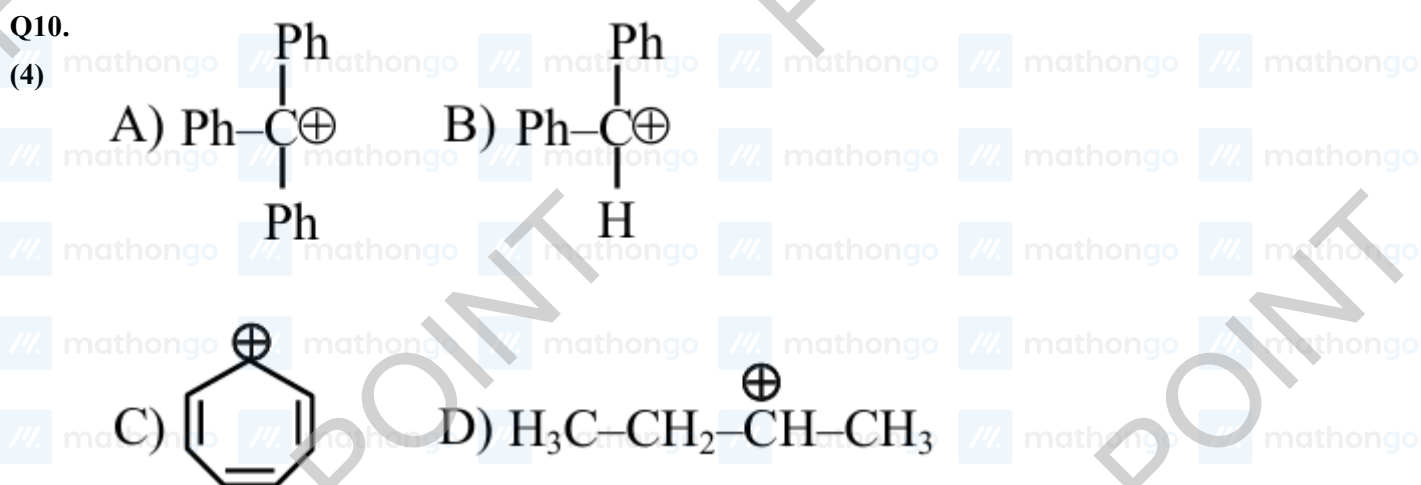


3-Ethyl-5-methylheptane





Q9. ---OCH_3 , NHCOCH_3 and ---OH are activating groups because the atom directly bonded to benzene ring activates the ring by +R effect using its lone pair of electrons. Activating groups are ortho- and para directing groups. ---CN and $\text{---SO}_3\text{H}$ are deactivating groups because the atom directly bonded to benzene is bonded to more electronegative atom through multiple bonds and they are meta directing groups due to -R effect. Halides are deactivating groups due to -I effect.



C is aromatic due to \oplus ve charge hence it is most stable

A have more resonance structure

B have less resonance structure

D have only hyper conjugation

Consider First Aromaticity > Resonance > Hyper conjugation

Ans. $D < B < A < C$

Q11. q is aromatic

(1) r is non-aromatic

p is antiaromatic

$q > r > p$ (order of stability)

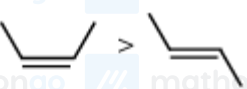
Aromatic > non-aromatic > antiaromatic

Q12. Total five nucleophiles are present

(4) $\text{NH}_3, \text{PhSH}, (\text{H}_3\text{C})_2\text{S}, \text{CH}_2 = \text{CH}_2, \overset{\ominus}{\text{O}}\text{H}$

Q13. (A) $\text{CH}_3 - \text{CH} = \text{CH}_2$. GI is not possible

(2) (B) Trans isomer has identical atoms/groups on the opposite side of double bond.

(C)  (dipole moment only)

(D)
$$\begin{array}{c} \text{H}_3\text{C}-\text{C}=\text{CH}-\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$$
 (does not show GI)
2-methylbut-2-ene

(E)  (Melting point)

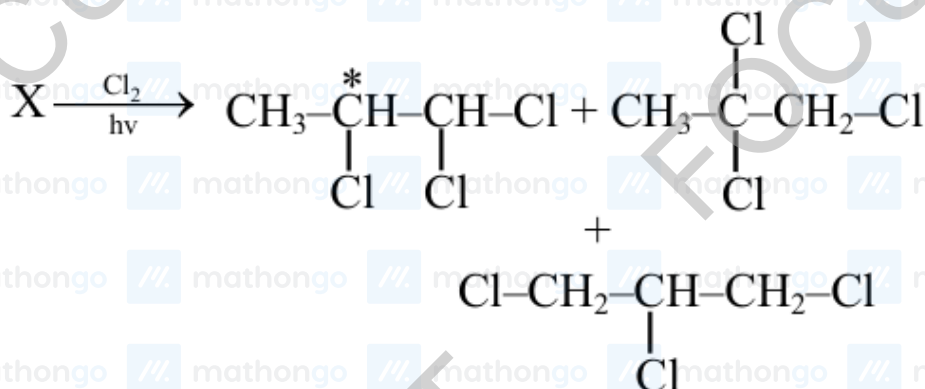
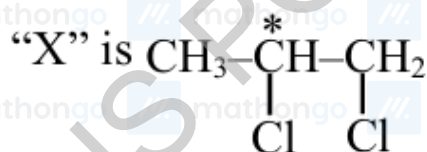
Q14. $\text{CH}_3-\underset{\text{OH}}{\text{CH}}-\text{CH}=\text{CH}-\text{CH}_3$

(3)

It has 4 stereoisomers $\left[\begin{array}{cc} R \text{ cis} & R \text{ trans} \\ S \text{ cis} & S \text{ trans} \end{array} \right]$

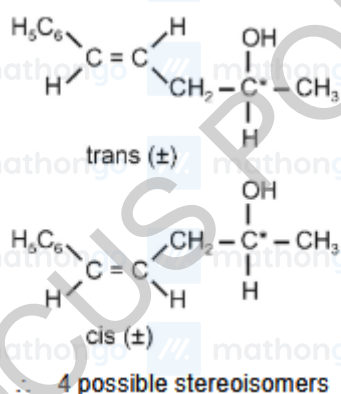
Q15.

(4)



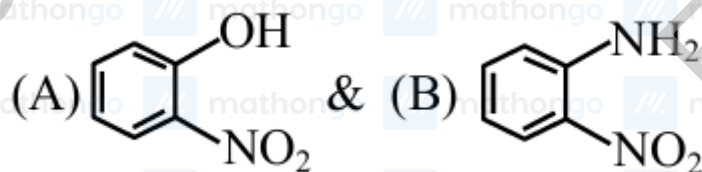
Q16. The given compound is 5-phenylpent-4-en-2-ol. Possible stereoisomers are

(4)



Q17.

(4)



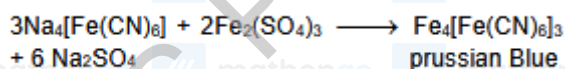
are steam volatile due to intramolecular hydrogen bonding.

Q18. The elements present in the compound are converted from covalent form into ionic form by fusing the

(4) compound with sodium in Lassaigne's test

Q19. Lassaigne's test is a general test for detection of halogen, nitrogen and sulphur in an organic compound. These

(1) elements covalently bonded to the organic compounds, In order to detect them, these have to converted into ionic forms.



$$\text{Q20. } n_{\text{Cl}} = n_{\text{AgCl}} = \frac{143.5 \times 10^{-3}}{143.5} = 10^{-3}$$

$$(20) \quad \% \text{Cl} = \frac{10^{-3} \times 35.5}{180 \times 10^{-3}} \times 100 = 19.72$$

$$\text{Q21. } m \text{ mole of BaSO}_4 = \text{mmoles of S} = \frac{466}{233}$$

$$(40) \quad \text{Mass of S} = \frac{466}{233} \times 32 \text{mg} \\ = 64 \text{mg}$$

$$\% \text{S} = \frac{64}{160} \times 100 = 40\%$$

Q22. Mass of organic compound = 0.25 g

(255) Mass of AgBr = 0.15 g

$$\text{No. of moles of Br} = \text{No. of moles of AgBr} = \frac{0.15}{188}$$

$$\text{Mass of Br} = \frac{0.15 \times 80}{188} \text{ g}$$

$$\% \text{ of Br} = \frac{0.15 \times 80 \times 100}{188 \times 0.25}$$

$$= 25.5\%$$

$$= 255 \times 10^{-1}\%$$

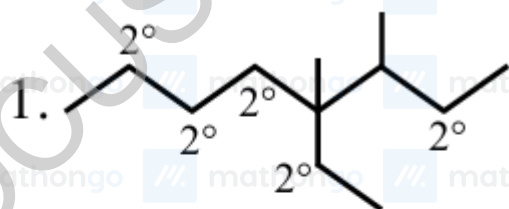
Q23. Organic Compound \rightarrow BaSO₄

$$(275) \quad \begin{array}{l} 0.20 \text{gm} \qquad \qquad \qquad 0.40 \text{gm} \\ \qquad \qquad \qquad \qquad \qquad \frac{0.40}{233} \text{ mol (BaSO}_4\text{)} \\ \qquad \qquad \qquad \qquad \qquad \frac{0.40}{233} \text{ mol (Sulphur)} \\ \qquad \qquad \qquad \qquad \qquad \frac{0.40}{233} \times 32 \text{gm (sulphur)} \end{array}$$

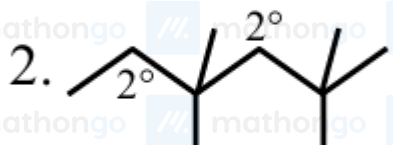
$$\% \text{ S} = \frac{\frac{0.40 \times 32}{233} \times 100}{0.20} = 27.5\% \text{ or } 275 \times 10^{-1}\%$$

Q1.
(2)

Alkane

 2°H 

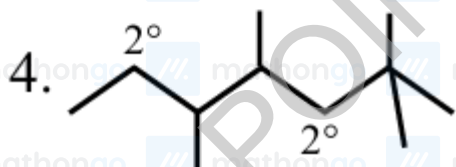
10



4



2



4

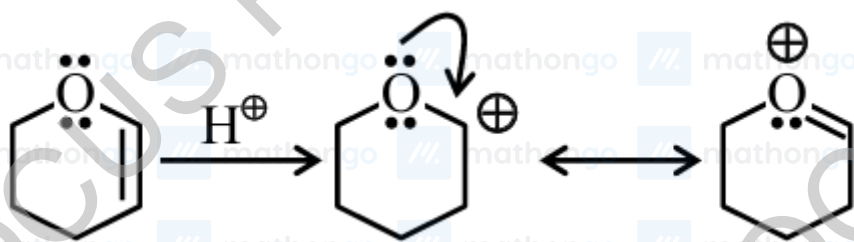
Q2.
(4)

LIST-I		LIST-II	
Name reaction		Product obtainable	
A.	Swarts reaction	I.	$\text{Et} - \text{I} \xrightarrow[\text{DF}]{\text{KFEt} - \text{F}}$
B.	Sandmeyer's reaction	II.	$\text{PhN}_2^+\text{Cl}^- \xrightarrow[\text{CuCN/KCN}]{\text{PhCN} + \text{N}_2}$
C.	Wurtz Fittig reaction	III.	$\text{Ph} - \text{Cl} + \text{EtCl} \xrightarrow[\text{ether}]{\text{Na}}$ $\text{Ph} - \text{Et} + \text{Ph} - \text{Ph} + \text{Et} - \text{Et}$
D.	Finkelstein reaction	IV.	$\text{Et} - \text{Cl} \xrightarrow[\text{actone}]{\text{NaI}} \text{Et} - \text{I} + \text{NaCl}$

Q3. Addition of $\text{H} - \text{Br}_{(\text{aq})}$ to alkene follows electrophilic addition mechanism. In the rate determining step a carbocation intermediate is formed. Among P, Q, R & S compound Q will form most stable carbocation

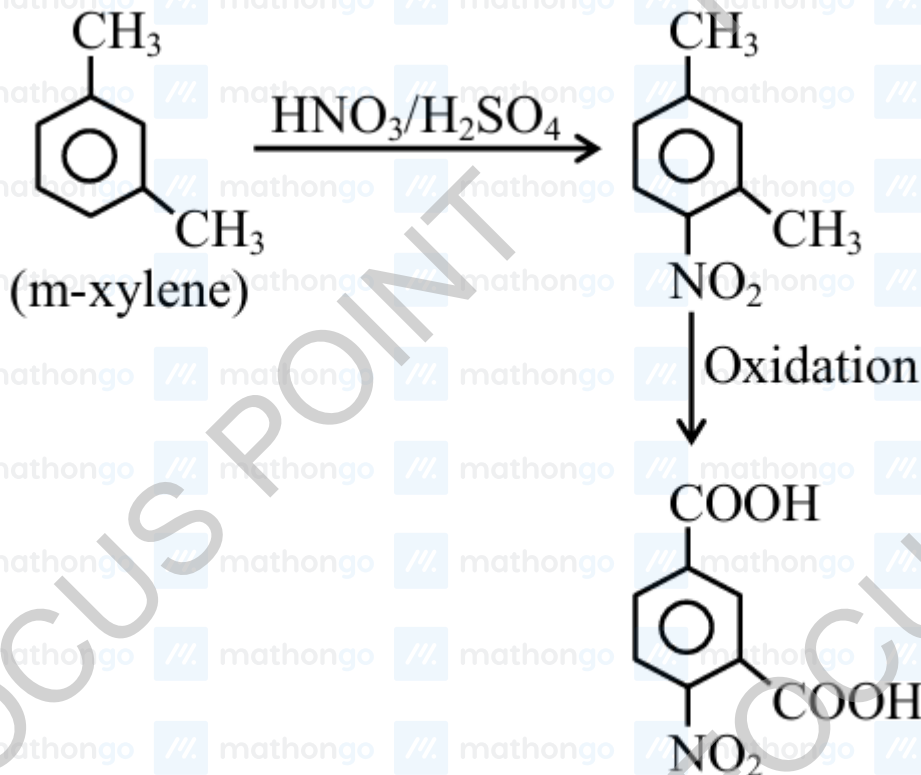
(3)

intermediate since it is resonance stabilized.



Q4. Statement - I

(4)



Statement-II $-\text{CH}_3$ group is o/p directing while $-\text{NO}_2$ group is meta directing.

Q5. $\text{CH}_3 - \text{C} \equiv \text{CH} + \text{Na} \rightarrow \text{CH}_3 - \text{C} \equiv \text{C}^- \text{Na}^+ + \frac{1}{2} \text{H}_2$

(3) Statement-I is correct.

Moles of $\text{C}_3\text{H}_4 = \frac{4}{40} = 0.1$ mole

$\text{CH}_3 - \text{C} \equiv \text{CH} + \text{NaNH}_2 \rightarrow \text{CH}_3 - \text{C} \equiv \text{C}^- \text{Na}^+ + \text{NH}_3$

0.1 mole

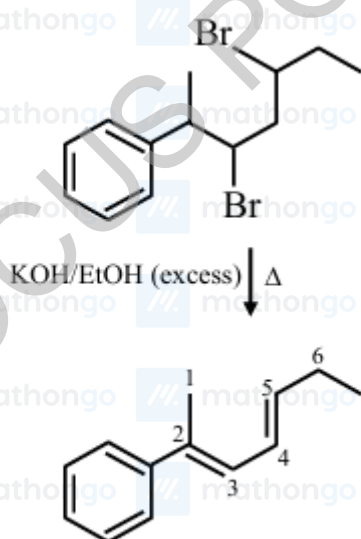
0.1 mole

Volume of $\text{NH}_3 = (0.1)(22.4) = 2.24$ L

Statement-II is incorrect.

Q9.

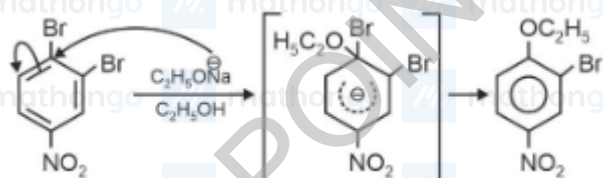
(4)



2-Phenylhepta-2,4-diene

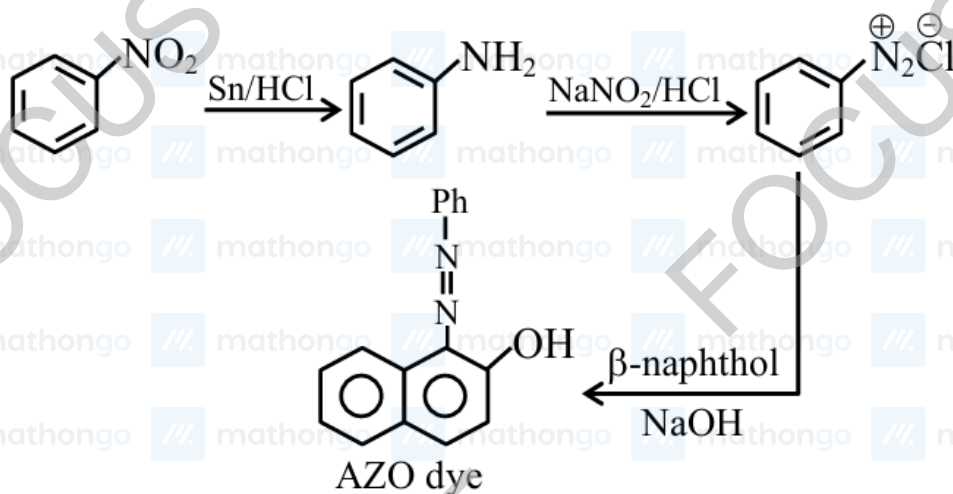
Q10. Br at the para of NO_2 will undergo aromatic nucleophilic substitution by nucleophile $\text{C}_2\text{H}_5\text{ONa}$.

(4)



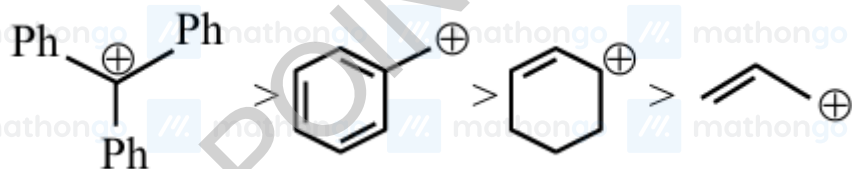
Q11.

(1)



Q12. Stability order of carbocation

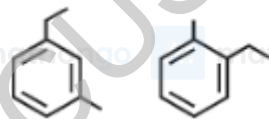
(3)



Q13. Degree of unsaturation = $C + 1 - \frac{H}{2}$

(2) $= 9 + 1 - 6 = 4$

Benzene shows negative Baeyer's test



Both compounds have four different non-aliphatic substitution sites.

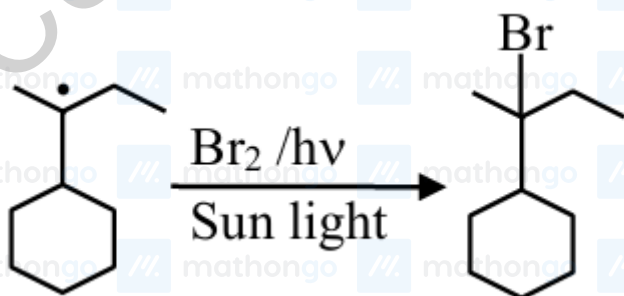
Q1. Both statement-I and statement-II are correct

(2) Statement - I: $\text{CH}_3 - \text{O} - \overset{\oplus}{\text{C}} \text{H}_2$ is highly stable carbocation.

Statement - II: Due to hindrance, $\text{S}_{\text{N}}2$ will not take place easily.

Q2.

(3)



Formation of more stable free radical intermediate

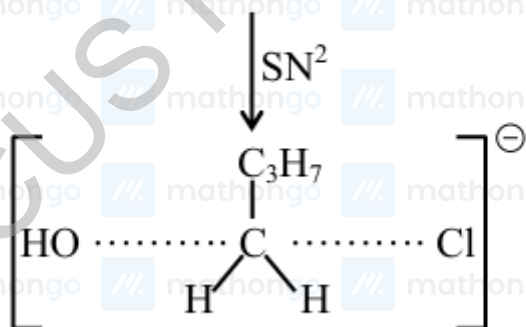
Q3. Since 4 moles of H_2 is being added for complete hydrogenation the degree of unsaturation = 4

(8) No. of π electrons in $\text{C}_6\text{H}_6 = 4 \times 2 = 8$

Q4.

(1) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{Cl} + \text{OH}^-$

Reactant (higher charge density)

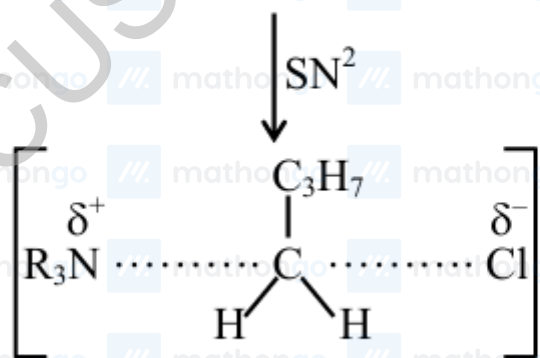


Transition state (less charge density)

\Rightarrow This reaction will proceed faster in less polar medium which will not increase the activation energy value.



Reactant (low charge density)

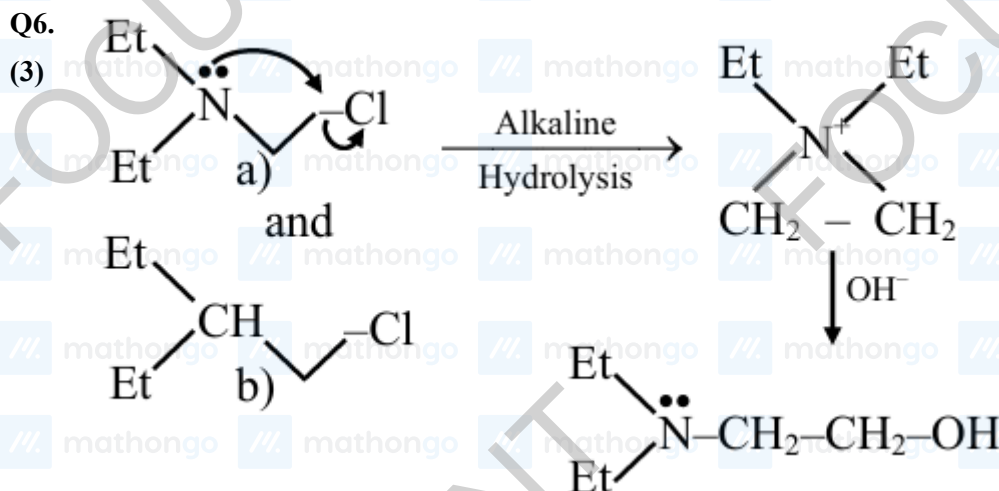
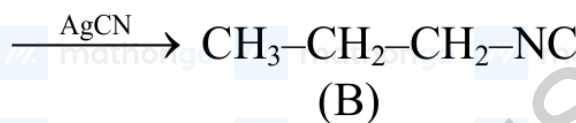


Transition state (Higher charge density)

⇒ This reaction will proceed faster in more polar medium which will decrease the activation energy value.

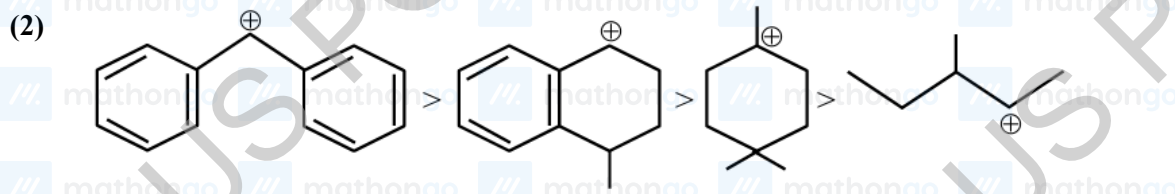


(A)



Rate of (a) is faster than rate of (b) because it is an intramolecular substitution.

Q7. Solvolysis or $\text{S}_{\text{N}}1 \propto$ stability of carbocation Stability order



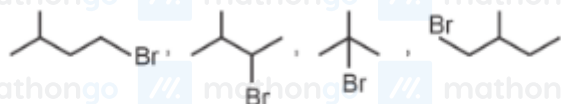
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Q8. Haloalkanes react with AgCN to give isocyanide as major product and haloarenes do not react with AgCN.



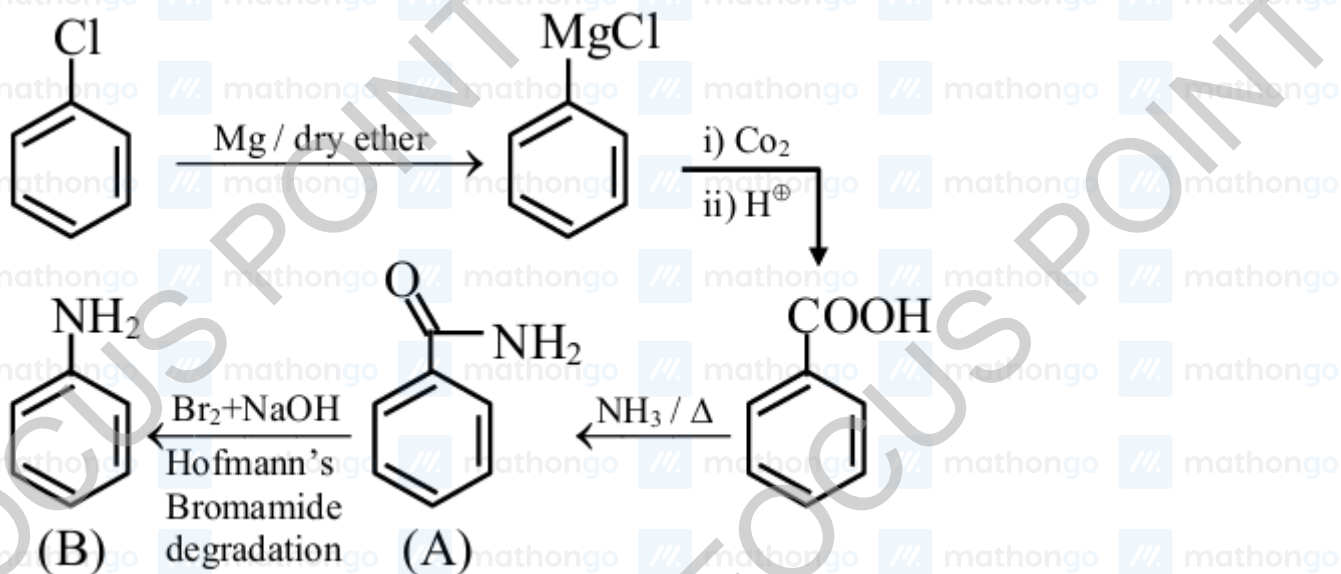
Q9. $RBr \xrightarrow[\text{dry Ether}]{Mg} RMgBr \xrightarrow{H_2O} R-H$

(2) Hence, RBr Can be



Total 4 Structural isomers.

Q10. (93)



No. of moles of = No. of moles of

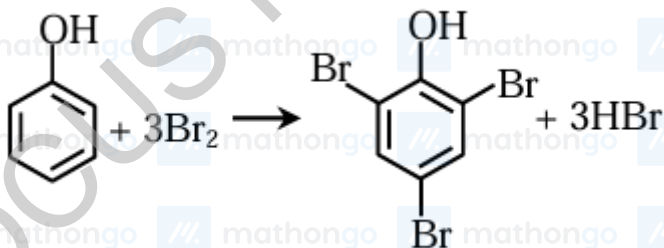
$$\frac{11.25 \times 10^{-3}}{x \times 10^{-1}} = \frac{x \times 10^{-1} \times 10^{-3}}{93}$$

$$x \times 10^{-1} = 93 \times 0.1$$

$$x = 93 \text{mg}$$

Q1.

(4)



$$\text{Moles of phenol} = \frac{2}{94} = 0.021$$

$$\therefore \text{Moles of bromine} = 0.021 \times 3 = 0.064$$

$$\therefore \text{Mass of bromine} = 0.064 \times 160 = 10.22 \text{ g}$$

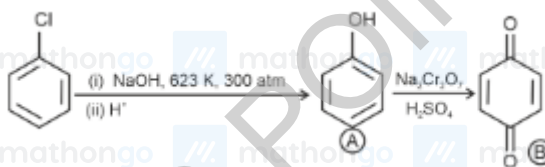
Q2. Statement I is correct as boiling point of alcohol phenols increase with increase in the number of C -atoms due to

(2) increase in van der Waals forces.

Statement II is correct, since alcohols phenols have intermolecular H -bonding therefore their boiling points are higher in comparison to other class of compounds such as ethers, haloalkanes.

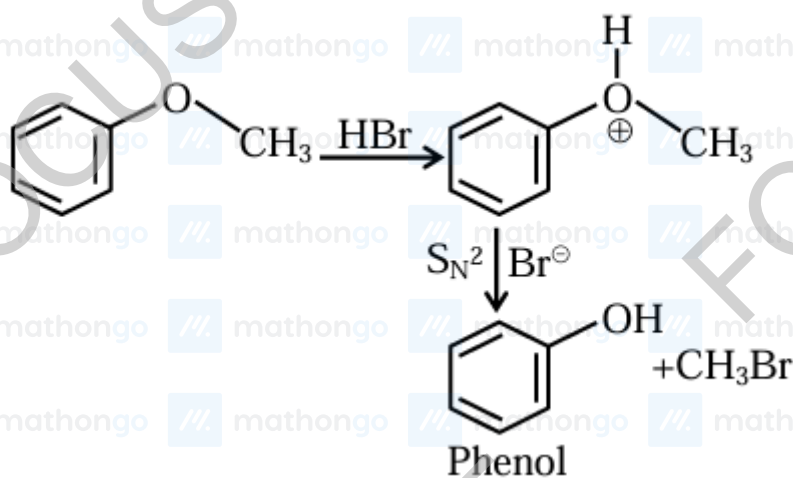
Q3.

(2)



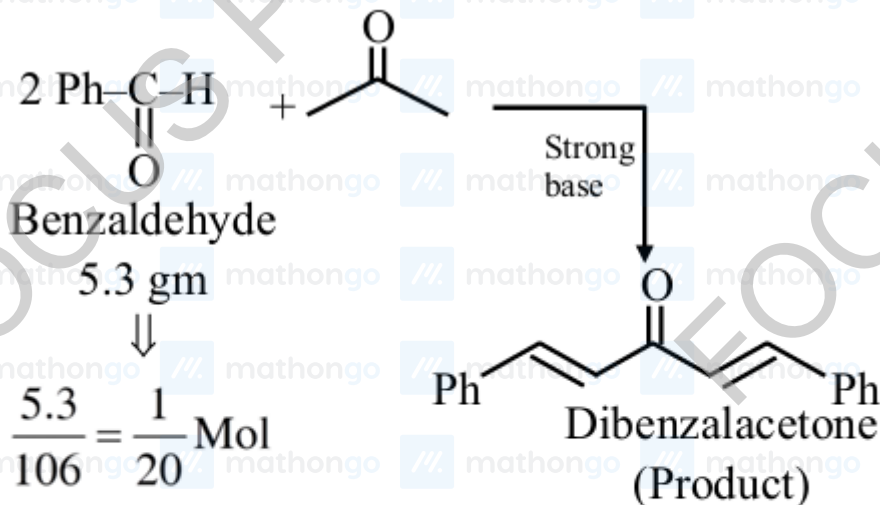
Q4.

(3)



Q5.

(60)



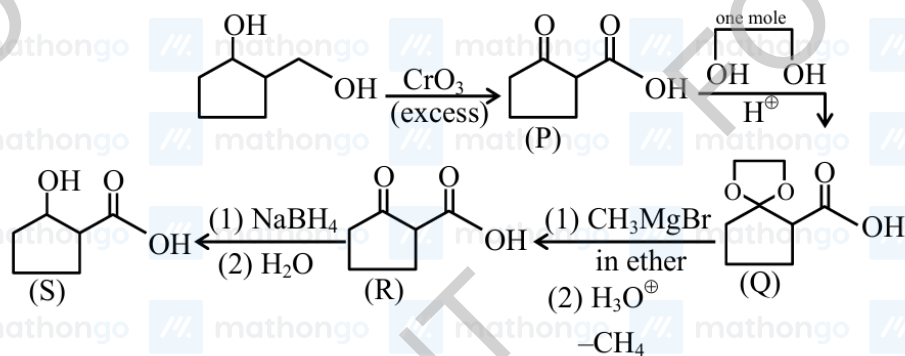
$$\text{Theoretical} = \frac{1}{40} \text{ Mol}$$

$$\% \text{ yield} = \frac{0.015}{1/40} \times 100$$

$$\Rightarrow 60\%$$

Q6.

(13)

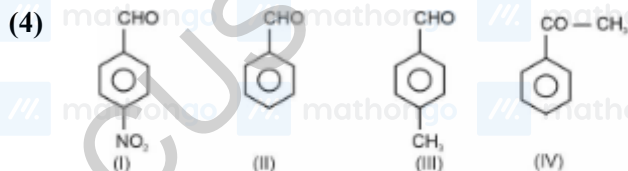


0.1 mole of compound (S) weight in gm

$$= 0.1 \times \text{molar mass of compound (S)}$$

$$= 0.1 \times 130 = 13 \text{ gm}$$

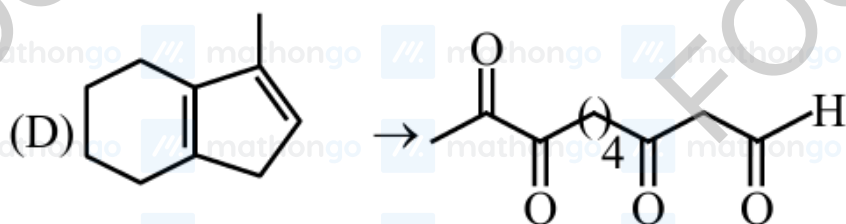
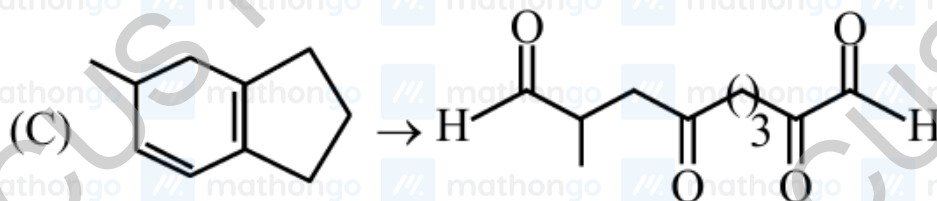
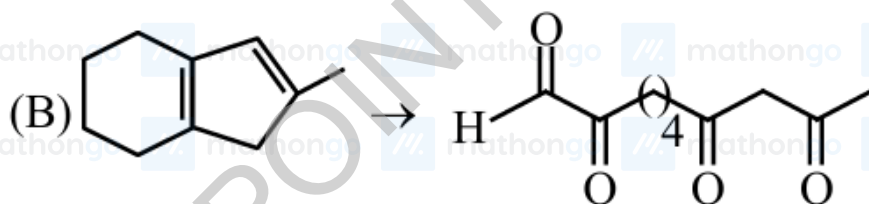
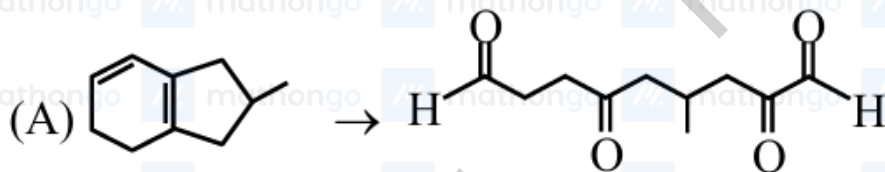
Q1. Reactivity \propto +ve charge on electrophilic carbon



Correct order I > II > III > IV

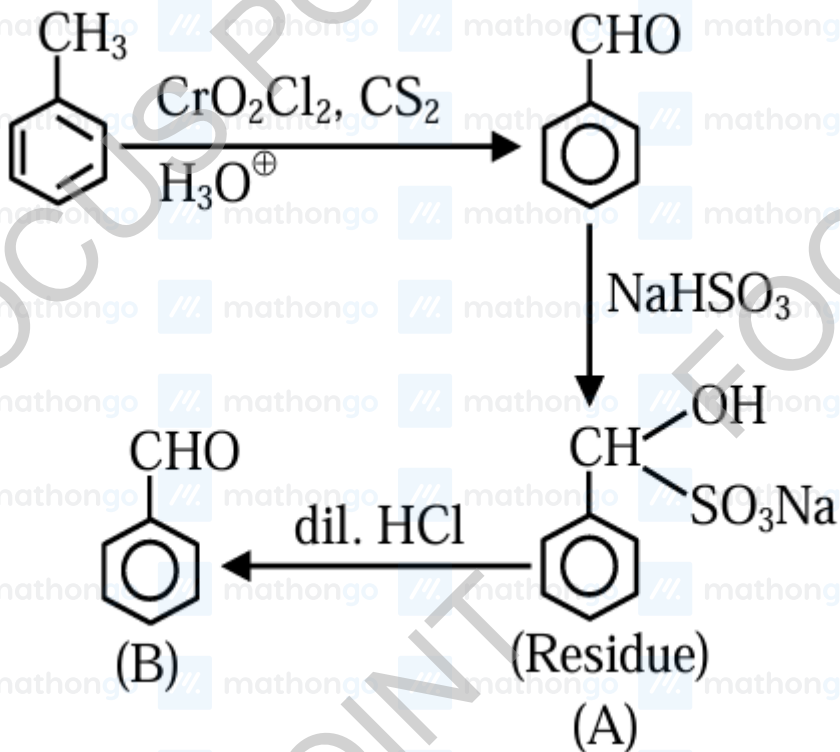
Q2. Ozonolysis product

(3)



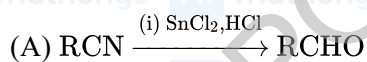
Q3.

(4)

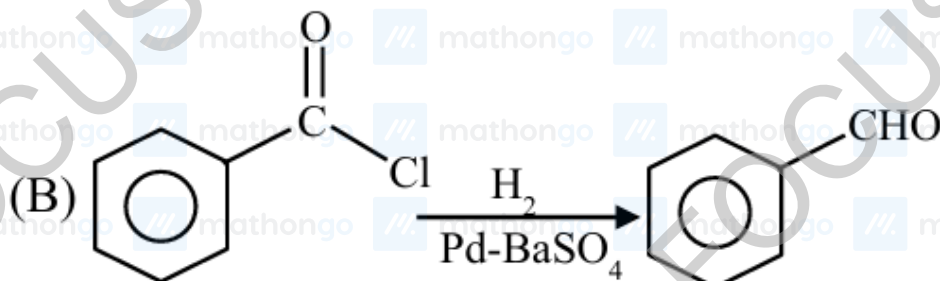


Q4.

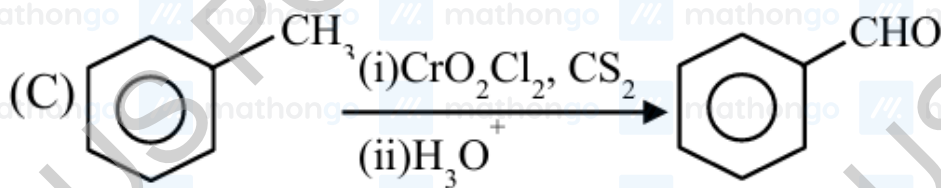
(4)



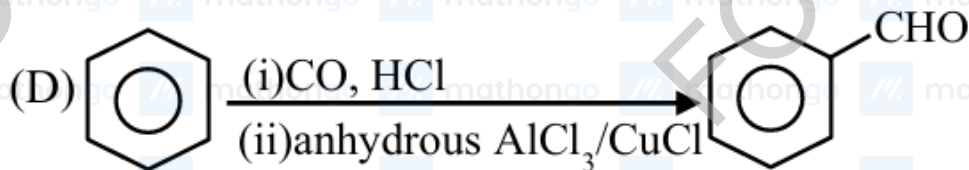
(i) H_3O^+
Stephen reaction



Rosenmund reduction

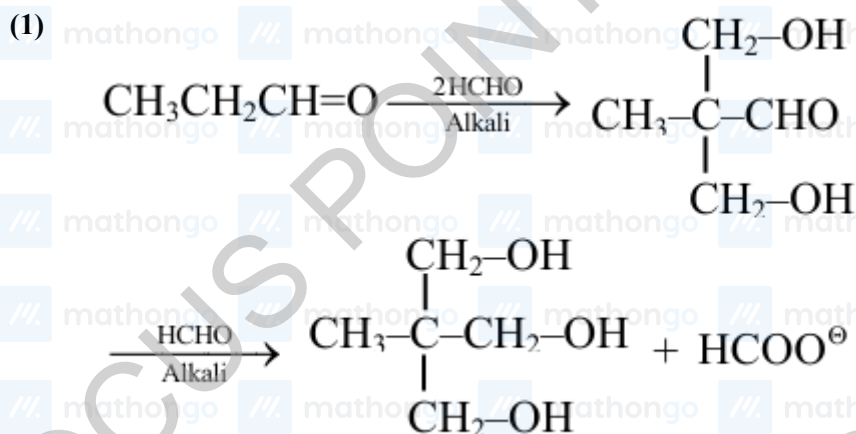


Etard reaction



Gatterman –Koch reaction

Q5. This is an example of Tollen's reaction i.e. multiple cross aldol followed by cross Cannizaro reaction



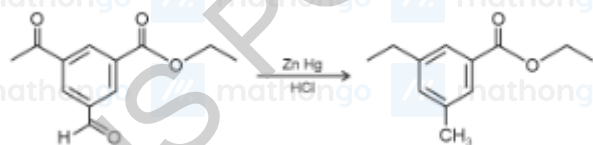
Q6.

(3)

	Name of Reaction	Acetaldehyde	Acetone
A.	Iodoform reaction	✓	✓
B.	Cannizaro reaction	×	×
C.	Aldol reaction	✓	✓
D.	Tollen's test	✓	×
E.	Clemmensen reduction	✓	✓

Q7. It is Clemmensen reduction, it will not reduce ester,

(1)



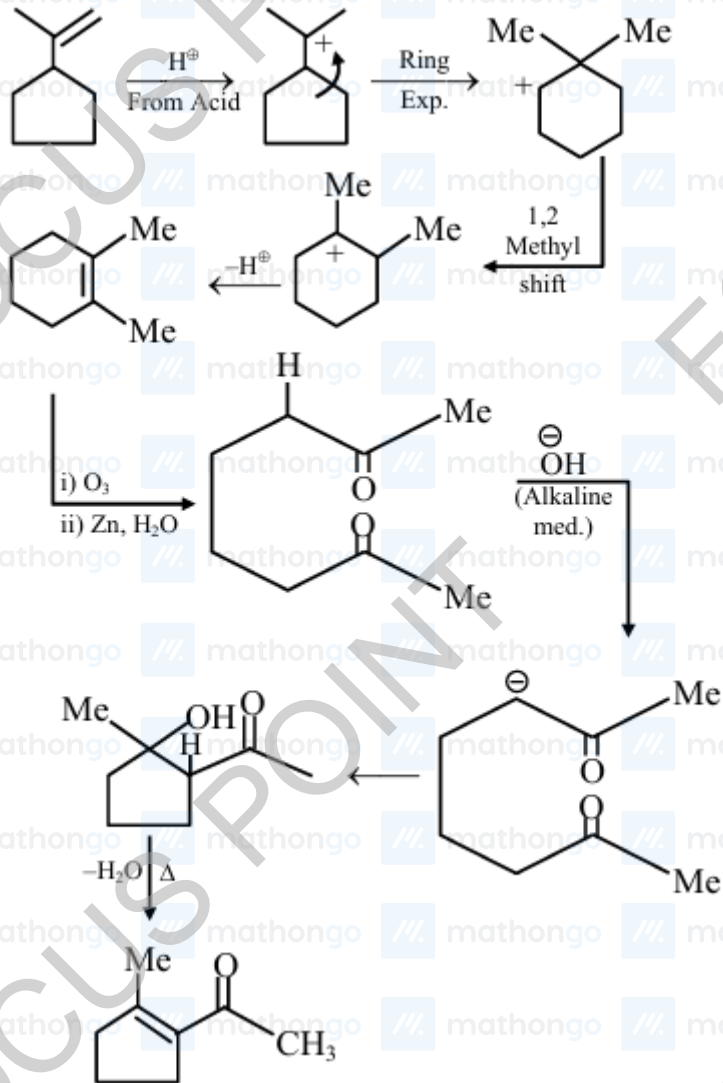
Ester cannot be reduced by clemmensen reduction

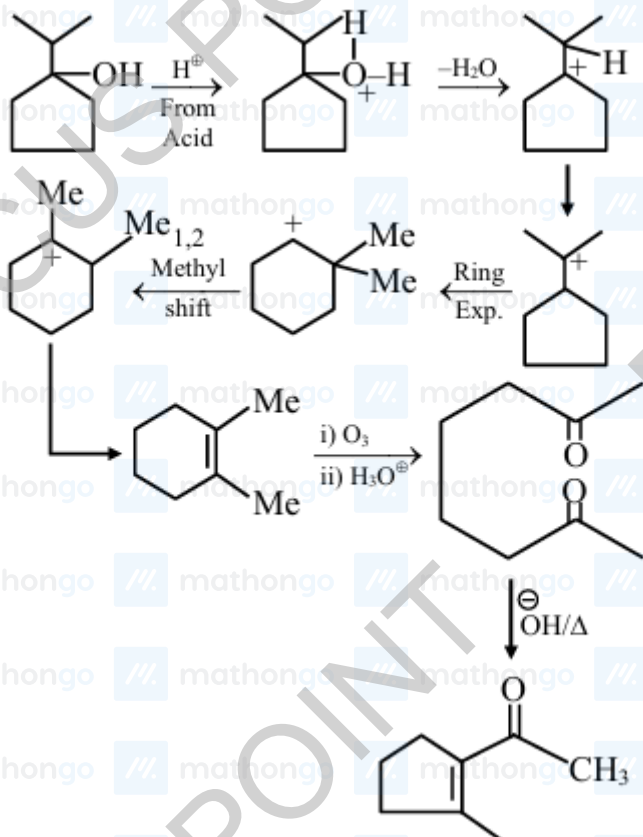
Q8.  

(2) Aliphatic aldehyde, α -hydroxy ketone gives fehling's solution test

Q9.

(4)



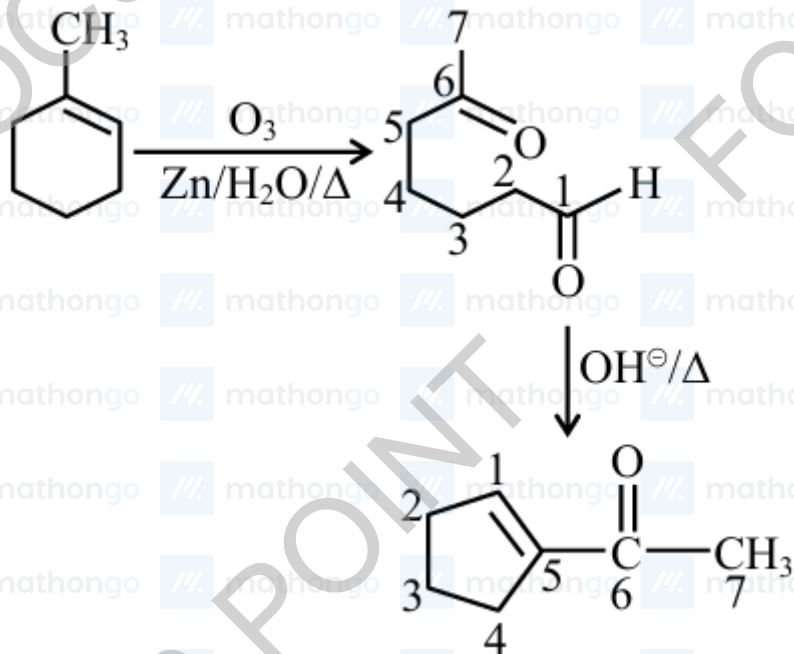


or

Q10. $k_{\text{eq}} = 2280$ is for HCHO(4) $k_{\text{eq}} = 2000$ is for chloralBoth data is given in clayden and warren book. $k_{\text{eq}} > 1$ because HCHO and chloral are more electrophilic.

Q11.

(3)

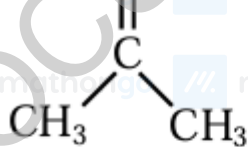


Q1. A, C, D produce CO_2 with aqueous NaHCO_3 solution.

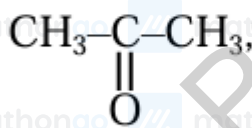
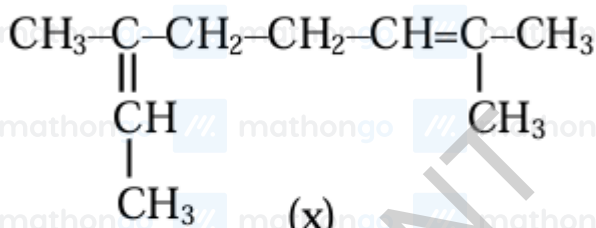
(1) A, C, D acids are stronger acid than H_2CO_3 (Carbonic acid)

Q2. $\text{CH}_3-\text{C}(\text{CH}_3)=\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_3$

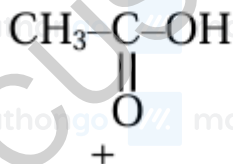
(27)



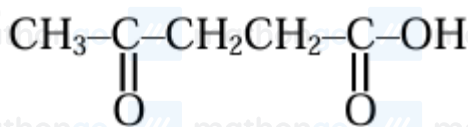
OR



+

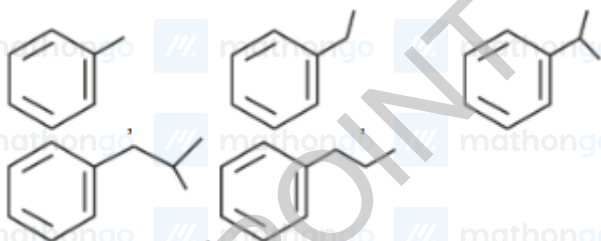


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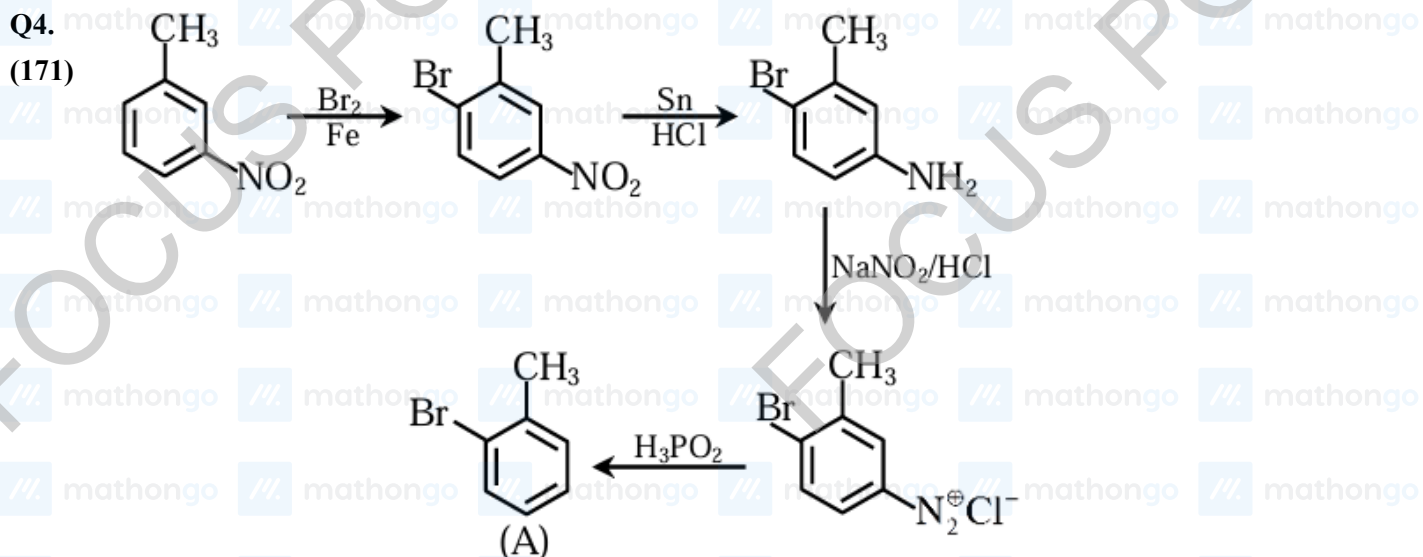


Q3. The compounds having benzylic hydrogen will give benzoic acid on treatment with hot KMnO_4 .

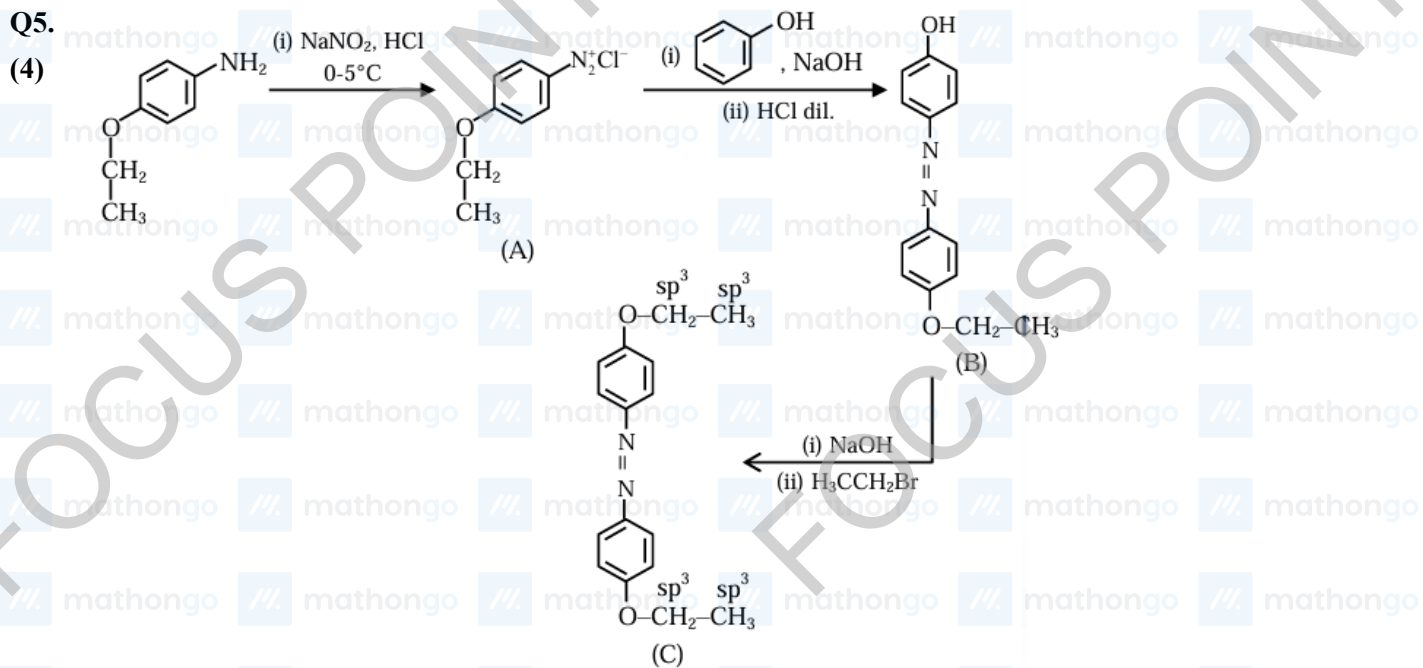
(3) Which are following:



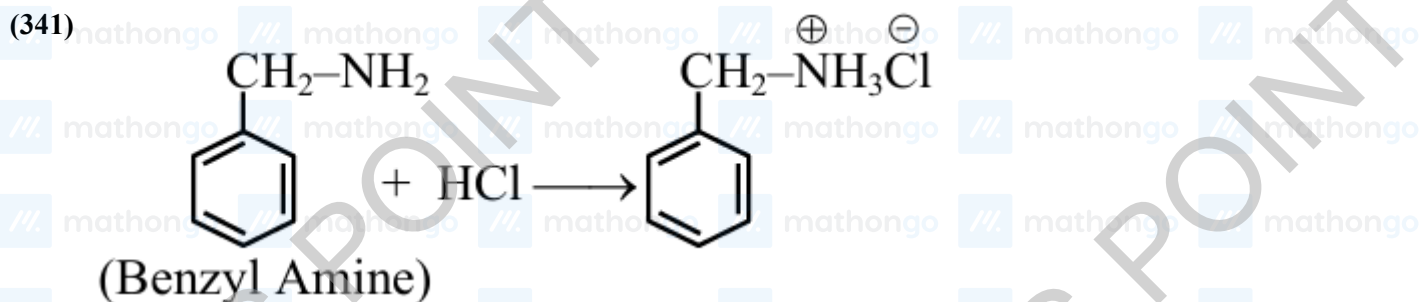
JEE Main 2025 January



Molar mass of product ($\text{C}_7\text{H}_7\text{Br}$) (A) is 171 g mol^{-1}



Q6. Benzyl Amine is most basic due to localised lone pair.



Mole of benzyl Amine $\Rightarrow \frac{1}{107} = 0.00934$ mole

1 Mole of Benzyl amine consumed 1 mole of HCl

So, Mole of HCl consumed \rightarrow 0.00934 mole

Mass of HCl consumed \rightarrow 0.00934 \times molar mass

of HCl

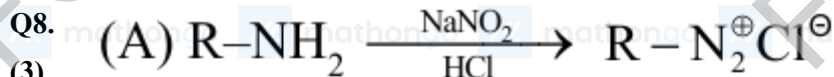
$$= 0.00934 \times 36.5$$

$$= 0.341 \text{ gm}$$

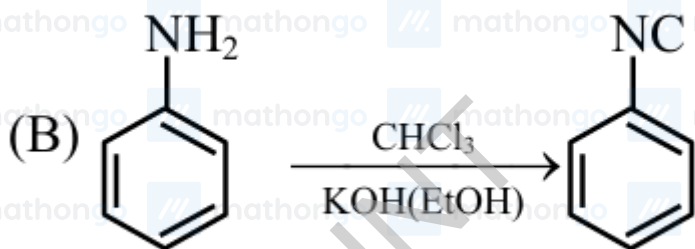
$$= 341 \text{ mg}$$

Q7. B and D are 3° amine which does not have replaceable H on N, So does not react.

(2)



(3)



(C) Only primary amine gives carbyl amine test

(D)

$\text{Ph-SO}_2\text{Cl}$ Hinsberg reagent

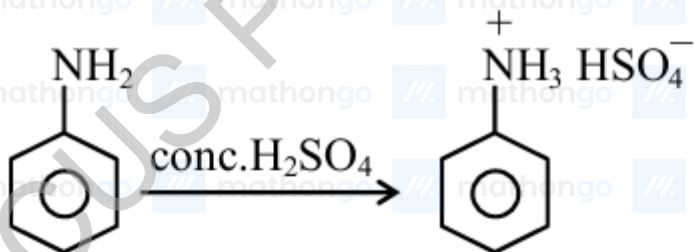
Benzene sulphonyl chloride

(E) Tertiary amine do not react with $\text{Ph-SO}_2\text{Cl}$

So correct options are (B) and (D) only

Q9.

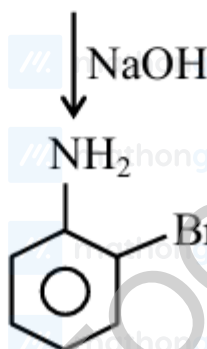
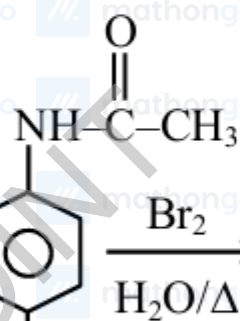
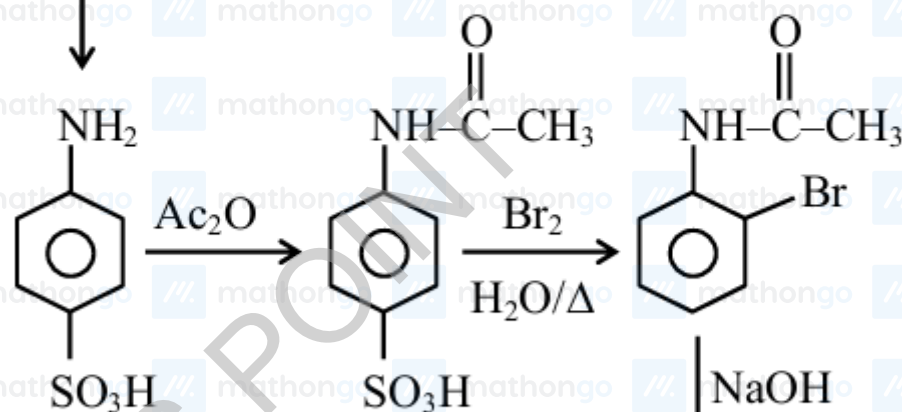
(2)



Anilium hydrogen

Suphate [intermediate]

453 – 473 K



Q1. Valine, Lysine and Threonine are essential amino acids.

(2)

Q2. α -helix and β -pleated sheet belongs to secondary structure of protein, which have hydrogen bonds.

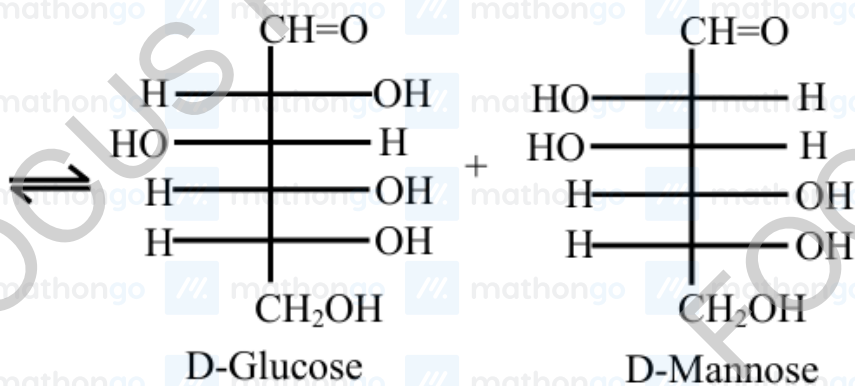
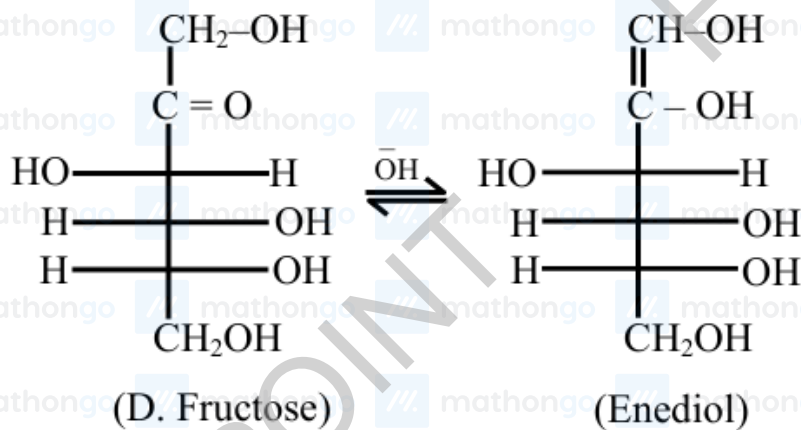
(3)

Q3. Vitamin-C is Ascorbic acid.

(2)

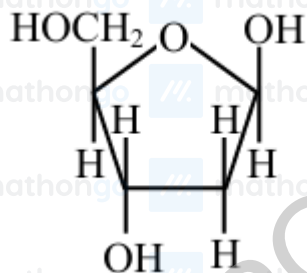
Q4.

(1)



Q5. In Ribose carbohydrate present in DNA is β - 2- Deoxy-D-Ribose whose structure is

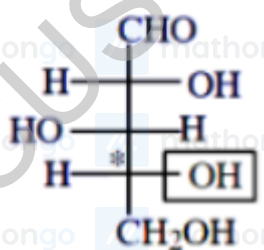
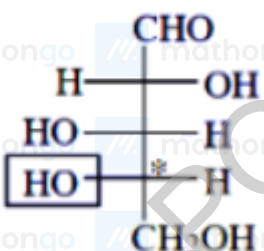
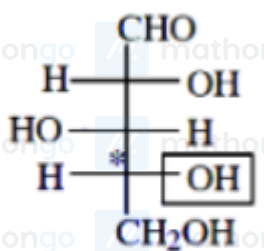
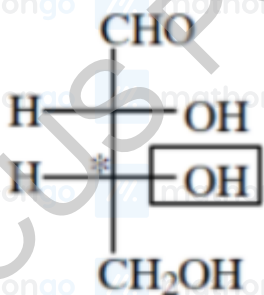
(2)



which is a reducing *D*-sugar in β anomeric form & it is a pentose sugar.

Q6.

(4)



In A, B, D - OH group in right hand side then D-configuration is assigned

Q7. - D-glucose pentaacetate do not react with 2,4 DNP

(1) - Starch $\xrightarrow[\Delta]{\text{conc. H}_2\text{SO}_4}$ Glucose
 2 - 3 atm
 100°C

Q8. (A) Sucrose $\rightarrow \alpha_1 - \beta_2$ Glycosidic linkage

(3) (B) Maltose $\rightarrow \alpha$ 1-4 Glycosidic linkage

(C) Lactose $\rightarrow \beta$ 1-4 Glycosidic linkage

(D) Amylopectin $\rightarrow \alpha$ 1 - 4 and α 1 - 6
 Glycosidic linkage

A-III, B-I, C-IV, D-II

Q9. Amylose \Rightarrow It is a plant based starch it has $\alpha - C_1 - C_4$ glycosidic linkage.

(4) Cellulose \Rightarrow It has $\beta - C_1 - C_4$ glycosidic linkage

Glycogen \Rightarrow It has $\alpha - C_1 - C_4$ and glycosidic linkage (animal starch)

Amylopectin \Rightarrow It is a plant based with $\alpha - C_1 - C_4$ and $C_1 - C_6$ glycosidic linkage

Q10. (A) Starch $\xrightarrow{H^+/H_2O}$ Glucose

(2) (B) Cane sugar $\xrightarrow{H^+/H_2O}$ glucose + fructose (Sucrose) 50% 50%

(C) Milk sugar $\xrightarrow{H^+/H_2O}$ glucose + galactose (Lactose)

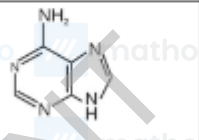
(D) Amylopectin $\xrightarrow{H^+/H_2O}$ Glucose

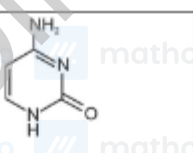
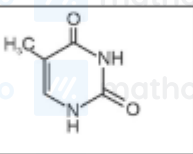
(E) Amylose $\xrightarrow{H^+/H_2O}$ Glucose

So, correct options are B,C,and E only.

Q11.

(2)

Compound	Structure
(A) Adenine	III. 

(B) Cytosine	IV. 
(C) Thymine	II. 
(D) Uracil	I. 