CHM 110 – Gases – Practice Problems ***SOLUTIONS***

Solve the problems.

1) 17.5 g of uranium is converted to the gas uranium (VI) fluoride in the following reaction:

$$U(s) + 3F_2(g) \rightarrow UF_6(g)$$

What volume of gas is produced at 0.983 atm by this reaction if the temperature is 50.0 °C?

- __1.98____________ L UF_6 gas produced.

Complete solution:
First, find out how many moles of UF_6 gas are produced using the formula weight of uranium and stoichiometry.

$$17.5\,\text{g U} \times \frac{1\,\text{mol}}{238.0\,\text{g}} \times \frac{1\,\text{mol UF}_6}{1\,\text{mol U}} = 0.0735294\,\text{mol UF}_6$$

Next, use the ideal gas law, PV=nRT, to find the volume.

P = 0.983 atm
V = ?
n = 0.0735294 mol
T = 50°C = 323 K

$$V = \frac{(0.0735294\,\text{mol}) \times (0.08206\,\frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}) \times (323\,\text{K})}{(0.983\text{atm})} = 1.98\,\text{L}$$

2) One method for refining iron ore (primarily Fe_2O_3) involves using a blast furnace to react the iron ore with carbon monoxide to produce iron.

$$Fe_2O_3(s) + 3\ CO(g) \rightarrow 2\ Fe(s) + 3\ CO_2(g)$$

What volume of carbon dioxide gas (at 2.50 atm and 300.0°C) is produced when 6413 grams of pure Fe is made?

- ___3240____________ L of CO_2 is produced.

Complete solution:
First, find the number of moles of carbon dioxide gas produced using the formula weight of iron and stoichiometry.

$$6413\ \text{g Fe} \times \frac{1\ \text{mol}}{55.85\ \text{g}} \times \frac{3\ \text{mol CO}_2}{2\ \text{mol Fe}} = 172.2381\ \text{mol CO}_2$$

Next, use the ideal gas law to find the volume of the CO_2 gas.

P = 2.50 atm
V = ?
n = 172.2381 mol
T = 300.0°C = 573.2 K

$$V = \frac{(172.2381\ \text{mol}) \times (0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}) \times (573.2\ \text{K})}{(2.50\ \text{atm})} = 3240\ \text{L}$$

3) What pressure would be produced by 15.5 grams of chlorine gas (Cl_2) contained in a 10.0L container kept at 21.0 ^oC?

- __0.528___________ atm pressure from the Cl_2.

Complete solution:
Use the formula weight to find out how many moles of Cl_2 gas are present, then use PV=nRT to find the pressure.

$$15.5\,\mathrm{g\,Cl_2} \times \frac{1\ \mathrm{mol\,Cl_2}}{70.90\,\mathrm{g}} = 0.21862\ \mathrm{mol\,Cl_2}$$

P = ?
V = 10.0 L
n = 0.021862 mol
T = 21.0^{o}C = 294.2 K

$$P = \frac{(0.21862\ \mathrm{mol}) \times (0.08206 \frac{\mathrm{L \cdot atm}}{\mathrm{mol \cdot K}}) \times (294.2\,\mathrm{K})}{(10.0\,\mathrm{L})} = 0.528\,\mathrm{atm}$$