CHEMISTRY

Time allowed : 3 hours ***Maximum marks: 70***

General Instructions:

(i) ***All*** *questions are compulsory.*

(ii) *Marks for each question are indicated against it.*

(iii) *Question number* ***1*** *to* ***5*** *are very short-answer questions, carrying* ***1*** *mark each. Answer these in* ***one*** *word or about* ***one*** *sentence each.*

(iv) *Question number* ***6*** *to* ***12*** *are short-answer questions, carrying 2 marks each. Answer these in about* ***30*** *words each.*

(v) *Question number* ***13*** *to* ***24*** *are short-answer questicms of* ***3*** *marks each. Answer these in about* ***40*** *words each.*

(vi) *Question number* ***25*** *to* ***27****are long-answer questions of* ***5*** *marks each. Answer these in about* ***70*** *words each.*

(vii) *Use Log Tables, if necessary. Use of calculators is not permitte*

QUESTION PAPER CODE 56/1/1

1. What is the number of atoms per unit cell in a body centered cubic structure ? 2

2. Define osmotic pressure. 2

3. For the reaction 1

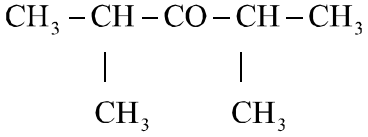
$Cl_2(g) + 2NO(g) \rightarrow 2NOCl(g)$

the rate law is expressed as

rate $= k[Cl_2][NO]^2$

What is the overall order ‘of this reaction ?

4. Write the IUPAC name of the compound: 1



5. Why do nitro compounds have high boiling points in comparison with other compounds of same molecular mass ? 1

6. State ‘Pauli’s exclusion principle’. Explain giving an example how this principle limits the maximum occupancy of an energy level in an atom. 2

OR

State 'Aufbau principle' and give the order in which the energies of orbitals increase and hence they are filled in that order. 2

7. A reaction with $\Delta_r G^{\ominus} < 0$ always has an equilibrium constant value greater than 1. Why ? 2

8. Write balanced chemical equations for the following reactions : 2

(i) Aluminium dissolves in aqueous hydrochloric acid

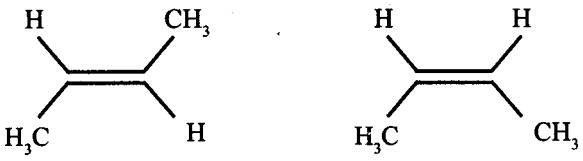
(ii) Tin reacts with a hot alkali solution

9. Write the structures of the following species: 2

(i) H_3PO_2 (ii) H_2SO_5

10. Identify whether the following pairs of compounds are structural or geometrical isomers : 2

(i)



(ii)

11. How would you account for the following : 2

(i) Phenols are much more acidic than alcohols.

(ii) The boiling points of ethers are much lower than those of the alcohols of comparable molar masses.

12. Draw the structure of the monomer of each of the following polymers : 2

(i) Polyvinylchloride (PVC) (ii) Nylon-6

13. Write the molecular orbital configurations of the following species and rearrange them in the increasing order of their bond lengths: 3

N_2^+, C_2^+ and O_2

14. Explain each of the following with a suitable example: 3

(i) Paramagnetism

(ii) Piezoelectric effect

(iii) Frenkel defect in crystals

15. In the production of water gas the reaction involved is : 3

$$C(s) + H_2O(g) \rightarrow CO(g) + H_2(g), \Delta_r H^{\ominus} = +131.4 \text{ kJ mol}^{-1}$$

For this reaction $\Delta_r S^{\ominus}$ is + 134 JK^{-1} mol^{-1}. Find out the spontaneous feasibility of this reaction at (i) 25°C and (ii) 1000°C.

16. An antifreeze solution is prepared from 222.6 g of ethylene glycol ($C_2H_4(OH)_2$) and 200 g of water. Calculate the molality of the solution. If the density of this solution be 1.072 g mL^{-1}, what will be the molarity of the solution ? 3

17. The decomposition of NH_3 on platinum surface, $2NH_3(g) \xrightarrow{Pt} N_2(g) + 3H_2(g)$ is a zero order reaction with $k = 2.5 \times 10^{-4} Ms^{-1}$. What are the rates of production of N_2 and H_2 ? 3

18. Explain the following terms giving a suitable example in each case : 3

(i) Emulsification

(ii) Homogeneous catalysis

OR

Define adsorption. Write any two features which distinguish physisorption from chemisorption. 3

19. How would you account for the following ? 3

(i) The lower oxidation state becomes more stable with increasing atomic number in Group 13.

(ii) Hydrogen fluoride is much less volatile than hydrogen chloride,

(iii) Interhalogen compounds are strong oxidising agents.

20. Write the name and draw the structure of each of the following complex compounds : 3

(i) $[Co(NH_3)_4 (H_2O)_2] Cl_3$

(ii) $[Pt(NH_3)_4]\ [NiCl_4]$

21. The net nuclear reaction of a radioactive decay series is written as : 3

$^{238}_{92}U \rightarrow ^{206}_{82}Pb + 8\ ^{4}_{2}He + 6\ ^{0}_{-1}e^{-}$

Write three pieces of information that you get from the above equation.

22. Give chemical tests to distinguish between the following pairs of compounds : 3

(i) Propanal and propanone

(ii) Methyl acetate and ethyl acetate

(iii) Benzaldehyde and benzoic acid

23. How would you achieve the following conversions : 3

(i) Nitrobenzene to aniline

(ii) An alkyl halide to a quaternary ammonium salt .

(iii) Aniline to benzonitrile

Write the chemical equation with reaction conditions in each case.

24. (i) Give an example of a hybrid propellant. 3

(ii) What are acid dyes ?

(iii) Name a food preservative which is most commonly used by food producers.

25. (a) Describe the general trends in the following properties of the first series of the transition elements : 3

(i) Stability of +2 oxidation state

(ii) Formation of oxometal ions

(b) Assign reason for each of the following: 2

(i) Transition elements exhibit variable oxidation states

(ii) Transition metal ions are usually coloured

OR

(a) Write the steps involved in the preparation of: 3

(i) $K_2Cr_2O_7$ from Na_2CrO_4

(ii) $KMnO_4$ from K_2MnO_4

(iii) Calomel from corrosive sublimate

(b) What is meant by lanthanoid contraction ? What effect does it have on the chemistry of the elements which follow lanthanoids ? 2

26. (a) Calculate the emf of the cell 3

$Mg(s)\,|\,Mg^{2+}(0.1M)\,||\,Cu^{2+}(1\times10^{-3}M)\,|\,Cu(s)$

Given : $E^{\Theta}Cu^{2+}/Cu = +0.34V, E^{\Theta}Mg^{2+}/Mg = -2.37V,$

(b) Explain with examples the terms weak and strong electrolytes. 2

OR

(a) The resistance of a conductivity cell containing 0.001 M KC1 solution at 298 K is 1500 Ω. What is the cell constant, if the conductivity of 0.001 M KCl solution at 298 K is $0.146\times10^{-3}\,S\,cm^{-1}$? 3

(b) Predict the products of electrolysis in the following: 2

A solution of H_2SO_4 with platinum electrodes.

27. (a) Name the three major classes of carbohydrates and give an example of each of these classes. 3

(b) Answer the following: 2

(i) What type of linkage is responsible for the primary structure of proteins ?

(ii) Name the location where protein synthesis occurs in our body.

OR

(a) How are lipids classified ? Give an example of each class. 3

(b) Explain the following terms : 2

(i) Mutarotation

(ii) Avitaminosis

QUESTION PAPER CODE 56/1

1. Find out the number of atoms per unit cell in a face-centred cubic structure having only single atoms at its lattice points. 1

2. State the condition resulting in reverse osmosis. 1

3. Express the rate of the following reaction in terms of disappearance of hydrogen in the reaction 1

$$3\,H_2(g) + N_2(g) \rightarrow 2\,NH_3(g)$$

4. Name the following compound according to IUPAC system : 1

$CH_3COCH_2COCH_3$

5. Why do amines react as nucleophiles ? 1

6. (a) Write the mathematical expression for the relationship of wavelength (λ) of a moving particle and its momentum (p).

(b) What physical meaning is attributed to the square of the absolute value of wave function, $|\Psi|^2$? 2

OR

State the Heisenberg Uncertainty Principle and explain as to why it is not of real consequence when applied to a macroscopic object, like a cricket ball. 2

7. Define conductivity and molar conductivity for the solution of an electrolyte. 2

8. How would you account for the following : 2

(i) Sulphur hexafluoride is less reactive than sulphur tetrafluoride.

(ii) Of the noble gases only xenon forms known chemical compounds.

9. On the basis of the standard electrode potential values stated for acid solution, predict whether Ti^{4+} species may be used to oxidise Fe^{II} to Fe^{III} . 2

Reaction	$E^{\ominus}$ / V
$Ti^{IV} + e^- \rightarrow Ti^{3+}$	: $+0.01$
$Fe^{3} + e^- \rightarrow Fe^{2+}$	: $+0.77$

10. What are chiral objects ? Indicate the presence of centre of chirality, if any, in the molecules of 3-bromopent-l-ene. 2

11. How may the following conversions be carried out : 2

(i) Propene to propan-2-ol

(ii) Anisole to phenol

(Write the reaction only.)

12. Write formulae of the monomers of polythene and teflon. 2

13. Define bond order in a diatomic molecule. Find the bond order in O_2 molecule. State and explain magnetic character of molecular oxygen. 3

14. Assign reasons for the following : 3

(i) Phosphorus doped silicon is a semiconductor.

(ii) Schottky defect lowers the density of a solid.

(iii) Some of the very old glass objects appear slightly milky instead of being transparent.

15. A 0.1539 molal aqueous solution of cane sugar (mol. mass = 342 g mol^{-1}) has a freezing ptiint of 271 K while the freezing point of pure water is 273.15 K. What will be the freezing point of an aqueous solution containing 5 g of glucose (mol. mass = 180 g mol^{-1}) per 100 g of solution ? 3

16. Calculate the standard cell potential of the galvanic cell in which the following reaction takes place : 3

$$2\ Cr(s) + 3\ Cd^{2+}(aq.) \rightarrow 2\ Cr^{3+}(aq.) + 3\ Cd(s)$$

Also calculate the $\Delta_r G^{\Theta}$ value of the reaction.

(Given : $E^{\Theta}_{Cr^{3+}/Cr} = +0.74V; E^{\Theta}_{Cd^{2+}/Cd} = -0.40V$ and F = 96500 C mol^{-1})

17. The rate constant for a first order reaction is 60 s^{-1}. How much time will it take to reduce the concentration of the reactant to 1/10th of its initial value ? 3

18. Describe the following types of colloids, giving an example for each : 3

(i) Multimolecular colloids

(ii) Macromolecular colloids

OR

Explain the following terms with a suitable example in each case : 3

(i) Shape-selective catalysis

(ii) Dialysis

19. How would you account for the following : 3

(i) The transition elements have high enthalpies of atomisation.

(ii) The transition metals and their compounds are found to be good catalysts in many processes.

20. Describe for any ***two*** of the following complex ions, the type of hybridization, shape and magnetic property : 3

(i) $[Fe(H_2O_6)]^{2+}$

(ii) $[Co(NH_3)_6]^{3+}$

(iii) $[NiCl_4]^{2-}$

(At. Nos. Fe = 26, Co = 27, Ni = 28)

21. Complete the following statements for nuclear reactions : 3

(i) $^{239}_{94}Pu\ (\alpha, \beta_-)$ .....

(ii) ..... $(\alpha, 2n)^{211}_{85}At$

(iii) $^{246}_{966}Cm + {}^{12}_{6}C \rightarrow ..... + 4\ {}^{1}_{0}n$

(*Note:* You may use 'X' as symbol if the correct symbol in a reaction is not known)

22. Write one chemical equation for each, to illustrate the following reactions : 3

(i) Rosenmund reduction

(ii) Cannizzaro reaction

(iii) Fischer esterification

23. Account for any ***two*** of the following :

(a) Amines are basic substances while amides are neutral.

(b) Nitro compounds have higher boiling points than the hydrocarbons having almost the same molecular mass.

(c) Aromatic amines are weaker bases than aliphatic amines. 3

24. (a) Describe and illustrate with an example each, a mordant dye and a detergent,

(b) Give an example of a liquid .propellant. 3

25. (a) Prove that $\Delta G_{system} = -T\Delta S_{total}$ for a system which is not isolated.

(b) The decomposition of Fe_2O_3 is a non-spontaneous process

$$2\ Fe_2O_3(s) \rightarrow 4\ Fe(s) + 3\ O_2(g),\ \Delta_r G^{\Theta} = +1487\ kJ\ mol^{-1}$$

Show that the reduction of Fe_2O_3 by CO can be made spontaneous by coupling with the following reaction :

$$2\ CO\ (g) + O_2\ (g) \rightarrow 2\ CO_2\ (g),\ \Delta_r G^{\Theta} = -514\ kJ\ mol^{-1}$$ 2, 3

OR

(a) Define the following terms :

(i) Entropy

(ii) A spontaneous process

(b) Given below are the standard Gibbs energy changes for two reactions at 1773 K :

$C + O_2 \rightarrow CO_2 \quad : \quad \Delta_r G^{\ominus} = -380 \text{ kJ mol}^{-1}$

$2C + O_2 \rightarrow 2CO \; : \; \Delta_r G^{\ominus} = -500 \text{ kJ mol}^{-1}$

Discuss the possibility of reducing Al_2O_3 with carbon at this temperature. Given that :

$4Al + 3O_2 \rightarrow 2Al_2O_3 \quad : \quad \Delta_r G^{\ominus} = -22500 \text{ kJ mol}^{-1}$ 2, 3

26. (a) Assign reasons for the following :

(i) PbO_2 is a stronger oxidising agent than SnO_2.

(ii) In solid state PCl_5 behaves as an ionic species,

(iii) Aluminium chloride ($A1C1_3$) is very often used as a catalyst.

(b) What is the structural difference between orthosilicates and pyrosilicates ? 3, 2

OR

(a) Assign reasons for the following :

(i) The acid strengths of acids increase in the order

HF < HCl < HBr < HI

(ii) The lower oxidation state becomes more stable with increasing atomic number in Group 13.

(iii) H_3PO_2 behaves as a monoprotic acid.

(b) Draw the structures of the following compounds :

(i) SF_4

(ii) XeF_2 3, 2

27. (a) Answer the following questions briefly :

(i) What are reducing sugars ?

(ii) What is meant by denaturation of a protein ?

(iii) How is oxygen replenished in our atmosphere ?

(b) Define enzymes. 3, 2

OR

(a) Answer the following questions briefly :

(i) What are any two good sources of vitamin A ?

(ii) What are nucleotides ?

(iii) Give an example of simple lipids.

(b) How are carbohydrates classified ? 3, 2

Marking Scheme — Chemistry

General Instructions :

1. The Marking Scheme provides general guidelines to reduce subjectivity in the marking. The answers given in the Marking Scheme are suggested answers. The content is thus indicative. If a student has given any other answer which is different from the one given in the Marking Scheme, but conveys the same meaning, such answers should be given full weightage.
2. Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration - Marking Scheme should be strictly adhered to and religiously followed.
3. If a question has parts, please award marks in the right hand side for each part. Marks awarded for different parts of the question should then be totalled up and written in the left hand margin and circled.
4. If a question does not have any parts, marks be awarded in the left-hand margin.
5. If a candidate has attempted an extra question, marks obtained in the question attempted first should be retained and the other answer should be scored out.
6. No Marks to be deducted for the cumulative effect of an error. It should be penalized only once.
7. A full scale of marks 0-70 has to be used. Please do not hesitate to award full marks if the answer deserves it.

QUESTION PAPER CODE 56/1/1

EXPECTED ANSWERS/VALUE POINTS

1. 2 — 1

2. It is the excess pressure that must be applied to stop the passage of solvent molecules through a semipermeable membrane into the solution. — 1

3. n =3 / third order — 1

4. 2, 4–Dimethylpentan –3– one — 1

5. Because of **polar nature**, they are much more **strongly associated**. — 1

6. Pauli's exclusion principle: No two electrons in an atom can have the same set of four quantum numbers. — 1

If $n = 1, \ell = 0$ hence number of orbitals is one and total number of electrons $= 2n^2 = 2 \times 1^2 = 2$ — 1

OR

Aufbau principle: It states that the electrons in the ground state of an atom are filled in orbitals in order of their increasing energies. 1

Order of filling: 1s<2s<2p<3s<3p<4s<3d 1

7. (i) As $\Delta_r G° < 0$ which means it is negative.

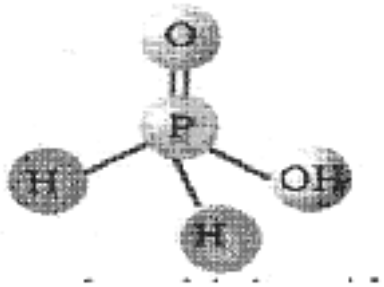
$\Delta_r G° = -2.303$ RT logK, 1

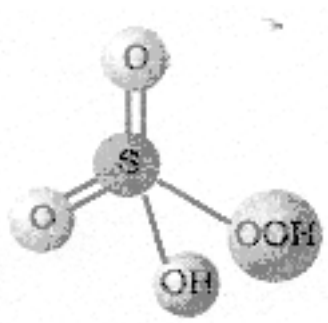
when $\Delta_r G°$ has negative value K is greater than 1 because log K must be positive. 1

8. (a) $2Al + 6HCl + 12H_2O \rightarrow 2[Al(H_2O)_6]Cl_3 + 3H_2$ 1

(b) $Sn + 2KOH + 4H_2O \rightarrow K_2[Sn(OH)_6] + 2H_2$ 1

9. (i) (ii) 1+1





10. (i) Geometrical

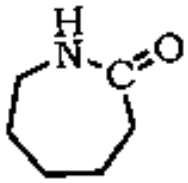
(ii) Structural 1+1

11. (i) It is due to the stability of the phenoxide ion/resonance stabilization of phenoxide ion 1

(ii) Due to the absence of hydrogen bonding in ethers / stronger hydrogen bonds in alcohols. 1

12. (i) $CH_2 = CHCl$ 1

(ii) 1



13. $N_2^+ = (\sigma 1s)^2(\sigma 1s^*)^2(\sigma 2s)^2(\sigma 2s^*)^2(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2pz)^1$ ½

$C_2^+ = (\sigma 1s)^2(\sigma 1s^*)^2(\sigma 2s)^2(\sigma 2s^*)^2(\pi 2px = \pi 2p_y^1)$ ½

$O_2^+ = (\sigma 1s)^2(\sigma 1s^*)^2(\sigma 2s)^2(\sigma 2s^*)^2(\sigma 2pz)^2(\pi 2p_x^2 = \pi 2p_y^2)(\pi 2p^{*1}_x = \pi 2p^{*1}_y)$ ½

Bond order : $N_2^+ = 2.5 \quad O_2 = 2 \quad C_2^+ = 1.5$ ½

Therefore bond length order is $C_2^+ > O_2 > N_2^+$ or $N_2^+ < O_2 < C_2^+$ 1

14. (i) Paramagnetism: due to the presence of unpaired electron, these materials are attracted by a magnetic field e.g. O_2,Cu^{2+},Fe^{3+} (any one) ½+½

(ii) Piezoelectric effect: The crystals where dipoles may align themselves in an ordered manner such that there is a net dipole moment in the crystal, show electrical conductivity on application of pressure e.g. lead zirconate, quartz, ammonium dihydrogen phosphate(any one) ½+½

(iii) Frenkel defect in crystals : In a Frenkel defect an ion leaves its position in the lattice and occupies an interstitial site e.g. AgCl, AgBr (any one) ½+½

15. $\Delta_r G° = \Delta_r H° - T\Delta_r S°$ ½

At 25°C or 298 K

$\Delta_r G° = +131.4 \text{kJ mol}^{-1} - (298\text{K} \times 0.134 \text{kJK}^{-1}\text{mol}^{-1})$

$= +91.47 \text{ kJ mol}^{-1}$ ½

Since $\Delta_r G°$ is positive, the reaction is not feasible

At 1000°C or 1273 K

$\Delta_r G° = +131.4 \text{ kJ mol}^{-1} - (1273\text{K} \times 0.134 \text{ kJ mol}^{-1})$ 1

$= -39.18 \text{ kJ mol}^{-1}$ ½

The reaction is feasible at 1000°C, Since $\Delta_r G°$ is negative.

(deduct ½ mark if correct units are not mentioned)

16. Molar mass of ethylene glycol = 62 g mol^{-1}

Number of moles of ethylene glycol = $\frac{222.6 \text{ g}}{62 \text{ g mol}^{-1}} = 3.59 \text{ mol}$

Molality of the solution = $\frac{222.6 \text{ g}}{62 \text{ g mol}^{-1}} \times \frac{1000}{200 \text{ kg}} = 17.95 \text{ m or } 17.95 \text{ mol kg}^{-1}$ 1

Mass of the solution 200g + 222.6g = 422.6 g

$\text{Volume} = \frac{\text{Mass of solution}}{\text{Density}} = \frac{422.6 \text{ g}}{1.072 \text{ gL}^{-1}} = 394.2 \text{ mL or } 0.3942 \text{ L}$ 1

$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution in litres}} = \frac{3.59 \text{ mol}}{0.394 \text{ L}} = 9.10\text{M or } 9.1 \text{ mol L}^{-1}$ 1

17. $2NH_3(g) \xrightarrow{Pt} N_2(g) + 3H_2(g)$

$$\frac{-d[NH_3]}{dt} = k[NH_3]^\circ = 2.5\times10^{-4}\,Ms^{-1}$$

$$-\frac{1}{2}\frac{d[NH_3]}{dt} = +\frac{d[N_2]}{dt} = +\frac{1}{3}\frac{d[H_2]}{dt}$$ 1

Rate of production of $N_2 = +\frac{d[N_2]}{dt} = -\frac{1}{2}\frac{d[NH_3]}{dt}$

$$= \frac{1}{2}\times(2.5\times10^{-4}\,Ms^{-1}) = 1.25\times10^{-4}\,Ms^{-1}$$ 1

Rate of production of hydrogen $= \frac{d[H_2]}{dt} = -\frac{3}{2}\frac{d[NH_3]}{dt}$

$$= \frac{3}{2}\times(2.5\times10^{-4}\ Ms^{-1})$$ 1

$$= 3.75\times10^{-4}\ Ms^{-1}$$

18. (i) Emulsification - The process of making an emulsion by mixing two liquids vigoursly is known as emulsification e.g. milk, vanishing cream, cold cream, butter etc. (any one) 1+½

(ii) Homogeneous catalysis – If the catalyst is present in the same phase as the reactant. The catalysis is called homogeneous catalysis 1

$$2CH_3CH_2OH(l) \xrightarrow{(conc)\ H_2SO_4(l)} C_2H_5 - O - C_2H_5(l) + H_2O(l)$$

$$2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$$

(or any other one example) ½

OR

Adsorption- The phenomenon of attraction and retention of the molecules of a substance on the surface of a liquid or a solid resulting into a higher concentration of the molecules on the surface is called adsorption. 1

Physisorption	Chemisorption
It usually takes place at low temperature and decreases with increasing temperature.	It takes place at relatively high temperatures.
It is not very specifiic i.e. all gases are adsorbed on all solids to some extent.	It is highly specific and takes place when there is some possibility of compound formation between the adsorbate and the adsorbent molecules
Multi Molecular layers may be formed on the adsorbent.	Usually mono-molecular layer is formed on the absorbent.

1+1

(any two)

(Or any other distinction)

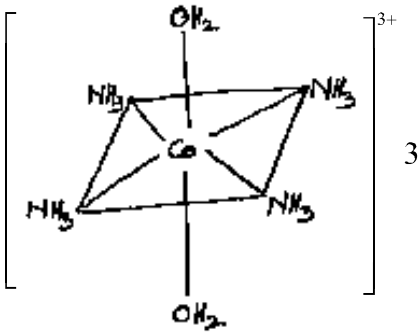
19. (i) Due to inert pair effect / the energy required to unpair the ns^2 electrons is not compensated by the energy released in forming the two additional bonds.

(ii) Due to strong hydrogen bonding in hydrogen fluoride.

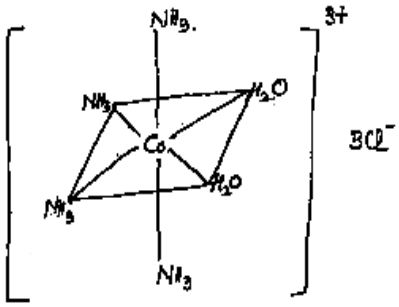
(iii) Due to lower bond energy of interhalogen compound. 1×3=3

20. (i) tetraamminediaquacobalt(III) chloride 1

structure



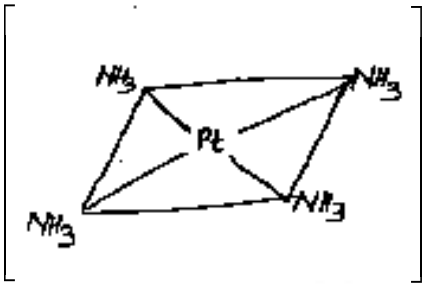
$3Cl^-$ or

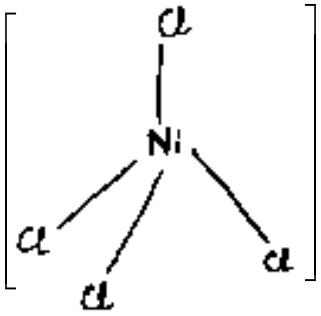


½

(ii) tetraammineplatinum (II) tetrachloronickelate (II) 1

structure





½

21. (i) $^{238}_{92}U$ is radioactive.

(ii) $^{206}_{82}Pb$ is stable.

(iii) 8α particles and $6\beta^-$ particles are produced.

(iv) The decay takes place in 14 steps.

(v) The equation corresponds to (4n+2) series.

(or any other) 1×3=3

22. (i) Propanal and propanone : On adding $NaOH+I_2$, propanone gives yellow ppt of Iodoform whereas propanal does not.

OR

On warming with Tollen's reagent, propanal forms silver mirror whereas propanone does not.

(or any other test)

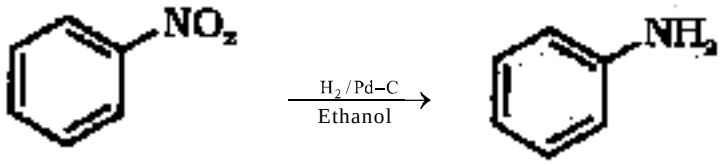
(ii) Methyl acetate and ethyl acetate: Ethyl acetate on hydrolysis gives ethanol which forms yellow ppt of Iodoform on adding NaOH+I_2. Methylacetate on hydrolysis gives methanol which does not give Iodoform reaction.

(iii) Benzaldehyde and benzoic acid: Benzoic acid gives effervescence with $NaHCO_3$ whereas benzaldehyde does not.

(or any other test) 1×3 = 3

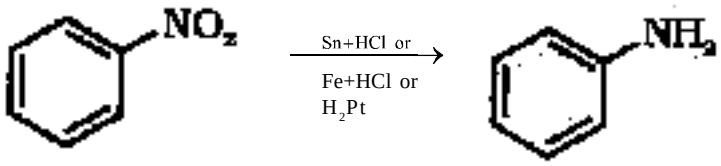
Note: Reagents, Conditions and products should be emphasized in each case.

23. (i)



1

OR



(ii) $RX + NH_3 \xrightarrow{OH^-} RNH_2$

$RNH_2 \xrightarrow{RX} R_2NH \xrightarrow{RX} R_3N \xrightarrow{RX} R_4N^+X^-$ 1

(iii) $ArNH_2 + NaNO_2 + HCl \xrightarrow{273-278} ArN_2^+Cl^- \xrightarrow{CuCN} ArCN$ 1

24. (i) Liquid N_2O_4 + Acrylic rubber. 1

(ii) These dyes are usually salts of sulphonic acids and can be applied to wool silk and nylon. 1

(iii) Sodium Benzoate or sodium metabisulphite 1

25. (a) (i) The stability increases with an increase in atomic number from Mn to Zn. Sc does not exhibit, Ti, V and Cr exhibit but are not stable. 1½

(ii) Corresponding to the highest oxidastion state (3d+4s) electrons, the stability of oxometal cations increases from Ti to Mn, therefore there is practically no oxometal cation. 1½

(b) (i) This is due to the incomplete filling of d-orbitals involved in their oxidation processes. 1

(ii) Due to the presence of unpaired electrons or d-d transition. 1

OR

(i) $2Na_2CrO_4 + 2H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$

$Na_2Cr_2O_7 + 2KCl \rightarrow K_2Cr_2O_7 + 2Na\,Cl$ 1

(ii) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$ 1

or

$MnO_4^{2-} \xrightarrow{\text{electrolytic oxidation in alkaline solution}} MnO_4^{2-}$

(or any other method)

(iii) (a) $HgCl_2 + Hg \rightarrow Hg_2Cl_2$ 1

or

$2HgCl_2 + SnCl_4 \rightarrow Hg_2Cl_2 + SnCl_2$

(b) The filling of 4f before 5d orbital results in a regular decrease in atomic radii called lanthanoid contraction. 1

Due to lanthanoid contraction the radii of the members of (5d) series are almost same as those of the corresponding members of the (4d) series which results into similarity in properties. 1

26. (a) The cell reaction : $Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$

$E^O_{cell} = E^O_{Cathode} - E^O_{anode} = [0.34 - (-2.37)]V = +2.71V$ 1

$E^O_{cell} = E^O_{cell} - \frac{0.059}{n}\log\frac{[Mg^{2+}]}{[Cu^{2+}]}$ 1

$E^O_{cell} = 2.71 - \frac{0.059}{2}\log\frac{0.1}{0.001}$

$E^O_{cell} = 2.71 - \frac{0.059}{2}\log 100$

$E^O_{cell} = 2.71 - 0.059 = 2.651\ V = 2.65V$ 1

(b) Strong electrolytes are the substances which almost completely dissociate into their ions in solution e.g. NaCl, KCl etc. ½+½

Weak electrolytes are the substances which partially dissociate into their ions in solution e.g., CH_3COOH ½+½

OR

$R = \rho(\ell/a)$

Cell constant $\ell/a = R/\rho = R\kappa$ 1

$= (1500\Omega) \times (0.146 \times 10^{-3} Scm^{-1})$ 1

$= 0.219\ cm^{-1}$ 1

(b) At cathode: H_2 gas is produced 1

At anode : O_2 gas is produced 1

27. (a) (i) Monosaccharides: eg. glucose, fructose (any one) ½+½

(ii) Oligosaccharides / Disaccharides : eg. sucrose, lactose, mannose (any one) ½+½

(iii) Polysaccharides: eg. starch, cellulose (any one) ½+½

(b) (i) Peptide linkage or – CO- NH- linkage 1

(ii) Ribosome / In the cytoplasm of the cell. 1

OR

(a) (i) Simple lipids (Homolipids) : e.g Natural fats / waxes. ½+½

(ii) Compound Lipids (Hetrolipids) – e.g Phospholopids / Glycolipids ½+½

(iii) Derived Lipids – fatty acids / fatty alcohols/ steroids / terpenes etc. ½+½

(b) (i) Mutarotation: The spontaneous change in specific rotation of an optically active compound is called mutarotation. 1

(ii) Avitaminosis: The deficiency of multiple vitamins leads to characteristic deficiency symptoms in humans. This condition of vitamin deficiency is known as avitaminosis 1

QUESTION PAPER CODE 56/1

EXPECTED ANSWERS/VALUE POINTS

1. 4 1

2. Reverse osmosis : pressure larger than osmotic pressure is applied on the solution side. 1

3. $\text{Rate} = -\frac{1}{3}\frac{d[H_2]}{dt}$ 1

4. Pentane –2, 4-dione 1

5. Due to the presence of lone pair of electrons on the nitrogen atom. 1

6. (a) $\lambda = \frac{h}{p}$, where h = Planck constant 1

(b) It measures the electron probability density at a point in an atom. 1

Or

It is impossible to determine simultaneously both the position and momentum of an object with certainty. 1

The principle is not of significance for macroscopic objects. This is because in the equation $\Delta v.\Delta x$ is extremely small when m is very large. 1

7. **Conductivity:** The conductivity of a solution at any given concentration is the conductance of unit volume of solution kept between two platinum electrodes with unit area of cross section and at a distance of unit length. 1

Molar conductivity: It can be defined as the conductance of the solution of an electrolyte kept between the electrodes of a conductivity cell at unit distance but area having cross section large enough to accommodate sufficient volume of solution that contains one mole of the electrolyte. 1

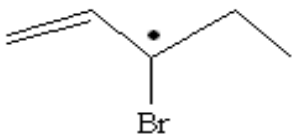
8. (i) Due to sterically protected sulphur atom. 1

(ii) Because Xe is with the lowest ionization enthalpy among the rest (except Rn which is radioactive). 1

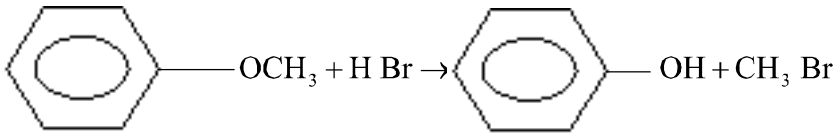
9. No, Ti^{2+} cannot oxidize Fe^{2+} to Fe^{3+}. 1

Due to lower standard reduction potential of Ti^{4+} / Ti^{3+} when compared with Fe^{+3} / Fe^{+2} 1

10. **Chiral objects:** Objects which are non-superimposable on their mirror images are said to be chiral 1



11. (i) $CH_3CH = CH_2 \xrightarrow{H_2SO_4} CH_3\underset{\underset{OSO_2OH}{|}}{CH}CH_3 \xrightarrow{H_2O} CH_3 - \underset{\underset{OH}{|}}{CH} - CH_3$ 1

(ii)  1

12. (i) $CH_2 = CH_2$ 1

(ii) $CF_2 = CF_2$ 1

13. Bond order is defined as one half the difference between the number of electrons present in the bonding and the antibonding orbitals. 1

$O_2 : (\sigma 1s)^2 (\sigma 1s^*)^2 (\sigma 2s)^2 (\sigma 2s^*)^2 (\sigma 2pz)^2 (\sigma 2p^2_x = \sigma 2p^2_y) (\sigma 2p^{*\,1}_x = \sigma 2p^{*\,1}_y)$ ½

Bond order = ½ (10-6) = 2 ½

Due to the presence of 2 unpaired electrons, it is paramagnetic 1

14. (i) Due to presence of free electrons on doping phosphorus 1

(ii) Due to the presence of holes or vacancies in the solid 1

(iii) Because of some crystallization in that region 1

15. $\Delta T_f = K_f m$ ½

$$K_f = \frac{\Delta T_f}{m} = \frac{2.15\ K}{0.1539\ m} = 13.97\ K\ kg\ mol^{-1}$$ ½

No. of moles of glucose $= \frac{5}{180}$ moles

Molality of glucose $= \frac{5}{180} \times \frac{1000}{95} = 0.292\ m$ ½

$\Delta T_f = K_f m$

$= 13.97\ K\ kg\ mol^{-1} \times 0.292\ mol\ kg^{-1}$

$= 4.07\ K$ ½

Freezing point of solution = $(273.15 - 4.07)K = 269.08\ K$ 1

16. $E^O = -0.40V - (-0.74)V = 0.34V$ 1

Number of electrons involved = 6 mol ½

$\Delta_r G^O = -n\ FE^O$ ½

$= -6 \times (96500C\ mol^{-1}) \times 0.34V$

$= -196.86\ kJ\ mol^{-1}$ 1

17. $t = \frac{2.303}{k} \times \log \frac{[A]_0}{[A]_t}$ 1

$= \frac{2.303}{60s^{-1}} \times \log \frac{1}{1/10}$ 1

$= 0.038s$ or $3.8 \times 10^{-2} s$ 1

18. (a) (i) **Multimolecular colloids:** When a large number of atoms or smaller molecules of a substance aggregate together to form species having size (with diameters less than 1nm) in the colloidal range are called multimolecular colloids. e.g. a gold sol, sulphur sol 1+½

(ii) **Macromolecular colloids:** When the size of the macromolecules may be in the colloidal range such systems are called macromolecular colloids. e.g. starch, cellulose, proteins, enzymes 1+½

OR

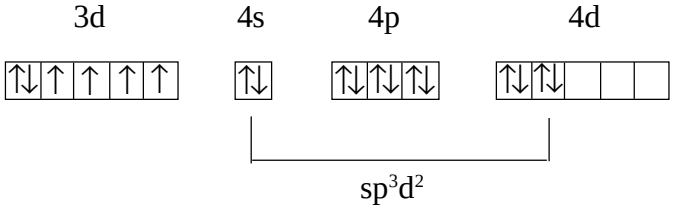
(i) **Shape-Selective catalysis:** The catalytic reaction that depends upon the pore structure of the catalyst and the size of the reactant and product molecules is called shape-selective catalysis e.g. zeolites 1+½

(ii) Dialysis: Removal of soluble impurities from sols by a semipermeable membrane is known as dialysis. e.g. ferric hydroxide sol is purified by this method. 1+½

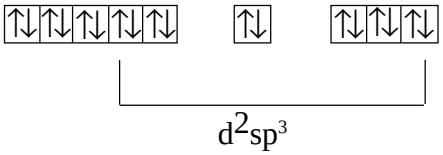
19. (i) Because of strong metallic bonds / they have stronger interatomic interaction. 1½

(ii) Because they are capable of exhibiting variables oxidation states and forming complex. 1½

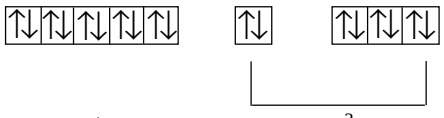
20. (i) sp^3d^2 - Paramagnetic (Octahedral) ½+½+½



(ii) d^3sp^3 - Diamagnetic (Octahedral) ½+½+½



(iii) sp^3 - Paramagnetic (Tetrahedral)



(any two)

21. $^{239}_{94}Pu + ^{4}_{2}He \rightarrow ^{243}_{47}X + ^{}_{-1}e^{0}$

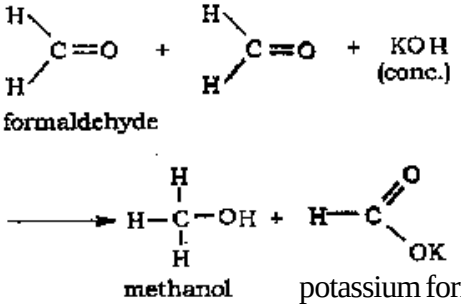
$^{209}_{83}X + ^{4}_{2}He \rightarrow ^{211}_{85}At + 2^{1}_{0}n$

$^{246}_{96}Cm + ^{12}_{6}C \rightarrow ^{254}_{102}X + 4^{1}_{0}n$ 1×3 = 3

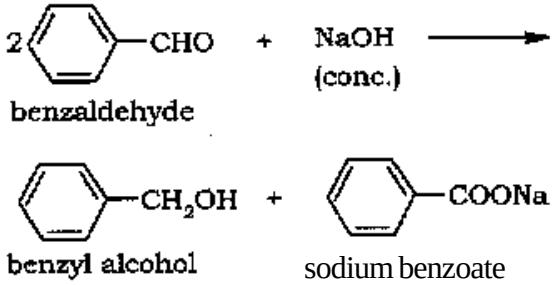
22. (i) Rosenmund Reduction : 1

$$RCOCl + H_2 \xrightarrow[\text{quinololine sulphur}]{Pd/BaSO_4} RCHO + HCl$$

(ii) Cannizzaro reaction: 1



OR



(iii) Fischer esterification 1

$$RCOOH + ROH \xrightarrow{H^+} RCOOR + H_2O$$

23. (i) Due to the presence of lone pair of electrons on nitrogen of amines they are basic in nature whereas nitrogen of amides acquire positive charge due to resonance with carbonyl group which makes it neutral. (or structural representation)

(ii) Because of the polar nature of nitro compounds leading to stronger interactions due to dipole- dipole interactions.

(iii) Due to resonance in aromatic amines nitrogen acquires positive charge which decreases its basic character whereas there is no resonance in aliphatic amines. (or structural representation)

(any two) 1½×2 = 3

24. (a) Mordant dye: These dyes are primarly used for dyeing of wool in the presence of metal ions. e.g. Alizarin

(any one) 1

Detergent: Detergents are sodium salts of long chain sulphonic acid or sulphonates. e.g. sodium alkyl benzene sulphonates

(any one) 1

(b) Liquid O_2, Nitrogen, Nitrogen tetraoxide or nitric acid as an oxidiser. Kerosene, alcohol, hydrazine, liquid hydrogen as fuel
(any one) 1

25. (a) $\Delta S_{total} = \Delta S_{system} + \Delta S_{surroundings}$

$\Delta S_{surroundings} = \Delta H_{surroundings} / T = -\Delta H_{system} / T$

Therefore,

$$\Delta S_{system} + \left(-\frac{\Delta H_{system}}{T} \right) = \Delta S_{total}$$

If we multiply this equation theoughout by T, we have

$$T\Delta S_{system} + (-\Delta H_{system}) = T\Delta S_{total}$$

or $\Delta H_{system} - (T\Delta S_{system}) = -T\Delta S_{total}$

Therefore $\Delta G_{system} = -T\Delta S_{total}$ 2

(b) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

For coupling, it may be written as

$2Fe_2O_3 + 6CO \rightarrow 4Fe + 6CO_2$ 1

$\Delta_r G^\circ = [+1487 + 3 \times (-514)]$ kJ mol^{-1}

$= -55$ kJ mol^{-1} 1

With $\Delta_r G^\circ$ having negative value the reduction of Fe_2O_3 can be made spontaneous. 1

OR

(a) (i) Entropy: is a measure of disorder or randomness of the system

(ii) A spontaneous process: is a process which takes place on its own without the help of any external agency.

(b) Considering the reduction of Al_2O_3 with the two reactions-

$= Al_2O_3 + 6C \rightarrow 4Al + 6CO$

$\Delta_r G^\circ = 22500 + (-1500) = +21000$ kJ mol^{-1} 1

$Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$

$\Delta_r G^O = [22500 + 3 \times (-380)]$ kJ mol^{-1}

$\Delta_r G^\circ = +21360$ kJ mol^{-1} 1

In either case Al_2O_3 cannot be reduced 1

26. **(**a) (i) Because Pb^{4+} changes to more stable Pb^{2+} whereas Sn^{4+} is more stable than Sn^{2+} due to inert pair effect.

(ii) Due to the formation of $[PCl_4]^+ [PCl_6]^-$.

(iii) Because $AlCl_3$ is a lewis acid / electron deficient. 1×3 = 3

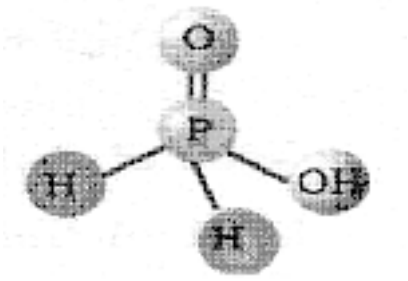
(b) Orthosilicates contain discrete SiO_4 tetrahedral units to form $Si_2O_7^{-6}$ whereas in pyrosilicates two tetrahedral SiO_4 units are joined sharing a common oxygen atom.

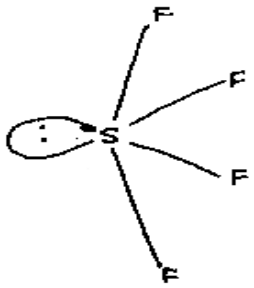
OR

(a) (i) Due to decrease in bond energy from HF to HI

(ii) Due to inert pair effect / the energy required to unpair the ns^2 electrons is not compensated by the energy released in forming the two additional bonds.

(iii) Due to the presence of one ionizable hydrogen atom. 1×3 = 3



(b) 

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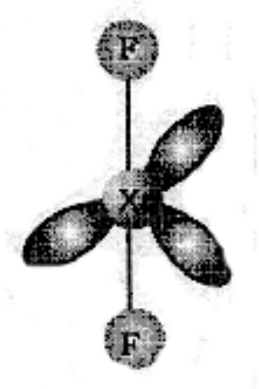

1

27. (a) (i) Reducing sugars : are the sugars which contains free aldehydic or ketonic group and reduce Fehling's solution and Tollen's reagent.

(ii) Denatured protein: If a native protein is subjected to physical or chemical treatment which may disrupt its higher structures withoutout affecting its primary structure, the protein is said to be denatured and it loses its biological activity.

(iii) By photosynthesis $1\times3 = 3$

(b) Enzymes: are the biological catalysts which increase the rate of metabolism and they are highly specific in nature. 2

OR

(a) (i) Green vegetables, fish oil, rice polishing, liver, kidney ***(any two)***

(ii) Nucleotides: A nucleotide is a phosphate ester of nucleoside.

(iii) Neutral fats / waxes/ tripalmitin / tristearate / trioleate ***(any one)*** $1\times3 = 3$

(b) Carbohydrates are classified into three categories: monosaccharides, oligosaccharides / disaccharides, polysaccharides. 2