

BETH "KEY"

Mole Conversions Worksheet

There are three mole equalities. They are:

$$1 \text{ mol} = 6.022 \times 10^{23} \text{ particles}$$

$$1 \text{ mol} = \text{molar mass in grams (periodic table - red numbers)}$$

$$1 \text{ mol} = 22.4 \text{ L for a gas at STP}$$

Mole-Particle Conversions

1. How many moles of magnesium are in 3.01×10^{22} atoms of magnesium?

$$3.01 \times 10^{22} \text{ atoms Mg} \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms Mg}} = 0.04998 \xrightarrow{\text{s.f.}} 0.0500 \text{ mol Mg}$$

2. How many molecules are there in 4.00 moles of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$?

$$4.00 \text{ mol C}_6\text{H}_{12}\text{O}_6 \times \frac{6.022 \times 10^{23} \text{ molec}}{1 \text{ mol C}_6\text{H}_{12}\text{O}_6} = 2.41 \times 10^{24} \text{ molec C}_6\text{H}_{12}\text{O}_6$$

How many atoms of carbon?

$$2.41 \times 10^{24} \text{ molec C}_6\text{H}_{12}\text{O}_6 \times \frac{6 \text{ atoms C}}{1 \text{ molec C}_6\text{H}_{12}\text{O}_6} = 1.45 \times 10^{25} \text{ atoms C}$$

How many atoms of hydrogen?

$$2.41 \times 10^{24} \text{ molec C}_6\text{H}_{12}\text{O}_6 \times \frac{12 \text{ atoms H}}{1 \text{ molec C}_6\text{H}_{12}\text{O}_6} = 2.89 \times 10^{25} \text{ atoms H}$$

3. How many moles are 1.20×10^{25} atoms of phosphorus?

$$1.20 \times 10^{25} \text{ atoms P} \times \frac{1 \text{ mol P}}{6.022 \times 10^{23} \text{ atoms P}} = 19.9 \text{ mol P}$$

4. How many atoms are in 0.750 moles of zinc?

$$0.750 \text{ mol Zn} \times \frac{6.022 \times 10^{23} \text{ atoms Zn}}{1 \text{ mol Zn}} = 4.52 \times 10^{23} \text{ atoms Zn}$$

5. How many molecules are in 0.400 moles of N_2O_5 ?

$$0.400 \text{ mol N}_2\text{O}_5 \times \frac{6.022 \times 10^{23} \text{ molec N}_2\text{O}_5}{1 \text{ mol N}_2\text{O}_5} = 2.41 \times 10^{23} \text{ molec N}_2\text{O}_5$$

How many atoms of nitrogen?

$$2.41 \times 10^{23} \text{ molec N}_2\text{O}_5 \times \frac{2 \text{ atoms N}}{1 \text{ molec N}_2\text{O}_5} = 4.82 \times 10^{23} \text{ atoms N}$$

How many atoms of oxygen?

$$2.41 \times 10^{23} \text{ molec N}_2\text{O}_5 \times \frac{5 \text{ atoms O}}{1 \text{ molec N}_2\text{O}_5} = 1.21 \times 10^{24} \text{ atoms O}$$

Mole-Mass Conversions

MM CO₂ 1. How many moles in 28 grams of CO₂?

$$\begin{array}{r} 1 \text{ C} \times 12.01 = 12.01 \text{ g} \\ 2 \text{ O} \times 16.00 = 32.00 \text{ g} \\ \hline 44.01 \text{ g/mol} \end{array}$$

$$28 \text{ g CO}_2 \times \frac{1 \text{ mol}}{44.01 \text{ g CO}_2} = \boxed{0.64 \text{ mol CO}_2}$$

MM Fe₂O₃ 2. What is the mass of 5 moles of Fe₂O₃?

$$\begin{array}{r} 2 \text{ Fe} \times 55.85 = 111.70 \text{ g} \\ 3 \text{ O} \times 16.00 = 48.00 \text{ g} \\ \hline 159.70 \text{ g/mol} \end{array}$$

$$5 \text{ mol Fe}_2\text{O}_3 \times \frac{159.70 \text{ g}}{1 \text{ mol}} = 798.5 \text{ g} \xrightarrow{\text{s.f.}} \boxed{8 \times 10^2 \text{ g}}$$

3. Find the number of moles of argon in 452 g of argon.

$$\begin{array}{r} \text{MM Ar} \\ 39.95 \text{ g/mol} \end{array}$$

$$452 \text{ g Ar} \times \frac{1 \text{ mol}}{39.95 \text{ g Ar}} = \boxed{11.3 \text{ mol Ar}}$$

4. Find the grams in 1.26×10^{-4} mol of HC₂H₃O₂.

MM HC₂H₃O₂

$$\begin{array}{r} 4 \text{ H} \times 1.01 = 4.04 \text{ g} \\ 2 \text{ C} \times 12.01 = 24.02 \text{ g} \\ 2 \text{ O} \times 16.00 = 32.00 \text{ g} \\ \hline 60.06 \text{ g/mol} \end{array}$$

$$1.26 \times 10^{-4} \text{ mol HC}_2\text{H}_3\text{O}_2 \times \frac{60.06 \text{ g/mol}}{1 \text{ mol HC}_2\text{H}_3\text{O}_2} = \boxed{7.57 \times 10^{-4} \text{ g HC}_2\text{H}_3\text{O}_2}$$

5. Find the mass in 2.6 mol of lithium bromide.

MM LiBr

$$\begin{array}{r} 1 \text{ Li} \times 6.94 = 6.94 \text{ g} \\ 1 \text{ Br} \times 79.90 = 79.90 \text{ g} \\ \hline 86.84 \text{ g/mol} \end{array}$$

$$2.6 \text{ mol LiBr} \times \frac{86.84 \text{ g}}{1 \text{ mol LiBr}} = 226 \text{ g} \xrightarrow{\text{s.f.}} \boxed{230 \text{ g or } 2.3 \times 10^2 \text{ g LiBr}}$$

Mole-Volume Conversions

1. Determine the volume, in liters, occupied by 0.030 moles of a gas at STP.

$$0.030 \text{ mol} \times \frac{22.4 \text{ L (for any gas at STP)}}{1 \text{ mol}} = \boxed{0.67 \text{ L}}$$

2. How many moles of argon atoms are present in 11.2 L of argon gas at STP?

$$11.2 \text{ L Ar} \times \frac{1 \text{ mol}}{22.4 \text{ L}} = \boxed{0.500 \text{ mol Ar}}$$

3. What is the volume of 0.05 mol of neon gas at STP?

$$0.05 \text{ mol Ne} \times \frac{22.4 \text{ L}}{1 \text{ mol Ne}} = 1.12 \text{ L} \xrightarrow{\text{s.f.}} \boxed{1 \text{ L Ne}}$$

4. What is the volume of 1.2 moles of water vapor at STP?

$$1.2 \text{ mol H}_2\text{O} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = \boxed{27 \text{ L H}_2\text{O}}$$

Mixed Mole Conversions

1. How many oxygen molecules are in 3.36 L of oxygen gas at STP?

$$3.36 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.4 \text{ L}} \times \frac{6.022 \times 10^{23} \text{ molec O}_2}{1 \text{ mol O}_2} = \boxed{9.03 \times 10^{22} \text{ molec O}_2}$$

MM F_2
 $2F \times 19.00g = 38.00g/mol$

2. Find the mass in grams of 2.00×10^{23} molecules of F_2 .

$$2.00 \times 10^{23} \text{ molec } F_2 \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ molec } F_2} \times \frac{38.00g}{1 \text{ mol } F_2} = 12.6g F_2$$

MM N_2
 $28.02g/mol$

3. Determine the volume in liters occupied by 14 g of nitrogen gas at STP.

$$14g N_2 \times \frac{1 \text{ mol}}{28.02g N_2} \times \frac{22.4L N_2}{1 \text{ mol}} = 11L N_2$$

4. Find the mass, in grams, of 1.00×10^{23} molecules of N_2 .

$$1.00 \times 10^{23} \text{ molec } N_2 \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ molec } N_2} \times \frac{28.02g N_2}{1 \text{ mol}} = 4.65g N_2$$

5. How many particles are there in 1.43 g of a molecular compound with a gram molar mass of 233 g?

$$1.43g \times \frac{1 \text{ mol}}{233g} \times \frac{6.022 \times 10^{23} \text{ particles}}{1 \text{ mol}} = 3.70 \times 10^{21} \text{ particles}$$

6. Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed by G.D. Searle as Nutra Sweet. The molecular formula of aspartame is $C_{14}H_{18}N_2O_5$.

a) Calculate the molar mass of aspartame.

14C	x	12.01g	=	168.14g	} Add	294.34g/mol $C_{14}H_{18}N_2O_5$
18H	x	1.01g	=	18.18g		
2N	x	14.01g	=	28.02g		
5O	x	16.00g	=	80.00g		

b) How many moles of molecules are in 10 g of aspartame?

$$10g \times \frac{1 \text{ mol}}{294.34g} = 0.03 \text{ mol } C_{14}H_{18}N_2O_5$$

c) What is the mass in grams of 1.56 moles of aspartame?

$$1.56 \text{ mol } C_{14}H_{18}N_2O_5 \times \frac{294.34g}{1 \text{ mol}} = 459g C_{14}H_{18}N_2O_5$$

d) How many molecules are in 5 mg of aspartame?

$$5 \text{ mg} \times \frac{1g}{1000 \text{ mg}} \times \frac{1 \text{ mol}}{294.34g} \times \frac{6.022 \times 10^{23} \text{ molec}}{1 \text{ mol}} = 1 \times 10^{19} \text{ molec } C_{14}H_{18}N_2O_5$$

e) How many atoms of nitrogen are in 1.2 grams of aspartame?

$$1.2g C_{14}H_{18}N_2O_5 \times \frac{1 \text{ mol}}{294.34g} \times \frac{6.022 \times 10^{23} \text{ molec } C_{14}H_{18}N_2O_5}{1 \text{ mol}} \times \frac{2 \text{ atoms N}}{1 \text{ molec } C_{14}H_{18}N_2O_5} = 4.9 \times 10^{21} \text{ atoms N}$$