GENERAL INSTRUCTIONS :
- All questions are compulsory. **Maximum Marks are 50**.
- The question paper consists of 27 Questions.
- **Section – A** : Question 1 to 10 are 1mark each.
- **Section – B** : Question 11 to 16 are 1 marks each.
- **Section – C** : Question 17 to 19 are 2 marks each.
- **Section – D** : Question 20 to 25 are 3 marks each.
- **Section – E** : Question 26 to 27 are 5 marks each.

SECTION A (1 ×10 = 10)

1. In the reaction, $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$. When one mole of ammonia and one mole of oxygen are made to react to completion, then
   (a) 1.0 mole of H_2O is produced
   (b) All the oxygen is consumed
   (c) 1.0 mol of NO is formed
   (d) All the ammonia is consumed.

2. Which of the following sets of the quantum numbers is permitted?
   (a) $n = 4, l = 2, m_l = + 3, m_s = + \frac{1}{2}$
   (b) $n = 3, l = 3, m_l = + 3, m_s = + \frac{1}{2}$
   (c) $n = 4, l = 0, m_l = 0, m_s = + \frac{1}{2}$
   (d) $n = 4, l = 3, m_l = + 1, m_s = 0$

3. The correct order of decreasing first ionization energy is
   (a) C > B > Be > Li
   (b) C > Be > B > Li
   (c) B > C > Be > Li
   (d) Be > Li > B > C.

4. The hybridisation of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ are respectively,
   (a) sp, sp^3, sp^2 (b) sp, sp^2, sp^3 (c) sp^2, sp, sp^3 (d) sp^2, sp^3, sp.

5. The ratio between the root mean square velocity of H_2 at 50 K and that of O_2 at 800 K is
   (a) 4   (b) 2   (c) 1   (d) 1/4

6. The enthalpy of formation of NH_3 is – 46 kJ mol^{-1}. The enthalpy change for the reaction,
   $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$, is
   (a) + 23 kJ   (b) + 184 kJ   (c) + 46 kJ   (d) + 92 kJ.

7. In the ration,
 $$N_2(g) + O_2(g) \overset{heat}{\rightleftharpoons} 2NO(g)$$
   If pressure is increased then the equilibrium constant would
   (a) increase
   (b) remain unchanged
   (c) decrease
   (d) sometimes increase sometimes decrease

8. The value of ΔG^0 for a reaction, having K = 1, would be
   (a) – RT   (b) – 1   (c) 0   (d) + RT.

9. The conjugate base of HCO_3^- is
   (a) H_2CO_3 (b) CO_2 (c) H_2O (d) CO_3^{2-}.

10. Species acting both as Bronsted acid and base is
    (a) HSO_4^- (b) Na_2CO_3 (c) NH_3 (d) OH^-.

SECTION B (1×6 = 6)

11. What is meant by common ion effect?

12. (a) predict the sign of ΔS for the following reaction:
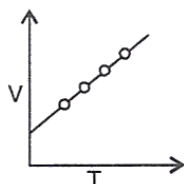
$$CaCO_3(s) \xrightarrow{heat} CaO(s) + CO_2(g)$$
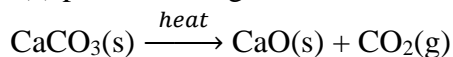
(b) State Hess's law.

OR

Define:
(a) Standard enthalpy of formation.
(b) Standard enthalpy of neutralisation.

13. Which gas law is shown by the following graph?

14. Write the IUPAC name and symbol for the element with atomic number 115.

15. Write K_p in terms of K_c for the following chemical equation:
$N_2 (g) + 3H_2 (g) \rightleftharpoons 2 NH_3(g)$

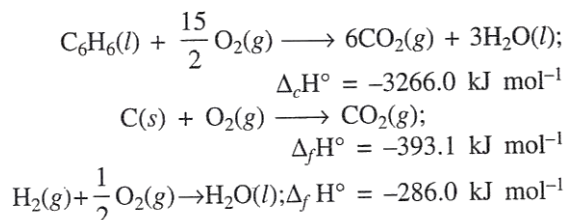16. Why are the droplets of water spherical in shape?

SECTION C(2×3 = 6)

17. Calculate the number of atoms in each of the following :
     (a) 7.85 g of Fe (Atomic mass of Fe= 56 u)
     (b) 4.68 mg of Si (Atomic mass of Si = 28 u)

18. (a) Write electronic configuration of Cu^+ ion (Z = 29).
     (b) Calculate the de Broglie wavelength of milligram sized object moving with 1% speed of light.
     Planck's constant (h) = 6.63×10^{-34} kg m^2 s^{-1}, Velocity of light (c) = 3.0×10^8 m s^{-1}

19. (a) What is the SI unit of density?
     (b) Calculate the volume occupied by 88 g of CO_2 at 30°C and 1 bar pressure.
     (R = 0.083 bar L K^{-1} mol^{-1})

SECTION D(3×6 = 18)

20. Calculate the bond order of N_2 and N_2^+ and compare their stability.

21. (a) Which series of lines of the hydrogen spectrum lies in UV region?

     (b)the mass of electron is 9.1×10^{-31} kg. If its K.E. is 3×10^{-25} J, calculate its wavelength. (h = 6.626 × 10^{-34}J s)

22. (a) Which hybrid orbitals are used by carbon in compound CH_3COOH?

(b) Predict the shape of PF_5 using VSEPR model.

(c) Write one difference between a sigma bond and a pi bond.

23. Account for the following:

(a) Ionisation enthalpy of 'Ne' is more than 'F' although 'Ne' has bigger atomic size than 'F'.

(b) Al^{3+} is smaller than Mg^{2+} although both are isoelectronic.

(c) Noble gases have low boiling points.

24. Calculate the standard enthalpy of formation of $C_6H_6(l)$ form the following data:

$$C_6H_6(l) + \frac{15}{2}O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(l);$$
$$\Delta_c H° = -3266.0 \text{ kJ mol}^{-1}$$
$$C(s) + O_2(g) \longrightarrow CO_2(g);$$
$$\Delta_f H° = -393.1 \text{ kJ mol}^{-1}$$
$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l); \Delta_f H° = -286.0 \text{ kJ mol}^{-1}$$

25. The density of 3 molal solution of NaCl is 1.110 g ml^{-1}. Calculate the molarity of the solution.

<div align="center">**OR**</div>

1 M solution of $NaNO_3$ has density 1.25 gcm^{-3}. Calculate the molality.

[Molar mass of $NaNO_3$ is 85 g mol^{-1}].

SECTION E (5×2 = 10)

26. (a) The concentration of hydrogen ion sample of soft drink is 4.0×10^{-3}M. What is its pH?

[log 4 = 0.6021]

(b)The equilibrium constant 'K' for reaction $H_2(g) + I_2 (g) \rightleftharpoons 2HI(g)$ is 4. What will be 'K'' for the reaction $HI (g) \rightleftharpoons \frac{1}{2}H_2(g) + \frac{1}{2}I_2 (g)$?

(c) What is solubility product? What is the effect temperature on K_{sp}?

<div align="center">**OR**</div>

(a) What do you conclude when $Q_c > K_c$?

(b) What is meant by common ion effect?

(c) What is the effect of temperature on K_w (ionic product of water)?

(d) K_w of water at 373 K is 1×10^{-12}. What will be the pH of H_2O at 373K? Is water acidic, basic or neutral at this temperature?

27. On the basis of Le Chatelier's principle, explain how temperature and pressure can be adjusted to increase the yield of ammonia in the following reaction:

$N_2 (g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; $\Delta H = $ =-92.38 kJ mol^{-1}

What will be the effect of addition of argon to the above reaction mixture at constant volume?

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

<div align="center">**OR**</div>

(a) The value of K_c for the reaction $2HI (g) \rightleftharpoons H_2 (g) + I_2 (g)$ is 1×10^{-4}.

At a given time, the composition of reaction mixture is

[HI] = 2×10^{-5} M, [H_2] = 1×10^{-5} M and [I_2] = 1×10^{-5} M

In which direction will the reaction proceed?