

- (1.) On a summer afternoon in Mexico City, the barometric pressure is 606 torr, and the temperature is 35 °C. At this temperature, the vapor pressure of water is 41.2 torr; given that $\Delta H_{\text{vap}} = 43.9$ kJ/mole, please use the Clausius-Clapeyron equation to estimate the boiling point of water. (10 points) On another day, in winter, the barometric pressure is again 606 torr, but the temperature is 17 °C. What is the boiling point of water on this day? Please explain. (5 points) Given that ΔH_{vap} does not change significantly with temperature, please calculate the vapor pressure of water at 17 °C. (10 points) For full credit, please show all your work.
- (2.) A particular commercial mixture of H₂ (g) and Ar (g) is required to have a mole percentage of 50% H₂. The mixture is to be prepared in a cylinder of volume 28.00 L, and safety regulations dictate that the total pressure of gas should not exceed 160 atm. What are the maximum amounts of hydrogen and argon (in grams) that can be introduced to the cylinder at 25 °C? (10 points) What is the density of each gas, in g/L, at a total pressure of 160 atm? (5 points) Using the densities just derived, please calculate the rate of effusion of H₂ (g) relative to Ar (g). (5 points) How does this compare to the calculation performed using M_{m} H₂ and molar mass Ar? (5 points)
- (3.) A hydrocarbon gas comprising 85.63% C and 14.37% H occupies a cylinder of volume 10.00 L; at 298 K the gas exerts a pressure of 1 atm, and has a density of 1.147 g/L. What is the molecular mass (M_{m}) of this gas? (5 points) Please determine both the empirical and molecular formulae of this gas (6 points), and write the balanced equation for the complete combustion reaction. (4 points) What mass of O₂ is required for this combustion? (5 points) Assuming *exactly* the right amount of O₂ was introduced for complete combustion, what is the pressure in the cylinder at 625 K? (5 points)
- (4.) (a) List three physical properties (each) expected for molecular solids, ionic solids, and metallic solids. (9 points)
- (b) Sodium (Na, m.pt. 98 °C) and calcium (Ca, m.pt. 851 °C.) are considered to be very similar in their chemical behavior; please explain why their melting points are so drastically different. (5 points)
- (c) Please name the so-called intermolecular attractive forces. Are these weaker or stronger than covalent bonds? How do they compare to ionic bonds? (5 points) What kind of attractive forces influence the shape of proteins? (3 points)
- (d) Lithium fluoride (LiF) only conducts electricity when molten; what kind of solid is LiF? Do you expect its melting point to be high or low? (3 points).