TH-GC General Chemistry Week 26 3/30

Universal Gas Constant

Jesus & Importance of units

~~8.314 J/mol·K~~

0.0821 atm·L/mol·K

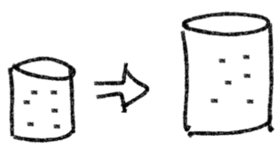
$P \cdot V \propto n \cdot T$ ← proportional to

$$PV = nRT \qquad PV = RnT$$

Ideal Gas Relationships [If all else is held constant]

As volume increases, pressure? decreases

$\downarrow P \uparrow V = nRT$



$$PV = nRT$$

As the number of moles decrease, absolute temperature? increases

$$PV = n\downarrow RT\uparrow$$

$K_E = \frac{1}{2}mv^2$

As temperature increases, pressure? increases

$$\uparrow PV = nRT\uparrow$$

What is the pressure of 1.8 moles (n) of an ideal gas with a 12.7 L volume and a temperature of 23 °C? $\{ R = 0.0821 \frac{atm \cdot L}{mol \cdot K} \}$

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

$$P = \frac{nRT}{V} = \frac{(1.8\ mol)(0.0821\ \frac{atm \cdot L}{mol \cdot K})(296\ K)}{12.7\ L}$$

$$\boxed{3.4\ atm}$$

$23°C + 273 = 296\ K$

What is the temperature of 2.2 mol of an ideal gas with a 1.9 atm pressure and a volume of 6.2 L? $R = 0.0821 \frac{atm \cdot L}{mol \cdot K}$

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

$$T = \frac{PV}{nR} = \frac{(1.9\ atm)(6.2\ L)}{(2.2\ mol)(0.0821\ \frac{atm \cdot L}{mol \cdot K})} = \boxed{65.2\ K}$$

What volume of carbon dioxide is produced from a reaction at 36 °C and 1.28 atm with 16.2 g of C_2H_6 and a seemingly infinite supply of oxygen?

$PV = nRT$

36+273 = T = 309 K

→ 2   7   4   6

$$C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$$

$$16.2\,g\ C_2H_6 * \frac{1\ mol\ C_2H_6}{30\,g\ C_2H_6} * \frac{4\ mol\ CO_2}{2\ mol\ C_2H_6} = 1.08\ mol\ CO_2 = n$$

$$V = \frac{nRT}{P} = \frac{(1.08\ mol)(0.0821)(309\,K)}{1.28\ atm}$$

21.4 L

What volume of carbon dioxide is produced from a reaction at 38 °C and 2.38 atm with 9.83 g of C_4H_{10} and a seemingly infinite supply of O_2?

$$C_4H_{10} + O_2 \longrightarrow CO_2 + H_2O$$

A 1.80 L (V) container of 3.72 g (mass) of an unknown ideal gas is measured at 1.38 atm (P) and 34.0 °C (T) what is the molar mass of the ideal gas?

$$PV = nRT$$

n = mol

$$mol = \frac{mass}{molar\ mass}$$

$$PV = \frac{mass\ R\ T}{molar\ mass}$$

$4 = \frac{12}{3}$

$3 = \frac{12}{4}$

$$\frac{34°C + 273}{307K}$$

$$molar\ mass = \frac{mass\ RT}{PV} = \frac{(3.72g)(0.0821)(307K)}{(1.38atm)(1.8L)}$$

31.7 g/mol

What is the partial pressure of oxygen if 2.80 mol of oxygen is combined with 1.68 mol of N_2 and 0.69 mol of CO_2 where the total pressure is 3.78 atm?

$$P_{O_2} = \left(\frac{\text{mol } O_2}{\text{tot mol of gases}}\right)(\text{tot pressure})$$

$$= \frac{2.8}{2.8 + 1.68 + 0.69} = \left(\frac{2.8}{5.17}\right)(3.78\text{ atm})$$

$$= \boxed{2.05\text{ atm}}$$

Kinetic Theory of Gases

$$E = mc^2 \qquad KE = \frac{1}{2}mv^2$$

$$\frac{r_1}{r_2} = \sqrt{\frac{MM_2}{MM_1}}$$