SUBJECT : CHEMISTRY (SET-I)

Time : 3 Hrs. **M.M.: 70**

General Instructions :

i) All questions are compulsory.

ii) Question numbers 1 to 8 are very short answer type questions carrying 1 mark each.

iii) Question numbers 9 to 18 are short answer type questions carrying 2 marks each.

iv) Question numbers 19 to 27 are also short answer type questions carrying 3 marks each.

v) Question numbers 28 to 30 are long answer type questions carrying 5 marks each.

vi) Use log tables, if necessary. Calculators are not permitted.

Q1. Predict the position of the element in the periodic table having electronic configuration $(n-1)\,d^5ns^2$ for n = 5.

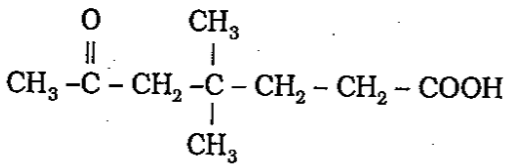
Q2. Find out total numbers of electrons present in one mole of methane.

Q3. How many electrons will be present in the subshells having m_s value of $\frac{-1}{2}$ for n = 4?

Q4. In terms of Charle's law explain why –273°C is the lowest possible temperature?

Q5. Find out the oxidation number of the underlined element in KAI $(\underline{SO_4})_2$.

Q6. Write the IUPAC name of the following organic compound :



Q7. What will be the conjugate bases for the following Bronsted acids : HF, HCO_3^-?

Q8. Explain the state of a chemical reaction when

(i) $\Delta G = 0$ (ii) $\Delta G > 0$

Q9. Calculate the number of KJ of heat necessary to raise the temperature of 60.0g of aluminium from 35°C to 55°C. Molar heat capacity of aluminium is 25J mol^{-1} K^{-1} [molar mass of Al = 27g].

OR

With the help of Born-Haber cycle, construct an enthalpy diagram to calculate the lattice enthalpy of NaCl.

Q10. The mass of an electron is 9.1×10^{-31} kg. If its kinetic energy is 3.0×10^{-25} J. Calculate its wavelength.

Q11. Molarity of H_2SO_4 is 0.8M and its density is 1.06g cm^{-3}. What will be the concentration of the solution in terms of molality?

Q12. Give reasons :

(a) Cis isomer has higher boiling point than its trans isomer.

(b) Branched isomer of n-alkane has lower boiling point.

Q13. Balance the following reaction in acidic medium :

$MnO_4^- + Fe^{+2} \rightarrow Mn^{+2} + Fe^{+3}$

Q14. Beryllium shows some similarities with aluminium. Point out four such properties.

Q15. Draw the bond line structural formula of the following molecules :

(a) Hexanedial

(b) 2, 4 – Dimethyl pentane.

Q16. What happens when :

(a) BF_3 is reacted with NH_3?

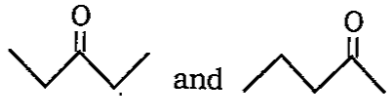
(b) Borax is heated strongly?

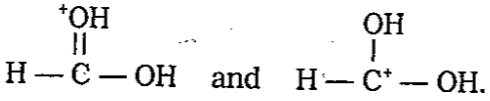
Q17. A compound containing carbon, hydrogen and oxygen, gave the following analytical data :

C = 40.0% H = 6.67% and O = 53.33%.

Calculate the molecular formula of the compound if its molecular mass is 180u.

Q18. What is the relationship between the members of the following pairs of structures? Are they structural or geometrical isomer or resonance contributors?

(a)  and

(b)  and .

Q19. Give reasons :

(a) Noble gases have positive electron gain enthalpy.

(b) First ionization enthalpy of Be is higher than that of B.

(c) Metallic character increases down the group.

Q20. Calculate the enthalpy of combustion of glucose from the following data :

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\quad \Delta_c H^o = -393 \text{ KJ mol}^{-1}$

$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(g)}$ $\quad \Delta_c H^o = -269.4 \text{ KJ mol}^{-1}$

$6C_{(s)} + 6H_{2(g)} + 3O_{2(g)} \rightarrow C_6H_{12}O_{6(s)}$ $\quad \Delta_f H^o = -1169.8 \text{ KJ mol}^{-1}$

Q21. (a) What do you mean by Biochemical Oxygen Demand (BOD)?

(b) What are the consequences of Ozone hole?

Q22. Explain the following giving example of each :

(a) Friedal Crafts alkylation

(b) Kharasch effect

(c) Kolbe's electrolytic reaction.

Q23. What causes permanent hardness of water? Explain the method of softening of hard water by synthetic ion exchange resins (permutit process).

Q24. Explain the following :

(a) A solution of Na_2CO_3 is alkaline.

(b) Lithium is the only alkali metal to form a nitride directly.

(c) Mg^{2+} ion is mere hydrated than Na^{+} ion.

Q25. What are the frequency and wavelength of a photon emitted during a transition from n = 5 state to the n = 2 state in the hydrogen atom.

OR

(a) State Heisenberg's uncertainty principle.

(b) Write the electronic configuration of Cr atom. Why are half filled orbitals more stable? Explain.

Q26. On a hot summer day, Amit and his friend Rohit went to petrol pump to get his car's tyre filled with air. He observed that the man who was pumping air did not inflate the tyres completely and took his charges. Amit argued with the man to inflate the tyres completely. Then his friend Rohit explained him the reason for that man's act.

Read the above passage and answer the following questions :

(a) What do you think that Rohit would have explained to Amit?

(b) Name the gaseous law involved in this.

(c) Also write the value associated with the above passage.

Q27. Comment on the following observations :

(a) Diamond is covalent yet it has high melting point.

(b) Pb (II) compounds are more stable than Pb (IV) compounds.

(c) Boron is unable to form BF_6^{3-} ion.

Q28. (a) Draw the shape of the following molecules using VSEPR model :

(i) SF_4 (ii) NH_3

(b) If B-Cl bond has a dipole moment, explain why BCl_3 molecule has zero dipole moment.

(c) Describe the change in hybridisation (if any) of the Al atom in the following reaction :

$AlCl_3 + Cl^- \rightarrow AlCl_4^-$

OR

(a) Compare the relative stability of the following species and indicate their magnetic properties :

N_2 , N_2^+ and N_2^-

(b) Describe the hybridisation in case of PCl_5. Why are the axial bonds larger as compared to equatorial bonds?

Q29. (a) An alkene 'X' on ozonolysis gives a mixture of butan-2-one and propanone. Write structure and IUPAC name of 'X'.

(b) Arrange ethene, ethane and ethyne in decreasing order of acidic behaviour. Also give reason for your answer.

(c) Draw the Newman projections of ethane in eclipsed and staggered form.

OR

(a) Draw the resonating structures for $C_6H_5NO_2$.

(b) Carry out the following conversions :

(i) Benzene to p-nitrotoluene

(ii) Benzene to benzophenone

(iii) Propyne to propanone.

Q30. (a) The concentration of hydrogen ion in a sample of soft drink is 3.8×10^{-3} M, What is its pH?

(b) Calculate the solubility of A_2X_3 in pure water, assuming that neither kind of ion reacts with water. The solubility product of A_2X_3, $K_{sp} = 1.1 \times 10^{-23}$.

OR

(a) Describe the effect of :

(i) increasing the pressure

(ii) using a catalyst

on the equilibrium of the reaction :

$2H_{2(g)} + CO_{(g)} \rightleftharpoons CH_3OH_{(g)}$

(b) A mixture of 1.57 mol of N_2 1.92 mol of H_2 and 8.13 mol of NH_3 is introduced into a 20L reaction vessel at 500 K. At this temperature, the equilibrium constant K_c for the reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ is 1.7×10^2. Is the reaction mixture at equilibrium? If not, what is the direction of the net reaction?