Name: _____
Hour: ____ Date: _____

Chemistry: *The Ideal Gas Law*

Directions: *Solve each of the following problems. Show your work, including proper units, to earn full credit.*

1. If 3.7 moles of propane are at a temperature of 28^{o}C and are under 154.2 kPa of pressure, what volume does the sample occupy?

2. A sample of carbon monoxide at 57^{o}C and under 0.67 atm of pressure takes up 85.3 L of space. What mass of carbon monoxide is present in the sample?

3. At –45^{o}C, 71 g of fluorine gas take up 6843 mL of space. What is the pressure of the gas, in kPa?

4. At 971 mm Hg, 145 g of carbon dioxide have a volume of 34.13 dm^{3}. What is the temperature of the sample, in ^{o}C?

5. At 137^{o}C and under a pressure of 3.11 atm, a 276 g sample of an unknown noble gas occupies 13.46 L of space. What is the gas?

Answers: 1. 60.0 L 2. 59 g CO 3. 517.6 kPa 4. –112^{o}C 5. radon

Chemistry: *The Ideal Gas Law* **KEY**

Directions: *Solve each of the following problems. Show your work, including proper units, to earn full credit.*

1. If 3.7 moles of propane are at a temperature of 28°C and are under 154.2 kPa of pressure, what volume does the sample occupy?

$n = 3.7\ \text{mol}$

$T = 28^{\circ}\text{C} + 273 = 301\ \text{K}$

$P = 154.2\ \text{kPa}$

$R = 8.314\ \text{kPa} \cdot \text{L/mol} \cdot \text{K}$

$V = ?\ \text{L}$

$$V = \frac{nRT}{P} \Rightarrow \frac{(3.7\ \text{mol})(8.314\ \text{kPa} \cdot \text{L/mol} \cdot \text{K})(301\ \text{K})}{154.2\ \text{kPa}}$$

$V = 60\ \text{L}$

2. A sample of carbon monoxide at 57°C and under 0.67 atm of pressure takes up 85.3 L of space. What mass of carbon monoxide is present in the sample?

$T = 57^{\circ}\text{C} + 273 = 330\ \text{K}$

$P = 0.67\ \text{atm}$

$V = 85.3\ \text{L}$

$n = ?\ \text{mol}$

$$n = \frac{PV}{RT} \Rightarrow \frac{(0.67\ \text{atm})(85.3\ \text{L})}{(0.0821\ \text{L} \cdot \text{atm/mol} \cdot \text{K})(330\ \text{K})} \Rightarrow 2.11\ \text{mol CO}$$

$$x\ \text{g CO} = 2.11\ \text{mol CO}\left(\frac{28\ \text{g CO}}{1\ \text{mol CO}}\right) = 59\ \text{g CO}$$

3. At –45°C, 71 g of fluorine gas take up 6843 mL of space. What is the pressure of the gas, in kPa?

$T = -45^{\circ}\text{C} + 273 = 228\ \text{K}$

$$V = 6843\ \text{mL}\left(\frac{1\ \text{L}}{1000\ \text{mL}}\right) = 6.843\ \text{L}$$

$P = ?\ \text{kPa}$

$$n = 71\ \text{g F}_2\left(\frac{1\ \text{mol F}_2}{38\ \text{g F}_2}\right) = 1.87\ \text{mol F}_2$$

$$P = \frac{nRT}{V} \Rightarrow \frac{(1.87\ \text{mol})(8.314\ \text{kPa} \cdot \text{L/mol} \cdot \text{K})(228\ \text{K})}{6.843\ \text{L}}$$

$P = 518\ \text{L}$

4. At 971 mm Hg, 145 g of carbon dioxide have a volume of 34.13 dm^3. What is the temperature of the sample, in °C?

$$P = 971\ \text{mm Hg}\left(\frac{1\ \text{atm}}{760\ \text{mm Hg}}\right) = 1.28\ \text{atm}$$

$$n = 145\ \text{g CO}_2\left(\frac{1\ \text{mol CO}_2}{44\ \text{g CO}_2}\right) = 3.3\ \text{mol CO}_2$$

$V = 34.13\ \text{dm}^3$

$T = ?\ ^{\circ}\text{C}$

$$T = \frac{PV}{RT} \Rightarrow \frac{(1.28\ \text{atm})(34.13\ \text{dm}^3)}{(3.3\ \text{mol})(0.0821\ \text{dm}^3 \cdot \text{atm/mol} \cdot \text{K})}$$

$T = 161\ \text{K}$ $\quad K - 273 = {}^{\circ}\text{C}$

$161 - 273 = {}^{\circ}\text{C}$

$T = -112^{\circ}\text{C}$

5. At 137°C and under a pressure of 3.11 atm, a 276 g sample of an unknown noble gas occupies 13.46 L of space. What is the gas?

$T = 137^{\circ}\text{C} + 273 = 410\ \text{K}$

$P = 3.11\ \text{atm}$

$V = 13.46\ \text{L}$

$n = ?\ \text{mol of unknown gas}$

$\text{mass} = 276\ \text{g of unknown gas}$

$$n = \frac{PV}{RT} \Rightarrow \frac{(3.11\ \text{atm})(13.46\ \text{L})}{(0.0821\ \text{L} \cdot \text{atm/mol} \cdot \text{K})(410\ \text{K})} \Rightarrow 1.24\ \text{mol gas}$$

$$x\ \frac{\text{g}}{\text{mol}} = \frac{276\ \text{g}}{1.24\ \text{mol}} \Rightarrow 222.6\ \frac{\text{g}}{\text{mol}} \quad \therefore \text{Radon gas}$$

Answers: 1. 60.0 L 2. 59 g CO 3. 517.6 kPa 4. –112°C 5. radon