Name _____ Hour _____

Mixed Gas Law Problems

Honors Chemistry

Determine which gas law is used and solve the following problems:

- ***All answers should be in grams, liters, atmospheres, or Kelvin.***

1. Chlorine gas occupies a volume of 1.2-L at 0.947-atm of pressure. What volume will it occupy at 1.00-atm assuming the temperature remains constant? Boyle's Law

$P_1 = .947\ atm \quad P_2 = 1.00\ atm$

$V_1 = 1.2\ L \quad V_2 = ?$

$$V_2 = \frac{P_1 \times V_1}{P_2} = \frac{(.947\ atm)(1.2\ L)}{1.00\ atm} = \boxed{1.1\ L}$$

2. Hydrogen gas was cooled from 150°C to 50 °C at a constant pressure. Its new volume is 75.0-mL, what was its original volume? Charles' Law

$V_1 = ? \quad V_2 = .075\ L$

$T_1 = 423\ K \quad T_2 = 323\ K$

$$V_1 = \frac{V_2 \times T_1}{T_2} = \frac{(.075\ L)(423\ K)}{323\ K} = \boxed{.098\ L}$$

3. What mass of Cl_2, in grams, is contained in a 10.0-L tank at 27.0°C and 3.5-atm of pressure? Ideal Gas Law

$P = 3.5\ atm \quad n = ?$

$V = 10.0\ L \quad T = 300\ K$

$$n = \frac{PV}{RT} = \frac{(3.5\ atm)(10.0\ L)}{(.0821\ \frac{L \cdot atm}{mol \cdot K})(300\ K)} = 1.42\ mol$$

$$\frac{1.42\ mol}{1} \times \frac{71\ g}{1\ mol} = \boxed{100.9\ g}$$

4. A mass of Fluorine gas exerts a pressure of 120-kPa. With temperature remaining constant, the pressure decreased by 24-kPa changing the volume to 250-mL. What was the original volume? Boyle's Law

$P_1 = 1.18\ atm \quad P_2 = .948\ atm$

$V_1 = ? \quad V_2 = .250\ L$

$$V_1 = \frac{P_2 \times V_2}{P_1} = \frac{(.948\ atm)(.250\ L)}{1.18\ atm} = \boxed{.201\ L}$$

5. A mass of unknown gas occupies 5.05-L at 27.5 °C and 0.938-atm. What is its new volume at STP? Combined gas law

$P_1 = .938\ atm \quad P_2 = 1.00\ atm$

$V_1 = 5.05\ L \quad V_2 = ?$

$T_1 = 300.5\ K \quad T_2 = 273\ K$

$$V_2 = \frac{P_1 \times V_1 \times T_2}{T_1 \times P_2} = \frac{(.938\ atm)(5.05\ L)(273\ K)}{(300.5\ K)(1.00\ atm)} = \boxed{4.30\ L}$$

6. What pressure will 2.07-kg of N_2O gas exert when placed in a 14.1 L container and it's stored at 72.0°C? Ideal gas law

$P = ? \quad n = 47.0\ mol$

$V = 14.1\ L \quad T = 345\ K$

$$\frac{2070\ g}{1} \times \frac{1\ mol}{44\ g} = 47.0\ mol$$

$$P = \frac{nRT}{V} = \frac{(47.0\ mol)(.0821\ \frac{L \cdot atm}{mol \cdot K})(345\ K)}{14.1\ L} = \boxed{94.4\ atm}$$

7. A sample of argon gas in a rigid container with constant volume is cooled down. If a manometer reads 1.46-atm when the gas temperature was at 97°C, what would the pressure of the gas be when the system reaches 0°C?

Gay-Lussac's Law

$P_1 = 1.46\ atm \quad P_2 = ?$

$T_1 = 370\ K \quad T_2 = 273\ K$

$$P_2 = \frac{P_1 \times T_2}{T_1} = \frac{(1.46\ atm)(273\ K)}{370\ K} = \boxed{1.08\ atm}$$

8. A gas occupied 355-mL at a pressure of 0.982-atm and a temperature of 22 °C. The pressure increases 0.11-atm and the temperature drops 7 °C, what is the new volume? Combined gas law

$P_1 = .982\text{atm}$ $P_2 = 1.092\text{ atm}$
$V_1 = .355\text{L}$ $V_2 = ?$
$T_1 = 295\text{K}$ $T_2 = 288\text{K}$

$$V_2 = \frac{P_1 \times V_1 \times T_2}{T_1 \times P_2} = \frac{(.982\text{atm})(.355\text{L})(288\text{K})}{(295\text{K})(1.092\text{ atm})} = \boxed{.312\text{ L}}$$

9. A mass of helium at constant pressure has a volume of 3.8-L at -45°C. What volume will it occupy at 45°C? Charles' Law

$V_1 = 3.8\text{L}$ $V_2 = ?$
$T_1 = 228\text{K}$ $T_2 = 318\text{K}$

$$V_2 = \frac{V_1 \times T_2}{T_1} = \frac{(3.8\text{L})(318\text{K})}{228\text{ K}} = \boxed{5.3\text{L}}$$

10. Determine the "mass" of CO_2 gas that has a volume of 7.1-L at a pressure of 112.4-kPa and a temperature of 31.0°C Ideal gas Law

$P = 1.110\text{atm}$ $n = ?$
$V = 7.1\text{L}$ $T = 304\text{K}$

$$n = \frac{PV}{RT} = \frac{(1.110\text{ atm})(7.1\text{L})}{(.0821\frac{\text{L·atm}}{\text{mol·K}})(304\text{K})} = .316\text{ mol}$$

$$\frac{.316\text{ mol}}{1} \times \frac{44\text{g}}{1\text{ mol}} = \boxed{14\text{g}}$$

11. A container with an initial volume of 1.0-L has a pressure of 1.48-atm at 25°C. The temperature is raised 100°C, changing the pressure of the gas to 5.92-atm. What is the new volume? Combined gas law

$P_1 = 1.48\text{atm}$ $P_2 = 5.92\text{ atm}$
$V_1 = 1.0\text{ L}$ $V_2 = ?$
$T_1 = 298\text{K}$ $T_2 = 398\text{K}$

$$V_2 = \frac{P_1 \times V_1 \times T_2}{T_1 \times P_2} = \frac{(1.48\text{ atm})(1.0\text{L})(398\text{K})}{(298\text{K})(5.92\text{ atm})} = \boxed{0.33\text{ -L}}$$

12. If 4.0 moles of a gas at a pressure of 5.4 atmospheres has a volume of 120.0 -L, what is the temperature? Ideal gas Law

$P = 5.4\text{ atm}$ $n = 4.0\text{ mol}$
$V = 120.0\text{ L}$ $T = ?$

$$T = \frac{PV}{nR} = \frac{(5.4\text{ atm})(120.0\text{L})}{(4.0\text{ mol})(.0821\frac{\text{L·atm}}{\text{mol·K}})} = \boxed{1973\text{ K}}$$

13. A given mass of gas has a pressure of 0.829-atm and a temperature of 35 °C. When the gas is heated an additional 230 degrees, what will the new pressure be in a rigid container? Gay-Lussac's Law

$P_1 = .829\text{ atm}$ $P_2 = ?$
$T_1 = 308\text{K}$ $T_2 = 538\text{K}$

$$P_2 = \frac{P_1 \times T_2}{T_1} = \frac{(.829\text{atm})(538\text{K})}{308\text{ K}} = \boxed{1.45\text{ atm}}$$

14. A solid metal cylinder has a volume of 260.0-L with an internal pressure of 760-torr. If the sun heats it from a temperature of 20° C to a temperature of 55° C, what will the new internal pressure be if mass remains constant? Gay-Lussac's Law

$P_1 = 1.0\text{atm}$ $P_2 = ?$
$T_1 = 293\text{K}$ $T_2 = 328\text{K}$

$$P_2 = \frac{P_1 \times T_2}{T_1} = \frac{(1.0\text{atm})(328\text{K})}{293\text{ K}} = \boxed{1.1\text{ atm}}$$