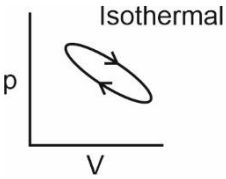
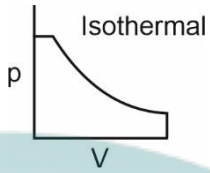
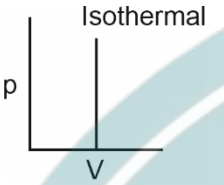
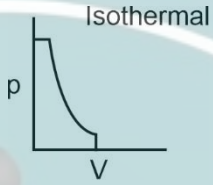
51. Which of the following p-V curves represents the maximum work done?

(1) 

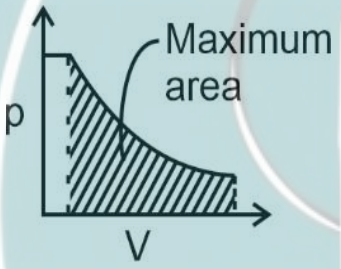
(2) 

(3) 

(4) 

Solution (2)

Sol. Work done under any thermodynamic process can be determined by area under the 'p-V' graph. As it can be observed maximum area is covered in option '2'.



52. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A): ICl is more reactive than I_2.

Reason (R): I-Cl bond is weaker than I-I bond.

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

(1) Both (A) and (R) are correct and (R) is the correct explanation of (A).

(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

(3) (A) is correct but (R) is not correct

(4) (A) is not correct but (R) is correct

Solution (1)

Sol. In general, interhalogen compounds are more reactive than halogens (except fluorine). This is because X – X′ bond in interhalogens is weaker than X – X bond in halogens excepts F – F bond. Therefore I –Cl is more reactive than I_2 because of weaker I – Cl bond then I – I bond.

53. Which compound amongst the following is **not** an aromatic compound?

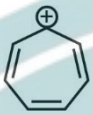
(1) 

(2) 

(3) 

(4) 

Solution (4)

Sol.
- Planar, cyclic, conjugated species containing $(4n + 2)\pi$ electrons will be aromatic in nature (n is an integer)
-  and  are aromatic species
-  is not an aromatic compound

54. The IUPAC name of an element with atomic number 119 is

(1) ununennium (2) unnilennium

(3) unununnium (4) ununoctium

Solution (1)

Sol. IUPAC name of element: 119 : ununennium

55. Match **List-I** with **List-II**.

	List-I (Drug class)		**List-II (Drug molecule)**
(a)	Antacids	(i)	Salvarsan
(b)	Antihistamines	(ii)	Morphine
(c)	Analgesics	(iii)	Cimetidine
(d)	Antimicrobials	(iv)	Seldane

Choose the correct Solution from the options given below :

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

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

Solution

(2) Sol.
- Cimetidine is an antacid
- Seldane is an antihistamine
- Morphine is an analgesic
- Salvarsan is an antimicrobial drug

56. Match List-I with List-II.

	List – I (Hydrides)		**List – II (Nature)**
(a)	MgH_2	(i)	Electron precise
(b)	GeH_4	(ii)	Electron deficient
(c)	B_2H_6	(iii)	Electron rich
(d)	HF	(iv)	Ionic

Choose the correct Solution from the options given below

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

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

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

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

Solution (1)

Sol.

List – I (Hydrides)		**List – II (Nature)**
(a) MgH_2	→	Ionic
(b) GeH_4	→	Electron precise
(c) B_2H_6	→	Electron deficient
(d) HF	→	Electron rich

(a) – (iv), (b) – (i), (c) – (ii), (d) – (iii)

57. The **incorrect** statement regarding enzymes is

(1) Enzymes are biocatalysts.

(2) Like chemical catalysts enzymes reduce the activation energy of bioprocesses.

(3) Enzymes are polysaccharides.

(4) Enzymes are very specific for a particular reaction and substrate.

Solution (3)

Sol. Enzymes are complex nitrogenous organic compounds which are produced by living plants and animals. They are protein molecules of high molecular mass. They are not polysaccharides.

58. The IUPAC name of the complex-

$[Ag(H_2O)_2][Ag(CN)_2]$ is:

(1) dicyanidosilver(II) diaquaargentate(II)

(2) diaquasilver(II) dicyanidoargentate(II)

(3) dicyanidosilver(I) diaquaargentate(I)

(4) diaquasilver(I) dicyanidoargentate(I)

Solution (4)

Sol. $[Ag(H_2O)_2][Ag(CN)_2]$

IUPAC name : diaquasilver(I)dicyanidoargentate(I)

59. Gadolinium has a low value of third ionisation enthalpy because of

(1) small size

(2) high exchange enthalpy

(3) high electronegativity

(4) high basic character

Solution (2)

Sol. Electronic configuration of Gadolinium

Gd :— $[Xe]\ 4f^7\ 5d^1\ 6s^2$

In case of 3rd ionisation enthalpy electron will be removed from 5d and resultant configuration will be $[Xe]4f^7$ that is stable electronic configuration as it will have high exchange energy, hence less energy will be required to remove 3rd electron.

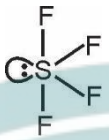
60. Amongst the following which one will have maximum 'lone pair - lone pair' electron repulsions?

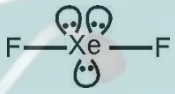
(1) ClF_3 (2) IF_5

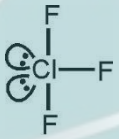
(3) SF_4 (4) XeF_2

Solution

(4) Sol.

$SF_4 \rightarrow sp^3d$ + 1 lone pair 

$XeF_2 \rightarrow sp^3d$ + 3 lone pair 

$ClF_3 \rightarrow sp^3d$ + 2 lone pair 

$IF_5 \rightarrow sp^3d^2$ + 1 lone pair 

XeF_2 having maximum lone pairs, so, it has maximum 'lone pair-lone pair' electron repulsions.

61. Which of the following statement is not correct about diborane?

(1) There are two 3-centre-2-electron bonds.

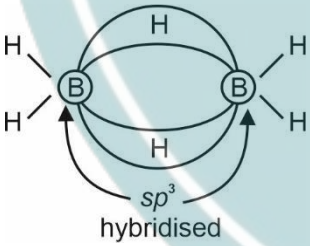
(2) The four terminal B-H bonds are two centre two electron bonds.

(3) The four terminal Hydrogen atoms and the two Boron atoms lie in one plane.

(4) Both the Boron atoms are sp^2 hybridised.

Solution (4)

Sol. Each boron atoms in diborane uses sp^3 hybrid orbitals for bonding.



62. Given below are two statements :

Statement I : The boiling points of aldehydes and ketones are higher than hydrocarbons of comparable molecular masses because of weak molecular association in aldehydes and ketones due to dipole - dipole interactions.

Statement II : The boiling points of aldehydes and ketones are lower than the alcohols of similar molecular masses due to the absence of H-bonding.

In the light of the above statements, choose the **most appropriate** Solution from the given below

(1) Both **Statement I** and **Statement II** are correct

(2) Both **Statement I** and **Statement II** are incorrect

(3) **Statement I** is correct but **Statement II** is incorrect

(4) **Statement I** is incorrect but **Statement II** is correct

Solution (1)

Sol.
- The boiling points of aldehydes and ketones are higher than hydrocarbons of comparable molecular masses due to weak molecular association in aldehydes and ketones arising out of the dipole - dipole interaction.
- Alcohols involved intermolecular hydrogen bonding, because of which the boiling point of aldehydes and ketones are lower than the alcohols of similar molecular masses.

63. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A):

In a particular point defect, an ionic solid is electrically neutral, even if few of its cations are missing from its unit cells.

Reason (R):

In an ionic solid, Frenkel defect arises due to dislocation of cation from its lattice site to interstitial site, maintaining overall electrical neutrality.

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

(1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(3) (A) is correct but (R) is not correct

(4) (A) is not correct but (R) is correct

Solution

(2) Sol.

- Assertion statement is classic explanation of Schottky defect in which cation and anion leaves their site, or impurity defect.
- Reason statement is true but not correct explanation as it is defining Frenkel defect in which ion does not leave crystal.

64. Given below are two statements

Statement I

The boiling points of the following hydrides of group 16 elements increases in the order –

$H_2O < H_2S < H_2Se < H_2Te$

Statement II

The boiling points of these hydrides increase with increase in molar mass.

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

(1) Both **Statement I** and **Statement II** are correct

(2) Both **Statement I** and **Statement II** are incorrect

(3) **Statement I** is correct but **Statement II** is incorrect

(4) **Statement I** is incorrect but **Statement II** is correct

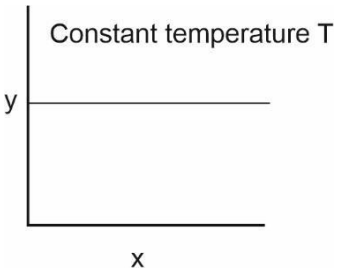
Solution

(2) Sol.

Compound	Boiling point (K)
H_2O	373
H_2S	213
H_2Se	232
H_2Te	269

- The boiling points of these hybrids not exactly increases with increase in molar mass.
- H_2O has maximum boiling point due to intermolecular hydrogen bonding.

65. The given graph is a representation of kinetics of a reaction.



The y and x axes for zero and first order reactions, respectively are

(1) zero order (y = concentration and x = time), first order (y = $t_{½}$ and x = concentration)

(2) zero order (y = concentration and x = time), first order (y = rate constant and x = concentration)

(3) zero order (y = rate and x = concentration), first order (y = $t_{½}$ and x = concentration)

(4) zero order (y = rate and x = concentration), first order (y = rate and x = $t_{½}$)

Solution

(3) Sol.

- For zero order reaction

  $r = k[A]^0$

  $r = k$ (constant)

  hence, 'y' as 'rate' and 'x' as concentration will give desired graph.

- For first order reaction

  $t_{½} = \frac{0.693}{k}$(constant)

  hence, 'y' as '$t_{½}$' and 'x' as concentration will give desired graph.

66. The **incorrect** statement regarding chirality is

(1) S_N1 reaction yields 1 : 1 mixture of both enantiomers

(2) The product obtained by S_N2 reaction of haloalkane having chirality at the reactive site shows inversion of configuration

(3) Enantiomers are superimposable mirror images on each other

(4) A racemic mixture shows zero optical rotation

Solution (3)

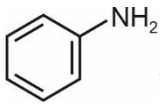
Sol. The stereoisomers related to each other as non-superimposable mirror image are called enantiomers.

67. Which of the following sequence of reactions is suitable to synthesize chlorobenzene?

(1) Benzene, Cl_2, anhydrous $FeCl_3$

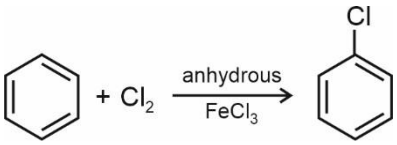
(2) Phenol, $NaNO_2$, HCl, CuCl

(3)  , HCl

(4) 

, HCl, Heating

Solution (1)

Sol. 

Benzene reacts with chlorine in presence of anhydrous $FeCl_3$ to give chlorobenzene

68. Identify the **incorrect** statement from the following.

(1) All the five 5*d* orbitals are different in size when compared to the respective 4*d* orbitals.

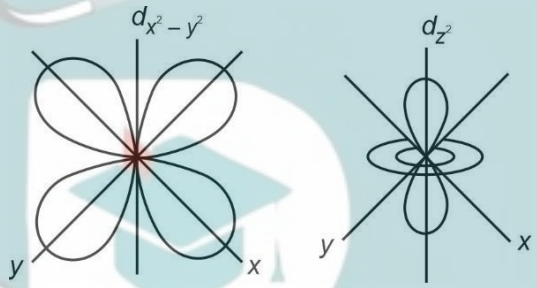
(2) All the five 4*d* orbitals have shapes similar to the respective 3*d* orbitals.

(3) In an atom, all the five 3*d* orbitals are equal in energy in free state.

(4) The shapes of d_{xy}, d_{yz} and d_{zx} orbitals are similar to each other; and $d_{x^2-y^2}$ and d_{z^2} are similar to each other.

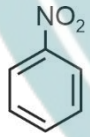
Solution (4)

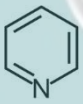
Sol.
- In an atom, all the five 3*d* orbitals are equal in energy in free state *i.e.*, degenerate.
- The shape of $d_{x^2-y^2}$ is different then shape of d_{z^2}

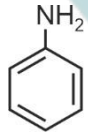


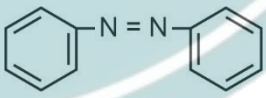
- The size of orbital depends on principal quantum number 'n' therefore all the five 3*d* orbitals are different in size when compared to the respective 4*d* orbitals.
- Shape of orbitals depends on azimuthal quantum number 'l' therefore shapes of 4*d* orbitals are similar to the respective 3*d* orbitals.

69. The Kjeldahl's method for the estimation of nitrogen can be used to estimate the amount of nitrogen in which one of the following compounds?

(1) 

(2) 

(3) 

(4) 

Solution (3)

Sol. Kjeldahl method is not applicable to compounds containing nitrogen in nitro group, azo groups and nitrogen present in the ring (e.g., pyridine) as nitrogen of these compounds does not change to ammonium sulphate under these conditions.

70. Choose the correct statement:

(1) Diamond and graphite have two dimensional network.

(2) Diamond is covalent and graphite is ionic.

(3) Diamond is sp^3 hybridised and graphite is sp^2 hybridized.

(4) Both diamond and graphite are used as dry lubricants.

Solution (3)

Sol. Diamond :
- sp^3 hybridised carbon atom
- Covalent solid
- 3-D structure
- Cannot be used as dry lubricant

Graphite :
- sp^2 hybridised carbon atom
- Covalent solid
- 3-D structure
- Used as dry lubricant

71. Identify the incorrect statement from the following

(1) Alkali metals react with water to form their hydroxides.

(2) The oxidation number of K in KO_2 is +4.

(3) Ionisation enthalpy of alkali metals decreases from top to bottom in the group.

(4) Lithium is the strongest reducing agent among the alkali metals.

Solution

(2) Sol.

- Alkali metals show only '+1' oxidation state in all of their compounds.
  KO_2 is a super-oxide in which O_2^- is anion and K^+ is cation oxidation state of K is +1.

72. Which one is not correct mathematical equation for Dalton's Law of partial pressure? Here p = total pressure of gaseous mixture

(1) $p = p_1 + p_2 + p_3$

(2) $p = n_1\frac{RT}{V} + n_2\frac{RT}{V} + n_3\frac{RT}{V}$

(3) $p_i = \chi_i p$, where p_i = partial pressure of i^{th} gas, χ_i = mole fraction of i^{th} gas in gaseous mixture

(4) $p_i = \chi_i p_i^\circ$, where χ_i = mole fraction of i^{th} gas in gaseous mixture, p_i° = pressure of i^{th} gas in pure state

Solution

(4) Sol.

- Dalton's law of partial pressure states that the total pressure by the mixture of non-reactive gases is equal to the sum of the partial pressures of individual gases.
- $p_{Total} = p_1 + p_2 + p_3$
- Also, $p_i = \chi_i p$; where p_i and χ_i are the partial pressure and mole fraction of i^{th} gas respectively and p is the total pressure.
- $p_{Total} = p_1 + p_2 + p_3$

$$= n_1\frac{RT}{V} + n_2\frac{RT}{V} + n_3\frac{RT}{V}$$

$$= (n_1 + n_2 + n_3)\frac{RT}{V}$$

73. Given below are two statements

Statement I:

The acidic strength of monosubstituted nitrophenol is higher than phenol because of electron withdrawing nitro group.

Statement II:

o-nitrophenol, *m*-nitrophenol and *p*-nitrophenol will have same acidic strength as they have one nitro group attached to the phenolic ring.

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

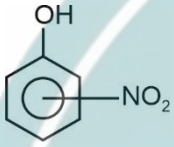
(1) Both **Statement I** and **Statement II** are correct.

(2) Both **Statement I** and **Statement II** are incorrect.

(3) **Statement I** is correct but **Statement II** is incorrect.

(4) **Statement I** is incorrect but **Statement II** is correct.

Solution (3)

Sol. 

- Nitro group has electron withdrawing tendency. It can withdraw electrons both by –I effect and –R effect. Thus the acidic strength of monosubstituted nitrophenol is higher than phenol.
- Nitro group present at o- and p-positions will have strong –R effect while nitro group present at m-position will influence only –I effect hence acidity or o/p isomer will be more meta isomer.

74. At 298 K, the standard electrode potentials of Cu^{2+} / Cu, Zn^{2+} / Zn, Fe^{2+} / Fe and Ag^{+} / Ag are 0.34 V, –0.76 V, –0.44 V and 0.80 V, respectively.

On the basis of standard electrode potential, predict which of the following reaction cannot occur?

(1) $CuSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Cu(s)$

(2) $CuSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Cu(s)$

(3) $FeSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Fe(s)$

(4) $2CuSO_4(aq) + 2Ag(s) \rightarrow 2Cu(s) + Ag_2SO_4(aq)$

Solution (4)

Sol. For a reaction to be spontaneous, E^{o}_{cell} must be positive.

- For, $FeSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Fe(s)$

  $E^{o}_{cell} = E^{o}_{cathode} - E^{o}_{anode}$

  $= -0.44\ V - (-0.76\ V)$

  $= 0.32\ V$

- For, $2CuSO_4(aq) + 2Ag(s) \rightarrow 2Cu(s) + Ag_2SO_4(aq)$

  $E^{o}_{cell} = 0.34\ V - 0.80\ V$

  $= -0.46\ V$

- For, $CuSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Cu(s)$

  $E^{o}_{cell} = 0.34\ V - (-0.76\ V)$

  $= 1.1\ V$

- For, $CuSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Cu(s)$

  $E^{o}_{cell} = 0.80\ V - (-0.44\ V)$

  $= 1.24\ V$

75. Given below are two statements

Statement I:

In the coagulation of a negative sol, the flocculating power of the three given ions is in the order

$Al^{3+} > Ba^{2+} > Na^{+}$

Statement II:

In the coagulation of a positive sol, the flocculating power of the three given salts is in the order

$NaCl > Na_2SO_4 > Na_3PO_4$

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

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

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

(3) Statement I is correct but Statement II is incorrect.

(4) Statement I is incorrect but Statement II is correct.

Solution (3)

Sol. According to hardy Schulze rule

- Flocculating power of cation increases with increases in charge on cation of electrolyte in case of negatively charge colloid, hence order is

  $Al^{3+} > Ba^{2+} > Na^{+}$

- Flocculating power of anion increases with increases in charge on anion of electrolyte in case of positively charge colloids

  Hence order is

  $NaCl < Na_2SO_4 < Na_3PO_4$

76. Match **List-I** with **List-II**

	List-I		**List-II**
(a)	Li	(i)	absorbent for carbon dioxide
(b)	Na	(ii)	electrochemical cells
(c)	KOH	(iii)	coolant in fast breeder reactors
(d)	Cs	(iv)	photoelectric cell

Choose the correct Solution from the options given below :

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

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

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

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

Solution

(4) Sol.

- Cs is used in photoelectric cell due to its low ionisation enthalpy
- KOH used to adsorb CO_2 and changes into K_2CO_3
- Liquid sodium metal is used as a coolant in fast breeder nuclear reactor
- Lithium is used in electrochemical cells

77. Given below are two statements

Statement I:

Primary aliphatic amines react with HNO_2 to give unstable diazonium salts.

Statement II:

Primary aromatic amines react with HNO_2 to form diazonium salts which are stable even above 300 K.

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

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

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

(3) Statement I is correct but Statement II is incorrect.

(4) Statement I is incorrect but Statement II is correct.

Solution (3)

Sol.

- Primary aliphatic amines react with HNO_2 and give unstable diazonium salt which turns into alcohol

$$R-NH_2 + HNO_2 \longrightarrow \left[R-N_2^+-Cl^-\right] \xrightarrow{H_2O} ROH + N_2 + HCl$$

- Primary aromatic amines reacts with HNO_2 and give stable diazonium salt which are stable at 273 to 278 K.

$$C_6H_5-NH_2 + HNO_2 \xrightarrow{273-278\ K} C_6H_5N_2^+Cl^-$$

78. Which statement regarding polymers is **not correct**?

(1) Elastomers have polymer chains held together by weak intermolecular forces

(2) Fibers possess high tensile strength

(3) Thermoplastic polymers are capable of repeatedly softening and hardening on heating and cooling respectively

(4) Thermosetting polymers are reusable

Solution (4)

Sol.

- Thermoplastic polymers are the linear or slightly long chain molecules capable of repeatedly softening and hardening on cooling.
- Thermosetting polymers are cross-linked or heavily branched molecules, which on heating undergo extensive cross-linking in moulds and again become infusible. These cannot be reused.
- Elastomers have polymer chains held together by weak intermolecular forces.
- Fibres possess high tensile strength.

79. In one molal solution that contains 0.5 mole of a solute, there is

(1) 500 mL of solvent (2) 500 g of solvent

(3) 100 mL of solvent (4) 1000 g of solvent

Solution (2)

Sol. Molality is the moles of solute dissolved per kg of solvent therefore 500 g, 1 molal solution contains 0.5 of solute, as

$$m = \frac{\text{Moles of solute}}{\text{Mass of solvent (in kg)}}$$

$$1 = \frac{0.5}{\text{Mass of solvent (in kg)}}$$

$\therefore$ Mass of solvent (in kg) = 0.5

= 500 g

80. $$RMgX + CO_2 \xrightarrow[\text{ether}]{\text{dry}} Y \xrightarrow{H_3O^+} RCOOH$$

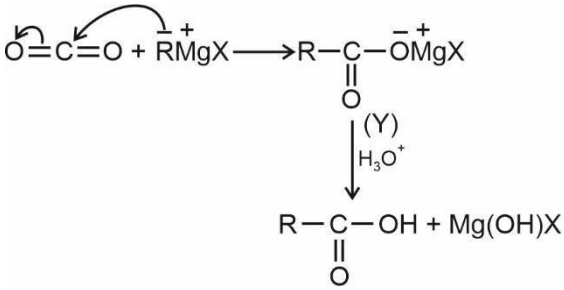
What is Y in the above reaction?

(1) $RCOO^-Mg^+X$ (2) $R_3CO^-Mg^+X$

(3) $RCOO^-X^+$ (4) $(RCOO)_2Mg$

Solution (1)

Sol.



Here Y is $RCOO^{-}Mg^{+}X$

81. Given below are half cell reactions:

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$,

$E^{\circ}_{Mn^{2+}/MnO_4^-} = -1.510\ V$

$\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$,

$E^{\circ}_{O_2/H_2O} = +1.223\ V$

Will the permanganate ion, MnO_4^- liberate O_2 from water in the presence of an acid?

(1) Yes, because $E^{\circ}_{cell} = +0.287\ V$ (2) No, because $E^{\circ}_{cell} = -0.287\ V$

(3) Yes, because $E^{\circ}_{cell} = +2.733\ V$ (4) No, because $E^{\circ}_{cell} = -2.733\ V$

Solution (1)

Sol. • $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$ …(i)

$E^{\circ}_{MnO_4^-/Mn^{2+}} = -E^{\circ}_{Mn^{2+}/MnO_4^-} = 1.51\ V$

• $H_2O \longrightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$ …(ii)

$E^{\circ}_{O_2/H_2O} = 1.223\ V$

Using 2 × (i) + 5 × (ii), net cell reactions is

$2MnO_4^- + 6H^+ \longrightarrow 2Mn^{2+} + \frac{5}{2}O_2 + 3H_2O$

$E^{\circ}_{cell} = E^{\circ}_{C} - E^{\circ}_{A} = E^{\circ}_{MnO_4^-/Mn^{2+}} - E^{\circ}_{O_2/H_2O} = 1.51 - 1.223 = 0.287\ V$

Since $E^{\circ}_{cell} > 0$, therefore net cell reaction is spontaneous and so MnO_4^- liberate O_2 from H_2O in presence of an acid.

82. What mass of 95% pure $CaCO_3$ will be required to neutralise 50 mL of 0.5 M HCl solution according to the following reaction?

$CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2(g)} + 2H_2O_{(l)}$

[Calculate upto second place of decimal point]

(1) 1.25 g (2) 1.32 g

(3) 3.65 g (4) 9.50 g

Solution (2)

Sol. Let m gram mass of $CaCO_3$ is required

Pure $CaCO_3$ in m gram = $\frac{95}{100} \times m$

Moles of $CaCO_3$ = $\frac{95}{100} \times \frac{m}{100}$

Moles of HCl required = 2 × moles of $CaCO_3$

$$= 2 \times \frac{95}{100} \times \frac{m}{100}$$

$$2 \times \frac{95}{100} \times \frac{m}{100} = \frac{50}{1000} \times 0.5$$

$m = 1.315\ g \approx 1.32\ g$

83. The pH of the solution containing 50 mL each of 0.10 M sodium acetate and 0.01 M acetic acid is [Given pK_a of CH_3COOH = 4.57]

(1) 5.57 (2) 3.57

(3) 4.57 (4) 2.57

Solution

(1) Sol.

$CH_3COONa + CH_3COOH$, $CH_3COOH(pK_a) = 4.57$

0.1M 0.01M

50 mL 50 mL

It is a mixture of weak acid and salt of its conjugate base. Hence it is acidic buffer.

$$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$

$$= 4.57 + \log\left(\frac{0.1}{0.01}\right)$$

$$= 4.57 + 1$$

$$= 5.57$$

84. Match List-I with List-II.

List – I (Products formed)	**List – II (Reaction of carbonyl compound with)**
(a) Cyanohydrin	(i) NH_2OH
(b) Acetal	(ii) RNH_2
(c) Schiff's base	(iii) alcohol
(d) Oxime	(iv) HCN

Choose the correct Solution from the options given below

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

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

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

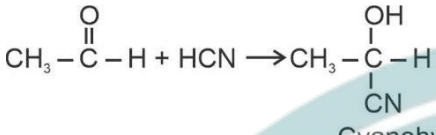
(4) (a) – (iv), (b) – (iii), (c) – (ii), (d) – (i)

Solution (4)

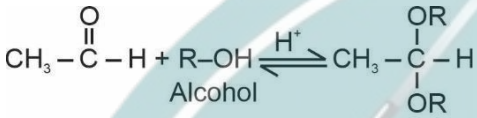
Sol. List – I **List – II**

	(Products formed)		(Reaction of carbonyl compound with)
(a)	Cyanohydrin	→	HCN
(b)	Acetal	→	Alcohol
(c)	Schiff's base	→	RNH_2
(d)	Oxime	→	NH_2OH

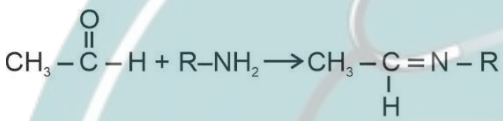
(a) – (iv), (b) – (iii), (c) – (ii), (d) – (i)



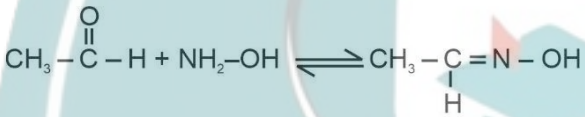
Cyanohydrin



Acetal



Schiff's base



Oxime

85. Which amongst the following is **incorrect** statement?

(1) The bond orders of O_2^+, O_2, O_2^- and O_2^{2-} are 2.5, 2, 1.5 and 1, respectively

(2) C_2 molecule has four electrons in its two degenerate π molecular orbitals

(3) H_2^+ ion has one electron

(4) O_2^+ ion is diamagnetic

Solution (4)

Sol. $\sigma 1s^2\sigma^*1s^2\sigma 2s^2\sigma^* 2s^2\sigma 2p_z^2$ $\begin{matrix}\pi 2p_x^2 & \pi^* 2p_x^1 \\ | & | \\ \pi 2p_y^2 & \pi 2p_y\end{matrix}$

Due to one unpaired electron in $\pi^* 2p$ molecular orbital, O^+ is a paramagnetic ion.

CHEMISTRY SECTION - B

2

86. Given below are two statements:

Statement I:

In Lucas test, primary, secondary and tertiary alcohols are distinguished based on their reactivity with conc. HCl + $ZnCl_2$, known as Lucas Reagent.

Statement II:

Primary alcohols are most reactive and immediately produce turbidity at room temperature on reaction with Lucas Reagent.

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

(1) Both Statement I and Statement II are correct

(2) Both Statement I and Statement II are incorrect

(3) Statement I is correct but Statement II is incorrect

(4) Statement I is incorrect but Statement II is correct

Solution (3)

Sol. Primary, secondary and tertiary alcohols can be differentiated by their reaction with (HCl + anhydrous $ZnCl_2$) Lucas reagent

- 3° alcohol $\longrightarrow$ Immediate turbidity at room temperature
- 2° alcohol $\longrightarrow$ Turbidity after 5 minutes at room temperature
- 1° alcohol $\longrightarrow$ Do not give turbidity at room temperature

87. If the radius of the second Bohr orbit of the He^+ ion is 105.8 pm, what is the radius of the third Bohr orbit of Li^{2+} ion?

(1) 158.7 pm (2) 15.87 pm

(3) 1.587 pm (4) 158.7 Å

Solution (1)

Sol. $r_n \propto \frac{n^2}{Z}$

$$\frac{r_3(Li^{2+})}{r_2(He^+)} = \frac{(n_3)^2}{Z(Li^{2+})} \times \frac{Z(He^+)}{(n_2)^2}$$

$$\frac{r_3(Li^{2+})}{105.8} = \frac{(3)^2}{3} \times \frac{2}{(2)^2}$$

$$= 105.8 \times \frac{3}{2}$$

$$r_3(Li^{2+}) = 158.7 \text{ pm}$$

88. For a first order reaction A $\rightarrow$ Products, initial concentration of A is 0.1 M, which becomes 0.001 M after 5 minutes. Rate constant for the reaction in min^{-1} is

(1) 1.3818 (2) 0.9212

(3) 0.4606 (4) 0.2303

Solution (2)

Sol. For first order reaction,

$K = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$; where A_0 is the initial concentration of reactant A.

A_0 = 0.1 M

A = 0.001 M

t = 5 minute

$$K = \frac{2.303}{5} \log \frac{0.1}{0.001} = \frac{2.303}{5} \log 10^2$$

$$= \frac{2.303}{5} \times 2$$

$K = 0.9212 \text{ min}^{-1}$

89. A 10.0 L flask contains 64 g of oxygen at 27ºC. (Assume O_2 gas is behaving ideally). The pressure inside the flask in bar is (Given R = 0.0831 L bar K^{-1} mol^{-1})

(1) 2.5 (2) 498.6

(3) 49.8 (4) 4.9

Solution (4)

Sol. We know for ideal gas

$PV = nRT$

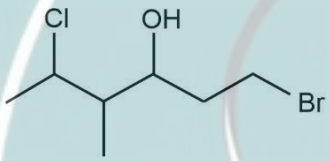
$$P = n\frac{RT}{V}$$

$$P = \frac{64}{32} \times \frac{0.0831 \times 300}{10}$$

$P = 4.9$ bar

Pressure of O_2 gas inside the flask = 4.9 bar

90. The correct IUPAC name of the following compound is

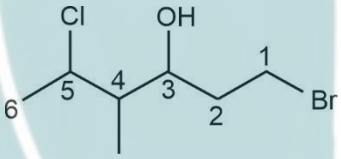


(1) 1-bromo-5-chloro-4-methylhexan-3-ol (2) 6-bromo-2-chloro-4-methythexan-4-ol

(3) 1-bromo-4-methyl-5-chlorohexan-3-ol (4) 6-bromo-4-methyl-2-chlorohexan-4-ol

Solution (1)

Sol.



1-bromo-5-chloro-4-methylhexan-3-ol

91. The pollution due to oxides of sulphur gets enhanced due to the presence of:

(a) particulate matter (b) ozone

(c) hydrocarbons (d) hydrogen peroxide

Choose the most appropriate Solution from the options given below:

(1) (a), (d) only (2) (a), (b), (d) only

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

Solution (2)

Sol. Presence of particulate matter in polluted air catalyzes the oxidation of SO_2 to SO_3

i.e., $2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$

This reaction can also be promoted by O_3 and H_2O_2, as

$SO_2(g) + O_3(g) \longrightarrow SO_3(g) + O_2(g)$

$SO_2(g) + H_2O_2(l) \longrightarrow H_2SO_4(aq)$

92. Copper crystallises in fcc unit cell with cell edge length of 3.608×10^{-8} cm. The density of copper is 8.92 g cm^{-3}. Calculate the atomic mass of copper.

(1) 63.1 u (2) 31.55 u

(3) 60 u (4) 65 u

Solution (1)

Sol. $d = \dfrac{ZM}{N_A(a)^3}$

Z = 4(FCC), d = 8.92 g cm^{-3}, $N_A = 6.023 \times 10^{23}$, $a = 3.608 \times 10^{-8}$ cm

$$M = \frac{dN_A(a)^3}{Z}$$

$$= \frac{8.92 \times 6.023 \times 10^{23} \times (3.608 \times 10^{-8})^3}{4}$$

$$= \frac{8.92 \times 6.023 \times 10^{23} \times 46.97 \times 10^{-24}}{4} = \frac{2523.47 \times 10^{-1}}{4}$$

$= 630.8 \times 10^{-1} = 63.08 \simeq 63.1\,u$

93. Find the emf of the cell in which the following reaction takes place at 298 K

$Ni(s) + 2Ag^+(0.001M) \rightarrow Ni^{2+}(0.001M) + 2Ag(s)$

$\left(\text{Given that } E^\circ_{cell} = 10.5\text{ V}, \dfrac{2.303\,RT}{F} = 0.059 \text{ at } 298\text{ K}\right)$

(1) 1.0385 V (2) 1.385 V

(3) 0.9615 V (4) 1.05 V

Solution (NA)

Sol. $Ni(s) + 2Ag^+(0.001\text{ M}) \rightarrow Ni^{2+}(0.001\text{ M}) + 2Ag(s)$

$E^\circ_{cell} = 10.5$ V

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log\frac{\left[Ni^{2+}\right]}{\left[Ag^+\right]^2}$$

$$= 10.5 - \frac{0.059}{2}\log\frac{\left(10^{-3}\right)}{\left(10^{-3}\right)^2}$$

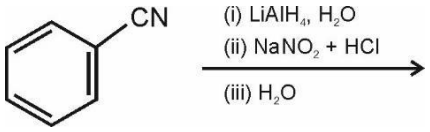
$$\Rightarrow 10.5 - \frac{0.059}{2}\log(10)^3$$

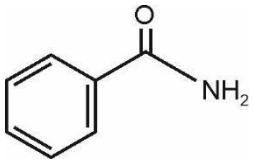
$\Rightarrow 10.5 - 0.0295 \times 3$

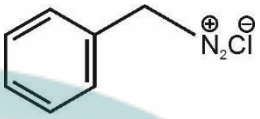
$= 10.5 - 0.0885$

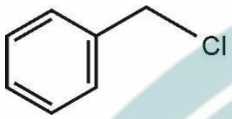
$= 10.4115$ V

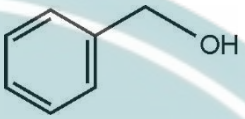
94. The product formed from the following reaction sequence is



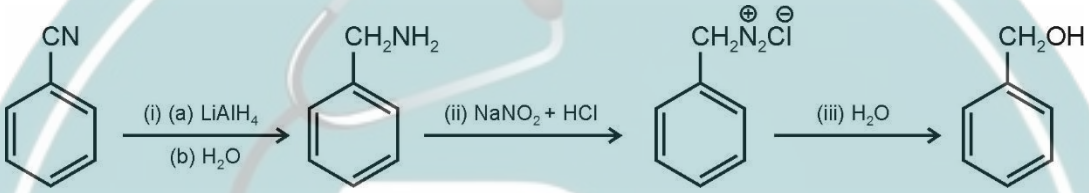
(1) 

(2) 

(3) 

(4) 

Solution (4)

Sol. 

95. The order of energy absorbed which is responsible for the color of complexes

(A) $[Ni(H_2O)_2(en)_2]^{2+}$

(B) $[Ni(H_2O)_4(en)]^{2+}$ and

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

is

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

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

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

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

Solution (3)

Sol. The stronger the field strength of ligand, the higher will be the energy absorbed by the complex. $\Rightarrow$ 'en' has a stronger field strength than 'H_2O' according to spectrochemical series

$\therefore$ Correct order of energy absorbed will be:

$[Ni(en)_3]^{2+} > [Ni(H_2O)_2(en)_2]^{2+} > [Ni(H_2O)_4(en)]^{2+}$ i.e. (C) > (A) > (B)

96. Match List-I with List-II.

	List-I (Ores)		**List-II (Composition)**
(a)	Haematite	(i)	Fe_3O_4
(b)	agnetite	(ii)	$ZnCO_3$
(c)	Calamine	(iii)	Fe_2O_3
(d)	Kaolinite	(iv)	$[Al_2(OH)_4Si_2O_5]$

Choose the correct Solution from the options given below:

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

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

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

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

Solution (2)

97. In the neutral or faintly alkaline medium, $KMnO_4$ oxidizes iodide into iodate. The change in oxidation state of manganese in this reaction is from

(1) +7 to +4
(2) +6 to +4
(3) +7 to +3
(4) +6 to +5

Solution (1)

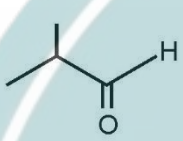
98. Compound X on reaction with O_3 followed by Zn/H_2O gives formaldehyde and 2-methyl propanal as products.

The compound X is

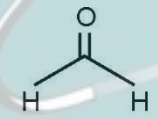
(1) 3-Methylbut-1-ene
(2) 2-Methylbut-1-ene
(3) 2-Methylbut-2-ene
(4) Pent-2-ene

Solution (1)

Sol.

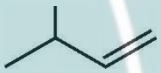


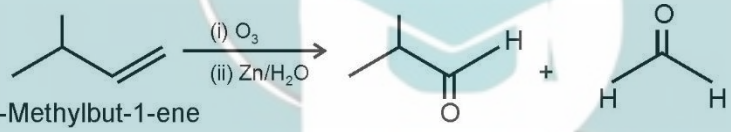
2-Methylpropanal



Formaldehyde

The given reaction is the reductive ozonolysis of an alkene. The alkene will be





3-Methylbut-1-ene

99. $3O_2(g) \rightleftharpoons 2O_3(g)$

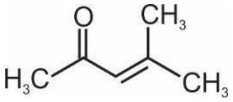
for the above reaction at 298 K, K_C is found to be 3.0×10^{-59}. If the concentration of O_2 at equilibrium is 0.040 M then concentration of O_3 in M is

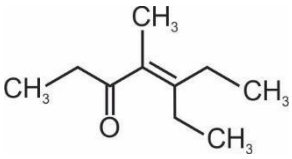
(1) 4.38×10^{-32}
(2) 1.9×10^{-63}
(3) 2.4×10^{31}
(4) 1.2×10^{21}

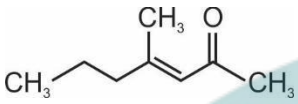
Solution (1)

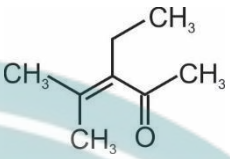
\

100. Which one of the following is not formed when acetone reacts with 2-pentanone in the presence of dilute NaOH followed by heating?

(1) 

(2) 

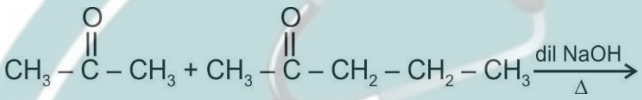
(3) 

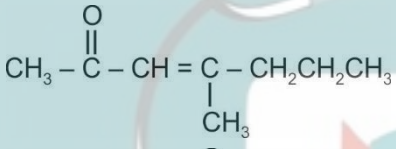
(4) 

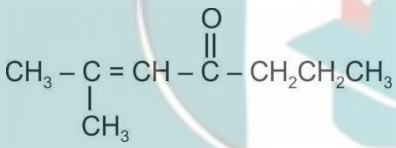
Solution (2)

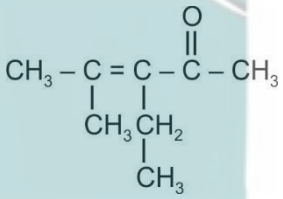
Sol. Cross Aldol condensation reaction:

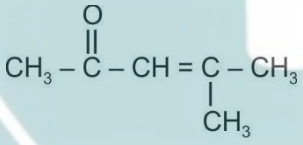
Both reactants contain α-Hydrogens, so multiple products are possible which are as follows:

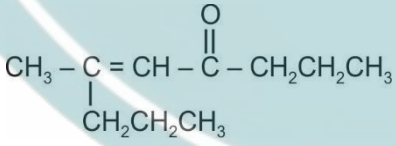


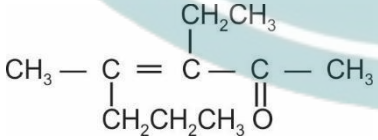
1. 

2. 

3. 

4. 

5. 

6. 

$\Rightarrow$ (2) is not possible.