Review 2

THE GENERAL GAS LAW

1. A tire on a large car has a final inflated pressure of 255 kPa. What is the inflated volume of this tire if 106 grams of nitrogen are required to fill it at a temperature of 12°C? $T = 12 + 273 = 285$

$PV = nRT$ $\quad V = \frac{nRT}{P} = \frac{(3.78301)(8.31)(285)}{255\,kPa} = 35.1353$

$\frac{1\,mol\,N_2}{x} = \frac{28.02g}{106g}$ $\quad x = 3.78301$

$V = 35.1\,L$

2. The very poisonous gas, *Arsine*, can be produced by reacting the metalloid arsenic with hydrogen gas in the following reaction:

Arsenic → $2\,As_{(s)} + 3\,H_{2(g)} \longrightarrow 2\,AsH_{3(g)}$ ← Arsine

a) What mass of arsenic must be supplied in this reaction in order to produce 200 litres of Arsine at 100°C and 145 kPa? 2:2 ratio ∴ 9.35596 mol As

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(145)(200)}{(8.31)(373)} = 9.35596\,mol\,As$ $\quad \frac{1\,mol\,As}{9.35596} = \frac{74.92g}{x}$

$x = 700.948g$

701 g Arsenic

b) What volume of hydrogen measured at 220 °C and 175 kPa would be required to react with 85 grams of Arsenic in this reaction?

$\frac{1\,mol\,As}{x} = \frac{74.92}{85}$

$x = 1.13454\,mol\,As$

$\frac{2\,mol\,As}{1.13454\,mol} = \frac{3\,mol\,H_2}{x}$ $\quad x = 1.70182\,mol\,H_2$

$V = \frac{nRT}{P} = \frac{(1.70182)(8.31)(493)}{175}$

$V = 39.8403$

$V = 40\,L$

3. A sample of gas at a pressure of 500 kPa has had its volume cut to 1/5 its original volume and the absolute temperature has been doubled. What is the new pressure?

$\frac{1}{5}V$ means $P \times 5$

$T \times 2$ means $P \times 2$

$P \times 10 = 500 \times 10$

$= 5000\,kPa$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ (or) $\frac{(500)(100)}{(100)} = \frac{P_2(20)}{200}$

$P_2 = 5000$

4. A 15.5 ml bubble of gas trapped in the middle of a hot molten block of glass (750 °C) is assumed to exert a pressure of 115 kPa. What will the pressure of this gas be when the glass cools to room temperature (22 °C) if the bubble shrinks to 12.5 ml?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(115)(15.5)}{1023} = \frac{P_2(12.5)}{295}$

$P_2 = 41.12$

$P_2 = 41.1\,kPa$