JANUARY 2025

APPLIED CHEMISTRY

Time Allowed: 3 Hours *Full Marks: 60*

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer.
Answer *any Five* (*05*) Questions from Group-B.

GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (*any ten*): 2×10=20

i. Number of sub-shells present in M-shell is (a) 2 (b) 3 (c) 4 (d) 5

ii. pH of 0.01(M) H_2SO_4 solution is (a) 2 (b) 0.1 (c) 1.7 (d) 0.01

iii. 1 ppm is equal to (a) 10^6 mg/L (b) 1gm/L (c) 10 mg/L (d) 1mg/L

iv. In the ground state, an element has 13 electrons in the M-shell, the element is - (a) Chromium (b) Iron (c) Nickel (d) Copper

v. Distilled water contains (a) only H^+ & OH^- ions (b) dissolved gases only (c) Na^+ & Cl^- ions only (d) micro organic bodies only

vi. Which element is not suitable to form H-bond? (a) Cl (b) F (c) O (d) C

vii. During the metal extraction from ore, froth flotation process is performed for (a) Sulphide ore (b) Carbonate ore (c) Oxide ore (d) Sulphate ore

viii. Proximate analysis of coal involves the estimation of % of (a) carbon, hydrogen, ash (b) moisture content, volatile matter, ash, free carbon (c) moisture content (d) volatile matter, free carbon.

ix. Which of the following is not a characteristic property of good lubricant? (a) high volatility (b) high thermal stability (c) high oiliness (d) high viscosity index

x. Setting and hardening of cement involves (a) hydrolysis and neutralization (b) hydration and neutralization (c) hydration and hydrolysis (d) dehydration and hydrolysis.

xi. The synthesis of which of the following polymers require the loss of water molecules on a regular basis? (a) Polythene (b) Buna-N (c) Nylon-6,6 (d) Buna-S

xii. The chemical added to detect leakage from LPG cylinder is (a) TEL (b) iso-octane (c) iso-butane (d) ethyl mercaptan

xiii. The amount of electricity required to produce 12 gm of O_2 at respective electrode from acidulated water is— (a) 1 F (b) 2 F (c) 1.5 F (d) 0.5 F

xiv. Oxidation number of O in H_2O_2 is (a) -2 (b) $+2$ (c) -1 (d) $+1$

xv. Octane number of petrol is calculated considering the percentage of (a) Isoprene (b) iso-octane (c) n-hexadecane (d) iso-butane.

GROUP-B

2. (a) How hydrogen atomic spectra can be explained from Bohr model?
(b) State Hund's rule of maximum multiplicity and explain it with proper example.
(c) Find all the quantum numbers of the last two electrons of O^{2-} ion. (2+3+3)

3. (a) Explain why ethyl alcohol has higher boiling point than dimethyl ether though they have same molecular formula.
(b) Mention two structural differences between graphite and diamond.
(c) Hybridisation of N is same in both NH_4^+ ion and NH_3 molecule although geometry of NH_4^+ ion is regular tetrahedral but NH_3 molecule is distorted tetrahedral. Explain why?
(3+2+3)

4. (a) Why hard water does not produce lather easily on mixing with soap?
(b) Write down the principal and chemical reaction involved in resin process of softening of hard water.
(c) An exhausted zeolite softner was regenerated by carefully passing 117 litres of NaCl solution having strength 50 gm/lit of NaCl. If hardness of water is 500 ppm, calculate the total volume of water softened by this softner. [Given; Mol.Wt. of NaCl and $CaCO_3$ are 58.5 and 100 respectively.] (2+3+3)

5. (a) Explain with chemical reaction setting and hardening of Portland cement.

(b) Classify lubricants with proper example.

(c) Explain the statement-'octane number of a sample gasoline is 60'.

(3+3+2)

6. (a) Define calcinations and roasting.

(b) Why cryolite is added during extraction of Al from Al_2O_3?

(c) State the composition of producer gas and bio gas.

(d) What is vulcanisation of rubber? (2+2+2+2)

7. (a) Mention the reaction occurring in blast furnace during iron extraction.

(b) Explain electrolytic refining of copper metal.

(c) Describe the principal of cathodic protection. (3+3+2)

8. (a) A current of 2.5 A is passed through two electrolytic cells containing ZnSO4 and NiSO4 solution for an hour. Find the ratio of the masses of zinc to nickel deposited at the respective electrodes. [At. Wt. of Zn and Ni are 65 & 59 respectively].

(b) Establish the relation between equivalent weight and electrochemical equivalent weight.

(c) Mention the electrodes used in a dry cell and write down the chemical changes take place at different electrodes in a dry cell? [3+2+(1+2)]

9. (a) Calculate the pH of 10^{-8}(M) HCl solution.

(b) What is buffer solution? Give one example of acidic buffer.

(c) A high strength brass alloy consists of 70% Cu, 25% Zn and 5% Fe. Find the mole fraction of each metal component. [Assume Mol Wt. Of Cu, Zn & Fe are 63.5, 65 and 56]

[3+(1+1)+3]