SHOW ALL CALCULATIONS & USE PROPER SIGNIFICANT FIGURES AND UNITS

Multiple Choice Questions: Circle the single best answer. No penalty for guessing.

1. How high must a column of H$_2$O be to exert a pressure equal to that of a 136 mm column of Hg (density of Hg = 13.6 g/mL, density of H$_2$O = 1.0 g/mL)? (4 points)
   A) 10 mm H$_2$O   B) 122 mm H$_2$O   C) 136 mm H$_2$O   D) 140 mm H$_2$O   E) 1850 mm H$_2$O

2. In the kinetic theory of gases, which statement is not true? (4 points)
   A) Gas molecules are in random, continuous motion
   B) Average kinetic energy is constant in time (elastic collisions)
   C) Repulsive forces are assumed to be negligible
   D) Attractive forces are assumed to be very large
   E) Gas volume of molecules is assumed to be negligible relative to total volume

3. What force dominates the intermolecular interactions in liquid formaldehyde, H$_2$CO? (4 points)
   A) covalent   B) London   C) dipole/dipole   D) gravitational   E) hydrogen bonding

4. Which of the following is an exothermic process? (4 points)
   A) condensation   B) boiling   C) melting   D) sublimation   E) all of these

5. What is the final concentration of a solution if 25.0 mL of 1.00 M Sucrose solution are diluted to 150.0 mL? (4 points)
   A) 0.0400 M   B) 0.167 M   C) 1.00 M   D) 3.75 M   E) 6.00 M

6. The normal boiling point of water is 100.0 °C. If 25.0 g of Ca(NO$_3$)$_2$ is dissolved into 250.0 g of water, what is the resulting boiling point? For water, $K_b = 0.52$ °C/m and $K_f = 1.86$ °C/m. (10 points)
7. Give the empirical formula or name the following ionic compounds. Indicate the solubility for each. (12 points)

- chromium (II) hydroxide  soluble/insoluble
- Li₃PO₄  soluble/insoluble

8. Given the following data, sketch the phase diagram for O₂: triple point 1.14 torr, –219°C; normal boiling point –183°C; normal melting point –218°C; critical point 49.8 atm, –119°C. Indicate which phases occur in which regions. If the pressure is 2.0 atm, describe the process of cooling O₂ from -100 °C to –220 °C. (18 points)

9. How many grams of N₂O are present in a pure sample occupying 125.0 L at 350°C and 890 mm Hg. Assume N₂O acts as an ideal gas with R = 0.082056 L atm mol⁻¹ K⁻¹, 1 atm = 760 mm Hg. (10 points)
10. Draw a picture showing the distribution of molecular speeds for neon, Ne, at 300K and 400K. Indicate specific values for minima and maxima. The rms average speed of an atom is given by 
\[ u = \left( \frac{3 R T}{MW} \right)^{1/2} \] 
where \( R = 8.31451 \text{ J mol}^{-1} \text{ K}^{-1} \) and MW is the molecular weight given in kg/mol. (10 points)

11. Explain why which molecule in each of the following pairs has the higher boiling point  
   a) KBr or Br₂  
   b) SiO₂ or CO₂  
   c) Se or CO. (10 points)

12. The Henry’s law (\( C_g = k P_g \)) coefficient for CO₂ is \( k = 3.1 \times 10^{-2} \text{ M atm}^{-1} \) in water at 25°C. Suppose you have a can of soda which has 5.0 mL of CO₂ gas on top of 375 mL of water. If the CO₂ is saturated in the water with a concentration of \( C_g = 0.12 \text{ M} \), what will be the pressure of CO₂ in the gas phase above the solution (ignore water vapor pressure)? How many total grams of CO₂ are in the can? (10 points)