HSE – I
Time : 2 Hours
Maximum : 60 scores

General Instructions
- There is a cool-off time of 15 minutes.
- You are neither allowed to write answers nor to discuss anything with others during the cool-off time.
- Use the cool-off time to get familiar with questions and to plan your answers.
- Read questions carefully before answering.
- All questions are compulsory.
- When you select a question all the sub-questions must be answered from the same question itself.
- Calculations, figures and graphs should be shown in the answer sheet itself.
- Give equations wherever necessary.

1.
   a) The ratio of different weights of O_2 that combine with twelve parts of carbon is 1:2. Which law is illustrated here? (1)
   b) How many electrons are present in 16g of CH_4? (2)
   c) Identify the limiting reagent when water is prepared from 6g of hydrogen and 36g of oxygen. (1)

2.
   a) Hydrogen spectrum consists of 5 series of lines.
      i) Which series of the hydrogen spectrum falls in the visible region? ($^1/_2$)
      ii) Write the Rydberg equation for the second line of that series. (1)
   b) Which of the following are isoelectronic species. Arrange them in the increasing order of their sizes. Na^+, K^+, Mg^{2+}, Al^{3+}, Ne, O^{2-}, Ca (2)
   c) Calculate the mass of a photon with wavelength 3.6A$^\circ$ (c = $3x10^8$ ms^{-1}, h = $6.626x10^{-34}$ Js) ($1^1/_2$)

3.
   a) Give reasons:
      i) Electron gain enthalpy of F is less negative than that of Cl
      ii) Oxygen has lower ΔH_i than Nitrogen. (2)
   b) What is the basic difference between Mendeleev's periodic law and modern periodic law? (2)

4.
   a) NH_3 and NF_3 have net dipole moment values. Which one has greater dipole moment? Account for your answer. ($1^1/_2$)
   b) Complete the following table (2)

Molecule	Hybridisation	Shape

CH_4	sp^3	Tetrahedral
NH_3	--------------	Trigonal pyramidal
---------	sp^3d	Seesaw
SF_6	--------------	Octahedral
H_2O	sp^3	----------

c) Stability of a molecule is given by its bond order. Arrange O_2, O_2^- and O_2^{2-} in the increasing order of their stability. $(1\frac{1}{2})$

5.

a) Which law is depicted by the following graph? State the law.

P   (1)

b) Why is it difficult to cook food on hills? (1)

c) A vessel of 120mL capacity contains a certain amount of gas at $35^\circ C$ and1. (2) bar pressure. The gas is transferred to another vessel of volume 180mL at 35^0C. What would be its pressure? (2)

6.

a) For the reaction $2A + B \rightarrow C$ at 298K, $\Delta H = 40kJmol^{-1}$ and $\Delta S = 200Jmol^{-1}$. At what temperature will the reaction become spontaneous? (2)

b) State Hess's law. (1)

c) Classify the following into extensive and intensive properties. (1)
   i) Specific heat capacity
   ii) Volume
   iii) Density
   iv) Enthalpy

7.

a) What happens when HCl gas is passed through a saturated solution of NaCl? Which is the effect behind it? (1)

b) At 475K, K_c for the reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ is 8.3×10^{-3}. $\Delta_r H^\circ = 124$ kJmol^{-1}
   i) Calculate K_c for the reverse reaction (1)
   ii) Calculate K_p for the reaction (1)
   iii) What would be the effect on K_c if (2)
       a. Pressure is increased
       b. Temperature is increased

8.

a) Balance the equation: $MnO_4^- + Fe^{2+} \rightarrow Mn^{2+} + Fe^{3+}$ in acidic medium (2)

b) Write the reactions at anode and cathode for the cell reaction (1)
   $Zn(s) + 2Ag^+ (aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$

9.

a) Hardness of water is classified into temporary and permanent hardness. (3)
   i) What causes the two types of hardness?

ii) Write one method to remove each type of hardness.
b) A painter restored his lead painting by dipping it in a solution. Which is the solution? What is its action there? (1)

10.
a) Match the following (2)

i) Na_2CO_3 - a) gypsum
ii) $CaSO_4.^{1}/_2H_2O$ - b) slaked lime
iii) NaOH   - c) plaster of paris
iv) $Ca(OH)_2$ - d) soda ash
                     - e) washing soda
                     - f) caustic soda

b) Discuss the various reactions that occur in the Solvay process. (2)

11.
a) What is inorganic benzene? (1)
b) Write a note on fullerenes? (2)
c) $PbCl_4$ is a strong oxidising agent. Why? (1)

12.
a) Write IUPAC names of the following compounds. (2)
i) $CH_3COCH_2CH_2CH_2COOH$
ii) $CH{\equiv}C{-}CH{=}CH{-}CH_3$
b) What is R_f (retardation) factor? (1)
c) Name one method for the estimation of nitrogen in organic compounds. (1)
d) Arrange the primary, secondary and tertiary carbocations in the increasing order of their stability. Justify your answer. (2)

13.
a) Explain Wurtz reaction. (2)
b) An alkene A on ozonolysis gave 1 molecule of methanal and 1 molecule of ethanal. Identify A. Write the chemical equation for the reaction. (2)
c) When HBr is added to propene in presence of peroxide and in the absence of peroxide two different products are obtained. Explain. (1)

14. Explain the terms
a) Green house effect (2)
b) Photochemical smog (1)