Answer Key

Gas Laws Practice One

1. A sample of nitrogen gas, N_2, occupies 3.0 L at a pressure of 3.0 atm. What volume will it occupy when the pressure is changed to 0.50 atm and the temperature remains constant? (Boyle's Law)

$P_1V_1 = P_2V_2 \quad V_2 = \frac{P_1V_1}{P_2} = \frac{(3.0)(3.0)}{0.5} = 18\,L$

2. A sample of methane gas, CH_4, occupies 4.50 L at a temperature of 20°C. If the pressure is held constant, what will be the volume of the gas at 100.0°C? (Charles' Law)

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad V_2 = \frac{V_1T_2}{T_1} = \frac{(4.50)(373)}{(273)} = 5.73\,L$

3. The pressure of hydrogen gas in a constant-volume cylinder is 4.25 atm at 0°C. What will the pressure be if the temperature is raised to 80.0°C? (Gay-Lussac's Law)

$\frac{P_1}{T_1} = \frac{P_2}{T_2} \quad P_2 = \frac{P_1T_2}{T_1} = \frac{(4.25)(353)}{(273)} = 5.50\,atm$

4. A 325 mL sample of air is at 720.0 torr and 30.0°C. What volume will this gas occupy at 800.0 torr and 75.0°C? (Combined Gas Law)

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \quad V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{(720.0)(325)(348)}{(800.0)(303)} = 336\,mL$

5. A sample of gas occupies 500.0mL at STP. What volume will the gas occupy at 85.0°C and 525 torr? (Combined Gas Law)

$V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{(1.00)(500.0)(358)}{(525/760)(273)} = 949\,mL$

6. A quantity of oxygen occupies a volume of 19.2L at STP. How many moles of oxygen are present? (Ideal Gas Law)

$n = \frac{PV}{RT} = \frac{(1.00)(19.2L)}{(0.0821)(273)} = 0.857\,mol$

7. A 425 mL volume of hydrogen chloride gas, $HCl_{(g)}$, is collected at 25°C and 720.0 torr. What volume will it occupy at STP? (Combined Gas Law)

$V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{(720.0)(425)(273)}{(760.0)(298)} = 369\,mL$

8. What volume would 10.5 g of nitrogen gas, N_2, occupy at 200.0K and 2.02 atm? (Ideal Gas Law and Molar Mass)

$10.5\,g\,N_2 \times \frac{1\,mol}{28.028} = 0.375\,mol \quad V = \frac{nRT}{P} = \frac{(0.375)(0.0821)(200)}{2.02} = 3.05\,L$

9. Calculate the density of sulfur dioxide, SO_2, at STP. (Ideal Gas Law and Density)

MM SO_2 = 64.06g

$V = \frac{nRT}{P} \quad d = \frac{mass}{volume} \quad d = \frac{m_m \cdot P}{RT} \quad \frac{(64.06)(1)}{(0.0821)(273)} = 2.86\,g/L$

10. In a laboratory experiment, 133mL of gas was collected over water at 24°C and 742 torr. Calculate the volume that the dry gas would occupy at STP. (Ideal Gas Law and Water Vapor Pressure)

$V_{WET} = 133mL \quad P_{TOT} = 742\,torr \quad P_{H_2O} = 22.4\,mmHg$ (from chart) $742 - 22.4 = 719.6\,torr$

$V_2 = P_1V_1T_2/P_2T_1 = (719.6)(133)(273)/(760)(297) = 116\,mL$

11. A volume of 122 mL of argon, Ar, is collected at 50.0 °C and 758 torr. What does this sample weigh? (Ideal Gas Law and Molar Mass)

$n = \frac{PV}{RT} = \frac{(\frac{758}{760})(0.122L)}{(0.0821)(323)} = 0.0045884$

$0.0045884 \times \frac{39.95\,g}{mol} = 0.183\,g\,Ar$

↳ #9 (alternate) $\frac{64.06\,g/mol}{22.4\,L/mol} = 2.86\,g/L$