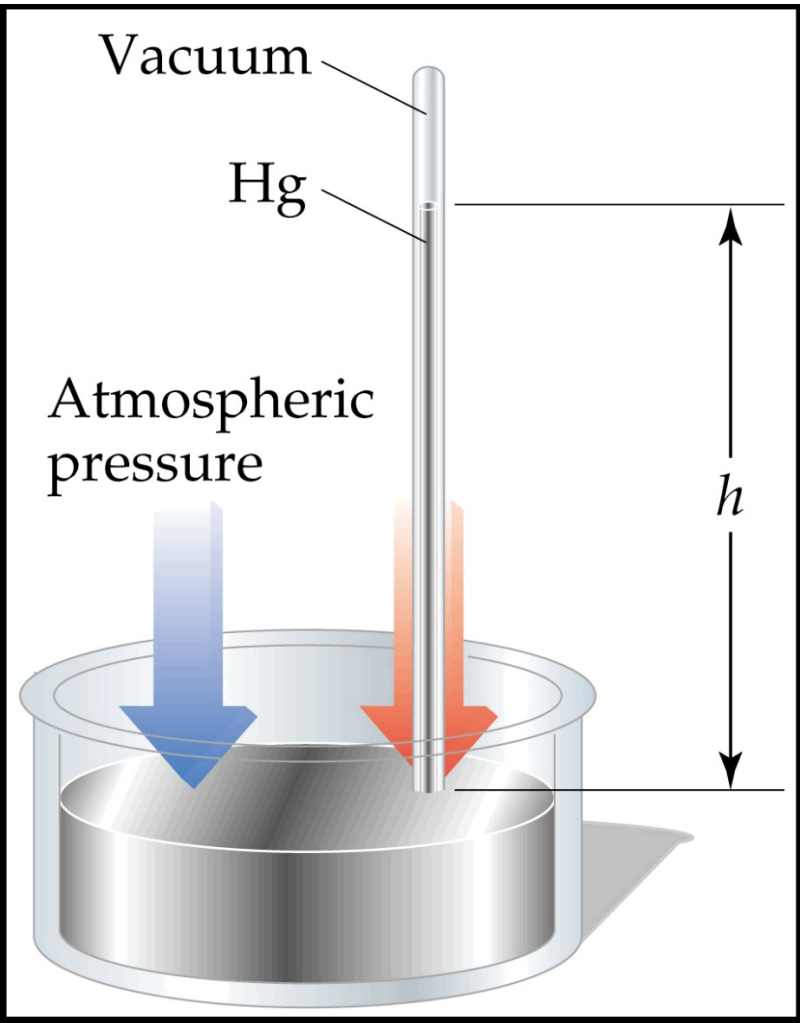
IB Chemistry Lesson 1.3

Gases

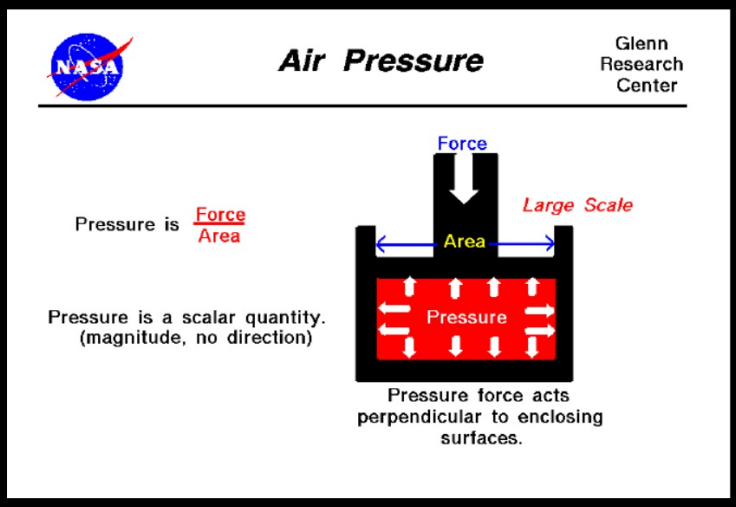
* Pressure - force per unit area.
  -Caused by collisions of particles with the walls of their container.
* Temperature - Measure of the average kinetic energy of the particles in a sample.

* Standard Temperature and Pressure (STP):
  0° C (273 K)
  1 atmosphere pressure (101.325 kPa, 760 torr)

* at STP, one mol of gas = 22.4 dm^3. (1.4.5)


Vacuum
Hg
Atmospheric
pressure
h

* How does each of the following affect the pressure of a gas?
    1. Increasing volume
    2. Increasing number of moles
    3. Increasing temperature



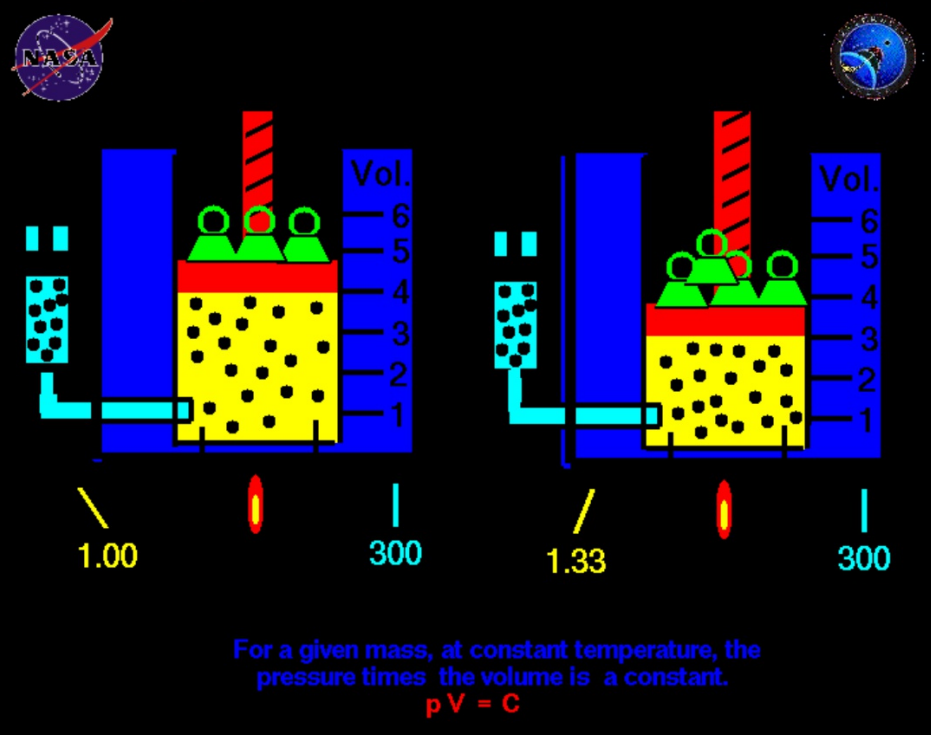
PV = k
P/T = k
P/n = k

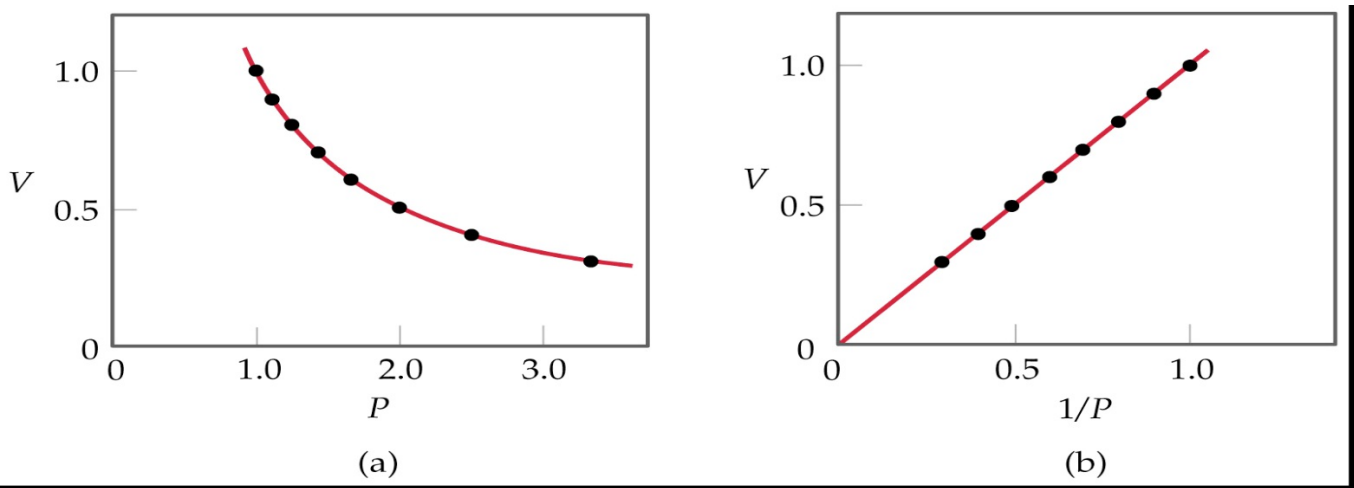
(1.4.6)

Boyle's Law: the volume of a fixed quantity of gas is inversely proportional to its pressure (assuming all other variables are unchanged).

$$P_1 V_1 = P_2 V_2$$

A plot of V versus P is a hyperbola.





1.4.8

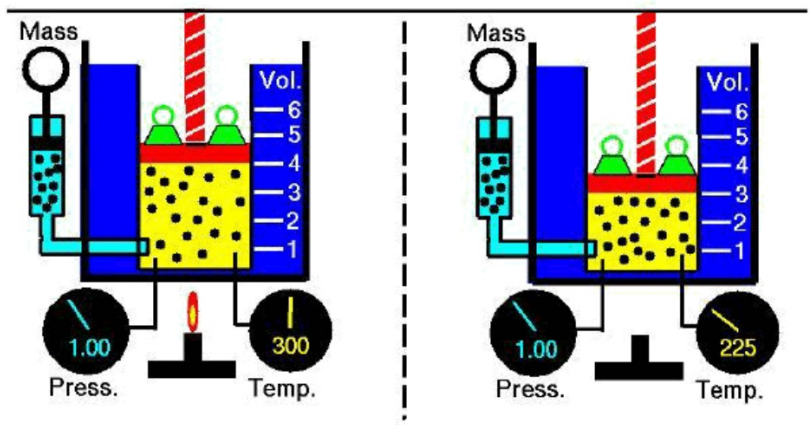
Examples

1. A gas that occupies 2.84 L has a pressure of 88.6 kPa. What would be the pressure of the gas sample if it only occupied 1.66 L (assuming the same temperature)?

2. A 10.0-L sample of argon gas has a pressure of 0.885 atm. At what volume would the sample have a pressure of 6.72 atm?

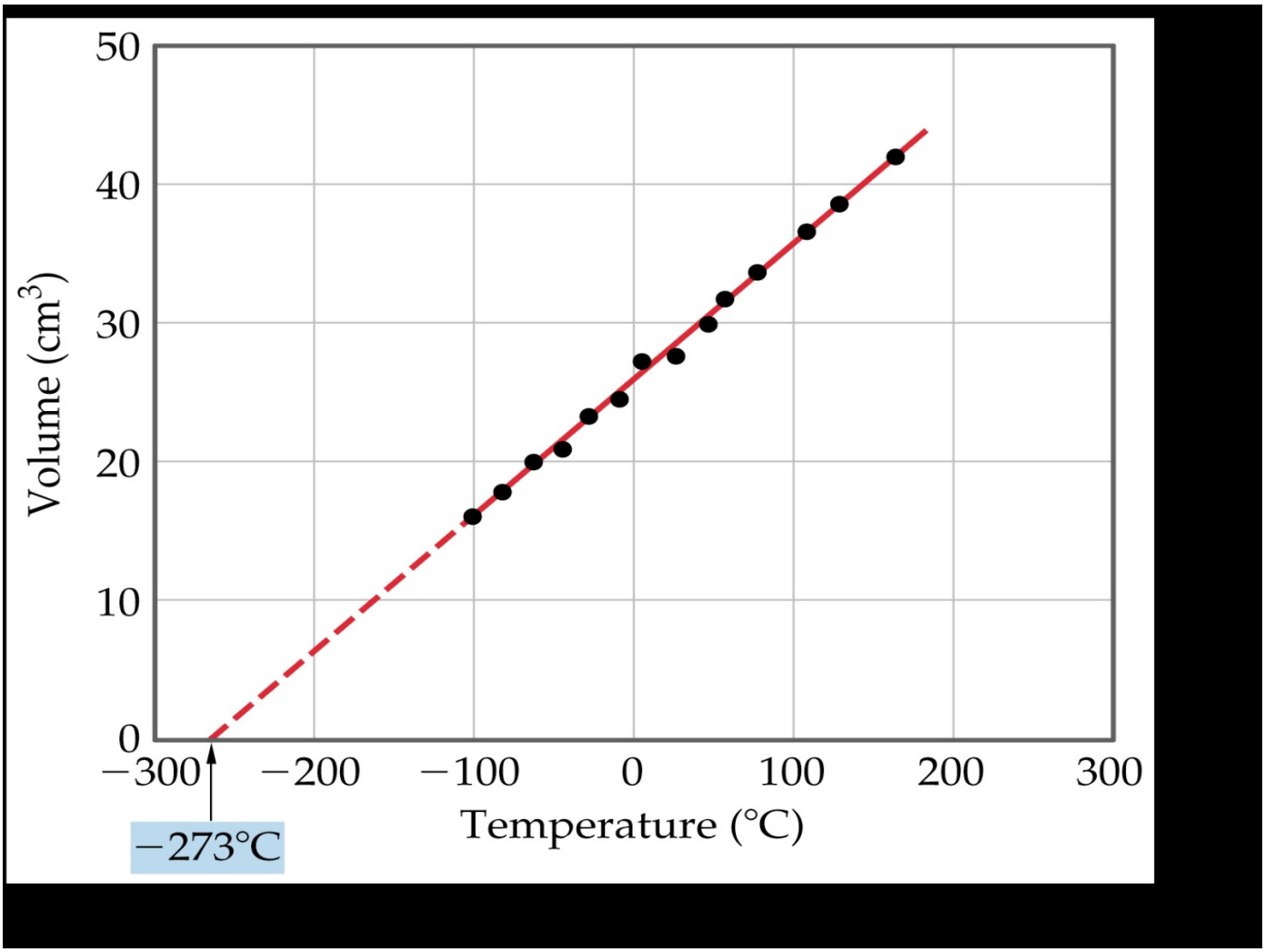
Charles's Law: the volume of a fixed quantity of gas at constant pressure increases as the temperature increases (assuming all other factors are constant).

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



For a given mass, at constant pressure, the volume is directly proportional to the temperature

V = C T


50
40
30
20
10
0
Volume (cm3)
−300
−200
−100
0
100
200
300
Temperature (°C)
−273°C

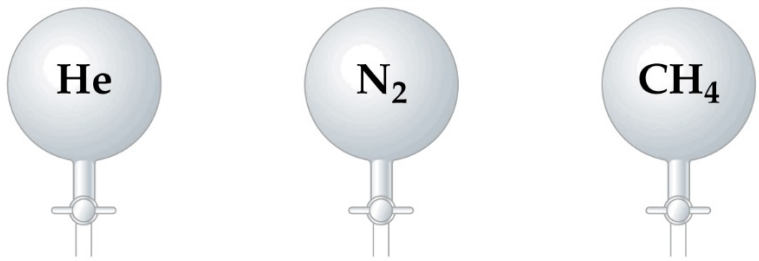
Examples

1. A gas sample occupies a volume of 1.89 L at 25°C. What would be the volume of the sample at 75°C?

2. A sample of carbon dioxide in a 5.00-L container has a temperature of 56.9°C. At what temperature will this sample of CO_2 occupy a volume of 3.00 L?

Avogadro's Law: the volume of gas at a given temperature and pressure is directly proportional to the number of moles of gas.

$$\frac{n_1}{V_1} = \frac{n_2}{V_2}$$



	He	N_2	CH_4
Volume	22.4 L	22.4 L	22.4 L
Pressure	1 atm	1 atm	1 atm
Temperature	0°C	0°C	0°C
Mass of gas	4.00 g	28.0 g	16.0 g
Number of gas molecules	6.02×10^{23}	6.02×10^{23}	6.02×10^{23}

Gay-Lussac'sLaw: At constant volume and moles of gas, pressure and temperature are directly proportional:

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

$$V \propto \frac{1}{P} \text{ (constant } n, T)$$

$$V \propto T \text{ (constant } n, P)$$

$$V \propto n \text{ (constant } P, T)$$

$$\longrightarrow \quad V \propto \frac{nT}{P}$$

The Ideal Gas Equation

$$V = R\left(\frac{nT}{P}\right)$$

$$PV = nRT$$

R = 0.08206 dm^3 atm mol^{-1} K^{-1} = 8.314 J mol^{-1} K^{-1}
= 62.4 dm^3 mm Hg mol^{-1} K^{-1} = 8.314 dm^3 kPa mol^{-1} K^{-1}

Examples

1. What is the volume of a 15.0-g sample of neon gas at 130.0 kPa and 39°C?

2. At what temperature will 2.85 moles of hydrogen gas occupy a volume of 0.58 dm^3 at 1.00 atm?

Solution: A homogeneous mixture.

*Solute - the component of a solution present in the smallest quantity.

*Solvent - the component of a solution present in the greatest quantity.

*Concentration - a measure of the relative amount of solute in a solution.

- measured in g dm^{-3} or mol dm^{-3}.

Molarity - moles of solute per cubic decimeter of solution. (mol dm^{-3})

Examples

1. What is the concentration of a solution created by dissolving 4.88 g of NaCl in enough water to make 106 cm^3 of solution?

2. How would you prepare 500 cm^3 of a solution that is 0.15 mol dm^{-3} in Na_2SO_4?