C11 - 3.2 - Mass/Moles/Volume/Density Notes

$\frac{g}{mol}$

$STP: \frac{22.4L}{mol}$

$D = \frac{m}{V}$

Calculate the molar mass of the following, assume 1 mol.

Cl $\quad mass\ Cl = 35.5g$ $\quad mass\ Cl = \frac{35.5g}{mol}$ $\quad \frac{g}{mol}$

N_2 $\quad mass\ N_2 = 2N = 2 \times 14g = 28g$ $\quad mass\ N_2 = \frac{28\ g}{mol}$ $\quad mass\ N = \frac{14\ g}{mol}$

H_2O $\quad mass\ H_2 = 2H = 2 \times \ 1g = \ 2g$

$mass\ O = 1O = 1 \times 16g = 16g$

$= 18g$ $\quad mass\ H_2O = \frac{18\ g}{mol}$ $\quad mass\ O = \frac{16\ g}{mol}$ $\quad mass\ H = \frac{1\ g}{mol}$

How many moles in 12g of carbon?

$Moles\ C = 12g\ C \times \frac{1\ mol}{12g} = 1\ mol\ C$

How many moles in 50g of H_2O?

$Moles\ H_2O = 50g\ H_2O \times \frac{1\ mol}{18g} = 2.78\ mol\ H_2O$

What is the mass of 3.5 moles of CO_2?

$g\ CO_2 = 3.5\ moles\ CO_2 \times \frac{44\ g}{1\ mol} = 154\ g\ C$

How many grams in 2 moles of Oxygen gas?

$2\ mol\ O_{2(g)} \times \frac{32g}{1\ mol\ O_{2(g)}} = 64\ g\ O_{2(g)}$ Diatomic

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Find Volume of 10.0 g $H_2S_{(g)}$ at STP. $STP: \frac{22.4L}{mol}$

$10.0\ g\ H_2S_{(g)} \times \frac{mol}{34.1g} = 0.2932\ mol$

$0.2932\ mol\ H_2S_{(g)} \times \frac{22.4L}{mol} = 6.57\ L\ H_2S_{(g)}$

OR

$10.0\ g\ H_2S_{(g)} \times \frac{mol}{34.1g} \times \frac{22.4L}{mol} = 6.57\ L\ H_2S_{(g)}$

Density: Mass per unit Volume

What is the density of an object with a mass of 100 g and a volume of 20 mL?

$D = \frac{m}{V}$ $\quad D = \frac{m}{V}$

$D = \frac{100}{20}$

$D = 5\frac{g}{mL}$

What is the volume of a 20 kg object with a density of 8 g/L?

$20kg \times \frac{1g}{10^{-3}kg} = 20000g$

OR

$20kg \times \frac{1g}{10^{-3}kg} \times \frac{1L}{8g} = 2500L$

$D = \frac{m}{V}$

$8 = \frac{20000}{V}$

$8V = 20000$

$V = \frac{20000}{8}$

$V = 2500\ L$

OR

Isolate 1st

$D = \frac{m}{V}$

$V = \frac{m}{D}$

$V = \frac{20000}{8}$

$V = 2500\ L$

Avagadros Hypothesis: Equal volumes of different gases, at the same temperature and pressure contain the same number of particles. $\frac{22.4L}{mol}$ *@ STP; Standard Temperature and Pressure*

$1\ atm, 0^0C$

$101.3\ kPa, 273.15\ K$

What is the volume occupied by 1 mol nitrogen gas at STP?

$Vol\ N_2 = 1\ mol \times \frac{22.4\ L}{mol} = 22.4\ L\ N_{2(g)}$

$SATP: 25^oC, 1atm, 24.8\ moles$

How many moles of carbon dioxide gas gas in a balloon with a volume of 50 L at STP?

$\#\ of\ mol\ CO_2 = 50\ L \times \frac{1\ mol}{22.4\ L} = 2.23\ mol\ CO_{2(g)}$

What is the density of 1 mol of carbon dioxide gas at STP?

$D = \frac{44g}{mol} \times \frac{1mol}{22.4L} = \frac{1.96g}{L}$

OR

$D = \frac{m}{V}$

$D = \frac{44g}{22.4L}$

$D = \frac{1.96g}{L}$