

## 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?  $T = 12 + 273 = 285$

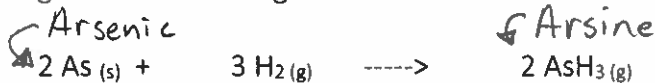
$$PV = nRT \quad V = \frac{nRT}{P} = \frac{(3.78301)(8.31)(285)}{255 \text{ kPa}} = 35.1353$$

$$\frac{1 \text{ mol N}_2 = 28.02 \text{ g}}{x \quad 106 \text{ g}}$$

$$x = 3.78301$$

$$V = 35.1 \text{ L}$$

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



- 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  $\therefore$  9.35596 mol As

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(145)(200)}{(8.31)(373)} = 9.35596 \text{ mol As}$$

$$\frac{1 \text{ mol As} = 74.92 \text{ g}}{9.35596 \quad x}$$

$$x = 700.948 \text{ g}$$

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?

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

$$x = 1.13454 \text{ mol As}$$

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

$$V = 39.8403$$

$$V = 40 \text{ L}$$

$$\frac{2 \text{ mol As} = 3 \text{ mol H}_2}{1.13454 \text{ mol} \quad x} \quad x = 1.70182 \text{ mol H}_2$$

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?

$$\left. \begin{array}{l} \frac{1}{5} V \text{ means } P \times 5 \\ T \times 2 \text{ means } P \times 2 \end{array} \right\}$$

$$P \times 10 = 500 \times 10 \quad \text{or} \quad \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$= 5000 \text{ kPa} \quad \frac{(500)(100)}{(100)} = \frac{P_2(20)}{200}$$

$$P_2 = 5000$$

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?

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

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

$$P_2 = 41.12$$

$$P_2 = 41.1 \text{ kPa}$$