Gas Laws and Chemical Reactions

1. 1 gram of CH_4 is added to a 1L flask and pressurized to 4 atm. What temperature is the flask at?

2. 10 moles of an ideal gas is added to gas cylinder at 300 K. 15% of the gas is released from the cylinder while holding the pressure and volume constant. What is the new temperature of the flask?

Strategy: Identify constants and variables. Derive a gas law that relates the variables. Determine the initial and final variables. Solve for T_2.

3. Inside a house where the room temperature is **25 °C**, a child is handed a **2 L** birthday balloon containing helium – this, of course, makes little Bobby really happy! When Bobby walks outside to the frigid Siberian winter day, the balloon **loses 10% of its volume** – Bobby cries. Stupid gas laws made a kid cry on his birthday. What is the temperature outside? Assume that the pressure is the same inside and outside. Report your answer in °C.

4. 100 grams of a **noble gas** is added to a 10 L flask at 300 K. The pressure of this flask is 2.94 atm. What is this gas? Hint: the only way to identify a gas is by determining the molecular weight.

Strategy: What do you need to calculate a MW? Do you know any of these values? What else do you need to know? Use the information given to calculate moles. Calculate the MW.

5. 4 liters of N_2O_4 (g) decomposes to nitrogen and oxygen gas. If this decomposition occurs at **STP** (so constant temperature and pressure!), determine the **total volume** of gas that is produced.

Strategy: Start with a balanced reaction. Calculate moles of the reactant. Determine the moles of each product that is formed. Calculate volume for each product. Calculate total volume.

6. 5 grams of solid phosphorus trichloride is added to a 4 L reaction flask that contains chlorine gas at STP. Solid phosphorus pentachloride is produced.
    a. Calculate the mass of product that is formed.

Strategy: Start with a balanced reaction. Calculate moles of each reactant. Calculate moles of product – remember to think about limiting reactants. Convert moles of product to mass.

    b. Assuming that the volume and temperature do not change, what is the pressure in the flask after the reaction?

Strategy: Only gases contribute to pressure, so find the moles of the gas left over when the reaction is complete. Convert to pressure.

7. 1 gram of C_5H_{12} is combusted in a 2.5 L reaction flask at 400 K.
    a. How many moles of O_2 are needed to react with C_5H_{12}?

    b. What pressure of O_2 is needed to react with all of the C_5H_{12}? Remember this is in a 2.5 L flask at 400 K.

    c. Assuming that all of the reactants are consumed:
        i. What is the partial pressure of CO_2 in the flask after the reaction? *Strategy: remember that partial pressure is a fancy way of saying "pressure of CO_2." So if you can determine the moles of CO_2 produced, you can calculate the pressure from CO_2.*

        ii. What is the partial pressure of H_2O in the flask after the reaction?

        iii. What is the partial pressure of O_2 in the flask after the reaction?

        iv. What is the total pressure in the flask?

8. 0.8 grams of glucose ($C_6H_{12}O_6$) is combusted in a 2.6 L reaction chamber at pressurized to 3 atm with oxygen at 400 K. Determine the **total pressure** in the flask after the reaction is complete.