Name: _____
Hour: ____ Date: _____

Chemistry: *The Combined Gas Law*

Solve the following problems. As always, include enough work and show the units to ensure full credit.

1. The pressure of a gas changes from 120 kPa to 50 kPa. The volume changes from 45 L to 40 L. If the initial temperature is 81^{o}C, what is the final temperature in ^{o}C?

2. A sample of nitrogen goes from 21 m^3 to 14 m^3 and its pressure increases from 100 kPa to 150 kPa. The final temperature is 300 K. What was the initial temperature in Kelvins?

3. A sample of argon goes from 500 K to 350 K and its pressure changes from 280 kPa to 380 kPa. If the initial volume is 18 dm^3, what is the final volume?

4. A sample of neon experiences a pressure drop from 75 kPa to 53 kPa. The temperature increases from 27^{o}C to 93^{o}C. If the initial volume is 12 L, what is the final volume?

5. The volume of a sample of helium increases from 5 L to 25 L and its temperature drops from 2000 K to 1750 K. If the initial pressure is 1500 mm Hg, what is the final pressure?

6. The temperature of a gas increases from 212^{o}C to 380^{o}C. The volume goes from 30 dm^3 to 18 dm^3. If the final pressure is 1.85 atm, what was the initial pressure?

Answers: 1. –142^{o}C 2. 300 K 3. 9.3 dm^3 4. 20.7 L 5. 262.5 mm Hg 6. 0.82 atm

Chemistry: ***The Combined Gas Law*** **KEY**

Solve the following problems. As always, include enough work and show the units to ensure full credit.

1. The pressure of a gas changes from 120 kPa to 50 kPa. The volume changes from 45 L to 40 L. If the initial temperature is 81°C, what is the final temperature in °C?

$P_1 = 120\ \text{kPa}$ $P_2 = 50\ \text{kPa}$

$V_1 = 45\ \text{L}$ $V_2 = 40\ \text{L}$

$T_1 = 81^\circ\text{C} + 273 = 354\ \text{K}$ $T_2 = x\ \text{K}$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(120\ \text{kPa})(45\ \text{L})}{354\ \text{K}} = \frac{(50\ \text{kPa})(40\ \text{L})}{T_2}$$

$T_2 = 131\ \text{K} \Rightarrow \text{K} - 273 = {}^\circ\text{C}$

$131\ \text{K} - 273 = {}^\circ\text{C}$

${}^\circ\text{C} = -142^\circ\text{C}$

2. A sample of nitrogen goes from 21 m^3 to 14 m^3 and its pressure increases from 100 kPa to 150 kPa. The final temperature is 300 K. What was the initial temperature in Kelvins?

$P_1 = 100\ \text{kPa}$ $P_2 = 150\ \text{kPa}$

$V_1 = 21\ \text{dm}^3$ $V_2 = 14\ \text{dm}^3$

$T_1 = x\ \text{K}$ $T_2 = 300\ \text{K}$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(100\ \text{kPa})(21\ \text{dm}^3)}{T_1} = \frac{(150\ \text{kPa})(14\ \text{dm}^3)}{300\ \text{K}}$$

$T_1 = 300\ \text{K}$

3. A sample of argon goes from 500 K to 350 K and its pressure changes from 280 kPa to 380 kPa. If the initial volume is 18 dm^3, what is the final volume?

$P_1 = 280\ \text{kPa}$ $P_2 = 380\ \text{kPa}$

$V_1 = 18\ \text{dm}^3$ $V_2 = x\ \text{dm}^3$

$T_1 = 500\ \text{K}$ $T_2 = 350\ \text{K}$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(280\ \text{kPa})(18\ \text{dm}^3)}{500\ \text{K}} = \frac{(380\ \text{kPa})(V_2)}{350\ \text{K}}$$

$V_2 = 9.3\ \text{dm}^3$

4. A sample of neon experiences a pressure drop from 75 kPa to 53 kPa. The temperature increases from 27°C to 93°C. If the initial volume is 12 L, what is the final volume?

$P_1 = 75\ \text{kPa}$ $P_2 = 53\ \text{kPa}$

$V_1 = 12\ \text{L}$ $V_2 = x\ \text{dm}^3$

$T_1 = 27^\circ\text{C} + 273 = 300\ \text{K}$ $T_2 = 93^\circ\text{C} + 273 = 366\ \text{K}$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(75\ \text{kPa})(12\ \text{L})}{300\ \text{K}} = \frac{(53\ \text{kPa})(V_2)}{366\ \text{K}}$$

$V_2 = 20.7\ \text{L}$

5. The volume of a sample of helium increases from 5 L to 25 L and its temperature drops from 2000 K to 1750 K. If the initial pressure is 1500 mm Hg, what is the final pressure?

$P_1 = 1500\ \text{mm Hg}$ $P_2 = x\ \text{mm Hg}$

$V_1 = 5\ \text{L}$ $V_2 = 25\ \text{L}$

$T_1 = 2000\ \text{K}$ $T_2 = 1750\ \text{K}$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(1500\ \text{mm Hg})(5\ \text{L})}{2000\ \text{K}} = \frac{(P_2)(25\ \text{L})}{1750\ \text{K}}$$

$P_2 = 262.5\ \text{mm Hg}$

6. The temperature of a gas increases from 212°C to 380°C. The volume goes from 30 dm^3 to 18 dm^3. If the final pressure is 1.85 atm, what was the initial pressure?

$P_1 = x\ \text{atm}$ $P_2 = 1.85\ \text{atm}$

$V_1 = 30\ \text{dm}^3$ $V_2 = 18\ \text{dm}^3$

$T_1 = 212^\circ\text{C} + 273 = 485\ \text{K}$ $T_2 = 380^\circ\text{C} + 273 = 653\ \text{K}$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(P_1)(30\ \text{dm}^3)}{485\ \text{K}} = \frac{(1.85\ \text{atm})(18\ \text{dm}^3)}{653\ \text{K}}$$

$P_1 = 0.82\ \text{atm}$

The Combined Gas Law

1.

$P_1 = 120\ kPa$ $P_2 = 50\ kPa$

$V_1 = 45\ L$ $V_2 = 40\ L$

$T_1 = 81^oC + 273 = 354\ K$ $T_2 = x\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(120\ kPa)(45\ L)}{354\ K} = \frac{(50\ kPa)(40\ L)}{T_2}$$

$T_2 = 131\ K \quad \Rightarrow \quad K - 273 = {}^oC$

$131\ K - 273 = {}^oC$

${}^oC = -142^oC$

2.

$P_1 = 100\ kPa$ $P_2 = 150\ kPa$

$V_1 = 21\ dm^3$ $V_2 = 14\ dm^3$

$T_1 = x\ K$ $T_2 = 300\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(100\ kPa)(21\ dm^3)}{T_1} = \frac{(150\ kPa)(14\ dm^3)}{300\ K}$$

$T_1 = 300\ K$

3.

$P_1 = 280\ kPa$ $P_2 = 380\ kPa$

$V_1 = 18\ dm^3$ $V_2 = x\ dm^3$

$T_1 = 500\ K$ $T_2 = 350\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(280\ kPa)(18\ dm^3)}{500\ K} = \frac{(380\ kPa)(x\ dm^3)}{350\ K}$$

$V_2 = 9.3\ dm^3$

4.

$P_1 = 75\ kPa$ $P_2 = 53\ kPa$

$V_1 = 12\ L$ $V_2 = x\ dm^3$

$T_1 = 27^oC + 273 = 300\ K$ $T_2 = 93^oC + 273 = 366\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(75\ kPa)(12\ L)}{300\ K} = \frac{(53\ kPa)(x\ L)}{366\ K}$$

$V_2 = 20.7\ L$

5.

$P_1 = 1500\ mm\ Hg$ $P_2 = x\ mm\ Hg$

$V_1 = 5\ L$ $V_2 = 25\ L$

$T_1 = 2000\ K$ $T_2 = 1750\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(1500\ mm\ Hg)(5\ L)}{2000\ K} = \frac{(x\ kPa)(25\ L)}{1750\ K}$$

$P_2 = 262.5\ mm\ Hg$

6.

$P_1 = x\ atm$ $P_2 = 1.85\ atm$

$V_1 = 30\ dm^3$ $V_2 = 18\ dm^3$

$T_1 = 212^oC + 273 = 485\ K$ $T_2 = 380^oC + 273 = 653\ K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(x\ atm)(30\ dm^3)}{485\ K} = \frac{(1.85\ atm)(18\ dm^3)}{653\ K}$$

$P_1 = 0.82\ atm$

Answers: 1. -142^oC 2. 300 K 3. 9.3 dm^3 4. 20.7 L 5. 262.5 mm Hg 6. 0.82 atm