ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)

Chapter 02 Contents

JEE (MAIN) TOPICWISE TEST PAPERS JANUARY & SEPTEMBER 2020

CHEMISTRY

PHYSICAL CHEMISTRY

ORGANIC CHEMISTRY

INORGANIC CHEMISTRY

JANUARY & SEPTEMBER 2020 ATTEMPT (PC)

MOLE CONCEPT

1. Amongst the following statements, that which was not proposed by Dalton was :

(1) all the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass.

(2) chemical reactions involve reorganisation of atoms. These are neither created nor destroyed in a chemical reaction.

(3) when gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are at the same T & P.

(4) matter consists of indivisible atoms.

2. The ammonia (NH_3) released on quantitative reaction of 0.6 g urea (NH_2CONH_2) with sodium hydroxide (NaOH) can be neutralized by :

(1) 100 ml of 0.1 N HCl

(2) 200 ml of 0.4 N HCl

(3) 100 ml of 0.2 N HCl

(4) 200 ml of 0.2 N HCl

3. Ferrous sulphate heptahydrate is used to fortify foods with iron. The amount (in grams) of the salt required to achieve 10 ppm of iron in 100 kg of wheat is _____.

Atomic weight : Fe = 55.85 ; S = 32.0 ; O = 16.00

4. $NaClO_3$ is used, even in spacecrafts, to produce O_2. The daily consumption of pure O_2 by a person is 492L at 1 atm, 300K. How much amount of $NaClO_3$, in grams, is required to produce O_2 for the daily consumption of a person at 1 atm, 300 K ?

$NaClO_3(s) + Fe(s) \rightarrow O_2(g) + NaCl(s) + FeO(s)$

$R = 0.082$ L atm mol^{-1} K^{-1}

5. The first and second ionisation enthalpies of a metal are 496 and 4560 kJ mol^{-1}, respectively. How many moles of HCl and H_2SO_4, respectively, will be needed to react completely with 1 mole of the metal hydroxide ?

(1) 1 and 0.5 (2) 2 and 0.5

(3) 1 and 1 (4) 1 and 2

6. 5 g of zinc is treated separately with an excess of

(a) dilute hydrochloric acid and

(b) aqueous sodium hydroxide.

The ratio of the volumes of H_2 evolved in these two reactions is :

(1) 1 : 4 (2) 1 : 2 (3) 2 : 1 (4) 1 : 1

7. The minimum number of moles of O_2 required for complete combustion of 1 mole of propane and 2 moles of butane is _____.

8. The ratio of the mass percentages of 'C & H' and 'C & O' of a saturated acyclic organic compound 'X' are 4 : 1 and 3 : 4 respectively. Then, the moles of oxygen gas required for complete combustion of two moles of organic compound 'X' is _____ .

9. In an estimation of bromine by Carius method, 1.6 g of an organic compound gave 1.88 g of AgBr. The mass percentage of bromine in the compound is _____

(Atomic mass, Ag=108, Br = 80 g mol^{-1})

CONCENTRATION TERMS

1. The molarity of HNO_3 in a sample which has density 1.4 g/mL and mass percentage of 63% is _____. (Molecular Weight of HNO_3 = 63)

2. 10.30 mg of O_2 is dissolved into a liter of sea water of density 1.03 g/mL. The concentration of O_2 in ppm is_____.

3. The volume strength of 8.9 M H_2O_2 solution calculated at 273 K and 1 atm is _____. (R=0.0821 L atm K^{-1} mol^{-1}) (rounded off to the nearest integer)

4. The mole fraction of glucose ($C_6H_{12}O_6$) in an aqueous binary solution is 0.1. The mass percentage of water in it, to the nearest integer, is _____.

5. 6.023×10^{22} molecules are present in 10 g of a substance 'x'. The molarity of a solution containing 5 g of substance 'x' in 2 L solution is _____ $\times 10^{-3}$.

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6. The strengths of 5.6 volume hydrogen peroxide (of density 1 g/mL) in terms of mass percentage and molarity (M), respectively, are:
(Take molar mass of hydrogen peroxide as 34 g/mol)
(1) 1.7 and 0.25 (2) 1.7 and 0.5
(3) 0.85 and 0.5 (4) 0.85 and 0.25

7. A solution of two components containing n_1 moles of the 1st component and n_2 moles of the 2nd component is prepared. M_1 and M_2 are the molecular weights of component 1 and 2 respectively. If d is the density of the solution in g mL^{-1}, C_2 is the molarity and x_2 is the mole fraction of the 2nd component, then C_2 can be expressed as :

(1) $C_2 = \frac{1000x_2}{M_1 + x_2(M_2 - M_1)}$

(2) $C_2 = \frac{dx_2}{M_2 + x_2(M_2 - M_1)}$

(3) $C_2 = \frac{dx_1}{M_2 + x_2(M_2 - M_1)}$

(4) $C_2 = \frac{1000dx_2}{M_1 + x_2(M_2 - M_1)}$

REDOX REACTIONS

1. Oxidation number of potassium in K_2O, K_2O_2 and KO_2 , respectively, is :
(1) +1, +4 and +2 (2) +1, +2 and +4
(3) +1, +1 and +1 (4) +2 , +1 and $+\frac{1}{2}$

2. The strength of an aqueous NaOH solution is most accurately determined by titrating :
(Note : consider that an appropriate indicator is used)
(1) Aq. NaOH in a volumetric flask and concentrated H_2SO_4 in a conical flask
(2) Aq. NaOH in a pipette and aqueous oxalic acid in a burette
(3) Aq. NaOH in a burette and concentrated H_2SO_4 in a conical flask
(4) Aq. NaOH in a burette and aqueous oxalic acid in a conical flask

3. The compound that cannot act both as oxidising and reducing agent is :
(1) H_2O_2
(2) H_2SO_3
(3) HNO_2
(4) H_3PO_4

4. The hardness of a water sample containing 10^{-3} M $MgSO_4$ expressed as $CaCO_3$ equivalents (in ppm) is _____.
(molar mass of $MgSO_4$ is 120.37 g/mol)

5. Consider the following equations :

$2\ Fe^{2+} + H_2O_2 \rightarrow x\ A + y\ B$

(in basic medium)

$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow x'\ C + y'\ D + z'\ E$

(in acidic medium)

The sum of the stoichiometric coefficients x, y, x', y' and z' for products A, B, C, D and E, respectively, is _____.

6. A 100 mL solution was made by adding 1.43 g of $Na_2CO_3 \cdot xH_2O$. The normality of the solution is 0.1 N. The value of x is _____.
(The atomic mass of Na is 23g/mol) :-

7. A 20.0 mL solution containing 0.2 g impure H_2O_2 reacts completely with 0.316 g of $KMnO_4$ in acid solution. The purity of H_2O_2 (in %) is _____ (mol. wt. of H_2O_2 = 34; mol. wt. of $KMnO_4$ = 158)

8. The volume (in mL) of 0.1 N NaOH required to neutralise 10 mL of 0.1 N phosphinic acid is _____ .

9. The volume, in mL, of 0.02 M $K_2Cr_2O_7$ solution required to react with 0.288 g of ferrous oxalate in acidic medium is_____.
(Molar mass of Fe = 56 g mol^{-1})

10. The oxidation states of transition metal atoms in $K_2Cr_2O_7$, $KMnO_4$ and K_2FeO_4, respectively, are x, y and z. The sum of x, y and z is ____.

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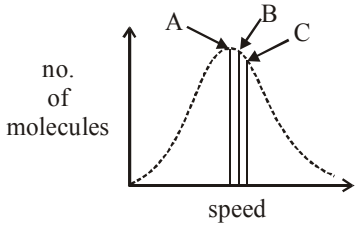
IDEAL GAS

1. Identify the correct labels of A, B and C in the following graph from the options given below:



Root mean square speed (V_{rms}) ; most probable speed (V_{mp}) ; Average speed ($V_{av.}$)

(1) A – V_{rms} ; B –V_{mp} ; C – V_{av}

(2) A – V_{av} ; B –V_{rms} ; C – V_{mp}

(3) A – V_{mp} ; B –V_{rms} ; C – V_{av}

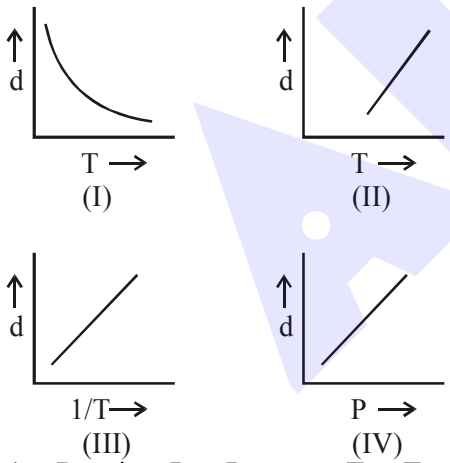
(4) A – V_{mp} ; B –V_{av} ; C – V_{rms}

2. A mixture of one mole each of H_2, He and O_2 each are enclosed in a cylinder of volume V at temperature T. If the partial pressure of H_2 is 2 atm, the total pressure of the gases in the cylinder is :

(1) 14 atm (2) 22 atm

(3) 6 atm (4) 38 atm

3. Which one of the following graphs is **not correct** for ideal gas ?



d = Density, P = Pressure, T = Temperature

(1) II (2) III

(3) I (4) IV

4. A spherical balloon of radius 3 cm containing helium gas has a pressure of 48×10^{-3} bar. At the same temperature, the pressure, of a spherical balloon of radius 12 cm containing the same amount of gas will be_____$\times 10^{-6}$ bar.

ATOMIC STRUCTURE

1. The number of orbitals associated with quantum numbers n = 5, $m_s = +\frac{1}{2}$ is :

(1) 11 (2) 25 (3) 15 (4) 50

2. For the Balmer series in the spectrum of H atom, $\bar{\nu} = R_H \left\{\frac{1}{n_1^2} - \frac{1}{n_2^2}\right\}$, the correct statements among (I) and (IV) are :

(I) As wavelength decreases, the lines in the series converge

(II) The integer n_1 is equal to 2

(III) The lines of longest wavelength corresponds to $n_2 = 3$

(IV) The ionization energy of hydrogen can be calculated from wave number of these lines

(1) (II), (III), (IV)

(2) (I), (II), (III)

(3) (I), (III), (IV)

(4) (I), (II), (IV)

3. The radius of the second Bohr orbit, in terms of the Bohr radius, a_0, in Li^{2+} is :

(1) $\frac{4a_0}{9}$ (2) $\frac{2a_0}{9}$

(3) $\frac{2a_0}{3}$ (4) $\frac{4a_0}{3}$

4. The de Broglie wavelength of an electron in the 4th Bohr orbit is :

(1) $8\pi a_0$ (2) $2\pi a_0$

(3) $4\pi a_0$ (4) $6\pi a_0$

5. The shortest wavelength of H atom in the Lyman series is λ_1. The longest wavelength in the Balmer series of He^+ is :-

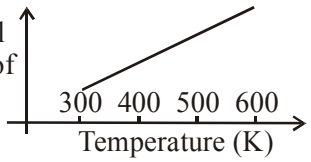
(1) $\frac{5\lambda_1}{9}$ (2) $\frac{27\lambda_1}{5}$ (3) $\frac{9\lambda_1}{5}$ (4) $\frac{36\lambda_1}{5}$

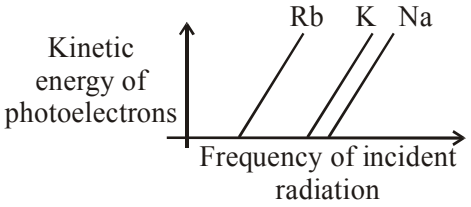
6. The difference between the radii of 3rd and 4th orbits of Li^{2+} is ΔR_1. The difference between the radii of 3rd and 4th orbits of He^+ is ΔR_2. Ratio $\Delta R_1 : \Delta R_2$ is :

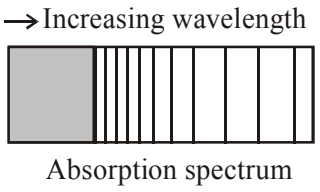
(1) 8 : 3 (2) 3 : 2

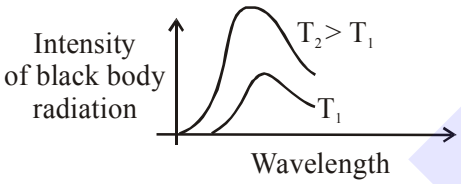
(3) 3 : 8 (4) 2 : 3

7. The figure that is not a direct manifestation of the quantum nature of atoms is :

(1)


(2)


(3)


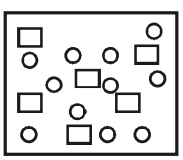
(4)


8. The work function of sodium metal is 4.41×10^{-19} J. If the photons of wavelength 300 nm are incident on the metal, the kinetic energy of the ejected electrons will be _____ $\times 10^{-21}$ J.

($h = 6.63 \times 10^{-34}$ Js; $c = 3 \times 10^{8}$ m/s)

CHEMICAL EQUILIBRIUM

1. In the figure shown below reactant A (represented by square) is in equilibrium with product B (represented by circle). The equilibrium constant is :



(1) 2 (2) 1

(3) 8 (4) 4

2. Consider the following reaction

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$; $\Delta H^0 = +58$ kJ

For each of the following cases (a, b), the direction in which the equilibrium shifts is:

(a) Temperature is decreased

(b) Pressure is increased by adding N_2 at constant T

(1) (a) towards reactant, (b) no change

(2) (a) towards product, (b) towards reactant

(3) (a) towards product, (b) no change

(4) (a) towards reactant, (b) towards product

3. The value of K_C is 64 at 800 K for the reaction

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

The value of K_C for the following reaction is :

$NH_3(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$

(1) $\frac{1}{4}$ (2) $\frac{1}{8}$ (3) 8 (4) $\frac{1}{64}$

IONIC EQUILIBRIUM

1. Two solutions A and B, each of 100 L was made by dissolving 4g of NaOH and 9.8 g of H_2SO_4 in water, respectively. The pH of the resultant solution obtained from mixing 40 L of solution A and 10 L of solution B is_____.

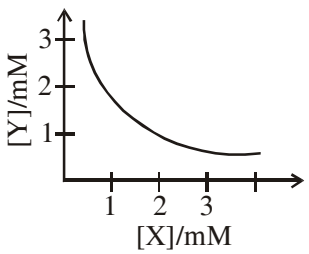
2. 3g of acetic acid is added to 250 mL of 0.1 M HCl and the solution made up to 500 mL.

To 20 mL of this solution $\frac{1}{2}$ mL of 5 M NaOH is added. The pH of the solution is _____.

[Given : pK_a of acetic acid = 4.75, molar mass of acetic acid = 60 g/mol, log3 = 0.4771]

Neglect any changes in volume

3. The stoichiometry and solubility product of a salt with the solubility curve given below is, respectively :



(1) X_2Y, $2\times10^{-9}M^3$ (2) XY_2, $1\times10^{-9}M^3$

(3) XY_2, $4\times10^{-9}M^3$ (4) XY, $2\times10^{-6}M^3$

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4. For the following Assertion and Reason, the correct option is :

Assertion : The pH of water increases with increase in temperature.

Reason : The dissociation of water into H^+ and OH^- is an exothermic reaction.

(1) Both assertion and reason are true, but the reason is not the correct explanation for the assertion.

(2) Both assertion and reason are false.

(3) Assertion is not true, but reason is true.

(4) Both assertion and reason are true, and the reason is the correct explanation for the assertion.

5. The K_{sp} for the following dissociation is 1.6×10^{-5}

$$PbCl_{2(s)} \ell Pb^{2+}_{(aq)} + 2Cl^-_{(aq)}$$

Which of the following choices is correct for a mixture of 300 mL 0.134 M $Pb(NO_3)_2$ and 100 mL 0.4 M NaCl ?

(1) $Q < K_{sp}$

(2) $Q > K_{sp}$

(3) $Q = K_{sp}$

(4) Not enough data provided

6. The solubility product of $Cr(OH)_3$ at 298 K is 6.0×10^{-31}. The concentration of hydroxide ions in a saturated solution of $Cr(OH)_3$ will be :

(1) $(18 \times 10^{-31})^{1/4}$

(2) $(2.22 \times 10^{-31})^{1/4}$

(3) $(4.86 \times 10^{-29})^{1/4}$

(4) $(18 \times 10^{-31})^{1/2}$

7. An acidic buffer is obtained on mixing :

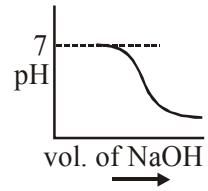
(1) 100 mL of 0.1 M CH_3COOH and 200 mL of 0.1 M NaOH

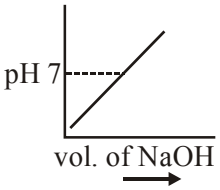
(2) 100 mL of 0.1 M CH_3COOH and 100 mL of 0.1 M NaOH

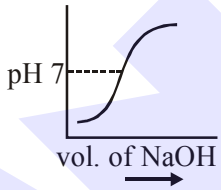
(3) 100 mL of 0.1 M HCl and 200 mL of 0.1 M CH_3COONa

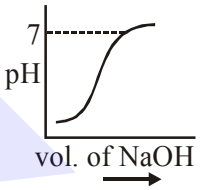
(4) 100 mL of 0.1 M HCl and 200 mL of 0.1 M NaCl

8. 100 mL of 0.1 M HCl is taken in a beaker and to it 100 mL of 0.1 M NaOH is added in steps of 2 mL and the pH is continuously measured. Which of the following graphs correctly depicts the change in pH?

(1) 

(2) 

(3) 

(4) 

9. A soft drink was bottled with a partial pressure of CO_2 of 3 bar over the liquid at room temperature. The partial pressure of CO_2 over the solution approaches a value of 30 bar when 44 g of CO_2 is dissolved in 1 kg of water at room temperature. The approximate pH of the soft drink is _____ $\times 10^{-1}$.

(First dissociation constant of $H_2CO_3 = 4.0 \times 10^{-7}$; log 2 = 0.3; density of the soft drink = 1 g mL^{-1})

10. If the solubility product of AB_2 is 3.20×10^{-11} M^3, then the solubility of AB_2 in pure water is_ _ _ _ _ $\times 10^{-4}$ mol L^{-1}. [Assuming that neither kind of ion reacts with water]

11. Arrange the following solutions is the decreasing order of pOH :

(A) 0.01 M HC1

(B) 0.01 M NaOH

(C) 0.01 M CH_3COONa

(D) 0.01 M NaCl

(1) (B) > (C) > (D) > (A)

(2) (A) > (C) > (D) > (B)

(3) (B) > (D) > (C) > (A)

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

THERMODYNAMICS

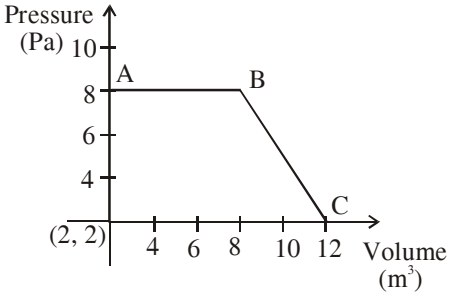
1. For the reaction ;

$A(l) \rightarrow 2B(g)$

$\Delta U = 2.1$ kcal , $\Delta S = 20$ cal K^{-1} at 300 K

Hence ΔG in kcal is_____ .

2. The magnitude of work done by a gas that undergoes a reversible expansion along the path ABC shown in the figure is _____



3. At constant volume, 4 mol of an ideal gas when heated from 300 K to 500K changes its internal energy by 5000 J. The molar heat capacity at constant volume is _____.

4. The true statement amongst the following is:

(1) Both ΔS and S are functions of temperature.

(2) S is not a function of temperature but ΔS is a function of temperature.

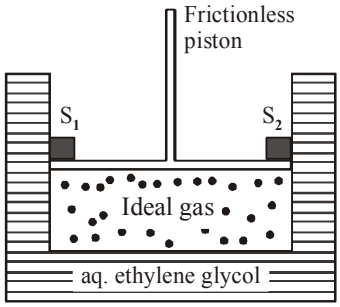
(3) Both S and ΔS are not functions of temperature.

(4) S is a function of temperature but ΔS is not a function of temperature.

5. A cylinder containing an ideal gas (0.1 mol of 1.0 dm^3) is in thermal equilibrium with a large volume of 0.5 molal aqueous solution of ethylene glycol at its freezing point. If the stoppers S_1 and S_2 (as shown in the figure) are suddenly withdrawn, the volume of the gas in litres after equilibrium is achieved will be____.

(Given, K_f (water) = 2.0 K kg mol^{-1},

R = 0.08 dm^3 atm K^{-1} mol^{-1})



6. Five moles of an ideal gas at 1 bar and 298 K is expanded into vacuum to double the volume. The work done is :-

(1) $C_V(T_2 - T_1)$ (2) $-RT \ln V_2/V_1$

(3) $-RT(V_2 - V_1)$ (4) zero

7. For one mole of an ideal gas, which of these statements must be true ?

(a) U and H each depends only on temperature

(b) Compressibility factor z is not equal to 1

(c) $C_{P,m} - C_{V,m} = R$

(d) $dU = C_V dT$ for any process

(1) (a), (c) and (d) (2) (b), (c) and (d)

(3) (c) and (d) (4) (a) and (c)

8. For a dimerization reaction,

$2\ A(g) \rightarrow A_2(g)$

at 298 K, $\Delta U^{\ominus}$, = – 20kJ mol^{-1}, $\Delta S^{\ominus}$ = –30 J K^{-1} mol^{-1}, then the $\Delta G^{\ominus}$ will be _____J.

9. The internal energy change (in J) when 90g of water undergoes complete evaporation at 100°C is ____ .

(Given : ΔH_{vap} for water at 373 K = 41 kJ/mol, R = 8.314 JK^{-1} mol^{-1})

10. The Gibbs energy change (in J) for the given reaction at $[Cu^{2+}] = [Sn^{2+}] = 1$ M and 298K is:

$Cu(s) + Sn^{2+}(aq.) \rightarrow Cu^{2+}(aq.) + Sn(s)$;

($E^0_{Sn^{2+}|Sn} = -0.16V$, $E^0_{Cu^{2+}|Cu} = 0.34V$,

Take F = 96500 C mol^{-1})

11. The variation of equilibrium constant with temperature is given below :

Temperature	**Equilibrium constant**
T_1 = 25°C	K_1 = 100
T_2 = 100°C	K_2 = 100

The values of $\Delta H°$, $\Delta G°$ at T_1 and $\Delta G°$ at T_2 (in kJ mol^{-1}) respectively, are close to

[Use R = 8.314 $JK^{-1}mol^{-1}$]

(1) 0.64, –5.71 and –14.29

(2) 28.4, –7.14 and –5.71

(3) 28.4, –5.71 and –14.29

(4) 0.64, –7.14 and –5.71

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THERMOCHEMISTRY

1. The standard heat of formation $\left(\Delta_f H^0_{298}\right)$ of ethane in (kJ/mol), if the heat of combustion of ethane, hydrogen and graphite are –1560, –393.5 and –286 kJ/mol, respectively is _____

2. If enthalpy of atomisation for $Br_{2(l)}$ is x kJ/mol and bond enthalpy for Br_2 is y kJ/mol, the relation between them :

(1) is x = y (2) is x < y

(3) does not exist (4) is x > y

3. Lattice enthalpy and enthalpy of solution of NaCl are 788 kJ mol^{-1} and 4 kJ mol^{-1}, respectively. The hydration enthalpy of NaCl is :

(1) –780 kJ mol^{-1} (2) –784 kJ mol^{-1}

(3) 780 kJ mol^{-1} (4) 784 kJ mol^{-1}

4. The heat of combustion of ethanol into carbon dioxide and water is –327 kcal at constant pressure. The heat evolved (in cal) at constant volume and 27°C (if all gases behave ideally) is (R = 2 cal mol^{-1} K^{-1})

SOLID STATE

1. Which of the following compounds is likely to show both Frenkel and Schottky defects in its crystalline form?

(1) AgBr (2) ZnS

(3) KBr (4) CsCl

2. An element with molar mass 2.7×10^{-2} $kgmol^{-1}$ forms a cubic unit cell with edge length 405 pm. If its density is 2.7×10^3 kgm^{-3}, the radius of the element is approximately ____ $\times 10^{-12}$ m (to the nearest integer).

3. An element crystallises in a face-centred cubic (fcc) unit cell with cell edge a. The distance between the centres of two nearest octahedral voids in the crystal lattice is

(1) a (2) $\sqrt{2}a$

(3) $\frac{a}{\sqrt{2}}$ (4) $\frac{a}{2}$

4. A crystal is made up of metal ions 'M_1' ana 'M_2' and oxide ions. Oxide ions form a ccp lattice structure. The cation 'M_1' occupies 50% of octahedral voids and the cation 'M_2' occupies 12.5% of tetrahedral voids of oxide lattice. The oxidation numbers of 'M_1' and 'M_2' are, respectively :

(1) +2, +4 (2) +3, +1

(3) +1, +3 (4) +4, +2

CHEMICAL KINETICS

1. For the reaction

$2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O(g)$

the observed rate expression is, rate = $k_f[NO]^2[H_2]$. The rate expression of the reverse reaction is :

(1) $k_b[N_2][H_2O]^2/[NO]$

(2) $k_b[N_2][H_2O]$

(3) $k_b[N_2][H_2O]^2$

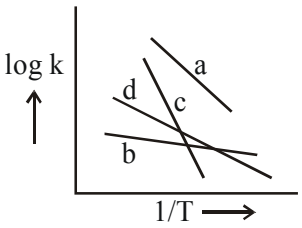
(4) $k_b[N_2][H_2O]^2/[H_2]$

2. The rate of a certain biochemical reaction at physiological temperature (T) occurs 10^6 times faster with enzyme than without. The change in the activation energy upon adding enzyme is :

(1) –6RT (2) +6RT

(3) +6(2.303)RT (4) –6(2.303)RT

3. Consider the following plots of rate constant versus $\frac{1}{T}$ for four different reactions. Which of the following orders is correct for the activation energies of these reactions?



(1) $E_b > E_d > E_c > E_a$

(2) $E_a > E_c > E_d > E_b$

(3) $E_c > E_a > E_d > E_b$

(4) $E_b > E_a > E_d > E_c$

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4. For the following reactions

$A \xrightarrow{700\,K} Product$

$A \xrightarrow[catalyst]{500\,K} Product$

it was found that E_a is decreased by 30 kJ/mol in the presence of catalyst.

If the rate remains unchanged, the activation energy for catalysed reaction is (Assume pre exponential factor is same):

(1) 135 kJ/mol (2) 105 kJ/mol

(3) 198 kJ/mol (4) 75 kJ/mol

5. A sample of milk splits after 60 min. at 300 K and after 40 min. at 400 K when the population of *lactobacillus acidophilus* in it doubles. The activa tion energy (in kJ/ mol) for this process is closest to_____.

(Given, R = 8.3 J mol^{-1} K^{-1}, $ln\left(\frac{2}{3}\right) = 0.4$, $e^{-3} = 4.0$)

6. The number of molecules with energy greater than the threshold energy for a reaction increases five fold by a rise of temperature from 27 °C to 42 °C. Its energy of activation in J/mol is _____. (Take ln 5 = 1.6094; R = 8.314 J $mol^{-1}K^{-1}$)

7. If 75% of a first order reaction was completed in 90 minutes, 60% of the same reaction would be completed in approximately (in minutes) _____. (Take : log 2 = 0.30; log 2.5 = 0.40)

8. It is true that :

(1) A zero order reaction is a single step reaction

(2) A second order reaction is always a multistep reaction

(3) A first order reaction is always a single step reaction

(4) A zero order reaction is a multistep reaction

9. For the reaction $2A + 3B + \frac{3}{2}C \rightarrow 3P$, which statement is correct ?

(1) $\frac{dn_A}{dt} = \frac{dn_B}{dt} = \frac{dn_C}{dt}$

(2) $\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$

(3) $\frac{dn_A}{dt} = \frac{3}{2}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$

(4) $\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{4}{3}\frac{dn_C}{dt}$

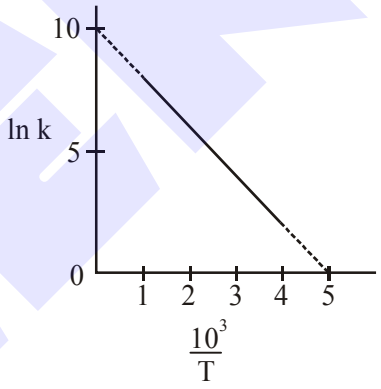
10. A flask contains a mixture of compounds A and B. Both compounds decompose by first-order kinetics. The half-lives for A and B are 300 s and 180 s, respectively. If the concentrations of A and B are equal initially, the time required for the concentration of A to be four times that of B(in s) : (Use ln 2 = 0.693)

(1) 180 (2) 120

(3) 300 (4) 900

11. The rate constant (k) of a reaction is measured at different temperatures (T), and the data are plotted in the given figure. The activation energy of the reaction in kJ mol^{-1} is :

(R is gas constant)



(1) 2R (2) R

(3) 1/R (4) 2/R

12. The results given in the below table were obtained during kinetic studies of the following reaction:

$2A + B \longrightarrow C + D$

Experiment	[A]/$molL^{-1}$	[B]/$molL^{-1}$	Initial rate/$molL^{-1}$ min^{-1}
I	0.1	0.1	6.00×10^{-3}
II	0.1	0.2	2.40×10^{-2}
III	0.2	0.1	1.20×10^{-2}
IV	X	0.2	7.20×10^{-2}
V	0.3	Y	2.88×10^{-1}

X and Y in the given table are respectively :

(1) 0.3, 0.4

(2) 0.4, 0.3

(3) 0.4, 0.4

(4) 0.3, 0.3

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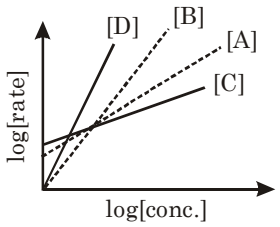
13. Consider the following reactions :

$A \rightarrow P1$; $B \rightarrow P2$; $C \rightarrow P3$; $D \rightarrow P4$

The order of the above reactions are a, b, c, and d, respectively. The following graph is obtained when log [rate] vs. log[conc] are plotted:



Among the following , the correct sequence for the order of the reactions is:

(1) a > b > c > d

(2) c > a > b > d

(3) d > b > a > c

(4) d > a > b > c

14. The rate of a reaction decreased by 3.555 times when the temperature was changed from 40°C to 30°C. The activation energy (in kJ mol^{-1}) of the reaction is_ _ _ _ _.

Take; R=8.314 J mol^{-1} K^{-1} In 3.555 = 1.268

RADIOACTIVITY

1. During the nuclear explosion, one of the products is ^{90}Sr with half life of 6.93 years. if 1 μg of ^{90}Sr was absorbed in the bones of a newly born baby in place of Ca, how much time, in years , is required to reduce it by 90% if it is not lost metabolically_____ .

SURFACE CHEMISTRY

1. The flucculation value of HCl for arsenic sulphide sol. is 30 m mole L^{-1}. If H_2SO_4 is used for the flocculation of arsenic sulphide, the amount, in grams, of H_2SO_4 in 250 ml required for the above purpose is _____.

(molecular mass of H_2SO_4 = 98 g/mol)

2. As per Hardy-Schulze formulation, the flocculation values of the following for ferric hydroxide sol are in the order :

(1) $AlCl_3 > K_3[Fe(CN)_6] > K_2CrO_4 > KBr=KNO_3$

(2) $K_3[Fe(CN)_6] < K_2CrO_4 < AlCl_3 < KBr < KNO_3$

(3) $K_3[Fe(CN)_6] > AlCl_3 > K_2CrO_4 > KBr > KNO_3$

(4) $K_3[Fe(CN)_6] < K_2CrO_4 < KBr=KNO_3=AlCl_3$

3. For the following Assertion and Reason, the correct option is

Assertion : For hydrogenation reactions, the catalytic activity increases from Group 5 to Group 11 metals with maximum activity shown by Group 7-9 elements.

Reason : The reactants are most strongly adsorbed on group 7-9 elements.

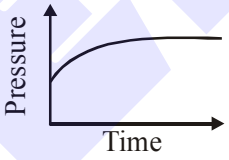
(1) Both assertion and reason are true but the reason is not the correct explanation for the assertion.

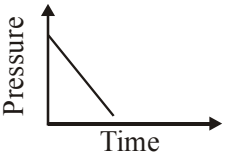
(2) Both assertion and reason are false.

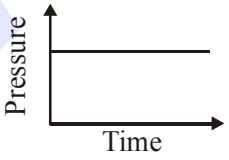
(3) Both assertion and reason are true and the reason is the correct explanation for the assertion.

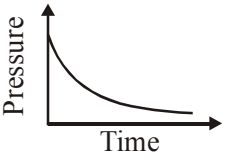
(4) The assertion is true, but the reason is false.

4. A mixture of gases O_2, H_2 and CO are taken in a closed vessel containing charcoal. The graph that represents the correct behaviour of pressure with time is :

(1) 

(2) 

(3) 

(4) 

5. Match the following :

(i) Foam	(a) smoke
(ii) Gel	(b) cell fluid
(iii) Aerosol	(c) jellies
(iv) Emulsion	(d) rubber
	(e) froth
	(f) milk

(1) (i)-(b), (ii)-(c), (iii)-(e), (iv)-(d)

(2) (i)-(d), (ii)-(b), (iii)-(e), (iv)-(f)

(3) (i)-(e), (ii)-(c), (iii)-(a), (iv)-(f)

(4) (i)-(d), (ii)-(b), (iii)-(a), (iv)-(e)

6. Tyndall effect of observed when :

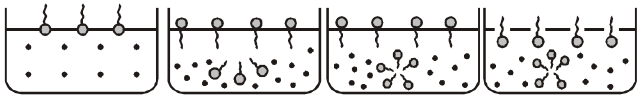
(1) The diameter of dispersed particles is much smaller than the wavelength of light used

(2) The diameter of dispersed particles is much larger than the wavelength of light used

(3) The diameter of dispersed particles is similar to the wavelength of light used

(4) The refractive index of dispersed phase is greater than that of the dispersion medium

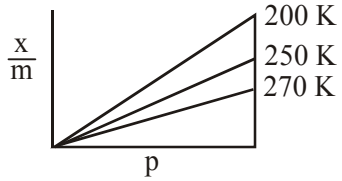
7. Identify the correct molecular picture showing that happens at the critical micellar concentration (CMC) of an aqueous solution of a surfactant (○ polar head; ∼ non-polar tail; • water).

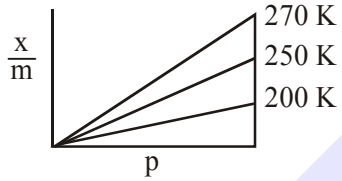


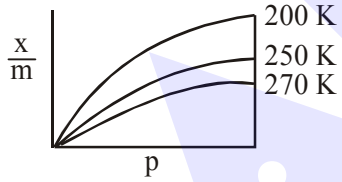
(A) (B) (C) (D)

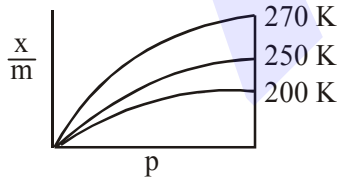
(1) (B) (2) (A) (3) (D) (4) (C)

8. Adsorption of a gas follows Freundlich adsorption isotherm. If x is the mass of the gas adsorbed on mass m of the adsorbent, the correct plot of $\frac{x}{m}$ versus p is :

(1)


(2)


(3)


(4)


9. The mass of gas adsorbed, x, per unit mass of adsorbate, m, was measured at various pressures, p. A graph between log $\frac{x}{m}$ and log p gives a straight line with slope equal to 2 and the intercept equal to 0.4771. The value of $\frac{x}{m}$ at a pressure of 4 atm is : (Given log 3 = 0.4771)

10. Amongst the following statements regarding adsorption, those that are valid are :

(a) ΔH becomes less negative as adsorption proceeds.

(b) On a given adsorbent, ammonia is adsorbed more than nitrogen gas.

(c) On adsorption, the residual force acting along the surface of the adsorbent increases.

(d) With increase in temperature, the equilibrium concentration of adsorbate increases.

(1) (b) and (c) (2) (a) and (b)

(3) (d) and (a) (4) (c) and (d)

11. For Freundlich adsorption isotherm, a plot of log (x/m) (y-axis) and log p (x-axis) gives a straight line. The intercept and slope for the line is 0.4771 and 2, respectively. The mass of gas, adsorbed per gram of adsorbent if the initial pressure is 0.04 atm, is_ _ _ _ _ × 10^{-4}g. (log 3 = 0.4771)

ELECTROCHEMISTRY

1. Given that the standard potentials (E°) of Cu^{2+}/Cu and Cu^{+}/Cu are 0.34 V and 0.522 V respectively, the E° of Cu^{2+}/Cu^{+} is :

(1) +0.158 V (2) 0.182 V

(3) –0.182 V (4) –0.158 V

2. The equation that is incorrect is -

(1) $\left(\Lambda_m^0\right)_{NaBr}-\left(\Lambda_m^0\right)_{NaI}=\left(\Lambda_m^0\right)_{KBr}-\left(\Lambda_m^0\right)_{NaBr}$

(2) $\left(\Lambda_m^0\right)_{H_2O}=\left(\Lambda_m^0\right)_{HCl}+\left(\Lambda_m^0\right)_{NaOH}-\left(\Lambda_m^0\right)_{NaCl}$

(3) $\left(\Lambda_m^0\right)_{KCl}-\left(\Lambda_m^0\right)_{NaCl}=\left(\Lambda_m^0\right)_{KBr}-\left(\Lambda_m^0\right)_{NaBr}$

(4) $\left(\Lambda_m^0\right)_{NaBr}-\left(\Lambda_m^0\right)_{NaCl}=\left(\Lambda_m^0\right)_{KBr}-\left(\Lambda_m^0\right)_{KCl}$

3. What would be the electrode potential for the given half cell reaction at pH = 5 ?_____

$2H_2O \rightarrow O_2 + 4H^{\oplus} + 4e^-$; E^0_{red} = 1.23 V

(R = 8.314 J mol^{-1} K^{-1} ; Temp = 298 K; oxygen under std. atm. pressure of 1 bar)

4. For an electrochemical cell

$Sn(s)\,|\,Sn^{2+}\,(aq,1M)||Pb^{2+}\,(aq,1M)|Pb(s)$

the ratio $\frac{[Sn^{2+}]}{[Pb^{2+}]}$ when this cell attains equilibrium is _____.

(Given $E^0_{Sn^{2+}|Sn} = -0.14V$,

$E^0_{Pb^{2+}|Pb} = -0.13V, \frac{2.303RT}{F} = 0.06$)

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5. 108 g of silver (molar mass 108 g mol^{-1}) is deposited at cathode from $AgNO_3$(aq) solution by a certain quantity of electricity. The volume (in L) of oxygen gas produced at 273 K and 1 bar pressure from water by the same quantity of electricity is _____.

6. Amongst the following, the form of water with the lowest ionic conductance at 298 K is:

(1) distilled water

(2) water from a well

(3) saline water used for intravenous injection

(4) sea water

7. 250 mL of a waste solution obtained from the workshop of a goldsmith contains 0.1 M $AgNO_3$ and 0.1 M AuCl. The solution was electrolyzed at 2 V by passing a current of 1 A for 15 minutes. The metal/metals electrodeposited will be :-

$\left(E^0_{Ag^+/Ag} = 0.80V,\ E^0_{Au^+/Au} = 1.69V\right)$

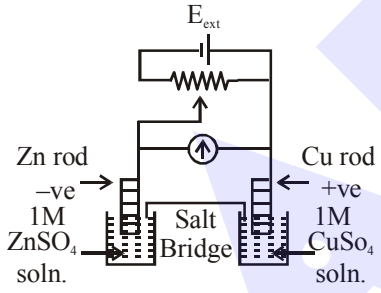
(1) only silver

(2) only gold

(3) silver and gold in equal mass proportion

(4) silver and gold in proportion to their atomic weights

8.



$E^o_{Cu^{2+}|Cu} = +0.34V$

$E^o_{Zn^{2+}|Zn} = -0.76V$

Identify the incorrect statement from the options below for the above cell :

(1) If E_{ext} > 1.1 V, Zn dissolves at Zn electrode and Cu deposits at Cu electrode

(2) If E_{ext} > 1.1 V, e^- flows from Cu to Zn

(3) If E_{ext} = 1.1 V, no flow of e^- or current occurs

(4) If E_{ext} < 1.1 V, Zn dissolves at anode and Cu deposits at cathode

9. The photoelectric current from Na (work function, w_0 = 2.3 eV) is stopped by the output voltage of the cell

Pt(s)|H_2(g, 1bar)|HCl(aq., pH = 1)|AgCl(s)|Ag(s)

The pH of aq. HCl required to stop the photoelectric current from K(w_0 = 2.25eV), all other conditions remaining the same, is ___$\times 10^{-2}$ (to the nearest integer).

Given, $2.303\frac{RT}{F} = 0.06V; E^0_{AgCl|Ag|Cl^-} = 0.22V$

10. An acidic solution of dichromate is electrolyzed for 8 minutes using 2A current. As per the following equation

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

The amount of Cr^{3+} obtained was 0.104 g. The efficiency of the process(in%) is

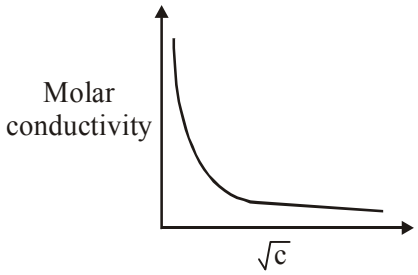
(Take : F = 96000 C, At. mass of chromium = 52)

_____.

11. an oxidation-reduction reaction in which 3 electrons are transferred has a ΔG^o of 17.37 kJ mol^{-1} at 25°C. The value of E^o_{cell} (in V) is _____ $\times 10^{-2}$

(1 F = 96,500 C mol^{-1})

12. The variation of molar conductivity with concentration of an electrolyte (X) in aqueous solution is shown in the given figure.



The electrolyte X is :

(1) CH_3COOH (2) KNO_3

(3) HCl (4) NaCl

13. For the disproportionation reaction

$2Cu^+$ (aq) $\rightleftharpoons$ Cu(s) + Cu^{2+}(aq) at 298 K, ln K (where K is the equilibrium constant) is _____ $\times 10^{-1}$.

Given

$(E^0_{Cu^{2+}/Cu^+} = 0.16V\ \ E^0_{Cu^+/Cu} = 0.52V\ \ \frac{RT}{F} = 0.025)$

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14. Potassium chlorate is prepared by the electrolysis of KCl in basic solution

$6OH^- + Cl^- \rightarrow ClO_3^- + 3H_2O + 6e^-$

If only 60% of the current is utilized in the reaction, the time (rounded to the nearest hour) required to produce 10 g of $KClO_3$ using a current of 2 A is_____.

(Given : F = 96,500 C mol^{-1} molar mass of $KClO_3$=122 $gmol^{-1}$)

15. For the given cell ;

$Cu(s)|Cu^{2+}(C_1M)||Cu^{2+}(C_2M)|Cu(s)$ change in Gibbs energy (ΔG) is negative, if :

(1) $C_1 = 2C_2$ (2) $C_2 = C1/\sqrt{2}$

(3) $C_1 = C_2$ (4) $C_2 = \sqrt{2}C_1$

LIQUID SOLUTION

1. At 35°C, the vapour pressure of CS_2 is 512 mm Hg and that of acetone is 344 mm Hg. A solution of CS_2 in acetone has a total vapour pressure of 600 mm Hg. The false statement amongst the following is :

(1) heat must be absorbed in order to produce the solution at 35°C

(2) Raoult's law is not obeyed by this system

(3) a mixture of 100 mL CS_2 and 100 mL acetone has a volume < 200 mL

(4) CS_2 and acetone are less attracted to each other than to themselves

2. Two open beakers one containing a solvent and the other containing a mixture of that solvent with a non volatile solute are together sealed in a container. Over time -

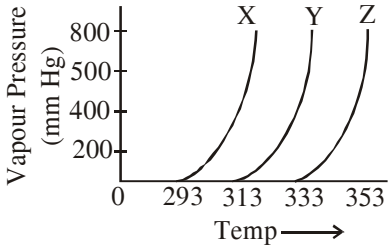
(1) The volume of the solution does not change and the volume of the solvent decreases

(2) The volume of the solution decrease and the volume of the solvent increases

(3) The volume of the solution increase and the volume of the solvent decreases

(4) The volume of the solution and the solvent does not change

3. A graph of vapour pressure and temperature for three different liquids X, Y and Z is shown below:



The following inferences are made :

(A) X has higher intermolecular interactions compared to Y.

(B) X has lower intermolecular interactions compared to Y.

(C) Z has lower intermolecular interactions compared to Y.

The correct inference(s) is/are :

(1) A

(2) (C)

(3) (B)

(4) (A) and (C)

4. How much amount of NaCl should be added to 600 g of water (ρ = 1.00 g/mL) to decrease the freezing point of water to – 0.2 °C ? _____. (The freezing point depression constant for water = 2K kg mol^{-1})

5. The osmotic pressure of a solution of NaCl is 0.10 atm and that of a glucose solution is 0.20 atm. The osmotic pressure of a solution formed by mixing 1 L of the sodium chloride solution with 2 L of the glucose solution is $x \times 10^{-3}$ atm. x is _____. (nearest integer) :-

6. At 300 K, the vapour pressure of a solution containing 1 mole of n-hexane and 3 moles of n-heptane is 550 mm of Hg. At the same temperature, if one more mole of n-heptane is added to this solution, the vapour pressure of the solution increases by 10 mm of Hg. What is the vapour pressure in mm Hg of n-heptane in its pure state ____ ?

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7. Henry's constant (in kbar) for four gases α, β, γ and δ in water at 298 K is given below :

	α	β	γ	δ
K_H	50	2	2×10^{-5}	0.5

(density of water = 10^3 kg m^{-3} at 298 K)

This table implies that :

(1) The pressure of a 55.5 molal solution of γ is 1 bar

(2) The pressure of a 55.5 molal solution of δ is 250 bar

(3) Solubility of γ at 308 K is lower than at 298 K

(4) α has the highest solubility in water at a given pressure

8. If 250 cm^3 of an aqueous solution containing 0.73 g of a protein A is isotonic with one litre of another aqueous solution containing 1.65 g of a protein B, at 298 K, the ratio of the molecular mases of A and B is _____ $\times 10^{-2}$ (to the nearest integer).

9. A set of solutions is prepared using 180 g of water as a solvent and 10 g of different non-volatile solutes A, B and C. The relative lowering of vapour pressure in the presence of these solutes are in the order [Given, molar mass of A = 100 g mol^{-1}; B = 200 g mol^{-1}; C = 10,000 g mol^{-1}]

(1) A > B > C

(2) A > C > B

(3) C > B > A

(4) B > C > A

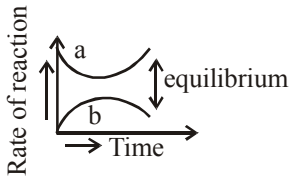
CHEMICAL EQUILIBRIUM

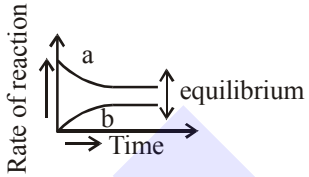
1. If the equilibrium constant for $A \rightleftharpoons B+C$ is $K_{eq}^{(1)}$ and that of $B+C \rightleftharpoons P$ is $K_{eq}^{(2)}$, the equilibrium constant for $A \rightleftharpoons P$ is :-

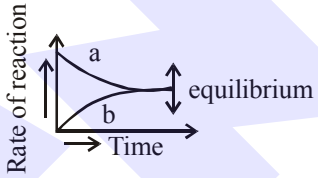
(1) $K_{eq}^{(2)} - K_{eq}^{(1)}$ (2) $K_{eq}^{(1)} K_{eq}^{(2)}$

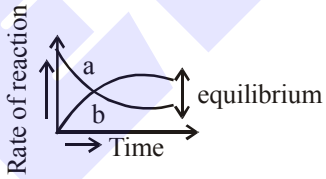
(3) $K_{eq}^{(1)} / K_{eq}^{(2)}$ (4) $K_{eq}^{(1)} + K_{eq}^{(2)}$

2. For the equilibrium $A \rightleftharpoons B$, the variation of the rate of the forward (a) and reverse (b) reaction with time is given by

(1) 

(2) 

(3) 

(4) 

3. For a reaction X + Y ⇌ 2Z, 1.0 mol of X, 1.5 mol of Y and 0.5 mol of Z were taken in a 1 L vessel and allowed to react. At equilibrium, the concentration of Z was 1.0 mol L^{-1}. The equilibrium constant of the reaction is _____ $\frac{x}{15}$. The value of x is _____ .

4. The value of K_C is 64 at 800 K for the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

The value of K_C for the following reaction is :

$$NH_3(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$$

(1) $\frac{1}{4}$ (2) $\frac{1}{8}$ (3) 8 (4) $\frac{1}{64}$

5. For the reaction :

$$Fe_2N(s) + \frac{3}{2}H_2(g) \rightleftharpoons 2Fe(s) + NH_3(g)$$

(1) $K_C = K_P(RT)$ (2) $K_C = K_P(RT)^{-1/2}$

(3) $K_C = K_P(RT)^{-3/2}$ (4) $K_C = K_P(RT)^{1/2}$

ANSWER KEY

MOLE CONCEPT										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	
Ans.	3	3	4.95 to 4.97	2120 to 2140	1	4	18	5.00	50.00	

CONCENTRATION TERMS								
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Ans.	14.00	10	100	47	25	2	4	

REDOX REACTIONS										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	3.00	4	4	100	19	10	85	10.00	50.00	19.00

IDEAL GAS					
Que.	**1**	**2**	**3**	**4**	
Ans.	4	3	1	750.00	

ATOMIC STRUCTURE									
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
Ans.	2	2	4	1	3	4	1	222.00	

CHEMICAL EQUILIBRIUM				
Que.	**1**	**2**	**3**	
Ans.	NTA-1, ALLEN 1 or Bonus	1	2	

IONIC EQUILIBRIUM										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	10.60	5.22 to 5.24	3	2	2	1	3	3	37	2.00
Que.	**11**									
Ans.	4									

THERMODYNAMICS										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	–2.70 to –2.71	48.00	6.25	1	2.17 to 2.23	4	1	NTA:–13538.00 Allen 13537.57	NTA:–189494.00 Allen 189494.39	96500.00
Que.	**11**									
Ans.	3									

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THERMODYNAMICS					
Que.	**1**	**2**	**3**	**4**	
Ans.	–192.50 or –85.00	4	2	NTA –326400.00 Allne 326400.00	

SOLID STATE					
Que.	**1**	**2**	**3**	**4**	
Ans.	1	143	3	1	

CHEMICAL KINETICS										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	4	4	3	4	3.98 to 4.00 or –3.98 to –4.00	NTA 84297 Allen 84297.47 or 84297.48	60	4	4	4
Que.	**11**	**12**	**13**	**14**						
Ans.	1	1	3	NTA 100.00 ALLEN 99.98						

RADIOACTIVITY		
Que.	**1**	
Ans.	23 to 23.03	

SURFACE CHEMISTRY										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	0.36 to 0.38	4	4	4	3	3	3	3	NTA 6.00 ALLEN 48.00	2
Que.	**11**									
Ans.	48.00									

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ELECTROCHEMISTRY										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	1	1	–0.93 to –0.94	2.13 to 2.17	5.66 to 5.68	1	4	1	NTA 58 ALLEN 142	60
Que.	**11**	**12**	**13**	**14**	**15**					
Ans.	6	1	144.00	11.00	4					

LIQUID SOLUTION									
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Ans.	3	3	3	1.74 to 1.76 or 0.03	167	600	2	177	1

CHEMICAL EQUILIBRIUM					
Que.	**1**	**2**	**3**	**4**	**5**
Ans.	2	3	16	2	4

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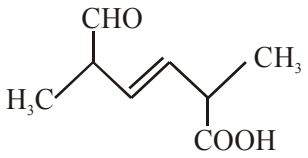
JANUARY & SEPTEMBER 2020 ATTEMPT (OC)

NOMENCLATURE

1. The IUPAC name for the following compound is:



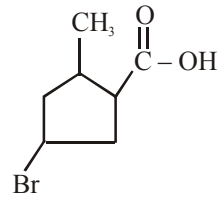
(1) 2, 5-dimethyl-6-carboxy-hex-3-enal

(2) 6-formyl-2-methyl-hex-3-enoic acid

(3) 2, 5-dimethyl-5-carboxy-hex-3-enal

(4) 2, 5-dimethyl-6-oxo-hex-3-enoic acid

2. The IUPAC name of the following compound is :



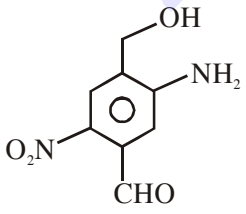
(1) 4-Bromo-2-methylcyclopentane carboxylic acid

(2) 5-Bromo-3-methylcyclopentanoic acid

(3) 3-Bromo-5-methylcyclopentane carboxylic acid

(4) 3-Bromo-5-methylcyclopentanoic acid

3. The IUPAC name of the following compound is :



(1) 3-amino-4-hydroxymethyl-5-nitrobenzaldehyde

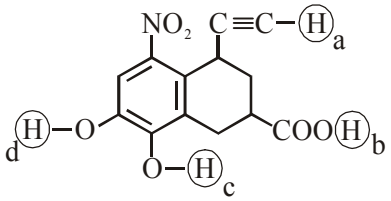
(2) 2-nitro-4-hydroxymethyl-5-aminobenzaldehyde

(3) 4-amino-2-formyl-5-hydroxymethylnitrobenzene

(4) 5-amino-4-hydroxymethyl-2-nitrobenzaldehyde

ACIDITY & BASICITY

1. Arrange the following labelled hydrogens in decreasing order of acidity :



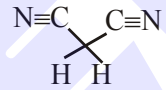
(1) b > c > d > a

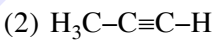
(2) c > b > a > d

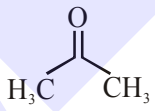
(3) b > a > c > d

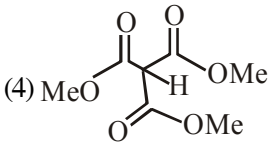
(4) c > b > d > a

2. Which one of the following compounds possesses the most acidic hydrogen ?

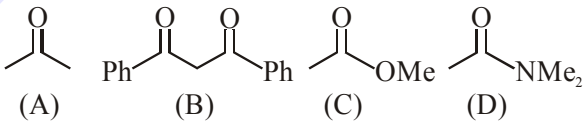
(1) 

(2) 

(3) 

(4) 

3. The increasing order of the acidity of the α-hydrogen of the following compounds is :



(A) (B) (C) (D)

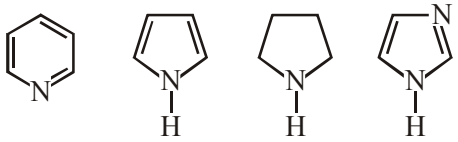
(1) (C) < (A) < (B) < (D)

(2) (B) < (C) < (A) < (D)

(3) (A) < (C) < (D) < (B)

(4) (D) < (C) < (A) < (B)

4. The increasing order of basicity of the following compounds is



(A) (B) (C) (D)

(1) (A) < (B) < (C) < (D)

(2) (B) < (A) < (C) < (D)

(3) (D) < (A) < (B) < (C)

(4) (B) < (A) < (D) < (C)

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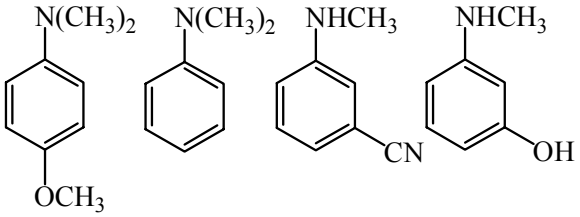
5. The increasing order of pK_b values of the following compounds is -



I II III IV

(1) I < II < IV < III

(2) II < IV < III < I

(3) II < I < III < IV

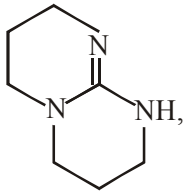
(4) I < II < III < IV

ELECTRONIC DISPLACEMENT EFFECT

1. The increasing order of pK_b for the following compounds will be :

$NH_2 - CH = NH$,

(A)



(B)

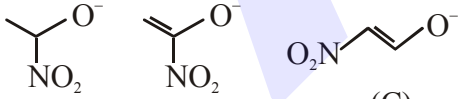
CH_3NHCH_3

(C)

(1) (A) < (B) < (C) (2) (C) < (A) < (B)

(3) (B) < (A) < (C) (4) (B) < (C) < (A)

2. The correct order of stability for the following alkoxides is :



(A) (B) (C)

(1) (C) > (B) > (A) (2) (C) > (A) > (B)

(3) (B) > (C) > (A) (4) (B) > (A) > (C)

3. Arrange the following compounds in increasing order of C–OH bond length : methanol, phenol, p-ethoxyphenol

(1) phenol < methanol < p-ethoxyphenol

(2) phenol < p-ethoxyphenol < methanol

(3) methanol < p-ethoxyphenol < phenol

(4) methanol < phenol < p-ethoxyphenol

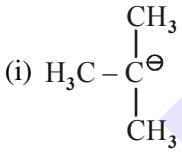
4. The correct order of heat of combustion for following alkadienes is :

(a)  (b)  (c) 

(1) (a) < (b) < (c) (2) (b) < (c) < (a)

(3) (c) < (b) < (a) (4) (a) < (c) < (b)

5. The increasing order of basicity for the following intermediates is (from weak to strong)

(i) 

(ii) $H_2C = CH - \overset{\ominus}{C}H_2$

(iii) $HC \equiv \overset{\ominus}{C}$ (iv) $\overset{\ominus}{C}H_3$ (v) $\overset{\ominus}{C}N$

(1) (v) < (i) < (iv) < (ii) < (iii)

(2) (iii) < (i) < (ii) < (iv) < (v)

(3) (v) < (iii) < (ii) < (iv) < (i)

(4) (iii) < (iv) < (ii) < (i) < (v)

6. Which of the following has the shortest C-Cl bond?

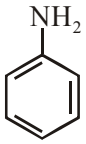
(1) Cl–CH=CH–OCH_3

(2) C1–CH=CH–CH_3

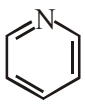
(3) C1–CH=CH_2

(4) C1–CH=CH–NO_2

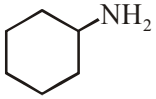
7. The decreasing order of basicity of the following amines is :



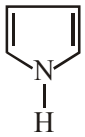
(I)



(II)



(III)



(IV)

(1) (I) > (III) > (IV) > (II)

(2) (III) > (I) > (II) > (IV)

(3) (III) > (II) > (I) > (IV)

(4) (II) > (III) > (IV) > (I)

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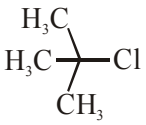
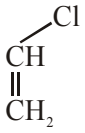
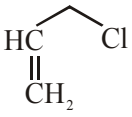
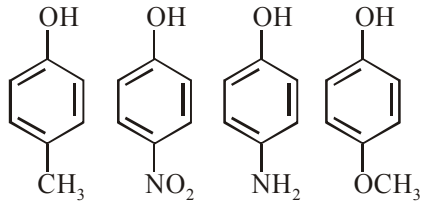
8. Among the following compounds, which one has the shortest C—Cl bond ?

(1) $H_3C–Cl$ (2) 

(3)  (4) 

9. The increasing order of boiling points of the following compounds is :



I II III IV

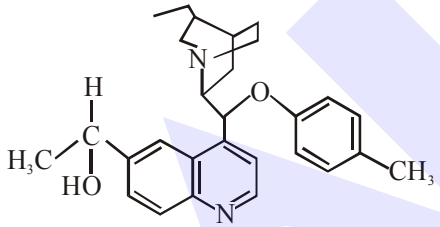
(1) I < IV < III < II (2) IV < I < II < III

(3) I < III < IV < II (4) III < I < II < IV

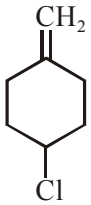
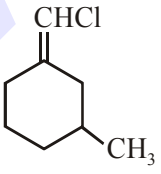
ISOMERISM

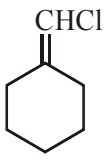
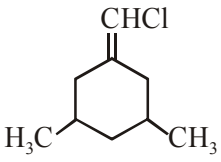
1. The number of chiral carbons in chloramphenicol is _____ .

2. The number of chiral carbons present in the molecule given below is _____ .



3. Among the following compounds, geometrical isomerism is exhibited by :

(1)  (2) 

(3)  (4) 

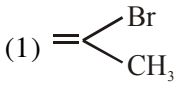
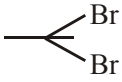
4. Which of the following compound shows geometrical isomerism

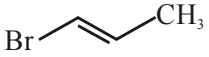
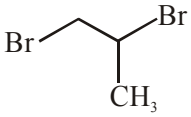
(1) 2-methylpent-2-ene (2) 4-methylpent-l-ene

(3) 4-methylpent-2-ene (4) 2-methylpent-l-ene

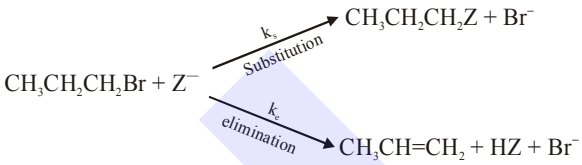
HALOGEN DERIVATIVE

1. 1-methyl ethylene oxide when treated with an excess of HBr produces :

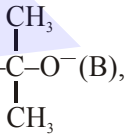
(1)  (2) 

(3)  (4) 

2. For the following reactions :



where

$Z^- = CH_3CH_2O^-$ (A) or  (B),

k_s and k_e , are , respectively, the rate constants for the substitution and elimination, and $\mu = \frac{k_s}{k_e}$, the correct options is -

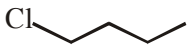
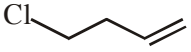
(1) $\mu_B > \mu_A$ and $k_e(B) > k_e(A)$

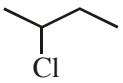
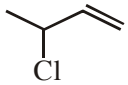
(2) $\mu_B > \mu_A$ and $k_e(A) > k_e(B)$

(3) $\mu_A > \mu_B$ and $k_e(B) > k_e(A)$

(4) $\mu_A > \mu_B$ and $k_e(A) > k_e(B)$

3. The decreasing order of reactivity towards dehydrohalogenation (E_1) reaction of the following compounds is :

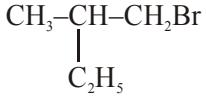
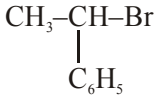
(A)  (B) 

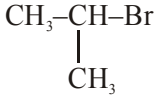
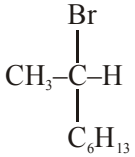
(C)  (D) 

(1) B > D > A > C (2) B > D > C > A

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

4. Which of the following compounds will show retention in configuration on nucleophic substitution by OH^- ion ?

(1)  (2) 

(3)  (4) 

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5. The major product obtained from E_2-elimination of 3-bromo-2-fluoropentane is:

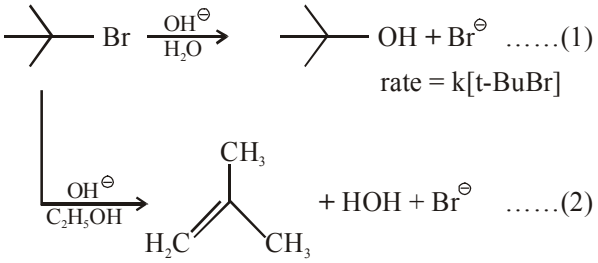
(1) $CH_3CH_2-\underset{\displaystyle Br}{\underset{|}{C}}H-CH=CH_2$

(2) $CH_3-CH_2-\underset{\displaystyle Br}{\underset{|}{C}}=CH-CH_3$

(3) $CH_3-CH=CH-\underset{\displaystyle F}{\underset{|}{C}}H-CH_3$

(4) $CH_3CH_2CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-F$

6. Consider the reaction sequence given below :



Which of the following statements is true :

(1) Changing the concentration of base will have no effect on reaction (1)

(2) Changing the concentration of base will have no effect on reaction (2)

(3) Changing the base from $OH^{\ominus}$ to $^{\ominus}OR$ will have no effect on reaction (2)

(4) Doubling the concentration of base will double the rate of both the reactions.

7. The mechanism of S_N1 reaction is given as :

$$R-X \rightarrow \underset{\text{Ion pair}}{R^{\oplus}X^{\ominus}} \rightarrow \underset{\text{Solvent separated ion pair}}{R^{\oplus}||X^{\ominus}} \xrightarrow{Y^{\ominus}} R-Y+X^{\ominus}$$

A student writes general characteristics based on the given mechanism as :

(a) The reaction is favoured by weak nucleophiles

(b) $R^{\oplus}$ would be easily formed if the substituents are bulky

(c) The reaction is accompained by recemization

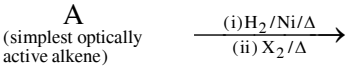
(d) The reaction is favoured by non-polar solvents.

Which observations are correct ?

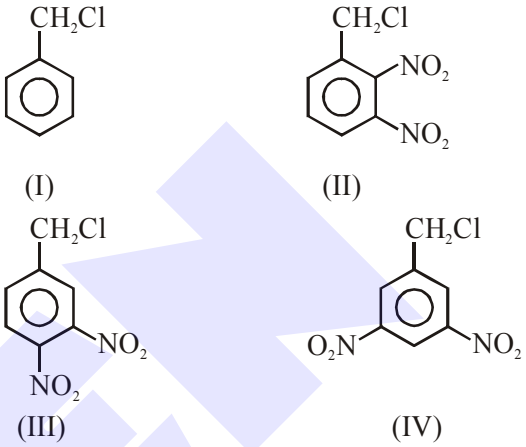
(1) b and d (2) a and c

(3) a, b and c (4) a and b

8. The total number of monohalogenated organic products in the following (including stereoisomers) reaction is _____.



9. The decreasing order of reactivity of the following compounds towards nucleophilic substitution (S_N2) is :



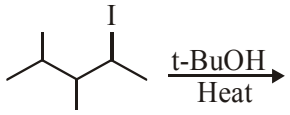
(1) (IV) > (II) > (III) > (I)

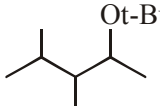
(2) (II) > (III) > (IV) > (I)

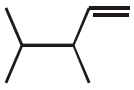
(3) (II) > (III) > (I) > (IV)

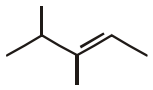
(4) (III) > (II) > (IV) > (I)

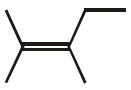
10. The major product in the following reaction is :



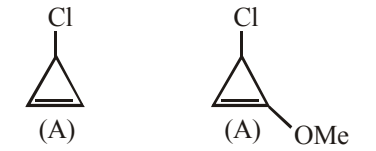
(1) 

(2) 

(3) 

(4) 

11. The decreasing order of reactivity of the following organic molecules towards $AgNO_3$ solution is :



$CH_3\underset{\displaystyle Cl}{\underset{|}{C}}HCH_3$ (C)

$CH_3\underset{\displaystyle Cl}{\underset{|}{C}}HCH_2NO_2$ (D)

(1) (A) > (B) > (D) > (C)

(2) (A) > (B) > (C) > (D)

(3) (C) > (D) > (A) > (B)

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

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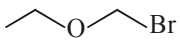
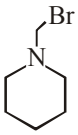
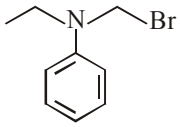
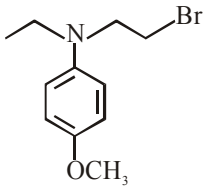
12. Which of the following compounds will form the precipitate with aq. $AgNO_3$ solution most readily?

(1) 

(2) 

(3) 

(4) 

13. The major product formed in the following reaction is :

$$CH_3CH=CHCH(CH_3)_2 \xrightarrow{HBr}$$

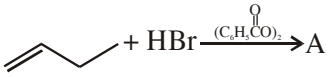
(1) $CH_3\ CH_2\ CH_2\ C(Br)\ (CH_3)_2$

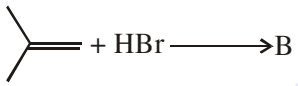
(2) $Br(CH_2)_3\ CH(CH_3)_2$

(3) $CH_3\ CH_2\ CH(Br)\ CH(CH_3)_2$

(4) $CH_3\ CH(Br)\ CH_2\ CH(CH_3)_2$

14. The increasing order of the boiling points of the major products A, B and C of the following reactions will be :

(a) 

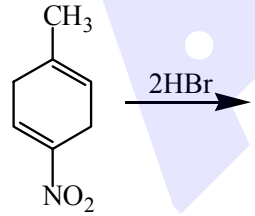
(b) 

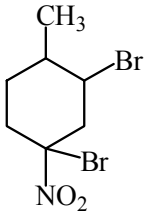
(c) 

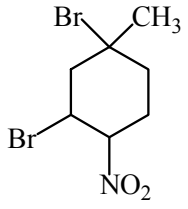
(1) C < A < B (2) B < C < A

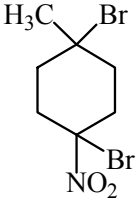
(3) A < B < C (4) A < C < B

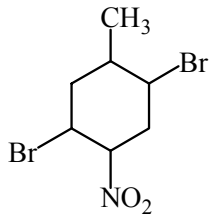
15. The major product of the following reaction is



(1) 

(2) 

(3) 

(4) 

ALCOHOL & ETHER

1. Consider the following reactions :

(a) $(CH_3)_3CCH(OH)CH_3 \xrightarrow{conc.H_2SO_4}$

(b) $(CH_3)_2CHCH(Br)CH_3 \xrightarrow{alc.KOH}$

(c) $(CH_3)_2CHCH(Br)CH_3 \xrightarrow[\text{It should be } (CH_3)_3CO^{\oplus}K^{\oplus}]{\text{given by NTA } (CH_3)_3O^{\ominus}K^{\oplus}}$

(d) $(CH_3)_2\underset{\underset{OH}{|}}{C}-CH_2-CHO \xrightarrow{\Delta}$

Which of these reaction(s) will not produce Saytzeff product ?

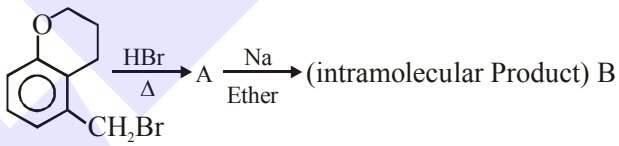
(1) (c) only

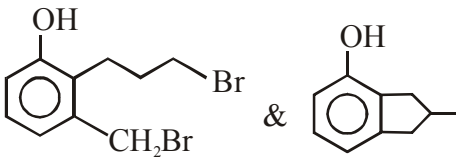
(2) (a), (c) and (d)

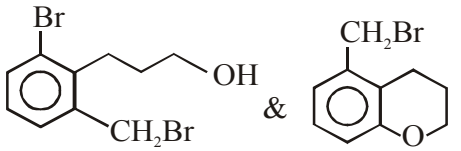
(3) (d) only

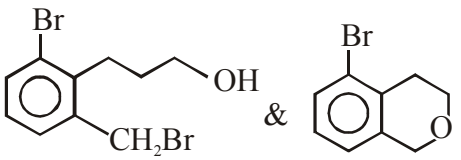
(4) (b) and (d)

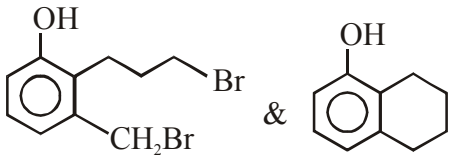
2. In the following reaction squence, structures of A and B, respectively will be :



(1) 

(2) 

(3) 

(4) 

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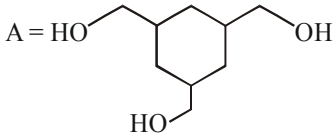
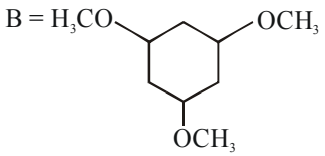
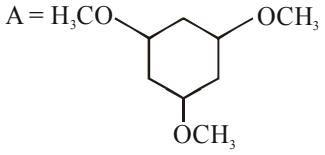
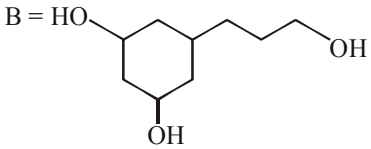
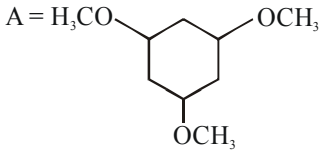
3. Among the compounds A and B with molecular formula $C_9H_{18}O_3$, A is having higher boiling point than B. The possible structures of A and B are :

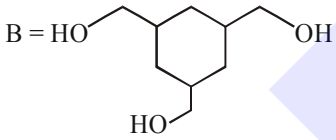
(1) A = 

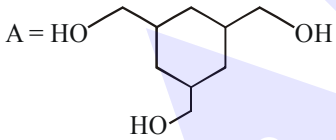
B = 

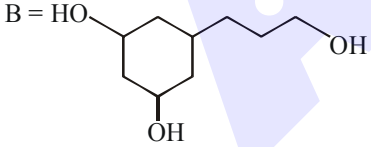
(2) A = 

B = 

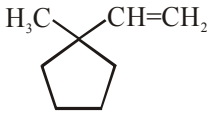
(3) A = 

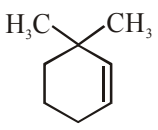
B = 

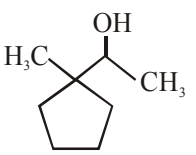
(4) A = 

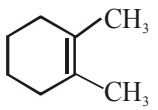
B = 

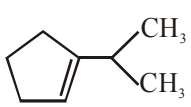
4. The major product in the following reaction is :



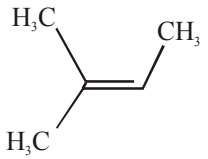
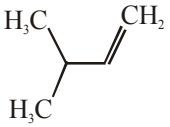
(1) 

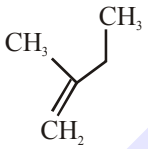
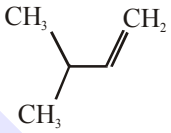
(2) 

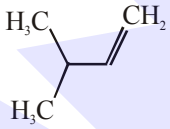
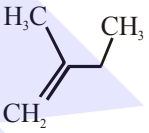
(3) 

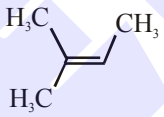
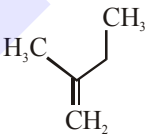
(4) 

5. When neopentyl alcohol is heated with an acid, it slowly converted into an 85 : 15 mixture of alkenes A and B, respectively. What are these alkenes ?

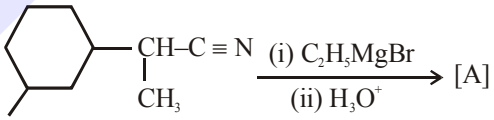
(1)  and 

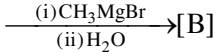
(2)  and 

(3)  and 

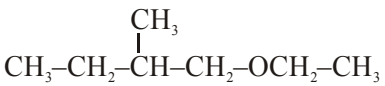
(4)  and 

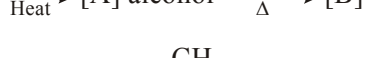
6. The number of chiral centres present in [B] is _____.

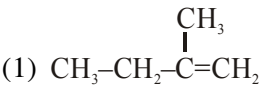




7. The major product [B] in the following reactions is :-

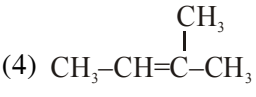




(1) 

(2) $CH_3–CH_2–CH=CH–CH_3$

(3) $CH_2=CH_2$

(4) 

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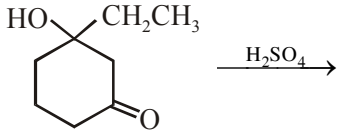
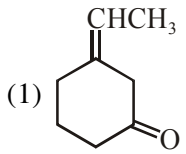
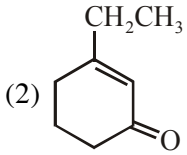
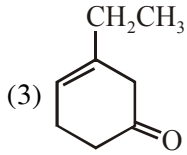
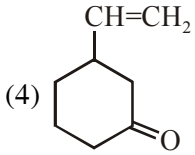
8. The major product of the following reaction is:



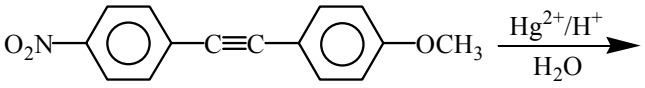
(1) 

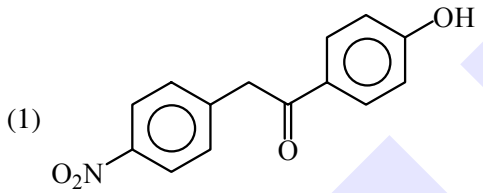
(2) 

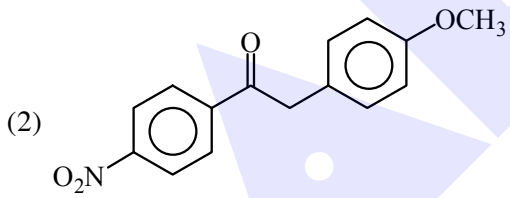
(3) 

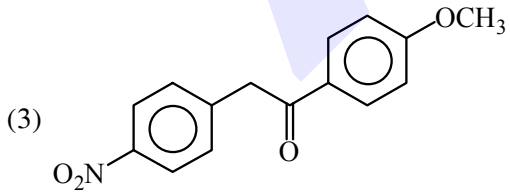
(4) 

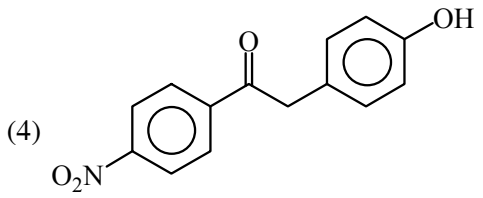
9. The major product obtained from the following reaction is -



(1) 

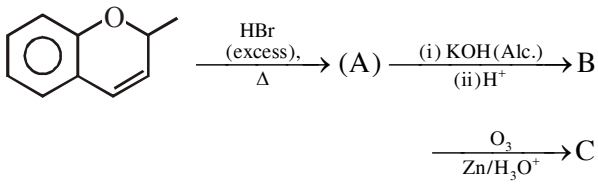
(2) 

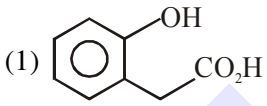
(3) 

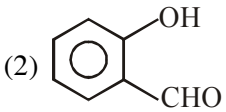
(4) 

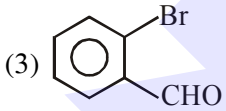
OXIDATION

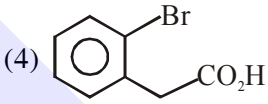
1. The major aromatic product C in the following reaction sequence will be :



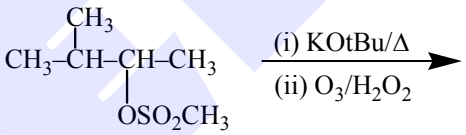
(1) 

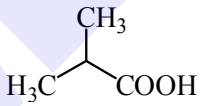
(2) 

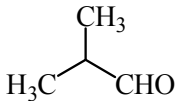
(3) 

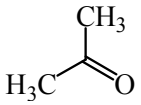
(4) 

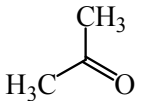
2. The major products of the following reaction are :



(1)  + HCOOH

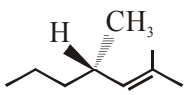
(2)  + HCHO

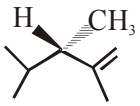
(3)  + CH_3CHO

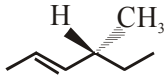
(4)  + CH_3COOH

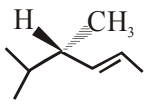
REDUCTION

1. Which of the following compounds produces an optically inactive compound on hydrogenation ?

(1) 

(2) 

(3) 

(4) 

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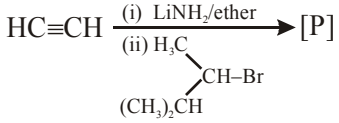
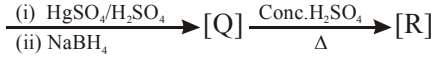
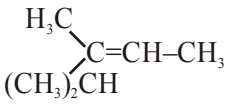
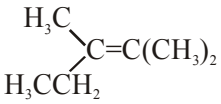
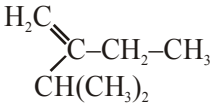
2. The major product [R] in the following sequence of reactions is :

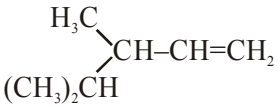




(1) 

(2) 

(3) 

(4) 

3. The most appropriate reagent for conversion of C_2H_5CN into $CH_3CH_2CH_2NH_2$ is :

(1) $Na(CN)BH_3$

(2) $LiAlH_4$

(3) $NaBH_4$

(4) CaH_2

4. The correct match between **Item-I** (starting material) and **Item-II** (reagent) for the preparation of benzaldehyde is :

Item-I	**Item-II**
(I) Benzene	(P) HCl and $SnCl_2$, H_3O^+
(II) Benzonitrile	(Q) H_2, Pd-$BaSO_4$, S and quinoline
(III) Benzoyl Chloride	(R) CO, HCl and $AlCl_3$

(1) (I)-(Q), (II)-(R) and (III)-(P)

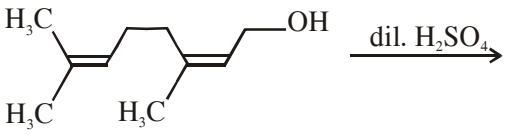
(2) (I)-(R), (II)-(Q) and (III)-(P)

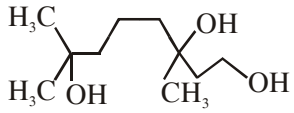
(3) (I)-(R), (II)-(P) and (III)-(Q)

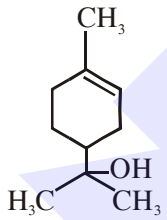
(4) (I)-(P), (II)-(Q) and (III)-(R)

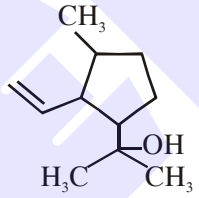
HYDROCARBON

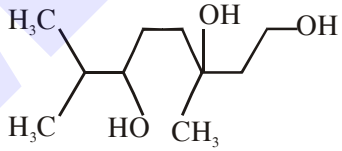
1. The major product of the following reaction is :



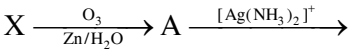
(1) 

(2) 

(3) 

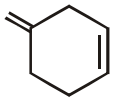
(4) 

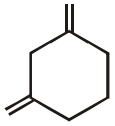
2. An unsaturated hydrocarbon X absorbs two hydrogen molecules on catalytic hydrogenattion, and also gives following reaction :

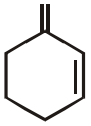


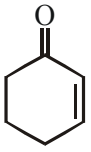
B(3 - oxo - hexanedicarboxylic acid)

X will be :

(1) 

(2) 

(3) 

(4) 

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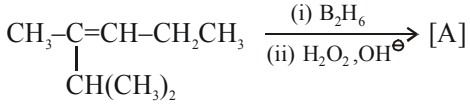
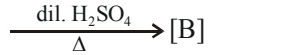
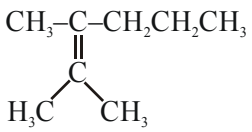
3. The major product [B] in the following sequence of reactions is :-

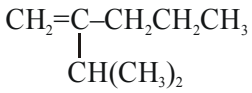


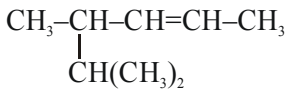
$$CH_3-\underset{\underset{CH(CH_3)_2}{|}}{C}=CH-CH_2CH_3 \xrightarrow[(ii)\ H_2O_2,OH^{\ominus}]{(i)\ B_2H_6} [A]$$

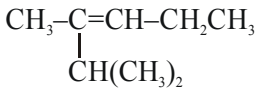


$$\xrightarrow[\Delta]{dil.\ H_2SO_4} [B]$$

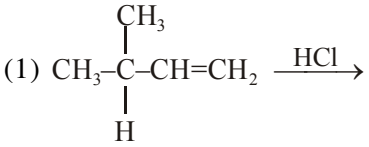
(1) 

(2) 

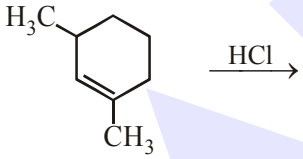
(3) 

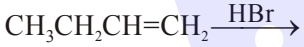
(4) 

4. Which of the following reactions will not produce a racemic product ?

(1) 

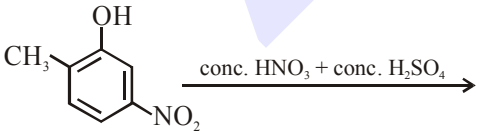
(2) 

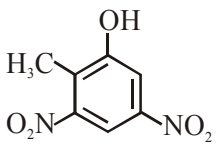
(3) 

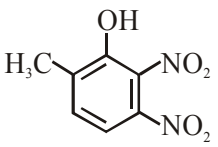
(4) 

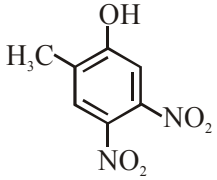
AROMATIC COMPOUND

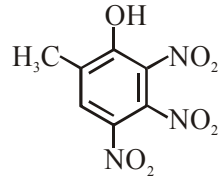
1. The major product of the following reaction is:



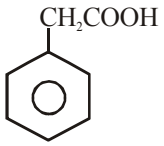
(1) 

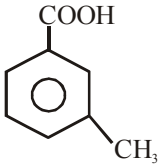
(2) 

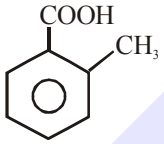
(3) 

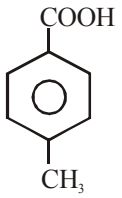
(4) 

2. [P] on treatment with $Br_2/FeBr_3$ in CCl_4 produced a single isomer $C_8H_7O_2Br$ while heating [P] with sodalime gave toluene.
The compound [P] is :

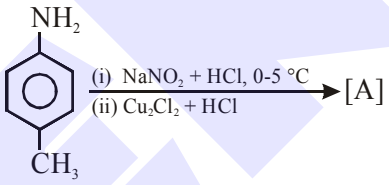
(1) 

(2) 

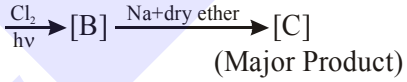
(3) 

(4) 

3. In the following reaction sequence, [C] is :-

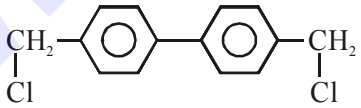


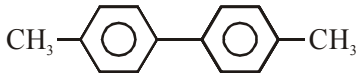
$$\xrightarrow[(ii)\ Cu_2Cl_2+HCl]{(i)\ NaNO_2+HCl,\ 0\text{-}5\ ^\circ C} [A]$$

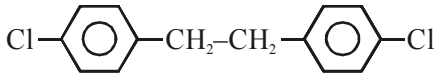


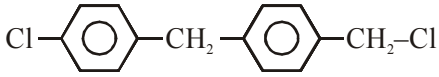
$$\xrightarrow[h\nu]{Cl_2} [B] \xrightarrow{Na+dry\ ether} [C]$$

(Major Product)

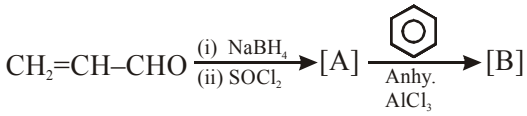
(1) 

(2) 

(3) 

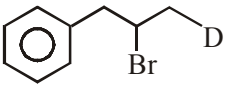
(4) 

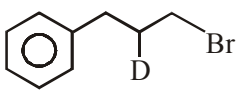
4. The major product [C] of the following reaction sequence will be :-

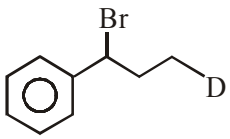


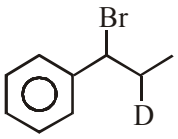
$$CH_2=CH-CHO \xrightarrow[(ii)\ SOCl_2]{(i)\ NaBH_4} [A] \xrightarrow[Anhy.\ AlCl_3]{} [B]$$

$$\xrightarrow{DBr} [C]$$

(1) 

(2) 

(3) 

(4) 

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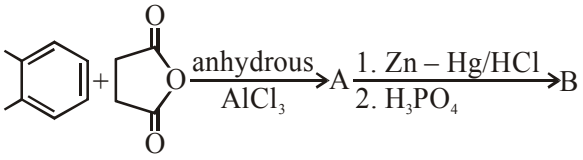
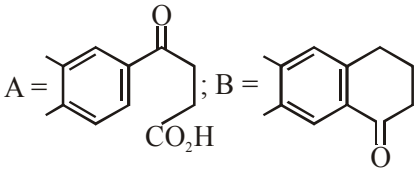
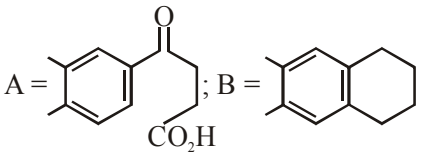
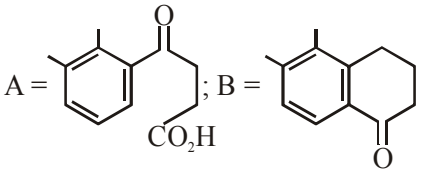
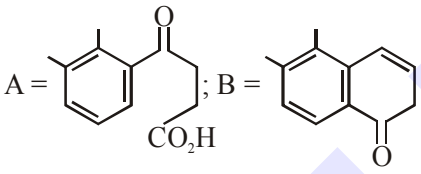
5. In the following reaction sequence the major products A and B are :



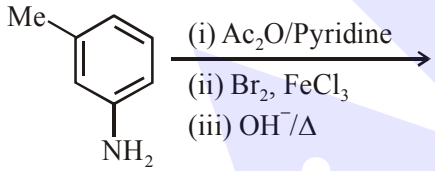
(1) 

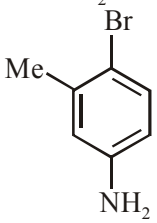
(2) 

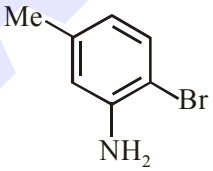
(3) 

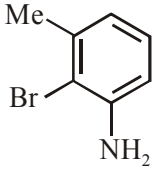
(4) 

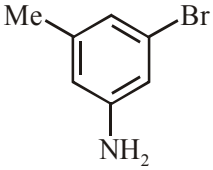
6. The final major product of the following reaction is :



(1) 

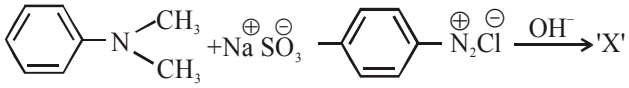
(2) 

(3) 

(4) 

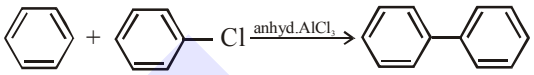
7. A solution of phenol in chloroform when treated with aqueous NaOH gives compound P as a major product. The mass percentage of carbon in P is_____. (to the nearest integer)
(Atomic mass : C = 12; H = 1; O = 16)

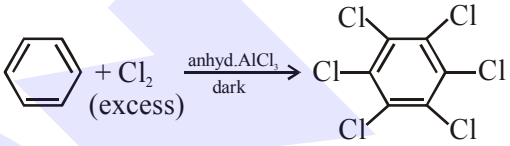
8. Consider the following reaction :



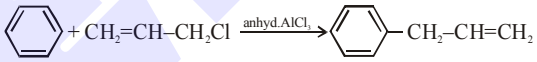
The product 'X' is used :
(1) in acid base titration as an indicator
(2) in protein estimation as an alternative to ninhydrin
(3) in laboratory test for phenols
(4) as food grade colourant

9. Consider the following reactions :

(a) 

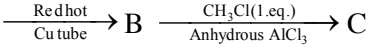
(b) 

(c) 

(d) 

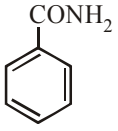
Which of these reactions are possible ?
(1) (a) and (d)
(2) (b) and (d)
(3) (a) and (b)
(4) (b) , (c) and (d)

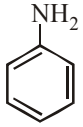
10. In the following sequence of reactions the maximum number of atoms present in molecule 'C' in one plane is _____.

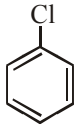


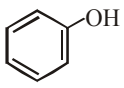
(A is a lowest molecular weight alkyne)

11. Which of these will produce the highest yield in Friedel Crafts reaction?

(1) 

(2) 

(3) 

(4) 

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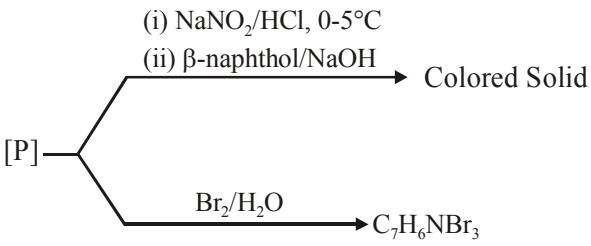
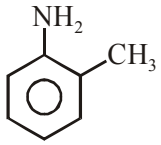
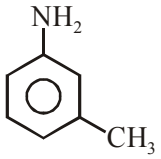
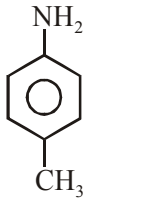
12. Consider the following reactions,

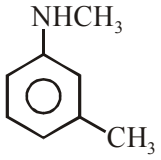


The compound [P] is :

(1) 

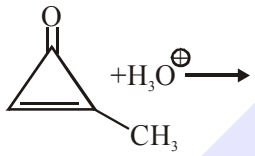
(2) 

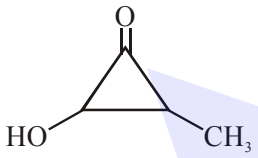
(3) 

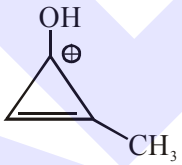
(4) 

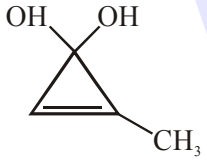
CARBONYL COMPOUNDS

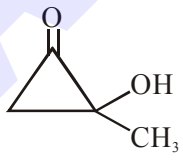
1. The major product in the following reaction is:



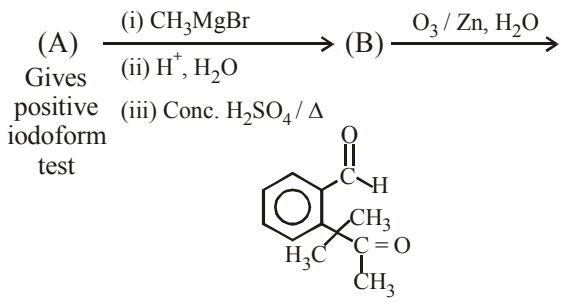
(1) 

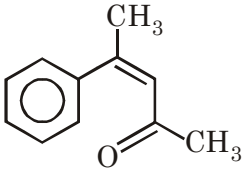
(2) 

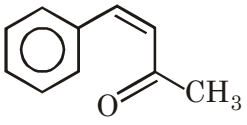
(3) 

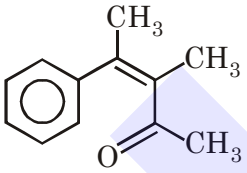
(4) 

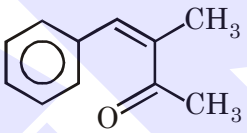
2. Identify (A) in the following reaction sequence :



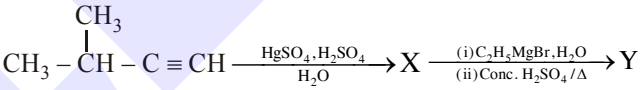
(1) 

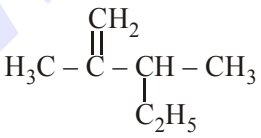
(2) 

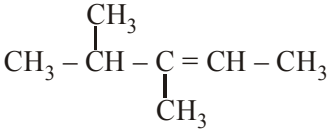
(3) 

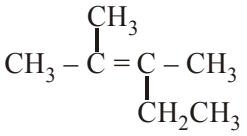
(4) 

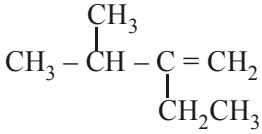
3. The major product (Y) in the following reactions is :



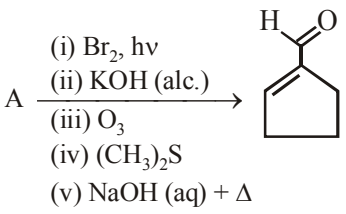
(1) 

(2) 

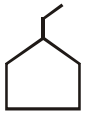
(3) 

(4) 

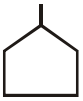
4. In the following reaction A is :



(1) 

(2) 

(3) 

(4) 

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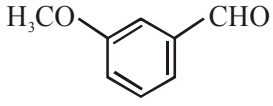
5. Consider the following reactions

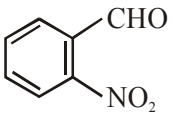
$$A \xrightarrow[(ii)H_3O^+]{(i)CH_3MgBr} B \xrightarrow[573K]{Cu} \text{2-methyl, 2-butene}$$

The mass percentage of carbon in A is _____.

6. The increasing order of the following compounds towards HCN addition is :



(i)



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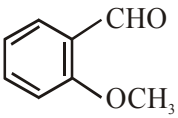
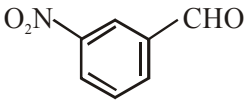


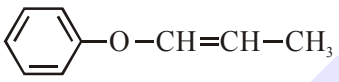
(iii)

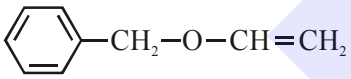


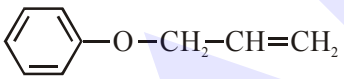
(iv)

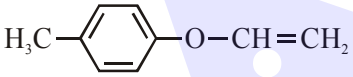
(1) (iii) < (iv) < (ii) < (i) (2) (iii) < (iv) < (i) < (ii)
(3) (iii) < (i) < (iv) < (ii) (4) (i) < (iii) < (iv) < (ii)

7. An organic compound 'A' ($C_9H_{10}O$) when treated with conc. HI undergoes cleavage to yield compounds 'B' and 'C'. 'B' gives yellow precipitate with $AgNO_3$ where as 'C' tautomerizes to 'D'. 'D' gives positive idoform test. 'A' could be :

(1) 

(2) 

(3) 

(4) 

8. The increasing order of the reactivity of the following compound in nucleophilic addition reaction is :

Propanal, Benzaldehyde, Propanone, Butanone

(1) Butanone < Propanone < Benzaldehyde < Propanal

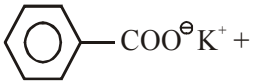
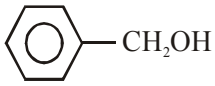
(2) Benzaldehyde < Butanone < Propanone < Propanal

(3) Propanal < Propanone < Butanone < Benzaldehyde

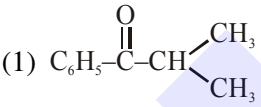
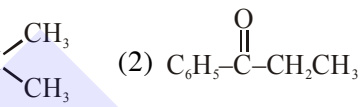
(4) Benzaldehyde < Propanal < Propanone < Butanone

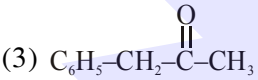
9. The compound A in the following reaction is :

$$A \xrightarrow[(ii)\text{ Conc. } H_2SO_4/\Delta]{(i)\ CH_3MgBr/H_2O} \quad B \xrightarrow[(ii)\ Zn/H_2O]{(i)O_3} C + D$$

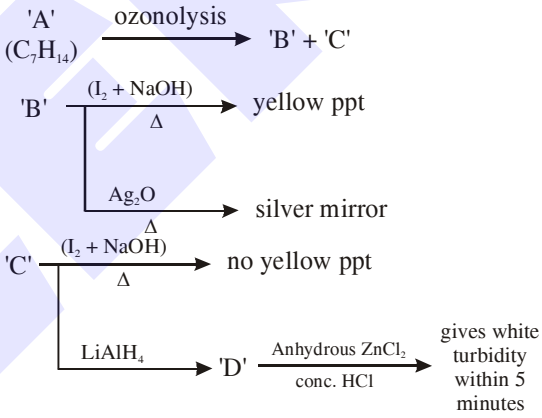
$$C \xrightarrow[(ii)\ \Delta]{(i)\text{ Conc.KOH}} \text{  } + \text{  }$$

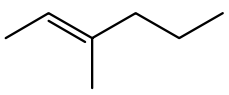
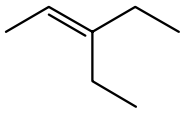
$$D \xrightarrow[\Delta]{Ba(OH)_2} H_3C-\overset{CH_3}{\overset{|}{C}}=CH-\overset{O}{\overset{||}{C}}-CH_3$$

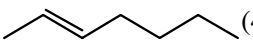
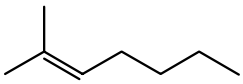
(1)  (2) 

(3)  (4) 

10. Consider the following reactions 'A' is -



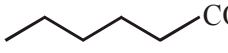
(1)  (2) 

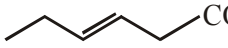
(3)  (4) 

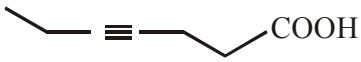
CARBOXYLIC ACID AND THEIR DERIVATIVES

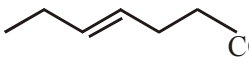
1. What is the product of following reaction ?

$$\text{Hex-3-ynal} \xrightarrow[\text{(iii) Mg/ether}]{\text{(i) } NaBH_4 \text{ (ii) } PBr_3} ?$$
$$\text{(iv) } CO_2/H_3O^+$$

(1) 

(2) 

(3) 

(4) 

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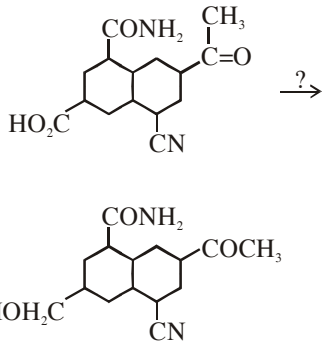
2. The most suitable reagent for the given conversion is :

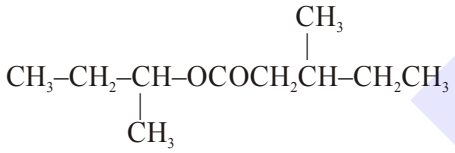


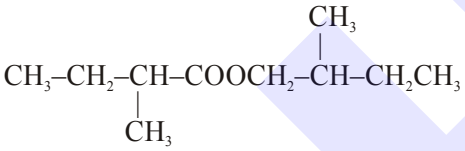
(1) $LiAlH_4$ (2) $NaBH_4$ (3) H_2/Pd (4) B_2H_6

3. An organic compound [A], molecular formula $C_{10}H_{20}O_2$ was hydrolyzed with dilute sulphuric acid to give a carboxylic acid [B] and alcohol [C]. Oxidation of [C] with $CrO_3 - H_2SO_4$ produced [B]. Which of the following structures are not possible for [A] ?

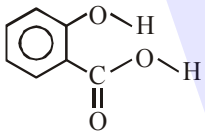
(1) $(CH_3)_3–C–COOCH_2C(CH_3)_3$

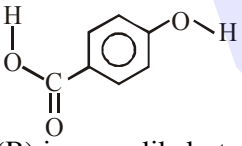
(2) $CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3$

(3) 

(4) 

4. Consider the following molecules and statements related to them :

(A) 

(B) 

(a) (B) is more likely to be crystalline than (A)

(b) (B) has higher boiling point than (A)

(c) (B) dissolves more readily than (A) in water

Identify the correct option from below :

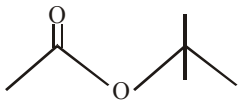
(1) only (a) is true

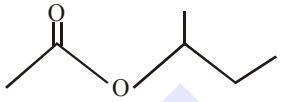
(2) (a) and (c) are true

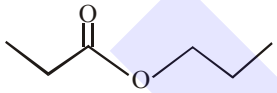
(3) (b) and (c) are true

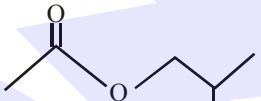
(4) (a) and (b) are true

5. An organic compound (A) (molecular formula $C_6H_{12}O_2$) was hydrolysed with dil. H_2SO_4 to give a carboxylic acid (B) and an alcohol (C). 'C' give white turbidity immediately when treated with anhydrous $ZnCl_2$ and conc. HCl. The organic compound (A) is :

(1) 

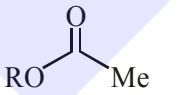
(2) 

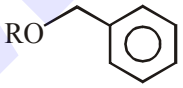
(3) 

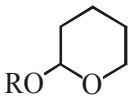
(4) 

6. Which of the following derivatives of alcohols is unstable in an aqueous base ?

(1) $RO - CMe_3$

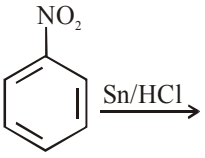
(2) 

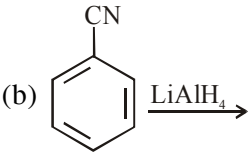
(3) 

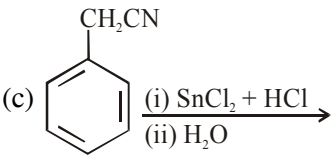
(4) 

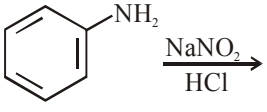
AMINES

1. The Kjeldahl method of Nitrogen estimation fails for which of the following reaction products ?

(a) 

(b) 

(c) 

(d) 

(1) a and d

(2) c and d

(3) a, c and d

(4) b and c

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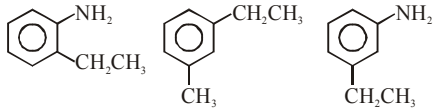
2. Three isomers A, B and C (mol. formula $C_8H_{11}N$) give the following results :

A and C $\xrightarrow{\text{Diazotization}}$ P + Q $\xrightarrow[\substack{\text{(ii) oxidation}\\(KMnO_4+H^+)}]{\text{(i) Hydrolysis}}$ R(product of A) + S(product of C)

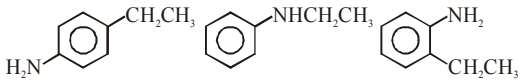
R has lower boiling point than S

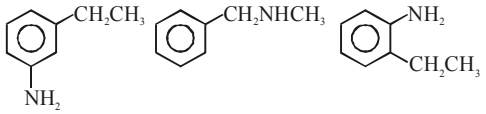
B $\xrightarrow{C_6H_5SO_2Cl}$ alkali-insoluble product

A, B and C, respectively are :

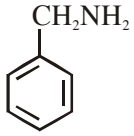
(1) 

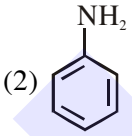
(2) 

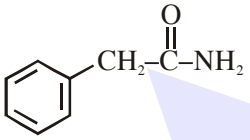
(3) 

(4) 

3. Which of the following compounds can be prepared in good yield by Gabriel phthalimide synthesis?

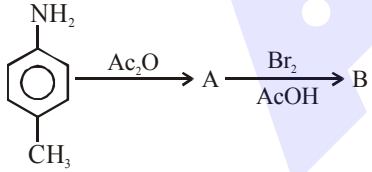
(1) 

(2) 

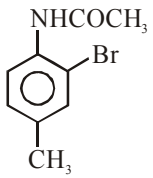
(3) 

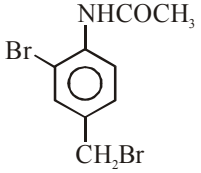
(4) $CH_3–CH_2–NHCH_3$

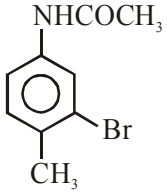
4. In the following reaction sequence

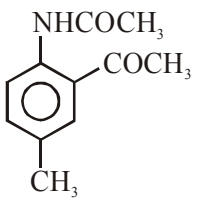


the major products B is -

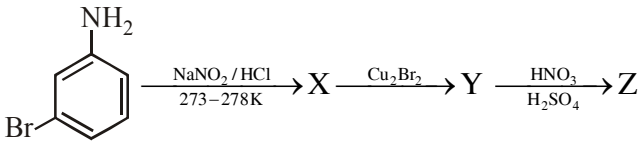
(1) 

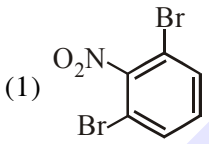
(2) 

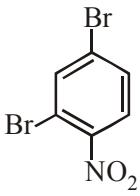
(3) 

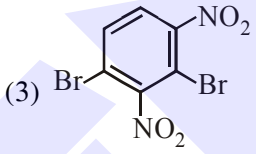
(4) 

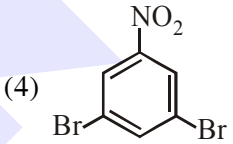
5. The major product Z obtained in the following reaction scheme is :



(1) 

(2) 

(3) 

(4) 

BIOMOLECULES

1. Which of the following statements is correct-

(1) Gluconic acid can form cyclic (acetal/ hemiacetal) structure

(2) Gluconic acid is a partial oxidation product of glucose

(3) Gluconic acid is obtained by oxidation of glucose with HNO_3

(4) Gluconic acid is a dicarboxylic acid

2. Which of the following statement is not true for glucose?

(1) The pentaacetate of glucose does not react with hydroxylamine to give oxime

(2) Glucose gives Schiff's test for aldehyde

(3) Glucose exists in two crystalline forms α and β

(4) Glucose reacts with hydroxylamine to form oxime

3. Two monomers in maltose are :

(1) α-D-glucose and β-D-glucose

(2) α-D-glucose and α-D-Fructose

(3) α-D-glucose and α-D-glucose

(4) α-D-glucose and α-D-galactose

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4. A, B and C are three biomolecules. The results of the tests performed on them are given below:

	Molisch's Test	Barfoed Test	Biuret Test
A	Positive	Negative	Negative
B	Positive	Positive	Negative
C	Negative	Negative	Positive

A, B and C are respectively :
(1) A = Glucose, B = Fructose, C = Albumin
(2) A = Lactose, B = Fructose, C = Alanine
(3) A = Lactose, B = Glucose, C = Alanine
(4) A = Lactose, B = Glucose, C = Albumin

5. Consider the following reactions :

(i) Glucose + ROH $\xrightarrow{\text{dry HCl}}$ Acetal $\xrightarrow[(CH_3CO)_2O]{\text{x eq.of}}$ acetyl derivative

(ii) Glucose $\xrightarrow{Ni/H_2}$ A $\xrightarrow[(CH_3CO)_2O]{\text{y eq.of}}$ acetyl derivative

(iii) Glucose $\xrightarrow[(CH_3CO)_2O]{\text{z eq.of}}$ acetyl derivative

'x', 'y' and 'z' in these reactions are respectively.
(1) 5, 6, & 5 (2) 4, 5 & 5
(3) 5, 4 & 5 (4) 4, 6 & 5

6. The correct observation in the following reactions is :

$$\text{Sucrose} \xrightarrow[\text{Cleavage}\\\text{(Hydrolysis)}]{\text{Glycosidic bond}} A + B \xrightarrow{\text{Seliwanoff's reagent}} ?$$

(1) Formation of blue colour
(2) Formation of violet colour
(3) Formation of red colour
(4) Gives no colour

7. The number of $>C=O$ groups present in a tripeptide Asp – Glu – Lys is _____ .

8. Which of the following will react with $CHCl_3$ + alc. KOH ?
(1) Adenine and lysine
(2) Adenine and thymine
(3) Adenine and proline
(4) Thymine and proline

9. What are the functional groups present in the structure of maltose ?
(1) One ketal and one hemiketal
(2) One acetal and one hemiacetal
(3) Two acetals
(4) One acetal and one ketal

10. The number of chiral centres present in threonine is _____.

11. Which of the following is not an essential amino acid :
(1) Valine (2) Leucine
(3) Lysine (4) Tyrosine

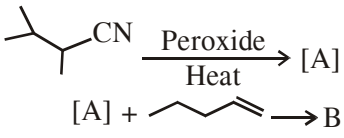
12. The number of chiral carbon(s) present in peptide, Ile-Arg-Pro, is _____.

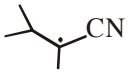
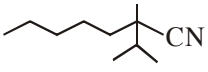
13. The number of chiral carbons present in sucrose is_____ .

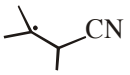
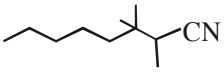
14. Which one of the following statements not true ?
(1) Lactose contains α-glycosidic linkage between C_1 of galactose and C_4 of glucose.
(2) Lactose ($C_{11}H_{22}O_{11}$) is a disaccharide and it contains 8 hydroxyl groups.
(3) On acid hydrolysis, lactose gives one molecule of D(+)-glucose and one molecule of D(+)-galactose.
(4) Lactose is a reducing sugar and it gives Fehling's test.

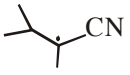
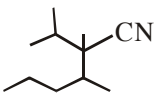
POLYMER

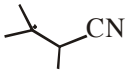
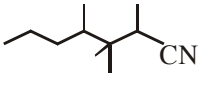
1. The major products A and B in the following reactions are :



(1) A =  and B = 

(2) A =  and B = 

(3) A =  and B = 

(4) A =  and B = 

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2. Preparation of Bakelite proceeds via reactions.
(1) Condensation and elimination
(2) Electrophilic addition and dehydration
(3) Electrophilic substitution and dehydration
(4) Nucleophilic addition and dehydration

3. Which polymer has 'chiral' monomer(s) ?
(1) Buna-N
(2) Nylon 6,6
(3) Neoprene
(4) PHBV

4. Which one of the following polymers is not obtained by condensation polymerisation?
(1) Buna - N
(2) Bakelite
(3) Nylon 6
(4) Nylon 6, 6

5. The correct match between **Item-I** and **Item-II** :

Item-I		**Item-II**
(a) Natural rubber	(I)	1, 3-butadiene + styrene
(b) Neoprene	(II)	1, 3-butadiene + acrylonitrile
(c) Buna-N	(III)	Chloroprene
(d) Buna-S	(IV)	Isoprene

(1) (a) - (III), (b) - (IV), (c) - (I), (d) - (II)
(2) (a) - (IV), (b) - (III), (c) - (II), (d) - (I)
(3) (a) - (IV), (b) - (III), (c) - (I), (d) - (II)
(4) (a) - (III), (b) - (IV), (c) - (II), (d) - (I)

6. Consider the Assertion and Reason given below.

Assertion (A) : Ethene polymerized in the presence of Ziegler Natta Catalyst at high temperature and pressure is used to make buckets and dustbins.

Reason (R): High density polymers are closely packed and are chemically inert. Choose the correct answer from the following :

(1) (A) is correct but (R) is wrong.
(2) (A) and (R) both are wrong.
(3) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(4) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

PRACTICAL ORGANIC CHEMISTRY (POC)

1. A solution of m-chloroaniline, m-chlorophenol and m-chlorobenzoic acid in ethyl acetate was extracted initially with a saturated solution of $NaHCO_3$ to give fraction A. The left over organic phase was extracted with dilute NaOH solution to give fraction B. The final organic layer was labelled as fraction C. Fractions A, B and C, contain respectively :
(1) m-chlorobenzoic acid, m-chloroaniline and m-chlorophenol
(2) m-chloroaniline, m-chlorobenzoic acid and m-chlorophenol
(3) m-chlorobenzoic acid, m-chlorophenol and m-chloroaniline
(4) m-chlorophenol, m-chlorobenzoic acid and m-chloroaniline

2. A chromatography column, packed with silica gel as stationary phase, was used to separate a mixture of compounds consisting of (A) benzanilide (B) aniline and (C) acetophenone. When the column is eluted with a mixture of solvents, hexane : ethyl acetate (20 : 80), the sequence of obtained compounds :
(1) (B), (C) and (A)
(2) (C), (A) and (B)
(3) (A), (B) and (C)
(4) (B), (A) and (C)

3. A flask contains a mixture of isohexane and 3-methylpentane. One of the liquids boils at 63°C while the other boils at 60°C. What is the best way to seprate the two liquids and which one will be distilled out first?
(1) simple distillation, 3-methylpentane
(2) simple distillation, isohexane
(3) fractional distillation, isohexane
(4) fractional distillation, 3-methylpentane

4. Kjeldahl's method cannot be used to estimate nitrogen for which of the following compounds?
(1) $C_6H_5NO_2$ (2) $C_6H_5NH_2$
(3) $CH_3CH_2–C\equiv N$ (4) $NH_2–\overset{\overset{O}{\|}}{C}–NH_2$

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5. A chemist has 4 samples of artificial sweetener A, B, C and D. To identify these samples, he performed certain experiments and noted the following observations :

(i) A and D both form blue-violet colour with ninhydrin.

(ii) Lassaigne extract of C gives positive $AgNO_3$ test and negative $Fe_4[Fe(CN)_6]_3$ test.

(iii) Lassaigne extract of B and D gives positive sodium nitroprusside test

Based on these observations which option is correct?

(1) A : Aspartame ; B : Saccharin ; C : Sucralose ; D ; Alitame

(2) A : Alitame ; B : Saccharin ; C : Aspartame ; D ; Sucralose

(3) A : Saccharin ; B : Alitame ; C : Sucralose ; D ; Aspartame

(4) A : Aspartame ; B : Alitame ; C : Saccharin ; D ; Sucralose

6. Two compounds A and B with same molecular formula (C_3H_6O) undergo Grignard's reaction with methylmagnesium bromide to give products C and D. Products C and D show following chemical tests.

Test	C	D
Ceric ammonium nitrate Test	Positive	Positive
Lucas Test	Turbidity obtained after five minutes	Turbidity obtained immediately
Iodoform Test	Positive	Negative

C and D respectively are :

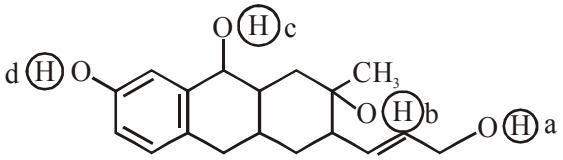
(1) C = $H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$; D = $H_3C-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$

(2) C = $H_3C-CH_2-CH_2-CH_2-OH$; D = $H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$

(3) C = $H_3C-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$; D = $H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$

(4) C = $H_3C-CH_2-CH_2-CH_2-OH$; D = $H_3C-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$

7. Consider the following reaction :



$\xrightarrow[\text{anhydride}]{\text{Chromic}}$ 'P'

The product 'P' gives positive ceric ammonium nitrate test. This is because of the presence of which of these –OH group(s) ?

(1) (c) and (d)

(2) (b) only

(3) (d) only

(4) (b) and (d)

8. Match the following :

	Test/Method		**Reagent**
(i)	Lucas Test	(a)	$C_6H_5SO_2Cl$/aq. KOH
(ii)	Dumas method	(b)	$HNO_3/AgNO_3$
(iii)	Kjeldahl's method	(c)	CuO/CO_2
(iv)	Hinsberg Test	(d)	Conc. HCl and $ZnCl_2$
		(e)	H_2SO_4

(1) (i)-(d), (ii)-(c), (iii)-(e), (iv)-(a)

(2) (i)-(b), (ii)-(d), (iii)-(e), (iv)-(a)

(3) (i)-(d), (ii)-(c), (iii)-(b), (iv)-(e)

(4) (i)-(b), (ii)-(a), (iii)-(c), (iv)-(d)

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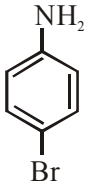
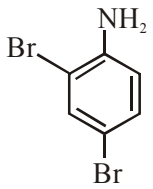
PURIFICATION AND SEPRATION TECHNIQUE

1. In Carius method of estimation of halogen, 0.172g of an organic compound showed presence of 0.08g of bromine. Which of these is the **correct** structure of the compound :

(1) 

(2) $H_3C–CH_2–Br$

(3) 

(4) $H_3C–Br$

CHEMISTRY IN EVERYDAY LIFE

1. Match the following :

(i) Riboflavin	(a) Beriberi
(ii) Thiamine	(b) Scurvy
(iii)Pyridoxine	(c) Cheilosis
(iv)Ascorbic acid	(d) Convulsions

(1) (i)-(c), (ii)-(a), (iii)-(d), (iv)-(b)

(2) (i)-(c), (ii)-(d), (iii)-(a), (iv)-(b)

(3) (i)-(d), (ii)-(b), (iii)-(a), (iv)-(c)

(4) (i)-(a), (ii)-(d), (iii)-(c), (iv)-(b)

2. The number of sp^2 hybridised carbons present in "Aspartame" is _____.

3. The number of chiral centres in penicillin is _____.

4. The mass percentage of nitrogen in histamine is _____.

5. Glycerol is separated in soap industries by :

(1) Steam distillation

(2) Differential extraction

(3) Distillation under reduced pressure

(4) Fractional distillation

6. The antifertility drug 'Novestrol" can react with :

(1) Br_2/water; $ZnCl_2$/HCl; $FeCl_3$

(2) Alcoholic HCN; NaOCl; $ZnCl_2$/HCl

(3) Br_2/water; $ZnCl_2$/HCl; NaOCl

(4) $ZnCl_2$/HCl; $FeCl_3$; Alcoholic HCN

7. Match the following drugs with their therapeutic actions :

(i) Ranitidine	(a) Antidepressant
(ii) Nardil (Phenelzine)	(b) Antibiotic
(iii)Chloramphenicol	(c) Antihistamine
(iv)Dimetane (Brompheniramine)	(d) Antacid
	(e) Analgesic

(1) (i)-(a); (ii)-(c); (iii)-(b); (iv)-(e)

(2) (i)-(e); (ii)-(a); (iii)-(c); (iv)-(d)

(3) (i)-(d); (ii)-(a); (iii)-(b); (iv)-(c)

(4) (i)-(d); (ii)-(c); (iii)-(a); (iv)-(e)

8. If a person is suffering from the deficiency of nor-adrenaline, what kind of drug can be suggested ?

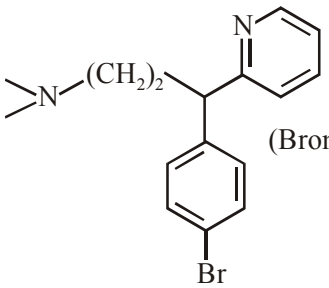
(1) Anti-inflammatory

(2) Analgesic

(3) Antihistamine

(4) Antidepressant

9. The following molecule acts as an :



(Brompheniramine)

(1) Antiseptic

(2) Anti-bacterial

(3) Anti-histamine

(4) Anti-depressant

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ANSWER KEY

NOMENCLATURE				
Que.	1	2	3	
Ans.	4	1	4	

ACIDITY & BASICITY					
Que.	1	2	3	4	5
Ans.	1	4	4	4	1

ELECTRONIC DISPLACEMENT EFFECT									
Que.	1	2	3	4	5	6	7	8	9
Ans.	3	1	2	1	3	4	3	3	1

ISOMERISM				
Que.	1	2	3	4
Ans.	2	5.00	NTA-2 Allen-2 & 4	3

HALOGEN DERIVATIVE									
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	4	3	3	1	4	1	2	8	2	4
Que.	11	12	13	14	15					
Ans.	4	2	NTA 4 ALLEN 4	2	2					

ALCOHOL & ETHER									
Que.	1	2	3	4	5	6	7	8	9
Ans.	1	4	1	3	4	4	4	2	3

OXIDATION		
Que.	1	2
Ans.	2	1

REDUCTION				
Que.	1	2	3	4
Ans.	2	2	2	3

HYDROCARBON				
Que.	1	2	3	4
Ans.	2	1	1	1

AROMATIC COMPOUND										
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	3	4	3	3	1	1	NTA 69.00 ALLEN 68.85	1	2	13
Que.	11	12								
Ans.	3	2								

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CARBONYL COMPOUNDS										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	2	4	3	3	66.65 to 66.70	3	2	1	3	2

CARBOXYLIC ACID AND THEIR DERIVATIVES						
Que.	**1**	**2**	**3**	**4**	**5**	**6**
Ans.	3	4	NTA (3) ALLEN (2 & 3)	NTA (3) ALLEN (2, 3 & 4)	1	2

AMINES					
Que.	**1**	**2**	**3**	**4**	**5**
Ans.	2	2	1	1	2

BIOMOLECULES										
Que.	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Ans.	2	2	3	4	4	3	5	1	2	2
Que.	**11**	**12**	**13**	**14**						
Ans.	4	4	9	1						

POLYMER						
Que.	**1**	**2**	**3**	**4**	**5**	**1**
Ans.	1	3	4	1	2	3

PRACTICAL ORGANIC CHEMISTRY (POC)								
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Ans.	3	2	3	1	1	3	2	1

PURIFICATION AND SEPRATION TECHNIQUE	
Que.	**1**
Ans.	1

CHEMISTRY IN EVERYDAY LIFE									
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Ans.	1	9.00	3.00	37.80 to 38.20	3	1	3	4	3

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JANUARY & SEPTEMBER 2020 ATTEMPT (IOC)

QUANTUM NUMBER

1. The correct electronic configuration and spin-only magnetic moment (BM) of Gd^{3+} (Z = 64), respectively, are
(1) $[Xe]5f^7$ and 8.9
(2) $[Xe]4f^7$ and 7.9
(3) $[Xe]5f^7$ and 7.9
(4) $[Xe]4f^7$ and 8.9

2. In the sixth period, the orbitals that are filled are
(1) 6s, 5f, 6d, 6p
(2) 6s, 6p, 6d, 6f
(3) 6s, 5d, 5f, 6p
(4) 6s, 4f, 5d, 6p

3. Consider the hypothetical situation where the azimuthal quantum number, *l*, takes values 0, 1, 2, ... n + 1, where n is the principal quantum number. Then, the element with atomic number :
(1) 13 has a half-filled valence subshell
(2) 9 is the first alkali metal
(3) 8 is the first noble gas
(4) 6 has a 2p-valence subshell

4. The number of subshells associated with n = 4 and m = –2 quantum numbers is :
(1) 4 (2) 8
(3) 16 (4) 2

PERIODIC TABLE

1. The electron gain enthalpy (in kJ/mol) of fluorine, chlorine, bromine and iodine, respectively are :
(1) – 333, – 349, – 325 and – 296
(2) –296, – 325, – 333 and – 349
(3) – 333, – 325, – 349 and – 296
(4) –349, – 333, – 325 and – 296

2. Within each pair of elements of F & Cl , S & Se, and Li & Na, respectively, the elements that release more energy upon an electron gain are-
(1) F, Se and Na (2) F, S and Li
(3) Cl, S and Li (4) Cl, Se and Na

3. The first ionization energy (in kJ/mol) of Na, Mg, Al and Si respectively, are :
(1) 496, 737, 577, 786
(2) 786, 737, 577, 496
(3) 496, 577, 737, 786
(4) 496, 577, 786, 737

4. The increasing order of the atomic radii of the following elements is :-
(a) C (b) O (c) F (d) Cl
(e) Br
(1) (b) < (c) < (d) < (a) < (e)
(2) (a) < (b) < (c) < (d) < (e)
(3) (d) < (c) < (b) < (a) < (e)
(4) (c) < (b) < (a) < (d) < (e)

5. B has a smaller first ionization enthalpy than Be. Consider the following statements :
(I) It is easier to remove 2p electron than 2s electron
(II) 2p electron of B is more shielded from the nucleus by the inner core of electrons than the 2s electrons of Be.
(III) 2s electron has more penetration power than 2p electron.
(IV) atomic radius of B is more than Be
(Atomic number B = 5, Be = 4)
The correct statements are :
(1) (I), (II) and (III)
(2) (II), (III) and (IV)
(3) (I), (III) and (IV)
(4) (I), (II) and (IV)

6. The correct order of the ionic radii of O^{2-}, N^{3-}, F^-, Mg^{2+}, Na^+ and Al^{3+} is :
(1) $Al^{3+} < Na^+ < Mg^{2+} < O^{2-} < F^- < N^{3-}$
(2) $N^{3-} < O^{2-} < F^- < Na^+ < Mg^{2+} < Al^{3+}$
(3) $Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$
(4) $N^{3-} < F^- < O^{2-} < Mg^{2+} < Na^+ < Al^{3+}$

7. Lattice enthalpy and enthalpy of solution of NaCl are 788 kJ mol^{-1} and 4 kJ mol^{-1}, respectively. The hydration enthalpy of NaCl is :
(1) –780 kJ mol^{-1}
(2) –784 kJ mol^{-1}
(3) 780 kJ mol^{-1}
(4) 784 kJ mol^{-1}

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8. The process that is NOT endothermic in nature is :-

(1) $Ar_{(g)} + e^- \rightarrow Ar^-_{(g)}$ (2) $H_{(g)} + e^- \rightarrow H^-_{(g)}$

(3) $Na_{(g)} \rightarrow Na^+_{(g)} + e^-$ (4) $O^-_{(g)} + e^- \rightarrow O^{2-}_{(g)}$

9. The ionic radii of O_2^-, F^-, Na^+ and Mg^{2+} are in the order :

(1) $F^- > O^{2-} > Na^+ > Mg^{2+}$

(2) $Mg^{2+} > Na^+ > F^- > O^{2-}$

(3) $O^{2-} > F^- > Mg^{2+} > Na^+$

(4) $O^{2-} > F^- > Na^+ > Mg^{2+}$

10. The elements with atomic numbers 101 and 104 belong to, respectively :

(1) Group 11 and Group 4

(2) Actinoids and Group 4

(3) Actinoids and Group 6

(4) Group 6 and Actinoids

11. The five successive ionization enthalpies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol^{-1}. The number of valence electrons in the element is :

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

12. Among the statements (I – IV), the correct ones are:

(I) Be has smaller atomic radius compared to Mg.

(II) Be has higher ionization enthalpy than Al.

(III) Charge/radius ratio of Be is greater than that of Al.

(IV) Both Be and Al form mainly covalent compounds.

(1) (I), (II) and (IV)

(2) (II), (III) and (IV)

(3) (I), (II) and (III)

(4) (I), (III) and (IV

13. The atomic number of the element unnilennium is :

(1) 119 (2) 108 (3) 102 (4) 109

14. Three elements X, Y and Z are in the 3rd period of the periodic table. The oxides of X, Y and Z, respectively, are basic, amphoteric and acidic. The correct order of the atomic numbers of X, Y and Z is :

(1) Z < Y < X (2) X < Z < Y

(3) X < Y < Z (4) Y < X < Z

15. In general, the property (magnitudes only) that shows an opposite trend in comparison to other properties across a period is

(1) Electronegativity

(2) Electron gain enthalpy

(3) Ionization enthalpy

(4) Atomic radius

16. The atomic number of Unnilunium is _____.

CHEMICAL BONDING

1. The dipole moments of CCl_4, $CHCl_3$ and CH_4 are in the order :

(1) $CH_4 = CCl_4 < CHCl_3$

(2) $CH_4 < CCl_4 < CHCl_3$

(3) $CCl_4 < CH_4 < CHCl_3$

(4) $CHCl_3 < CH_4 = CCl_4$

2. The relative strength of interionic/ intermolecular forces in decreasing order is :

(1) ion-dipole > ion-ion > dipole-dipole

(2) dipole-dipole > ion-dipole > ion-ion

(3) ion-dipole > dipole-dipole > ion-ion

(4) ion-ion > ion-dipole > dipole-dipole

3. The bond order and the magnetic characteristics of CN^- are :

(1) 3, diamagnetic

(2) $2\frac{1}{2}$, paramagnetic

(3) 3, paramagnetic

(4) $2\frac{1}{2}$, diamagnetic

4. The predominant intermolecular forces present in ethyl acetate, a liquid, are :

(1) hydrogen bonding and London dispersion

(2) Dipole-dipole and hydrogen bonding

(3) London dispersion and dipole-dipole

(4) London dispersion, dipole-dipole and hydrogen bonding

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5. Arrange the following bonds according to their average bond energies in descending order : C–Cl, C–Br, C–F, C–I
(1) C–I > C–Br > C–Cl > C–F
(2) C–Br > C–I > C–Cl > C–F
(3) C–F > C–Cl > C–Br > C–I
(4) C–Cl > C–Br > C–I > C–F

6. 'X' melts at low temperature and is a bad conductor of electricity in both liquid and solid state. X is :
(1) Carbon tetrachloride (2) Mercury
(3) Silicon carbide (4) Zinc sulphide

7. If the magnetic moment of a dioxygen species is 1.73 B.M, it may be :
(1) O_2^- or O_2^+ (2) O_2 or O_2^+
(3) O_2 or O_2^- (4) O_2, O_2^- or O_2^+

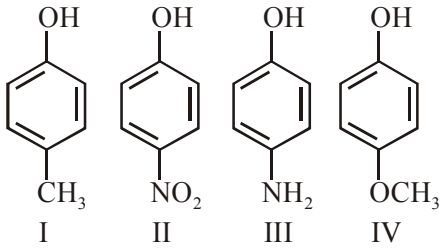
8. The acidic, basic and amphoteric oxides, respectively, are :
(1) MgO, Cl_2O, Al_2O_3
(2) Cl_2O, CaO, P_4O_{10}
(3) Na_2O, SO_3, Al_2O_3
(4) N_2O_3, Li_2O, Al_2O_3

9. The number of sp^2 hybrid orbitals in a molecule of benzene is :
(1) 24 (2) 6 (3) 12 (4) 18

10. Among the sulphates of alkaline earth metals, the solubilities of $BeSO_4$ and $MgSO_4$ in water, respectively, are:
(1) high and high (2) poor and poor
(3) high and poor (4) poor and high

11. The number of CI = O bonds in perchloric acid is, "_____"

12. The increasing order of boiling points of the following compounds is :



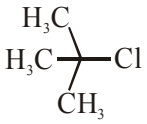
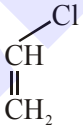
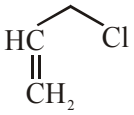
I II III IV

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

13. The compound that has the largest H–M–H bond angle (M=N, O, S, C), is :
(1) H_2O (2) CH_4
(3) NH_3 (4) H_2S

14. Hydrogen peroxide, in the pure state, is :
(1) non-planar and almost colorless
(2) linear and almost colorless
(3) planar and blue in color
(4) linear and blue in color

15. The structure of PCl_5 in the solid state is
(1) square pyramidal
(2) tetrahedral $[PCl_4]^+$ and octahedral $[PCl_6]^-$
(3) square planar $[PCl_4]^+$ and octahedral $[PCl_6]^-$
(4) trigonal bipyramidal

16. Among the following compounds, which one has the shortest C—Cl bond ?
(1) H_3C–Cl (2) 
(3)  (4) 

17. The reaction in which the hybridisation of the underlined atom is affected is :-
(1) $\underline{N}H_3 \xrightarrow{H^+}$
(2) $\underline{Xe}F_4 + SbF_5 \rightarrow$
(3) $H_2\underline{S}O_4 + NaCl \xrightarrow{420\ K}$
(4) $H_3\underline{P}O_2 \xrightarrow{\text{Disproportionation}}$

18. Of the species, NO, NO^+, NO^{2+}, NO^-, the one with minimum bond strength is :
(1) NO^{2+} (2) NO^+
(3) NO (4) NO^-

19. In a molecule of pyrophosphoric acid, the number of P–OH, P=O and P–O–P bonds/ moiety(ies) respectivey are :
(1) 3, 3 and 3
(2) 2, 4 and 1
(3) 4, 2 and 0
(4) 4, 2 and 1

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20. Match the type of interaction in Column A with the distance dependence of their interaction energy in Column B :

A	B
(I) ion - ion	(a) $\frac{1}{r}$
(II) dipole - dipole	(b) $\frac{1}{r^2}$
(III) London dispersion	(c) $\frac{1}{r^3}$
	(d) $\frac{1}{r^6}$

(1) (I)-(a), (II)-(b), (III)-(c)

(2) (I)-(a), (II)-(c), (III)-(d)

(3) (I)-(a), (II)-(b), (III)-(d)

(4) (I)-(b), (II)-(d), (III)-(c)

21. The molecular geometry of SF_6 is octahedral. What is the geometry of SF_4 (including lone pair(s) of electrons, if any) ?

(1) Trigonal bipyramidal

(2) Square planar

(3) Tetrahedral

(4) Pyramidal

22. If AB_4 molecule is a polar molecule, a possible geometry of AB_4 is :

(1) Square pyramidal

(2) Tetrahedral

(3) Square planar

(4) Rectangular planar

23. The shape/structure of $[XeF_5]^-$ and XeO_3F_2, respectively, are :

(1) pentagonal planar and trigonal bipyramidal

(2) trigonal bipyramidal and pentagonal planar

(3) octahedral and square pyramidal

(4) trigonal bipyramidal and trigonal bipyramidal

COORDINATION CHEMISTRY

1. The theory that can completely/properly explain the nature of bonding in $[Ni(CO)_4]$ is:

(1) Werner's theory

(2) Crystal field theory

(3) Valence bond theory

(4) Molecular orbital theory

2. The IUPAC name of the complex $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is :

(1) Diammine (methanamine) chlorido platinum (II) chloride

(2) Bisammine (methanamine) chlorido platinum (II) chloride

(3) Diamminechlorido (aminomethane) platinum(II) chloride

(4) Diamminechlorido (methanamine) platinum (II) chloride

3. Among the statements(a)-(d), the incorrect ones are-

(a) Octahedral Co(III) complexes with strong field ligands have very high magnetic moments

(b) When $\Delta_0 < P$, the d-electron configuration of Co(III) in an octahedral complex is $t_{eg}^4 e_g^2$

(c) Wavelength of light absorbed by $[Co(en)_3]^{3+}$ is lower than that of $[CoF_6]^{3-}$

(d) If the Δ_0 for an octahedral complex of Co(III) is 18,000 cm^{-1}, the Δ_t for its tetrahedral complex with the same ligand will be 16,000 cm^{-1}

(1) (a) and (b) only (2) (c) and (d) only

(3) (b) and (c) only (4) (a) and (d) only

4. The number of possible optical isomers for the complexes MA_2B_2 with sp^3 and dsp^2 hybridised metal atom, respectively, is :

Note : A and B are unidentate neutral and unidentate monoanionic ligands, respectively

(1) 0 and 0 (2) 0 and 2

(3) 0 and 1 (4) 2 and 2

5. The complex that can show fac-and mer-isomers is :

(1) $[Pt(NH_3)_2Cl_2]$

(2) $[Co(NH_3)_4Cl_2]^+$

(3) $[Co(NH_3)_3(NO_2)_3]$

(4) $[CoCl_2(en)_2]$

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6. The volume (in mL) of 0.125 M $AgNO_3$ required to quantitatively precipitate chloride ions in 0.3 g of $[Co(NH_3)_6]Cl_3$ is _____.
$^M[Co(NH_3)_6]Cl_3$ = 267.46 g/mol
$^MAgNO_3$ = 169.87 g/mol

7. Among (a) – (d) the complexes that can display geometrical isomerism are :
(a) $[Pt(NH_3)_3Cl]^+$ (b) $[Pt(NH_3)Cl_5]^-$
(c) $[Pt(NH_3)_2Cl(NO_2)]$ (d) $[Pt(NH_3)_4ClBr]^{2+}$
(1) (d) and (a) (2) (a) and (b)
(3) (b) and (c) (4) (c) and (d)

8. The correct order of the calculated spin-only magnetic moments of complexes (A) to (D) is:
(A) $Ni(CO)_4$
(B) $[Ni(H_2O)_6]Cl_2$
(C) $Na_2[Ni(CN)_4]$
(D) $PdCl_2(PPh_3)_2$
(1) (A) ≈ (C) ≈ (D) < (B)
(2) (A) ≈ (C) < (B) ≈ (D)
(3) (C) < (D) < (B) < (A)
(4) (C) ≈ (D) < (B) < (A)

9. Complexes (ML_5) of metals Ni and Fe have ideal square pyramidal and trigonal bipyramidal grometries, respectively. The sum of the 90°, 120° and 180° L-M L angles in the two complexes is _____.

10. $[Pd(F)(Cl)(Br)(I)]^{2-}$ has n number of geometrical isomers. Then, the spin-only magnetic moment and crystal field stabilisation energy [CFSE] of $[Fe(CN)_6]^{n-6}$, respectively, are:
[Note : Ignore the pairing energy]
(1) 2.84 BM and $-1.6\ \Delta_0$
(2) 1.73 BM and $-2.0\ \Delta_0$
(3) 0 BM and $-2.4\ \Delta_0$
(4) 5.92 BM and 0

11. Complex X of composition $Cr(H_2O)_6Cl_n$ has a spin only magnetic moment of 3.83 BM. It reacts with $AgNO_3$ and shows geometrical isomerism. The IUPAC nomenclature of X is:
(1) Tetraaquadichlorido chromium (III) chloride dihydrate
(2) Hexaaqua chromium (III) chloride
(3) Dichloridotetraaqua chromium (IV) chloride dihydrate
(4) Tetraaquadichlorido chromium(IV) chloride dihydrate

12. The correct order of the spin-only magnetic moments of the following complexes is :
(I) $[Cr(H_2O)_6]Br_2$
(II) $Na_4[Fe(CN)_6]$
(III) $Na_3[Fe(C_2O_4)_3]$ (Δ_0 > P)
(IV) $(Et_4N)_2[CoCl_4]$
(1) (III) > (I) > (II) > (IV)
(2) (I) > (IV) > (III) > (II)
(3) (II) ≈ (I) > (IV) > (III)
(4) (III) > (I) > (IV) > (II)

13. The isomer(s) of $[Co(NH_3)_4Cl_2]$ that has/have a Cl–Co–Cl angle of 90°, is/are :
(1) meridional and trans
(2) cis and trans
(3) trans only
(4) cis only

14. The species that has a spin only magnetic moment of 5.9 BM, is -
(1) $Ni(CO)_4(T_d)$
(2) $[MnBr_4]^{2-}(T_d)$
(3) $[NiCl_4]^{2-}(T_d)$
(4) $[Ni(CN)_4]^{2-}$ (square planar)

15. For a d^4 metal ion in an octahedral field, the correct electronic configuration is :
(1) $t_{2g}^4e_g^0$ when $\Delta_O < P$
(2) $e_g^2t_{2g}^2$ when $\Delta_O < P$
(3) $t_{2g}^3e_g^1$ when $\Delta_O < P$
(4) $t_{2g}^3e_g^1$ when $\Delta_O > P$

16. Considering that Δ_0 > P, the magnetic moment (in BM) of $[Ru(H_2O)_6]^{2+}$ would be_____ .

17. Consider the complex ions,
trans-$[Co(en)_2Cl_2]^+$ (A) and
cis-$[Co(en)_2Cl_2]^+$ (B). The correct statement regarding them is :
(1) both (A) and (B) can be optically active
(2) both (A) and (B) cannot be optically active
(3) (A) can be optically active, but (B) cannot be optically active
(4) (A) cannot be optically active, but (B) can be optically active

18. The total number of coordination sites in ethylenediaminetetraacetate ($EDTA^{4-}$) is _____.

19. The values of the crystal field stabilization energies for a high spin d^6 metal ion in octahedral and tetrahedral fields, respectively, are :

(1) $-0.4\ \Delta_0$ and $-0.27\ \Delta_t$

(2) $-1.6\ \Delta_0$ and $-0.4\ \Delta_t$

(3) $-0.4\ \Delta_0$ and $-0.6\ \Delta_t$

(4) $-2.4\ \Delta_0$ and $-0.6\ \Delta_t$

20. The molecule in which hybrid MOs involve only one d-orbital of the central atom is :-

(1) $[Ni(CN)_4]^{2-}$ (2) $[CrF_6]^{3-}$

(3) BrF_5 (4) XeF_4

21. The one that can exhibit highest paramagnetic behaviour among the following is :-

gly = glycinato; bpy = 2, 2'-bipyridine

(1) $[Pd(gly)_2]$

(2) $[Ti(NH_3)_6]^{3+}$

(3) $[Co(OX)_2(OH)_2]^-$ ($\Delta_0 > P$)

(4) $[Fe(en)(bpy)(NH_3)_2]^{2+}$

22. The crystal Field stabilization Energy (CFSE) of $[CoF_3(H_2O)_3](\Delta_0 < P)$ is :-

(1) $-0.8\ \Delta_0$

(2) $-0.4\ \Delta_0 + P$

(3) $-0.8\ \Delta_0 + 2P$

(4) $-0.4\ \Delta_0$

23. The pair in which both the species have the same magnetic moment (spin only) is :

(1) $[Mn(H_2O)_6]^{2+}$ and $[Cr(H_2O)]^{2+}$

(2) $[Cr(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$

(3) $[Cr(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{2+}$

(4) $[Co(OH)_4]^{2-}$ and $[Fe(NH_3)_6]^{2+}$

24. The number of isomers possible for $[Pt(en)(NO_2)_2]$ is :

(1) 3 (2) 2

(3) 1 (4) 4

25. Complex A has a composition of $H_{12}O_6Cl_3Cr$. If the complex on treatment with conc. H_2SO_4 loses 13.5% of its original mass, the correct molecular formula of A is :

[Given : atomic mass of Cr = 52 amu and Cl = 35 amu]

(1) $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

(2) $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$

(3) $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$

(4) $[Cr(H_2O)_6]Cl_3$

26. The d-electron configuration of $[Ru(en)_3]Cl_2$ and $[Fe(H_2O)_6]Cl_2$, respectively are :

(1) $t_{2g}^4 e_g^2$ and $t_{2g}^6 e_g^0$

(2) $t_{2g}^6 e_g^0$ and $t_{2g}^6 e_g^0$

(3) $t_{2g}^6 e_g^0$ and $t_{2g}^4 e_g^2$

(4) $t_{2g}^4 e_g^2$ and $t_{2g}^4 e_g^2$

27. The electronic spectrum of $[Ti(H_2O)_6]^{3+}$ shows a single broad peak with a maximum at 20,300 cm^{-1}. The crystal field stabilization energy (CFSE) of the complex ion, in kJ mol^{-1}, is :

(1) 242.5 (2) 83.7

(3) 145.5 (4) 97

28. The complex that can show optical activity is:

(1) trans-$[Fe(NH_3)_2(CN)_4]^-$

(2) cis-$[Fe(NH_3)_2(CN)_4]^-$

(3) cis-$[CrCl_2(ox)_2]^{3-}$ (ox = oxalate)

(4) trans-$[Cr(Cl_2)(ox)_2]^{3-}$

29. The one that is not expected to show isomerism is :

(1) $[Ni(NH_3)_4(H_2O)_2]^{2+}$

(2) $[Ni(NH_3)_2Cl_2]$

(3) $[Pt(NH_3)_2Cl_2]$

(4) $[Ni(en)_3]^{2+}$

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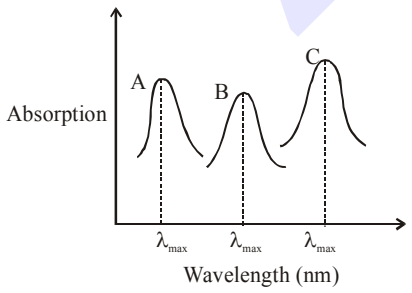
30. For octahedral Mn(II) and tetrahedral Ni(II) complexes, consider the following statements:
(I) both the complexes can be high spin
(II) Ni(II) complex can very rarely be low spin.
(III) with strong field ligands, Mn(II) complexes can be low spin.
(IV) aqueous solution of Mn(II) ions is yellow in color.
The **correct** statements are :
(1) (I), (III) and (IV) only
(2) (II), (III) and (IV) only
(3) (I), (II) and (III) only
(4) (I) and (II) only

31. Consider that a d^6 metal ion (M^{2+}) forms a complex with aqua ligands, and the spin only magnetic moment of the complex is 4.90 BM. The geometry and the crystal field stabilization energy of the complex is :
(1) tetrahedral and $-1.6\ \Delta_t + 1P$
(2) tetrahedral and $-0.6\ \Delta_t$
(3) octahedral and $-1.6\ \Delta_0$
(4) octahedral and $-2.4\ \Delta_0 + 2P$

32. The oxidation states of iron atoms in compounds (A), (B) and (C), respectively, are x, y and z. The sum of x,y and z is ____.

$Na_4[Fe(CN)_5NOS)]$ (A) $Na_4[FeO_4]$ (B) $[Fe_2(CO)_9]$ (C)

33. Simplified absorption spectra of three complexes ((i), (ii) and (iii)) of M^{n+} ion are provided below; their λ_{max} values are marked as A, B and C respectively. The correct match between the complexes and their λ_{max} values is :



(i) $[M(NCS)_6]^{(-6+n)}$ (ii) $[MF_6]^{(-6+n)}$
(iii) $[M(NH_3)_6]^{n+}$
(1) A-(ii), B-(i), C-(iii) (2) A-(iii), B-(i), C-(ii)
(3) A-(ii), B-(iii), C-(i) (4) A-(i), B-(ii), C-(iii)

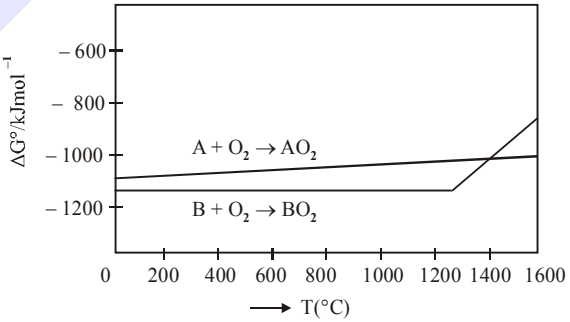
METALLURGY

1. The purest form of commercial iron is
(1) scrap iron and pig iron
(2) wrought iron
(3) cast iron
(4) pig iron

2. The refining method used when the metal and the impurities have low and high melting temperatures, respectively, is -
(1) zone refining
(2) liquation
(3) vapour phase refining
(4) distillation

3. Among the reactions (a) - (d), the reaction(s) that does/do not occur in the blast furnace during the extraction of iron is/are :
(a) $CaO + SiO_2 \rightarrow CaSiO_3$
(b) $3Fe_2O_3 + CO \rightarrow 2Fe_3O_4 + CO_2$
(c) $FeO + SiO_2 \rightarrow FeSiO_3$
(d) $FeO \rightarrow Fe + \frac{1}{2}O_2$
(1) (c) and (d) (2) (a) and (d)
(3) (d) (4) (a)

4. According to the following diagram, A reduces BO_2 when the temperature is :



(1) < 1400 °C
(2) > 1400 °C
(3) < 1200 °C
(4) > 1200 °C but < 1400 °C

5. The element that can be refined by distillation is :
(1) nickel (2) zinc (3) gallium (4) tin

6. Boron and silicon of very high purity can be obtained through :
(1) vapour phase refining
(2) electrolytic refining
(3) liquation
(4) zone refining

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7. An Ellingham diagram provides information about :

(1) the pressure dependence of the standard electrode potentials of reduction reactions involved in the extraction of metals.

(2) the kinetics of the reduction process.

(3) the temperature dependence of the standard Gibbs energies of formation of some metal oxides.

(4) the conditions of pH and potential under which a species is thermodynamically stable.

8. The processes of calcination and roasting in metallurgical industries, respectively, can lead to :-

(1) Global warming and acid rain

(2) Photochemical smog and ozone layer depletion

(3) Global warming and photochemical smog

(4) Photochemical smog and global warming

9. Among statements (a) -(d), the correct ones are :

(a) Lime stone is decomposed to CaO during the extraction of iron from its oxides.

(b) In the extraction of silver, silver is extracted as an anionic complex.

(c) Nickel is purified by Mond's process.

(d) Zr and Ti are purified by Van Arkel method.

(1) (c) and (d) only

(2) (a), (c) and (d) only

(3) (b), (c) and (d) only

(4) (a), (b), (c) and (d)

10. Cast iron is used for the manufacture of :

(1) wrought iron and pig iron

(2) wrought iron and steel

(3) wrought iron, pig iron and steel

(4) pig iron, scrap iron and steel

HYDROGEN & IT'S COMPOUND

1. Dihydrogen of high purity (> 99.95%) is obtained through:

(1) the electrolysis of warm $Ba(OH)_2$ solution using Ni electrodes.

(2) the reaction of Zn with dilute HCl

(3) the electrolysis of brine solution.

(4) the electrolysis of acidified water using Pt electrodes.

2. The one that is NOT suitable for the removal of permanent hardness of water is :

(1) Treatment with sodium carbonate

(2) Calgon's method

(3) Clark's method

(4) Ion-exchange method

SALT ANALYSIS

1. Reaction of an inorganic sulphite X with dilute H_2SO_4 generates compound Y. Reaction of Y with NaOH gives X. Further, the reaction of X with Y and water affords compound Z. Y and Z, respectively, are:

(1) S and Na_2SO_3

(2) SO_2 and $NaHSO_3$

(3) SO_3 and $NaHSO_3$

(4) SO_2 and Na_2SO_3

COMPLETE S-BLOCK

1. In the following reactions products(A) and (B), respectively , are :

$NaOH + Cl_2 \rightarrow$ (A) + side products
(hot and conc.)

$Ca(OH)_2 + Cl_2 \rightarrow$ (B) + side products
(dry)

(1) $NaClO_3$ and $Ca(OCl)_2$

(2) NaOCl and $Ca(ClO_3)_2$

(3) $NaClO_3$ and $Ca(ClO_3)_2$

(4) NaOCl and $Ca(OCl)_2$

2. When gypsum is heated to 393 K, it forms :

(1) Dead burnt plaster

(2) Anhydrous $CaSO_4$

(3) $CaSO_4.5H_2O$

(4) $CaSO_4.0.5H_2O$

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3. A metal (A) on heating in nitrogen gas gives compound B. B on treatment with H_2O gives a colourless gas which when passed through $CuSO_4$ solution gives a dark blue-violet coloured solution. A and B respectively, are :
(1) Mg and Mg_3N_2
(2) Na and $NaNO_3$
(3) Mg and $Mg(NO_3)_2$
(4) Na and Na_3N

4. Among the statements (a)-(d) the correct ones are:
(a) Lithium has the highest hydration enthalpy among the alkali metals.
(b) Lithium chloride is insoluble in pyridine.
(c) Lithium cannot form ethynide upon its reaction with ethyne.
(d) Both lithium and magnesium react slowly with H_2O.
(1) (a), (b) and (d) only
(2) (b) and (c) only
(3) (a), (c) and (d) only
(4) (a) and (d) only

5. Match the following compounds (Column-I) with their uses (Column-II) :

S.No.	Column – I	S.No.	Column – II
(I)	$Ca(OH)_2$	(A)	casts of statues
(II)	NaCl	(B)	white wash
(III)	$CaSO_4.\frac{1}{2}H_2O$	(C)	antacid
(IV)	$CaCO_3$	(D)	washing soda preparation

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

6. An alkaline earth metal 'M' readily forms water soluble sulphate and water insoluble hydroxide. Its oxide MO is very stable to heat and does not have rock-salt structure. M is :-
(1) Ca (2) Be (3) Mg (4) Sr

7. On combustion Li, Na and K in excess of air, the major oxides formed, respectively, are :
(1) Li_2O, Na_2O and K_2O_2
(2) Li_2O, Na_2O_2 and K_2O
(3) Li_2O, Na_2O_2 and KO_2
(4) Li_2O_2, Na_2O_2 and K_2O_2

8. If you spill a chemical toilet cleaning liquid on your hand, your first aid would be :
(1) aqueous NH_3 (2) vinegar
(3) aqueous $NaHCO_3$ (4) aqueous NaOH

9. The metal mainly used in devising photoelectric cells is:
(1) Na (2) Rb (3) Li (4) Cs

10. Two elements A and B have similar chemical properties. They don't form solid hydrogencarbonates, but react with nitrogen to form nitrides. A and B, respectively, are :
(1) Na and C (2) Li and Mg
(3) Cs and Ba (4) Na and Rb

COMPLETE D-BLOCK

1. The atomic radius of Ag is closest to :
(1) Cu (2) Hg (3) Au (4) Ni

2. Conside the following reactions :
$NaCl + K_2Cr_2O_7 + H_2SO_4(Conc.) \rightarrow (A) + Side\ products$
$(A) + NaOH \rightarrow (B) + Side\ product$
$(B) + H_2SO_4(dilute) + H_2O_2 \rightarrow (C) + Side\ product$
The sum of the total number of atoms in one molecule each of (A), (B) and (C) is

3. The third ionization enthalpy is minimum for :
(1) Fe (2) Ni
(3) Co (4) Mn

4. The sum of the total number of bonds between chromium and oxygen atoms in chromate and dichromate ions is _____.

5. The set that contains atomic number of only transition element is -
(1) 21, 32, 53, 64
(2) 21, 25, 42, 72
(3) 9, 17, 34, 38
(4) 37, 42, 50, 64

6. The incorrect statement(s) among (a) - (c) is (are) :-
(a) W(VI) is more stable than Cr(VI).
(b) in the presence of HCl, permanganate titrations provide satisfactory results.
(c) some lanthanoid oxides can be used as phosphors.
(1) (a) and (b) only (2) (a) only
(3) (b) and (c) only (4) (b) only

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7. The INCORRECT statement is :
(1) bronze is an alloy of copper and tin.
(2) brass is an alloy of copper and nickel
(3) cast iron is used to manufacture wrought iron
(4) german silver is an alloy of zinc, copper and nickel

8. The incorrect statement is :
(1) In manganate and permanganate ions, the π-bonding takes place by overlap of p-orbitals of oxygen and d-orbitals of manganese
(2) Manganate ion is green in colour and permanganate ion in purple in colour
(3) Manganate and permanganate ions are paramagnetic
(4) Manganate and permanganate ions are tetrahedral

COMPLETE P-BLOCK

1. Chlorine reacts with hot and concentrated NaOH and produces compounds (X) and (Y). Compound (X) gives white precipitate with silver nitrate solution. The average bond order between Cl and O atoms in (Y) is _____.

2. The redox reaction among the following is :
(1) Combination of dinitrogen with dioxygen at 2000 K
(2) Formation of ozone from atmosphereic oxygen in the presence of sunlight
(3) Reaction of H_2SO_4 with NaOH
(4) Reaction of $[Co(H_2O)_6]Cl_3$ with $AgNO_3$

3. Among the statements (a) - (d), the correct ones are -
(a) Decomposition of hydrogen peroxide gives dioxygen
(b) Like hydrogen peroxide, compounds , such as $KClO_3$, $Pb(NO_3)_2$ and $NaNO_3$when heated liberated dioxygen
(c) 2-Ethylanthraquinone is useful for the industrial preparation of hydrogen peroxide.
(d) Hydrogen peroxide is used for the manufacture of sodium perborate
(1) (a), (b) and (c) only
(2) (a) and (c) only
(3) (a), (b) , (c) and (d)
(4) (a), (c) and (d) only

4. The number of bonds between sulphur and oxygen atoms in $S_2O_8^{2-}$ and the number of bonds between sulphur and sulphur atoms in rhombic sulphur, respectively, are :
(1) 4 and 8 (2) 4 and 6
(3) 8 and 8 (4) 8 and 6

5. White Phosphorus on reaction with concentrated NaOH solution in an inert atmosphere of CO_2 gives phosphine and compound (X). (X) on acidification with HCl gives compound (Y). The basicity of compound (Y) is :
(1) 4 (2) 1 (3) 2 (4) 3

6. The reaction of $H_3N_3B_3Cl_3$ (A) with $LiBH_4$ in tetrahydrofuran gives inorganic benzene (B). Further, the reaction of (A) with (C) leads to $H_3N_3B_3(Me)_3$. Compounds (B) and (C) respectively, are:
(1) Boron nitride and MeBr
(2) Borazine and MeMgBr
(3) Borazine and MeBr
(4) Diborane and MeMgBr

7. The reaction of NO with N_2O_4 at 250 K gives :
(1) N_2O_5 (2) NO_2
(3) N_2O (4) N_2O_3

8. Reaction of ammonia with excess Cl_2 gives :
(1) NH_4Cl and N_2
(2) NCl_3 and NH_4Cl
(3) NH_4Cl and HCl
(4) NCl_3 and HCl

9. The correct statement with respect to dinitrogen is :
(1) liquid dinitrogen is not used in cryosurgery.
(2) it can be used as an inert diluent for reactive chemicals.
(3) it can combine with dioxygen at 25°C
(4) N_2 is paramagnetic in nature.

10. The equation that represents the water-gas shift reaction is :
(1) $CO(g) + H_2O(g) \xrightarrow[\text{Catalyst}]{673K} CO_2(g) + H_2(g)$
(2) $CH_4(g) + H_2O(g) \xrightarrow[Ni]{1270K} CO(g) + 3\,H_2(g)$
(3) $C(s) + H_2O(g) \xrightarrow{1270K} CO(g) + H_2(g)$
(4) $2C(s) + O_2(g) + 4N_2(g) \xrightarrow{1273K} 2CO(g) + 4N_2(g)$

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11. On heating, lead(II) nitrate gives a brown gas (A). The gas (A) on cooling changes to a colourless solid/liquid (B). (B) on heating with NO changes to a blue solid (C). The oxidation number of nitrogen in solid (C) is :

(1) +5 (2) +2

(3) +4 (4) +3

12. The statement that is not true about ozone is :

(1) in the stratosphere, it forms a protective shield against UV radiation.

(2) it is a toxic gas and its reaction with NO gives NO_2.

(3) in the atmosphere, it is depleted by CFCs.

(4) in the stratophere, CFCs release chlorine free radicals ($\dot{Cl}$) which reacts with O_3 to give chlorine dioxide radicals.

13. On heating compound (A) gives a gas (B) which is constituent of air. This gas when treated with H_2 in the presence of a catalyst gives another gas (C) which is basic in nature. (A) should not be:

(1) $(NH_4)_2Cr_2O_7$

(2) $Pb(NO_3)_2$

(3) NaN_3

(4) NH_4NO_2

HYDROGEN AND ITS COMPOUND

1. In comparison to the zeolite process for the removal of permanent hardness, the synthetic resins method is :

(1) less efficient as it exchanges only anions

(2) more efficient as it can exchange only cations

(3) less efficient as the resins cannot be regenerated

(4) more efficient as it can exchange both cations as well as anions

2. Hydrogen has three isotopes (A), (B) and (C). If the number of neutron(s) in (A), (B) and (C) respectively, are (x), (y) and (z), the sum of (x), (y) an (z) is :

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

ENVIRONMENTAL CHEMISTRY

1. Among the gases (a) - (e), the gases that cause greenhouse effect are :

(a) CO_2 (b) H_2O (c) CFCs

(d) O_2 (e) O_3

(1) (a), (b), (c) and (d)

(2) (a), (c), (d) and (e)

(3) (a) and (d)

(4) (a), (b), (c) and (e)

2. Biochemical Oxygen Demand (BOD) is the amount of oxygen required (in ppm):

(1) by anaerobic bacteria to breakdown inorganic waste present in a water body.

(2) for the photochemical breakdown of waste present in 1 m^3 volume of a water body.

(3) by bacteria to break-down organic waste in a certain volume of a water sample.

(4) for sustaining life in a water body.

F-BLOCK

1. The electronic configurations of bivalent europium and trivalent cerium are

(atomic number : Xe = 54, Ce = 58, Eu = 63)

(1) [Xe] $4f^4$ and [Xe] $4f^9$

(2) [Xe] $4f^7$ and [Xe] $4f^1$

(3) [Xe] $4f^7$ $6s^2$ and [Xe] $4f^2$ $6s^2$

(4) [Xe] $4f^2$ and [Xe] $4f^7$

2. The lanthanoid that does NOT show +4 oxidation state is

(1) Dy (2) Eu (3) Ce (4) Tb

3. Mischmetal is an alloy consisting mainly of:

(1) lanthanoid metals

(2) actinoid metals

(3) actinoid and transition metals

(4) lanthanoid and actinoid metals

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ANSWER KEY

QUANTUM NUMBER					
Que.	**1**	**2**	**3**	**4**	
Ans.	2	4	NTA (1) ALLEN (2,3)	4	

PERIODIC TABLE										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	1	3	1	4	1	3	2	2	4	2
Que.	**11**	**12**	**13**	**14**	**15**	**16**				
Ans.	2	3	4	3	4	101.00				

CHEMICAL BONDING										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	1	4	1	3	3	1	1	4	4	1
Que.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.	3.00	1	2	1	2	3	2	4	4	NTA (3) ALLEN (2)
Que.	**21**	**22**	**23**							
Ans.	1	1	1							

COORDINATION CHEMISTRY										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	4	4	4	1	3	26.60 to 27.00	4	1	20	2
Que.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.	1	2	4	2	3	0	4	6	3	1
Que.	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	2	NTA (4) ALLEN (2, 4)	3	1	3	3	4	3	2	3
Que.	**31**	**32**	**33**							
Ans.	3	6	2							

METALLURGY										
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	2	2	1	2	2	4	3	1	4	2

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HYDROGEN & IT'S COMPOUND			
Que.	1	2	
Ans.	1	3	

SALT ANALYSIS		
Que.	1	
Ans.	2	

COMPLETE S-BLOCK										
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	1	4	1	3	4	2	3	3	4	2

COMPLETE D-BLOCK								
Que.	1	2	3	4	5	6	7	8
Ans.	3	18	1	NTA (12.00) ALLEN (18.00)	2	4	2	3

COMPLETE P-BLOCK										
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	1.66 to 1.67	1	3	3	2	2	4	4	2	1
Que.	11	12	13							
Ans.	4	4	2							

HYDROGEN AND ITS COMPOUND			
Que.	1	2	
Ans.	4	2	

ENVIRONMENTAL CHEMISTRY			
Que.	1	2	
Ans.	4	3	

F-BLOCK				
Que.	1	2	3	
Ans.	2	2	1	

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IMPORTANT NOTES

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