

- (15%) A quantity of a certain gas has a mass of 0.157 g and is collected over water at 25°C and a measured pressure of 745 mmHg. If the volume of the gas is 135 mL and the vapor pressure of water at 25°C is 23.76 mmHg.
 - Calculate the molecular mass (molar mass) of the gas. Make proper assumption(s) when necessary.
 - What law (laws) is (are) used in the calculation?
- (15%) Suppose 3.00 mol of HI, 2.00 mol of H₂, and 1.00 mol of I₂ are placed together in a rigid 1.00-L container at 458°C. After equilibrium has been established, what are the concentrations of all species? [K_c for $2 \text{ HI (g)} \rightleftharpoons \text{H}_2 \text{ (g)} + \text{I}_2 \text{ (g)}$ is 2.06×10^{-2} at 458°C]
- (15%) Describe in detail steps how to prepare 500 mL of 1.0 M H₂SO₄ from concentrated sulfuric acid (95% w/w, specific gravity 1.83).
- (15%)
 - Please define **buffer solution** and list two applications of buffer solution.
 - How many grams of CH₃COONa should be added to 275 mL of 0.20 M CH₃COOH (acetic acid) in order to prepare a buffer with pH = 4.50? (Na=23.0, and K_a for acetic acid is 1.75×10^{-5})
- (15%) Please name the following compounds *in English*.
 - CuCl
 - NaNO₂
 - SnCrO₄
 - Ca(HCO₃)₂
 - KClO₄
- (15%) Please define the following terms:
 - cathode
 - critical point
 - activation energy
 - amu
 - standard reduction potential
- (10%) Draw the pressure-temperature phase diagram for water. (a) Label all the axes, curves, regions and important points. (b) Draw a line with an arrow head to represent the process of heating water from 25°C to boiling under 1 atm. (c) What physical phenomena do these curve represent?