

MC12.28

$$PV = Nk_B T$$

$$w/U = \text{const}$$

$$T = \text{const}$$

$$\text{If } N \rightarrow 2N$$

$$P \propto N$$

$$P \rightarrow 2P$$

P12.101

CO_2

$$PV = nRT$$

$$^{12}\text{C} \rightarrow 12 \text{ u}$$

$$^{16}\text{O} \rightarrow 16 \text{ u}$$

$$\text{O}_2 \rightarrow 32 \text{ u}$$

$$\left. \begin{array}{l} \\ \\ \end{array} \right\} \text{CO}_2 \rightarrow 44 \text{ u}$$

$$M_{\text{mol CO}_2} = \frac{44 \text{ g}}{\text{mol}}$$

$$1 \text{ kg CO}_2 \rightarrow 1000 \text{ g CO}_2 \times \frac{\text{mol}}{44 \text{ g}} = 22.7272 \text{ mol}$$

$$P = 1.013 \times 10^5 \text{ Pa}$$

$$n = 22.7272 \text{ mol}$$

$$T = 20 + 273 = 293 \text{ K}$$

$$R = 8.314 \frac{\text{J}}{\text{mol K}}$$

$$PV = nRT$$

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

$$V = \frac{(22.7272)(293)(8.314)}{(1.013 \times 10^5)}$$

$$\sim 0.547 \text{ m}^3$$

P12.12

$$V = 5 \text{ L} = 0.005 \text{ m}^3$$

$$P = 1.013 \times 10^5 \text{ Pa}$$

$$T = 37 + 273 = 310 \text{ K}$$

$$PV = nRT$$

$$n = \frac{PV}{RT}$$

$$n = \frac{(1.013 \times 10^5)(0.005)}{(8.314)(310)} \text{ mol}$$

$$n = 0.19652 \text{ mol}$$

$$n_{\text{O}_2} = 20\% n$$

$$n_{\text{O}_2} \approx 0.0393 \text{ mol}$$

P12.17

$$n = 3.0 \text{ mol}$$

$$T = -20 + 273 = 153 \text{ K}$$

$$V = 2 \text{ L} = 0.002 \text{ m}^3$$

$$PV = nRT$$

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

$$P = \frac{(3)(8.314)(153)}{0.002} \text{ Pa}$$

$$P = 1908063 \text{ Pa}$$

$$P \approx 1910000 \text{ Pa} \text{ or } 1910 \text{ kPa}$$

P 12.18

$$P = 4 \times 10^{-11} \text{ Pa}$$

$$T = 20^\circ\text{C} = 293 \text{ K}$$

$$V = 0.090 \text{ m}^3$$

$$PV = N k_B T$$

$$N = \frac{PV}{k_B T}$$

$$N = \frac{(4 \times 10^{-11})(0.09)}{(1.38 \times 10^{-23})(293)}$$

$$N = 890339813 \text{ PARTICLES}$$

$$N \approx 8.9 \times 10^8 \text{ PARTICLES}$$

P 12.19

$${}^4\text{He} \rightarrow M_{\text{He}} = 4 \text{ U}$$

$$M_{\text{mol He}} = \frac{4 \text{ g}}{\text{mol}}$$

$$125 \text{ g} \times \frac{\text{mol}}{4 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ particles}}{1 \text{ mol}} = 1.88 \times 10^{25} \text{ molecules He}$$

$$T = 0^\circ\text{C} = 273 \text{ K}$$

$$V = 0.001 \text{ m}^3$$

$$P = 1.013 \times 10^5 \text{ Pa}$$

$$PV = N k_B T$$

$$V = \frac{N k_B T}{P}$$

$$V = \frac{(1.88 \times 10^{25})(1.38 \times 10^{-23})(273)}{1.013 \times 10^5} \text{ m}^3 \approx 0.70 \text{ m}^3 \text{ or } 700 \text{ L}$$