Answer key

11/10/25

Gases

List some characteristics of gases?

Physical properties = similiar

Expand to fill containers / spaces

Highly compressible

Low densities (large volumes)

What type of mixture do gasses form?

Homogenous mixture ← pure air

↳ uniform in mixture

What are the properties of a gas sample?

Temp

– ↑ temp → ↑ kinetic energy

volume = amount of space taken up

pressure = amount of force applied to an area

What are the units for standard atmospheric pressure?

1 atm = 760 torr = 760 mmHg = 101.325 kPa

Convert 0.457atm to torr

$$\frac{0.457\ \text{atm} \times 760\ \text{torr}}{1\ \text{atm}} = \boxed{347\ \text{torr}}$$

Convert 137.4 kPa to torr

$$\frac{137.4\ \text{kPa} \times 760\ \text{torr}}{101.325\ \text{kPa}} = \boxed{1031\ \text{torr}}$$

What are ideal gasses?

At high temps + low pressure

↳ gases far apart

What is the combined gas law equation?

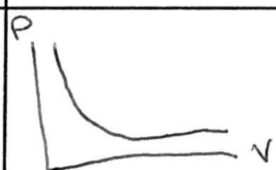
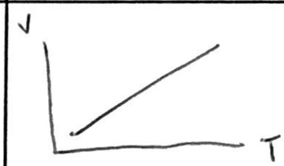
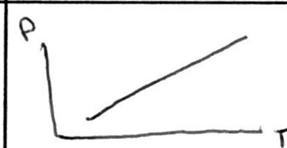
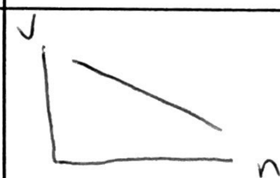
$$\frac{P_1V_1}{T_1n_1} = \frac{P_2V_2}{T_2n_2}$$

P = pressure

V = volume

T = temp

n = mole

Gas Law	Equation	Properties	Graph
Boyle's Law * Inversely *	$P_1V_1 = P_2V_2$	P↑, V↓	
Charles' Law	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$	V↑, T↑	
Gay-Lussac's Law	$\frac{P_1}{T_1} = \frac{P_2}{T_2}$	P↑, T↑	
Avogadros's Law	$\frac{V_1}{n_1} = \frac{V_2}{n_2}$	V↓, n↓	

Standard volume @ STP

1 mol = 22.4L

What is STP?

Standard temp + pressure

T = 0°C or 273K

P = 1atm or 760 torr

Using Boyle's Law, what happens when volume is decreased?

Volume ↓ → Pressure ↑

Using Charles' Law, what happens when volume is decreased?

Volume ↓ → temp ↓

Using Gay-Lussac's Law, what happens when pressure is increased?

Pressure ↑ → temp ↑

Using Avogadro's Law, what happens when moles are increased?

moles ↑ → volume ↑

Gas pressure in a can is 2.5 atm at 25°C. Gas volume and amount of gas are constant, what is the pressure when heated to 454°C?

$P_1 = 2.5$ atm

$T_1 = 25°C \sim 298K$

$P_2 = ?$

$T_2 = 454°C \sim 727K$

$$\frac{P_1 \cancel{V_1}}{T_1 \cancel{n_1}} = \frac{P_2 \cancel{V_2}}{T_2 \cancel{n_2}}$$

$$T_2 \cdot \frac{P_1}{T_1} = \frac{P_2}{T_2} \cdot T_2$$

$$P_2 = \frac{P_1 T_2}{T_1}$$

$$P_2 = \frac{(2.5 \text{ atm})(727K)}{298K}$$

$$= \boxed{6.1 \text{ atm}}$$

A 0.52 mol gas sample is at 0.0°C and 2.0 atm. The final volume is half of the initial, and the final pressure is 2.2 atm. What is the final temp of the gas?

$n = 0.52$ ← stays constant

$T_1 = 0°C \sim 273K$

$P_1 = 2.0$ atm

$V_1 = 1L$

$V_2 = 0.5L$

$P_2 = 2.2$ atm

$T_2 = ?$

$$\frac{P_1 V_1}{T_1 \cancel{n_1}} = \frac{P_2 V_2}{T_2 \cancel{n_2}}$$

$$T_1 \cdot T_2 \cdot \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \cdot T_2 \cdot T_1$$

$$\frac{P_1 V_1 T_2}{P_1 V_1} = \frac{P_2 V_2 T_1}{P_1 V_1}$$

$$T_2 = \frac{P_2 V_2 T_1}{P_1 V_1}$$

$$T_2 = \frac{(2.2 \text{ atm})(0.5L)(273K)}{(2.0 \text{ atm})(1L)}$$

$$= \boxed{150K}$$

A gas at 25.0°C occupies 4.60 liters at a pressure of 1.00 atm, what is its volume at a pressure of 3.50 atm?

$T_1 = 25.0°C$ ← constant

$V_1 = 4.60\ L$

$P_1 = 1.00\ atm$

$V_2 = ?$

$P_2 = 3.50\ atm$

$$\frac{P_1V_1}{\cancel{T_1}\cancel{n_1}} = \frac{P_2V_2}{\cancel{T_2}\cancel{n_2}}$$

$$\frac{P_1V_1}{P_2} = \frac{P_2V_2}{P_2}$$

$$V_2 = \frac{P_1V_1}{P_2}$$

$$V_2 = \frac{(1.00atm)(4.60L)}{3.50\ atm} = \boxed{1.31L}$$

What is the ideal gas equation?

$$PV = nRT$$

$$R = 0.08206\ \frac{L \cdot atm}{mol \cdot K}$$

Calcium carbonate is decomposed into CO_2 and collected in a 250. mL flask. The gas has a pressure of 3.3 atm at a temp of 34°C. How many moles of CO_2 gas were generated?

$V = 250.\ mL \sim 0.250L$

$P = 3.3\ atm$

$T = 34°C \sim 307K$

$n = ?$

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

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

$$n = \frac{(3.3atm)(0.250L)}{\left(0.08206\ \frac{L \cdot atm}{mol \cdot K}\right)(307K)}$$

$$= \boxed{0.033\ moles\ CO_2}$$

What is the volume of 2.5 moles of a gas at a pressure of 1.2 atm and a temperature of 298 K?

$V = ?$

$n = 2.5\ moles$

$P = 1.2\ atm$

$T = 298K$

$$PV = nRT$$

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

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

$$V = \frac{(2.5moles)\left(0.08206\ \frac{L \cdot atm}{mol \cdot K}\right)(298K)}{1.2\ atm}$$

$$= \boxed{51L}$$