GASES PROBLEM SET

1. A 10.0 litre tank of helium is filled to a pressure of 150.0 atm. How many 1.50 litre toy balloons can be inflated to a pressure of 1.00 atm from the tank? Assume no change in temperature.

2. A gas thermometer contains 250.00 mL of a gas at 0°C and 1.00 atm pressure. If the pressure remains at 1.00 atm, how many millilitres will the volume increase for every one degree Celsius that the temperature rises.

3. A container is filled with a gas to a pressure of 2.00 atm at 25°C.
   (a) What pressure will develop within the sealed container if it is warmed to 75°C?
   (b) At what temperature (in °C) will the pressure be 10.0 atm?

4. A 1.00 litre sample of a gas is collected at 25°C and 1.25 atm. What is the pressure of the gas (in mm of Hg) at 200.0°C if the volume is 4.00 litre?

5. What volume will 3.00 kg of CO_2 occupy at 100.0°C and 266 torr?

6. What is the density of N_2O gas at 25°C and 0.750 atm?

7. If the temperature is held constant at 50.0°C, at what pressure will the density of N_2 gas be 0.500 g/L?

8. A gas has a density of 0.572 g/L at 90.0°C and 380.0 mm of Hg pressure. What is the molecular weight of the gas?

9. A 0.300 g sample of a liquid was vaporized at 150.0°C. The vapour occupied a volume of 180.0 mL at 0.998 atm. What is the molecular weight of the liquid?

10. Aluminum carbide, Al_4C_3, reacts with water to produce methane gas, CH_4, and $Al(OH)_3$ as follows:

$$Al_4C_3 + 12H_2O \rightarrow 3CH_4 + 4Al(OH)_3$$

   (a) What volume of methane, at 20.0°C and 0.750 atm, would be obtained by the reaction of 1.50 g of Al_4C_3?
   (b) What weight of Al_4C_3 would yield 487 mL of methane at 45°C and 743 torr?

11. In a mixture of CO and CO_2, the partial pressures of CO and CO_2 are 0.200 atm and 0.600 atm, respectively.
   (a) What is the total pressure?
   (b) What is the mole fraction of each gas in the mixture?
   (c) If the mixture occupies 11.6 L at 50.0°C, what is the total number of moles of gas?
   (d) How many grams of each gas does the mixture contain?

12. Calculate the mass, in grams, of Na_2CO_3 formed by the reaction of 475 mL of 1.085 *M* NaOH and 5.50 L of CO_2 gas at 25°C and 815 mm of Hg. The equation for the reaction is:

$$2NaOH(aq) + CO_2(g) \rightarrow Na_2CO_3(aq) + H_2O(l)$$

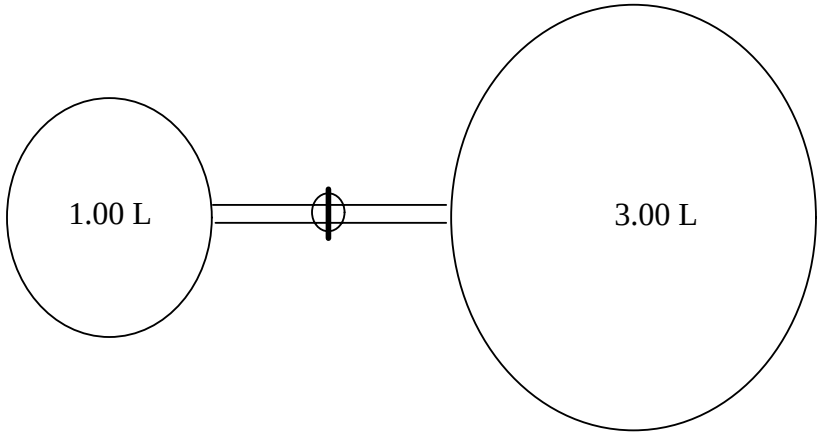
13. The combustion, in air, of an unknown hydrocarbon (i.e., a compound containing only carbon and hydrogen) produces 3.30 mg of CO_2 and 2.05 mg of H_2O. Helium was found to effuse, through a pinhole, about 2.7 times faster than does the unknown hydrocarbon, under identical conditions. Determine the molar mass and molecular formula of the hydrocarbon.

14. A gas mixture contains 6.00 g He, 143.0 g CO_2 and 26.0 g H_2O. The total pressure is 720 torr. Calculate (a) the mole fraction, and (b) the partial pressure of each gas in the mixture.

15. Two evacuated (i.e., P = 0) flasks are isolated from each other by a closed valve (as shown; assume the connecting tube has a negligible volume). The 1.00 L flask initially contained an unknown mass of $NH_4NO_3(s)$ which was then heated to 125°C, allowing the following reaction to go to completion.

$$2NH_4NO_3(s) \rightarrow 2N_2(g) + O_2(g) + 4H_2O(g)$$

The resulting pressure in the 1.00 L flask after the reaction was found to be 2.86 atm.



(a) Determine the mass of $NH_4NO_3(s)$ present before the reaction occurred.

(b) What is the partial pressure of water vapour in the 1.00 L flask after the reaction occurred?

(c) The valve between the two flasks is then opened, allowing the gases (still at 125°C) to enter the 3.00 L flask as well. What is the pressure inside the two flasks at this point?