PH.D./M.PHIL. COMMON ENTRANCE TEST MODEL QUESTION PAPER

PART B

Subject: Chemistry
Max Marks: 45

SECTION A

A. Answer all the following: 15 x 2 = 30 marks

1. Electronegativity is the
   (a) energy required by an atom to gain an electron. 
   (b) attraction force exerted by an atom on a bonding pair of electrons. 
   (c) attraction between the nucleus of an atom and its valence electrons. 
   (d) ability of an atom to pull off an electron from another atom.

2. Observe the following statements about NaCl crystal structure
   A. Each Na⁺ ion is surrounded by six Cl⁻ ions. 
   B. The Cl⁻ ions are arranged octahedrally around each Na⁺ ion. 
   C. The NaCl lattice structure is cubic.

   Choose the correct statements from the following
   (a) A and B
   (b) A and C
   (c) C and B
   (d) All the three

3. Which of the following compounds have sp and sp³ hybridized orbitals in carbon atoms
   (i) cyclohexane, (ii) toluene, (iii) propyne, and (iv) 1,2-butadiene?

   (a) (i) and (iii)
   (b) (iii) and (iv)
   (c) (ii) and (iii)
   (d) (ii), (iii) and (iv)

4. The rate of a chemical reaction doubles for every 10°C rise in temperature. If the temperature is raised by 50°C, the rate of the reaction increases by

   (a) 64 times
   (b) 10 times
   (c) 24 times
   (d) 32 times
5. The standard reduction potentials of \( \text{Mg}^{2+} \), \( \text{Sn}^{2+} \), and \( \text{Zn}^{2+} \) are -2.37 V, -0.14 V and -0.76 V, respectively. If the corresponding metals are treated with dil. \( \text{H}_2\text{SO}_4 \), the order of rate of liberation of hydrogen gas will be

(a) Sn > Zn > Mg
(b) Mg > Zn > Sn
(c) Zn > Mg > Sn
(d) Mg > Sn > Zn

6. Which of these compounds would produce ammonia when heated with alcoholic \( \text{NaOH} \) solution: (i) benzonitrile, (ii) benzamide, (iii) aniline?

(a) (i) only
(b) (ii) and (iii)
(c) (i) and (ii)
(d) all three of them

7. Which of the following would form benzenediazonium chloride (Ph-\( \text{N}_2 \)\(^+\)Cl\(^-\)), when treated with sodium nitrite and dil. \( \text{HCl} \)?

(a) Ph-CONH\(_2\)
(b) Ph-NH-NH\(_2\)
(c) Ph-NH\(_2\)
(d) Ph-NO\(_2\)

8. Which of the following compounds shows a strong IR peak around 2100 cm\(^{-1}\)?

(a) 1-Butyne
(b) 2-butyne
(c) Butanoic acid
(d) Ethyl butanoate

9. The mobile phase in any chromatographic analysis can be

(a) gas or liquid
(b) solid or liquid
(c) liquid only
(d) gas only

10. The work done by a closed system in a reversible process is --------- that done in an irreversible process.

(a) either less or more than
(b) more than
(c) less than
(d) equal to

11. The oxidation state of the metal atom in the complex \( \text{NH}_4[\text{Cr(NH}_3)_2\text{(NCS)}_4] \) is

(a) +6  (b) +5  (c) +4  (d) +3
12. *The current year (2019) is celebrated as the Year of Periodic Table to commemorate the*

(a) centenary of its first publication by Mendeleev.
(b) bicentenary of Mendeleev’s birthday.
(c) death centenary of Mendeleev.
(d) sesquicentenary of its first publication by Mendeleev.

13. *The two elements that were synthesized before they were discovered in nature are*

(a) technetium and promethium.
(b) radium and polonium.
(c) neptunium and plutonium.
(d) scandium and germanium (which Mendeleev called eka-boron and eka-silicon).

14. *A nucleophile is a species that attacks*

(a) a nucleus in the reactant.
(b) an electron deficient location in the reactant.
(c) only the positively charged centre in the reactant.
(d) any easily removable functional group in the reactant.

15. *Which of the following compounds can exist as optical isomers:*

(i) CH=C=CHCl, (ii) Ph-CH(NH₂)-COOH, (iii) 4-NH₂-C₆H₄-COOH, and (iv) tartaric acid?

Choose the correct answer from the following
(a) all the four
(b) (i), (ii) and (iv)
(c) (ii) and (iv) only
(d) (iv) only

**SECTION B**

B. **Answer any three of the following questions**  

3 x 5 = 15 marks

1. Describe hapticity (η) with examples of suitable organometallic complexes.
2. Describe hydroboration of styrene to get 2-phenylethanol and give its mechanism.

**OR**

Explain the kind of isomerism in each of the following pairs of compounds:
(a) CH₃-CO-NH₂ and HCO-NH-CH₃ (b) *ortho-* and *para-*toluidine.
3. Explain briefly, with examples, how the intermolecular hydrogen bonding in alcohols determines their physical properties.
4. Write a note on the structure of Al₂Cl₆.
5. Describe the various electronic transitions that are responsible for absorption of light in the UV-visible region.