Problem Set #5 Unit 8 Gases (GRADED HOMEWORK)
Chemistry 3A Fall 2025 (Secs 43957 & 43958)

SHOW YOUR WORK, YOUR CALCULATIONS, not just the result. This is PART of the grading. Be careful of precision (significant digits, decimal places). All the information to is in the Chap 8 Content lecture slides. Point value is given in question.

How to do this homework? Easiest is to print out and do by hand (neatly please: work it out on scratch paper first). If you can do this online in PDF or DOCX as I did, that's fine too.

1. A gas at 1.00 atm in a volume of 100.0 L is compressed to 5.000 L volume. What is the pressure in the smaller volume?

The problem uses **gas**, **Pressure** and **Volume**, which should identify it as an application of **Boyle's Law** ($PV = k$)

$$P_1V_1 = P_2V_2$$

$$P_2 = \frac{P_1V_1}{V_2}$$

$$P_2 = \frac{1.00\ \text{atm} \times 100.0\ \text{L}}{5.000\ \text{L}} = 20.0\ \text{atm}$$

2. 10.0 mol argon (Ar) at 400 K in a volume of 5.00 L will have a pressure of how many atmospheres (atm)?

The problem mentions **argon**, a gas, an amount in **moles**, a **Volume (*V*)** in **liters (L)**, a **Temperature (*T*)** in **Kelvin (K)** and it requests the calculation for a **Pressure (*P*)**. It provides values for *V*, *T*, and *n*. This is recognized as an application of the **Ideal Gas Law** and the equation is known.

It also requires selection of the **gas constant *R*** with the correct units to be able to calculate. The value *n* should be **moles**, and the value given is in moles. If the amount (as a mass) was given in **grams**, a conversion to moles using the **molar mass** of the gas substance would be necessary. The value for **temperature** must be given in **K (Kelvin)**, which is given. If it were in another scale like Celsius (°C), a conversion $K = {}^\circ C + 273$ would be necessary. Finally a volume *V* is given and should be in liters (L) for use of the constant R. A couverion would be required if not in liters. So $R = 0.08205\ \text{L atm/mol K}$ will be used which should cancel the units L, mol, K and leave units of atm

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

$$P = \left(\frac{(10.0\ \text{mol})\ (400\ \text{K})}{5.00\ \text{L}}\right)\left(\frac{0.08205\ \text{L atm}}{\text{mol K}}\right) =$$

$$\left(\frac{\left(10.0\ \cancel{\text{mol}}\right)\left(400\ \cancel{\text{K}}\right)}{5.00\ \cancel{\text{L}}}\right)\left(\frac{0.08205\ \text{atm}\ \cancel{\text{L}}}{\cancel{\text{mol}}\ \cancel{\text{K}}}\right) = 65.6\ \text{L}$$

3. Helium (He) in a balloon of 2.00 L volume on a cold (10°C) day is brought into a room at room temperature (25°C) and the balloon expands. What is the new volume?

4. From problem #3, the mass of helium is 10.00 g. What is the pressure of the gas at the initial conditions of 10°C?

5. A gas at a temperature of 100°C has a pressure of 1.0 atm. The temperature is brought way down to –20°C. What is the pressure now?

6. 50.0 g of potassium chlorate is heated in a 20.0 L sealed container, and produces diatomic oxygen (O_2) according to the reaction below. If the temperature after reaction is at 25°C, what is the pressure in the flask? Use any units for the pressure you want.

$$2\ \mathrm{KClO_3}\ (s) \xrightarrow{\Delta} 2\ \mathrm{KCl}\ (s) + 3\ \mathrm{O_2}\ (g)$$