1. Explain the following terms: (32%)
   (1) Octet rule?
   (2) Gibbs free energy and spontaneous process?
   (3) Surface tension of a liquid?
   (4) The colligative properties of electrolyte solution?
   (5) The Raoult's law and Ideal solution?
   (6) Heisenberg's uncertainty principle?
   (7) The physical meanings of the four quantum numbers (n, l, m, mₓ)?
   (8) 2.35 g/L = __?__ μg/(mm)³ = __?__ kg/m³

2. Assuming that the partial pressure of CO₂ in the atmosphere is 4.0 x 10⁻⁴ atm, and the solubility of CO₂ in water at 25°C is 1.28 x 10⁻³ M. How many grams of CO₂ must be added in 800 mL water to prepare a sealed bottle of soft drink which has 5.0 atm CO₂ gas over the liquid in the sealed bottle at 25°C? (Molecular weight of CO₂ = 44.0 g/mole) (15%)

3. HCl is a strong acid. Its molecular weight is 36.5 g/mole. There is a concentrated HCl(ₐq) solution that has 35wt% HCl, and specific gravity of 1.20. How many milliliters (mL) of this concentrated HCl(ₐq) must be used to prepare 1 liter (L), 0.20M HCl(ₐq) solution? (15%)

4. Give the expected ground state electron configuration for the following elements:
   (a) 40Ti;  (b) 60Cu;  (c) 54Se;  (d) Z=16;  (e) Z=25?  (Note: Z = atomic number) (10%)

5. Draw electron-dot structures and predict the shapes of the following molecules or ions:
   (1) O₃  (2) XeF₂  (3) ICl⁻  (4) SiCl₄ (8%)

6. A gas sample “A” containing 1.50 mole at 25°C exerts a pressure of 400 torr in a container. Some gas “B” is added to the same container and mixed with the above gas A, the temperature is increased to 50°C and the pressure increases to 800 torr. Calculate the mole fractions of gas A and B in the container? Assume the volume of container is constant. (10%)

7. What are differences of the molecular structure between
   (1) Graphite and diamond? (10%)
   (2) CO₂ and SiO₂?