M.M. : 70

CLASS-XI

CHEMISTRY (THEORY) (2023-24)

Marking Scheme/Hints to Solution

Note : Any other relevant answer, not given herein but given by the candidate be suitably rewarded.

S. No.	Value Points/Key Points	Marks Allotted to each value point/key point	Total Marks
	Section-A		
1.	(c)	1	1
2.	(a)	1	1
3.	(b)	1	1
4.	(c)	1	1
5.	(b)	1	1
6.	(b)	1	1
7.	(a)	1	1
8.	(c)	1	1
9.	(a)	1	1
10.	(c)	1	1
11.	(d)	1	1
12.	(c)	1	1
13.	(d)	1	1
14.	(b)	1	1

15.	(c)	1	1
16.	(a)	1	1
	Section-B		
17.	The associated wavelength is obtained from de-Broglie equation :	½	2
	$\lambda = h/p = h/mv$		
	$m = 100\ g = 0.1\ kg$	½	
	$\frac{6.626 \times 10^{-34}}{0.1 \times 2.11 \times 10^{5}}$	½	
	$= 3.14 \times 10^{-38}\ m$	½	
18.	(a) Na_2S	1	2
	(b) $BeCl_2$	1	
	OR		
	(a) $Al^{3+} < Mg^{2+} < F^{-} < O^{2-}$ (increasing ionic radii)	1	
	(b) I < Br < F < Cl (increasing electron gain enthalpy) considering electron gain enthalpy to be negative.	1	
19.	Reduction half equation :		2
	$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O(l)$	½	
	Oxidation half equation :		
	$Fe^{2+} \rightarrow Fe^{3+} + e^-$] × 6	½	
	And we add the equations together in such a way that the electrons are eliminated.		
	$6Fe^{2+} + CrO_7^{2-} + 14H^+ \longrightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O(l)$	1	
	Note : The equation may be balanced by Half reaction method or Oxidation number method.		

20.	(a) Glycerol has a high boiling point and since in this method the external pressure is lowered, it boils at a lower temperature.	1	2
	(b) In ethanol, –OH can be placed on any carbon and that will give the same IUPAC name / Both terminal carbon only / the carbon having –OH will be numbered 1 so its the same compound.	1	
21.	The mass of the compound = 0.24 g		2
	Mass of $Mg_2P_2O_7$ = 0.44 g		
	Since 222 g of $Mg_2P_2O_7$ = 62 g of P		
	So, 0.44 g of $Mg_2P_2O_7$		
	contains P = 62/222 × 0.44 g	1	
	So % P present in the compound		
	= (62 × 0.44 × 100) / (222 × 0.24)		
	= 51.20%	1	
	Section-C		
22.	(a) For 4p orbital, n = 4 and l = 1		
	Number of angular nodes, l = 1	½	
	Number of radial nodes = $n - l - 1 = 2$	½	
	(b) $r_n = \frac{(0.0529\ nm)n^2}{z}$	1	
	(c) 2 electrons in an atom can have n = 5, l = 2 and m_l = 1	1	3
23.	(a) SF_4 has trigonal bipyramidal geometry. The lone pair is in the equatorial plane giving an overall see-saw shape.	1	
	(b) PH_3 has Tetrahedral geometry. The central atom has one lone pair and there are three bond pairs so the shape is trigonal pyramidal.	1	

	(c) $SiCl_4$ has 4 bond pairs only hence shape and geometry both tetrahedral.	1	3
24.	(a) Ne is a noble gas / it has stable configuration / completely filled shells or orbitals.	1	
	(b) N has stable configuration as it has half filled 2p orbital hence higher I.E.	1	
	(c) Li is the most metallic among given elements as it has minimum I.E. in the period.	1	3
25.	The electronic configuration of O_2^+ according to MOT is	1	3
	$(\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2(\sigma 2pz)^2(\pi 2px)^2 = (\pi 2py)^2(\pi^* 2px)^1$		
	Bond order is $= \frac{10-5}{2} = 2.5$		
	The electronic configuration of N_2^- according to MOT is		
	$\sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \pi 2px^2 = \pi 2py^2 \sigma 2pz^2 \pi^* 2px^1$	1	
	Bond order = (10 – 5)/2 = 2.5		
	They have same bond order as total number of electrons in bonding and antibonding MOs are the same.	1	
26.	(a) For a reaction to be spontaneous ΔG should be negative. Both ΔH and ΔS are negative, ΔG can be negative only if $T\Delta S < \Delta H$ in magnitude.		3
	$\Delta G = \Delta H - T\Delta S$		
	$\Delta G = (-) - T\ (-)$	1	
	This is possible only if either ΔH has a large negative value or T is so low that $T\Delta S < \Delta H$.	½	
	(b) Hess's Law states that if a reaction takes place in several steps then its standard reaction enthalpy is the sum of the standard enthalpies of the intermediate reactions at the same temperature.	1	

Any example into which the overall reaction may be divided. ½

(c) $\Delta U = q + w$ ½

For isothermal reversible change : 1

$q = -w = nRT\ln (Vf/Vi)$

$= 2.303\ nRT \log (Vf/Vi)$

(Any two)

27. Mass of copper = 100 g 3

Molar mass of copper = 63.5 g

Moles of copper = 100/63.5 ½

Molar heat capacity of copper = 24.5 J/K/mol

$\Delta T = 10$

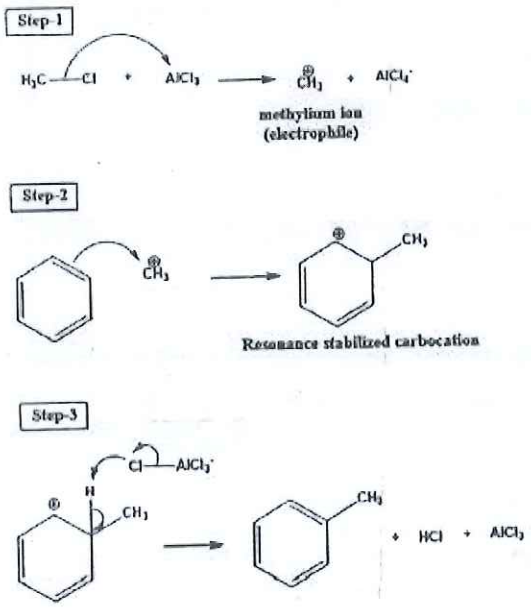
$q = m \times c \times \Delta T$ ½

$= (100/63.5) \times 24.5 \times 10$ ½

$= 385.8$ J ½

$= 0.3858$ KJ 1

28. 3



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1

1

Section-D

29. (a) When light of a particular frequency is directed on a metal, electrons can be ejected from the surface of the metal.

This phenomenon is known as the photoelectric effect. 1

(b) The electron will have kinetic energy due to extra energy as compared to threshold energy. 1

(c) Let λm = Longest wavelength of light 1

$(hc/\lambda m) = w_0$ (work function)

$\lambda m = hc/w_0 = (6.626 \times 10^{-34}) \times (3 \times 10^8) / (2.0 \times 1.6 \times 10^{-19})$

$= 621$ nm 1

OR

Threshold energy $= 3.84 \times 10^{-19}$ J

Energy corresponding to given wavelength : ½

$E = hc / \lambda$

$= (6.626 \times 10^{-34}) \times (3 \times 10^8) / 480 \times 10^{-9})$

$= 4.1 \times 10^{-19}$ J 1

Yes it will be enough to provide kinetic energy to the emitted photon. ½

4

30. (a) The organic compound has covalent bond between C and Cl hence no ionisation takes place easily to test for chloride. 1

(b) The sodium fusion extract is first boiled with concentrated nitric acid to decompose cyanide or sulphide (in case S and N are present) of sodium formed during Lassaigne's test. Otherwise these ions will interfere with silver nitrate test and result in other color formation. 1

(c) In this test blue colour is obtained when only nitrogen is present whereas red colour is obtained when both nitrogen and sulphur are present. However complete fusion with Sodium produces blue colour for Nitrogen. 1

The blue coloured compound is named as iron(III) hexacyanoferrate(II) / (ferriferrocyanide) / hexacyanido ferrate (II) iron (III) 1

OR

$6CN^- + Fe^{2+} \rightarrow [Fe(CN)_6]^{4-}$

$3[Fe(CN)_6]^{4-} + 4Fe^{3+} \rightarrow Fe_4[Fe(CN)_6]_3.xH_2O$ 1

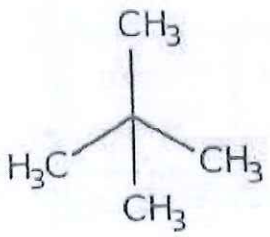
Prussian blue

$Na + C + N + S \rightarrow NaSCN$ 1

$Fe^{3+} + SCN^- \rightarrow [Fe(SCN)]^{2+}$

Blood red 4

Section-E

31. (a)  1×5=5

(b) Wurtz Reaction

$2CH_3CH_2CH_2\text{–}Cl + 2Na \xrightarrow{\text{dry ether}} CH_3CH_2CH_2CH_2CH_2CH_3 + 2NaCl$

Propyl chloride n-hexane 1

(c) Huckel's rule : A Cyclic, Planar molecule is considered to be Aromatic if it has $(4n + 2)\pi$ electrons. 1

(d) The ethane molecule gains thermal or kinetic energy sufficient enough to overcome this energy barrier of 12.5 kJ/mol through intermolecular collisions. 1

(e) 9 sigma bonds and 2 pi bonds — 1

(f) Buy-2-yne < Propyne < Ethyne — 1

There is no acidic hydrogen in But-2-yne. Ethyne is more acidic than propyne due to presence of 2 acidic H atoms, also since there is methyl group present in propyne which exerts + I effect & makes it less acidic.

(g) NO_2 shows – R effect. There is less electron density at ortho-and para- position and more electron density at meta- position. — 1

(Any 5 to be done)

32. (a) The mass unit equal to exactly one-twelfth the mass of one atom of carbon-12 is called one atomic mass unit. — 1 — 5

(b) mass spectrometry — 1

(c)

Element	Msss %	Atomic mass	Moles	Simplest ratio
H	2.46	1	2.46	2
S	39.06	32	1.22	1
O	58.48	16	3.65	2.99 = 3

— 2

Empirical formula = H_2SO_3 — ½

Empirical formula mass = 2 + 32 + 48 = 82 g

Given molar mass = 82 g — ½

Hence molecular formula and Empirical formula are the same.

OR

(a) 1 Molar is more concentrated as in 1M 1 mole of NaCl is in 1 litre solution but in 1 m, 1 mole of solute is in 1 kg/1 L of Solvent only. — 1 — 1

(b) Mass % = 32

Density = 1.16 g/cm^3

Let mass of solution be 100 g then — 1

Volume of the solution = mass/density

= 100/1.16 = 86.20 ml

Volume in litres = 0.0862 L — 1

Moles of HCl = 32/36.5 = 0.876 moles

Molarity of the solution = 0.876/0.0862 = 10.16 M — 1

33. (a) Conjugate acid : NH_4^+ — ½

Conjugate base : NH_2^- — ½ — 5

(b) Buffer keeps the pH maintained to control malfunctioning of living systems / Buffer controls the pH changes. — ½

e.g. NH_4Cl and NH_4OH

(c) Kc for the reaction = 1×10^{-8} — ½

Reaction quotient (Qc) $= \dfrac{[SO_3]^2}{[SO_2]^2\,[O_2]}$ — 1

$= \dfrac{(10^{-5})^2}{(2 \times 10^{-5})^2\,(10^{-5})}$ — 1

$= 5 \times 10^4$

As Qc > Kc, the reaction will proceed backward. — 1

OR

(a) The dissociation of H_2S decreases on adding strong acid HCl to it as H^+ from HCl is common ion which suppresses the ionisation of H_2S decreasing the concentration of Sulphide ions in solution. — 1

This phenomena is called Common ion effect. — 1

(b) The ksp of AX = 4×10^{-36}

$AX \rightleftarrows A^+ + X^-$ 1

S S (S is solubility)

Ksp = SXS = 4×10^{-36}

$S = 2 \times 10^{-18}$ Mol/L

Ksp of $MX_3 = 2.7 \times 10^{-27}$

$MX_3 = M^{3+} + 3X^-$ 1

Ksp = S 3S

Ksp = $S \times (3S)^3$

$27\ S^4 = 2.7 \times 10^{-27}$

$S^4 = (27/27) \times 10^{-28}$

$S \approx 10^{-7}$

Ratio of solubilities = S (AX)/S (MX_3)

$= 2 \times 10^{-18}/10^{-7}$ 1

$= 2 \times 10^{-11}$