March 2023

APPLIED CHEMISTRY

Time Allowed: 2.5 Hours *Full Marks: 60*

Answer to Question No. 1 of Group A is compulsory and to be answered first. This answer is to be made in separate loose script(s) provided for the purpose. Maximum time allowed is 30 minutes, after which the loose answer scripts will be collected and fresh answer scripts for answering the remaining part of the question will be provided. On early submission of answer scripts of Question No. 1, a student will get the remaining script earlier.
Answer any Five (05) Questions from Group B.

Group A

1. Choose the correct answer from the given alternatives (any twenty): 1x20

i) The hybridization of B atom in BF_3 is (a) sp (b) sp^2 (c) sp^3 (d) sp^3d.

ii) Photovoltaic cell is also known as (a) storage cell (b) solar cell (c) dry cell (d) all of them.

iii) he mass percentage (m/m)% of NaOH solution, prepared by dissolving 5 gm of NaOH in 45 gm of water is- (a) 10% (b) 11.11% (c) 0.11% (d) none of them

iv) Permissible limit of As in the absence of alternate source in drinking water is- (a) 0.01 ppm (b) 0.5 ppm (c) 0.05 ppm (d) 0.1 ppm.

v) Unit of electrochemical equivalence is- (a) gm (b) Coulomb (c) gm/Coulomb (d) Coulomb/gm.

vi) Ultimate analysis is used to determine the % of- (a) C, H, S, moisture and volatile matter (b) moisture and volatile matter (c) C, H, N, S, O (d) ash content in a coal sample.

vii) Al is extracted from alumina through- (a) electrolytic reduction method (b) C reduction method (c) self-reduction method (d) all of them.

viii) pH of 0.01 (N) NaOH solution is (a) 2 (b) 10 (c) 7 (d) 12

ix) Hydrodynamic lubrication is used in (a) watches (b) tractors (c) lathe machines (d) rail axles.

x) The structure of $BeCl_2$ is (a) trigonal planar (b) tetrahedral (c) pyramidal (d) linear.

xi) Carborundum is (a) B_4C (b) SiC (c) Al_4C_3 (d) CaC_2.

xii) Which of the following is not a step for Municipal Water treatment? (a) Sedimentation (b) filtration (c) H_2 liberation (d) Sterilization.

xiii) Calamine is an ore of- (a) Zn (b) Mg (c) Ca (d) None of these.

xiv) Polystyrene is an example of (a) homopolymer and thermoplastic (b) copolymer and thermoplastic (c) homopolymer and thermosetting plastic (d) copolymer and thermosetting plastic

xv) The number of lone pair present in H_2O molecule is (a) 0 (b) 1 (c) 2 (d) 3.

xvi) To coat Cu on Fe in an electroplating process, the cathode, the anode and the electrolyte will be respectively (a) Cu, Fe, $CuSO_4$ (b) Fe, Cu, $CuSO_4$ (c) Cu, Fe, $FeSO_4$ (d)Fe, Cu, $FeSO_4$

xvii) The property by virtue of which a lubricating oil sticks to a surface is known as (a) viscosity index (b) oiliness (c) cloud point (d) saponification value

xviii) The process of protecting a metal from corrosion by connecting it with a more active metal is known as (a) Sherardizing (b) Electroplating (c) Cathodic Protection (d) Cathodic Inhibitors

xix) The Zeolite bed is revived by passing (a) 10% HCl (b) 10% NaCl (c) 10% Cl_2 (d) 10% $CaCl_2$.

xx) Composition of water gas is (a) $CO + N_2$ (b) $CO + H_2$ (c) $CH_4 + CO_2$ (d) $CH_4 + H_2$.

xxi) Number of electrons present in d orbital of Fe^{3+} ion is (a) 4 (b) 5 (c) 6 (d) 7

xxii) Which of the following is not a vulcanizing agent? (a) S (b) SO_2 (c) SiO_2 (d) S_2Cl_2.

xxiii) NH_4Cl has (a) ionic bonding (b) covalent bonding (c) coordinate bonding (d) all three of them.

xxiv) Oxidation number of Cl in Cl_2 is (a) -1 (b) 0 (c) +1 (d) none of these.

xxv) Which one is an example of buffer solution (a) NH_4Cl+NaOH (b) NaOH + NaCl (c) $NH_4Cl + CH_3COOH$ (d) $NH_4Cl + NH_4OH$.

Group B

2. a) Find out the values of four quantum numbers for 12th electron of $_{13}Al$
   b) State with example Hund's rule of maximum multiplicity.
   c) Write down the electronic configuration of $_{24}Cr$ and $_{17}Cl$ (4+2+2)

3. a) Explain why graphite is good conductor of electricity but diamond is bad conductor of electricity.
   b) Why ice is lighter than water?
   c) A solution is prepared by dissolving 1.11 gm of $CaCl_2$ in 18 gm of H_2O. Calculate the mole fraction of $CaCl_2$ and H_2O? (At. Wt. of Ca =40, Cl = 35.5, H=1, O=16) (3+2+3)

4. a) What is the reason of hardness of water?
   b) Why is hard water not used in boiler?
   c) Calculate the total hardness of a sample of water which contains 16.2 mg of $Ca(HCO_3)_2$, 14.6 mg of $Mg(HCO_3)_2$, 11.1 mg of $CaCl_2$,, 9.5 mg $MgCl_2$ and 12 mg of $MgSO_4$ and 5.85 mg NaCl in 1 L of water. Also calculate the amount of temporary and permanent hardness of water. (At.Wt. of Ca = 40, Mg =24, Cl = 35.5, S = 32, H = 1, C = 12, O =16, Na = 23) (1+2+(3+1+1))

5. a) How water is softened using Ion Exchange process? (Write only chemical reactions)
   b) Why excess soap is required to produce lather using hard water?
   c) 10 ml of 0.01 (M) [0.02(N)] EDTA solution is required to neutralize the hardness of 50 ml sample water. Find the hardness of sample water. [Eqv. Wt. of $CaCO_3$= 50] (3+2+3)

6. a) Write down names of monomers and 2 uses of following polymers (i) Nylon 6 (ii) Bakelite
   b) What is vulcanisation of rubber?
   c) How does gypsum retard the setting time of Portland Cement? ((2×2)+2+2)

7. a) Write down the name and chemical formula of 1 ore of Cu. Write down the chemical reactions related to extraction of iron from haematite ore in blast furnace.
   b) Give one example each of ferrous alloy and non-ferrous alloy and write 1 use of each of them
   c) How the impure Cu is purified by electrorefining method? ((1+3)+(1+1)+2)

8. a) Classify lubricants with examples.
   b) How will you determine the % of C and % moisture content of a coal sample?
   c) Define Octane Number. (3+(2+2)+1)

9. a) Write the electrodes, electrolytes and chemical reactions for dry cell.
b) What is the actual reason behind the corrosion of a metal?
c) Define flash point and fire point of a lubricating oil. Mention the name of a solid lubricant.
(3+2+(2+1))

10. a) State Faraday's laws of Electrolysis.
b) How long it will take for 5 amperes of current to deposit 0.12 gm of Mg from $MgCl_2$ solution? (At. Wt. of Mg = 24, F= 96500 Coulomb)
c) Calculate the oxidation numbers of 2 N atoms in NH_4NO_3. (3+3+2)