

CHAPTER 4	Molar Volumes and the Law of Combining Volumes Answer Key	BLM 4.1.6A
ANSWER KEY		

$$1. \text{ (a) } \frac{25 \text{ mol O}_2}{16 \text{ mol CO}_2} = \frac{4.0 \text{ L O}_2}{V_{\text{CO}_2}}$$

$$V_{\text{CO}_2} = 2.6 \text{ L}$$

$$\frac{25 \text{ mol O}_2}{18 \text{ mol H}_2\text{O}} = \frac{4.0 \text{ L}}{V_{\text{H}_2\text{O}}}$$

$$V_{\text{H}_2\text{O}} = 2.9 \text{ L}$$

$$\text{(b) } V_{\text{CO}_2} = (8.5 \times 10^3 \text{ kL})(30\%)$$

$$V_{\text{CO}_2} = 2.55 \times 10^3 \text{ kL}$$

$$\frac{25 \text{ mol O}_2}{16 \text{ mol CO}_2} = \frac{V_{\text{O}_2}}{2.55 \times 10^3 \text{ kL}}$$

$$V_{\text{O}_2} = 4.0 \times 10^3 \text{ kL}$$

$$2. \frac{2 \text{ mol F}_2}{1 \text{ mol Xe}} = \frac{V_{\text{F}_2}}{85 \text{ mL}}$$

$$V_{\text{F}_2} = 1.7 \times 10^2 \text{ mL}$$

3. At SATP, all gases have a molar volume of 24.8 L/mol.

$$v = \frac{V}{n}$$

$$n = \frac{V}{v}$$

$$n = \frac{3.7 \text{ L}}{24.8 \frac{\text{L}}{\text{mol}}}$$

$$n = 0.15 \text{ mol}$$

4. The molar volume of gases at STP is 22.4 L/mol and the molar volume of gases at SATP is 24.8 L/mol.

$$v = \frac{V}{n}$$

$$n = \frac{V}{v}$$

$$n_{\text{NO}_2} = \frac{15 \text{ L}}{22.4 \frac{\text{L}}{\text{mol}}}$$

$$n_{\text{NO}_2} = 0.67 \text{ mol}$$

$$n_{\text{O}_2} = \frac{18 \text{ L}}{24.8 \frac{\text{L}}{\text{mol}}}$$

$$n_{\text{O}_2} = 0.73 \text{ mol}$$

There are more moles of O<sub>2</sub> than of NO<sub>2</sub>. This is a combined effect of the greater volume of oxygen present and the fact that gases at SATP have a greater molar volume than those at STP.

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$$5. \quad M_{\text{Cl}_2} = (2) \left( 35.45 \frac{\text{g}}{\text{mol}} \right)$$

$$M_{\text{Cl}_2} = 70.90 \frac{\text{g}}{\text{mol}}$$

$$n = \frac{m}{M}$$

$$n = \frac{3.7 \text{ g}}{70.90 \frac{\text{g}}{\text{mol}}}$$

$$n = 5.22 \times 10^{-2} \text{ mol}$$

$$v = \frac{V}{n}$$

$$v = \frac{10.8 \text{ L}}{5.22 \times 10^{-2} \text{ mol}}$$

$$v = 2.1 \times 10^2 \frac{\text{L}}{\text{mol}}$$

6. Gas molecules are considered to be point masses that are neither attracted nor repelled by one another. When considering a one litre volume, a gas molecule takes up negligible space, so any difference in size between molecules is not significant. Since gas molecules do not exert attractive or repulsive forces on one another, the chemical nature of the molecules present in a gas does not affect the number of molecules that can fit in a given volume.