*and 9-12 on Gas Laws (2). #64

Ideal Gas Law Problems

Use the ideal gas law to solve the following problems:

1) If I have 4 moles of a gas at a pressure of 5.6 atm and a volume of 12 liters, what is the temperature?

$PV = nRT$ $\quad T = \frac{PV}{nR} = \frac{(5.6\ atm)(12\ L)}{(4\ mol)\left(0.0821 \frac{atm \cdot L}{mol \cdot K}\right)}$

205 K or **T = 200 K**

2) If I have an unknown quantity of gas at a pressure of 1.2 atm, a volume of 31 liters, and a temperature of 87 °C, how many moles of gas do I have?

$PV = nRT$ $\quad n = \frac{PV}{RT} = \frac{(1.2\ atm)(31\ L)}{\left(0.0821 \frac{atm \cdot L}{mol \cdot K}\right)(360.15\ K)}$

$T = 87°C + 273.15 = 360.15\ K$ $\quad 1.2\ mol$ or **n = 1.3 moles**

3) If I contain 3 moles of gas in a container with a volume of 60 liters and at a temperature of 400 K, what is the pressure inside the container?

$\frac{PV}{V} = \frac{nRT}{V}$ $\quad P = \frac{(3\ mol)\left(0.0821 \frac{atm \cdot L}{mol \cdot K}\right)(400\ K)}{60\ L}$

$P = \frac{nRT}{V}$ $\quad 1.64\ atm$ or **P = 2 atm**

4) If I have 7.7 moles of gas at a pressure of 0.09 atm and at a temperature of 56 °C, what is the volume of the container that the gas is in?

$T = 52°C + 273.15 = 329.15\ K$

$\frac{PV}{P} = \frac{nRT}{P}$ $\quad V = \frac{(7.7\ mol)\left(0.0821 \frac{atm \cdot L}{mol \cdot K}\right)(329.15\ K)}{0.09\ atm}$

$V = \frac{nRT}{P}$ $\quad 2310\ L$ or **V = 2000 L**

5) If I have 17 moles of gas at a temperature of 67 °C, and a volume of 88.89 liters, what is the pressure of the gas?

$T = 67°C + 273.15 = 340.15\ K$

$\frac{PV}{V} = \frac{nRT}{V}$ $\quad P = \frac{(17\ mol)\left(0.0821 \frac{atm \cdot L}{mol \cdot K}\right)(340.15\ K)}{88.89\ L}$

$P = \frac{nRT}{V}$ $\quad P = 5.34\ atm$ or **5.3 atm**

6) If I have an unknown quantity of gas at a pressure of 0.5 atm, a volume of 25 liters, and a temperature of 300 K, how many moles of gas do I have?

$\frac{PV}{RT} = \frac{nRT}{RT}$ $\quad n = \frac{(0.5\ atm)(25\ L)}{\left(0.0821 \frac{atm \cdot L}{mol \cdot K}\right)(300\ K)}$ $\quad$ **n = 0.5 mol**

$n = \frac{PV}{RT}$

7) If I have 21 moles of gas held at a pressure of 78 atm and a temperature of 900 K, what is the volume of the gas?

$\frac{PV}{P} = \frac{nRT}{P}$

$V = \frac{nRT}{P}$

$V = \frac{(21\ \text{mol})\left(0.0821\ \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}}\right)(900\ \text{K})}{78\ \text{atm}}$

$V = 19.9\ \text{L}$ or **20 L**

8) If I have 1.9 moles of gas held at a pressure of 5 atm and in a container with a volume of 50 liters, what is the temperature of the gas?

$\frac{PV}{nR} = \frac{nRT}{nR}$

$T = \frac{PV}{nR}$

$T = \frac{(5\ \text{atm})(50\ \text{L})}{(1.9\ \text{mol})\left(0.0821\ \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}}\right)}$

$T = 1603\ \text{K}$ or **2000 K**

9) If I have 2.4 moles of gas held at a temperature of 97 °C and in a container with a volume of 45 liters, what is the pressure of the gas? $97\ ^\circ\text{C} + 273.15 = 370.15\ \text{K}$

$\frac{PV}{V} = \frac{nRT}{V}$

$P = \frac{nRT}{V}$

$P = \frac{(2.4\ \text{mol})\left(0.0821\ \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}}\right)(370.15\ \text{K})}{45\ \text{L}}$

$P = 1.62$ or **1.6 atm**

10) If I have an unknown quantity of gas held at a temperature of 1195 K in a container with a volume of 25 liters and a pressure of 560 atm, how many moles of gas do I have?

$\frac{PV}{RT} = \frac{nRT}{RT}$

$n = \frac{PV}{RT}$

$n = \frac{(560\ \text{atm})(25\ \text{L})}{\left(0.0821\ \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}}\right)(1195\ \text{K})}$

$n = 143\ \text{mol}$ or **140 mol**

11) If I have 0.275 moles of gas at a temperature of 75 K and a pressure of 1.75 atmospheres, what is the volume of the gas?

$\frac{PV}{P} = \frac{nRT}{P}$

$V = \frac{nRT}{P}$

$V = \frac{(0.275\ \text{mol})\left(0.0821\ \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}}\right)(75\ \text{K})}{1.75\ \text{atm}}$

$V = 0.968$ or **0.97 L**

12) If I have 72 liters of gas held at a pressure of 3.4 atm and a temperature of 225 K, how many moles of gas do I have?

$\frac{PV}{RT} = \frac{nRT}{RT}$

$n = \frac{PV}{RT}$

$n = \frac{(3.4\ \text{atm})(72\ \text{L})}{\left(0.0821\ \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}}\right)(225\ \text{K})}$

$n = 13.3$ or **13 mol**