Unique Paper Code	: 32171102
Name of the Paper	: C-2 Physical Chemistry-I
Name of the Course	: B.Sc.(H) Chemistry
Semester	: I
Duration	: 3 hours
Maximum Marks	: 75

Instructions for Candidates:

i. Following details must be written on first page:
   - University Roll No.:
   - Unique Paper Code:
   - Name:
   - Class:
   - Course:
   - Semester:
   - Paper Name:

ii. Put page numbers on every page of the answer script.
iii. Attempt any **four** questions in all. **Q. No.- 1** is **compulsory**.
iv. Marks are mentioned at the end of each question.
v. Attempt all parts of a question together.

Q. No.-1: Attempt any **seven** questions and give answers in brief.

a. Will a solution of 0.01 M sodium acetate acidic, alkaline or neutral? Explain.
b. Differentiate between the isotropic and anisotropic substances?
c. At 25 °C, a saturated solution of $Ag_2(CrO_4)$ has a solubility of 1.48×10^{-4} M. What will be its value of K_{sp} at the same temperature?
d. What is fourfold axis of symmetry in crystalline solids?
e. Give the expression for Maxwell's law of distribution of molecular speeds of gases. Show with the help of diagram how a change in temperature of gas influence this distribution?
f. Give the units of coefficient of viscosity in CGS and SI.
g. Calculate the molecular diameter 'd' of helium atom from its van der Waals' constant b = 24 cm^3 mol^{-1}
h. Calculate the pH of 0.001 M solution of acetic acid at 25 °C, if $K_a = 1.8 \times 10^{-5}$ M.
i. What is a buffer mixture? How can you calculate the pH of a buffer mixture of weak acid and its salt with strong base?
j. Explain the physical significance of 'a' and 'b' in van der Waals' equation of state. Find their units also.

(3×7)

Q. No.-2:

a. How will you designate the Weiss and Miller indices of a plane intersecting all the three crystallographic axes?

b. Calculate the pH when 0.0, 40.0, 49.9 and 55.0 cm^3 of 0.1 M NaOH has been added to 50 cm^3 of 0.1 M HCl solution.

c. The critical constants using van der Waals' equation for one mole of a gas are given by: $P_c = \frac{a}{27b^2}$, $V_c = 3b$, $T_c = \frac{8a}{27\,Rb}$. Using these derive the relation:

$$P_r = \frac{8\,T_r}{3\,V_r - 1} - \frac{3}{V_r^2}$$

(6×3)

Q. No.-3:

a. What is coefficient of viscosity and describe the Ostwald's method to measure the coefficient of viscosity of a liquid?

b. Calculate the pH of a buffer which is 0.01 M in acetic acid and 0.01 M in sodium acetate. What will happen to the pH of this solution if 0.01 mole of HCl is added to 1 dm^3 of this solution? Explain with the help of calculations.

c. In a cubic lattice how many Bravais Lattices are possible in three dimensions, give relative axial length and bond angle between the edges.

(6×3)

Q, No.-4:

a. Derive the expression for the heat capacities of linear and non-linear polyatomic molecules on the basis of equipartition of energy.

b. A capillary tube of internal diameter 0.21 mm is dipped into a liquid whose density is 0.79 g cm^{-3}. The liquid rises in this capillary to a height of 6.30 cm. Calculate the surface tension of the liquid. (g =980 cm sec^{-2})

c. Show that the exact concentration of $[H_3O^+]$ in an aqueous solution of a monoprotic acid HA can be computed by:

$$K_a = \frac{[H_3O^+]^3 - [H_3O^+]K_w}{[H_3O^+][HA]_0 - [H_3O^+]^2 + K_w}$$

(6×3)

Q. No.-5:

a. The following are the unit cell intercepts, convert them to Weiss indices and Miller indices: (i) a: 3b: 2c (ii) 3a : 2b : 4c

b. Define (i) most probable velocity (ii) average velocity (iii) root mean square velocity of a gas molecule. Using Maxwell's distribution of molecular velocity derive the expression of most probable velocity.

c. Discuss the factors on which the degree of ionization, α depends.

(6×3)

Q. No.-6:

a. Derive the Bragg' equation to determine the interatomic distance by X-ray diffraction pattern.

b. The mean free path of the molecule of nitrogen gas at 300 K is 2.6×10^{-5}m. The collision diameter of molecule is 0.26 nm. Calculate (i) pressure of gas (ii) number of molecules per unit volume of gas.

c. How are indictors chosen for acid base titrations? Explain by taking suitable examples for strong acid-strong base, strong acid-weak base and weak acid-strong base titrations.

(6×3)