BETH "KEY"

Mole Conversions Worksheet

There are three mole equalities. They are:

1 mol = 6.022×10^{23} particles
1 mol = molar mass in grams (periodic table – red numbers)
1 mol = 22.4 L for a gas at STP

Mole-Particle Conversions

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

$$3.01 \times 10^{22} \text{ atoms Mg} \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms Mg}} = 0.04998$$

s.f. → **0.0500 mol Mg**

2. How many molecules are there in 4.00 moles of glucose, $C_6H_{12}O_6$?

$$4.00 \text{ mol } C_6H_{12}O_6 \times \frac{6.022 \times 10^{23} \text{ molec}}{1 \text{ mol } C_6H_{12}O_6} = \boxed{2.41 \times 10^{24} \text{ molec } C_6H_{12}O_6}$$

How many atoms of carbon?

$$2.41 \times 10^{24} \text{ molec } C_6H_{12}O_6 \times \frac{6 \text{ atoms C}}{1 \text{ molec } C_6H_{12}O_6} = \boxed{1.45 \times 10^{25} \text{ atoms C}}$$

How many atoms of hydrogen?

$$2.41 \times 10^{24} \text{ molec } C_6H_{12}O_6 \times \frac{12 \text{ atoms H}}{1 \text{ molec } C_6H_{12}O_6} = \boxed{2.89 \times 10^{25} \text{ atoms H}}$$

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

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

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

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

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

$$0.400 \text{ mol } N_2O_5 \times \frac{6.022 \times 10^{23} \text{ molec } N_2O_5}{1 \text{ mol } N_2O_5} = \boxed{2.41 \times 10^{23} \text{ molec } N_2O_5}$$

How many atoms of nitrogen?

$$2.41 \times 10^{23} \text{ molec } N_2O_5 \times \frac{2 \text{ atoms N}}{1 \text{ molec } N_2O_5} = \boxed{4.82 \times 10^{23} \text{ atoms N}}$$

How many atoms of oxygen?

$$2.41 \times 10^{23} \text{ molec } N_2O_5 \times \frac{5 \text{ atoms O}}{1 \text{ molec } N_2O_5} = \boxed{1.21 \times 10^{24} \text{ atoms O}}$$

Mole-Mass Conversions

MM CO_2
$1C \times 12.01 = 12.01\,g$
$2O \times 16.00 = 32.00\,g$
$44.01\,g/mol$

1. How many moles in 28 grams of CO_2 ?

$$28\,g\,CO_2 \times \frac{1\,mol}{44.01\,g\,CO_2} = \boxed{0.64\,mol\,CO_2}$$

MM Fe_2O_3
$2Fe \times 55.85 = 111.70\,g$
$3O \times 16.00 = 48.00\,g$
$159.70\,g/mol$

2. What is the mass of 5 moles of Fe_2O_3 ?

$$5\,mol\,Fe_2O_3 \times \frac{159.70\,g}{1\,mol} = 798.5\,g \xrightarrow{s.f.} \boxed{8 \times 10^2\,g}$$

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

MM Ar
$39.95\,g/mol$

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

4. Find the grams in 1.26×10^{-4} mol of $HC_2H_3O_2$.

MM $HC_2H_3O_2$
$4H \times 1.01 = 4.04\,g$
$2C \times 12.01 = 24.02\,g$
$2O \times 16.00 = 32.00\,g$
$\} 60.06\,g/mol$

$$1.26 \times 10^{-4}\,mol\,HC_2H_3O_2 \times \frac{60.06\,g/mol}{1\,mol\,HC_2H_3O_2} = \boxed{7.57 \times 10^{-4}\,g\,HC_2H_3O_2}$$

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

MM LiBr
$1Li \times 6.94 = 6.94\,g$
$1Br \times 79.90 = 79.90\,g$
$86.84\,g/mol$

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

Mole-Volume Conversions

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

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

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

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

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

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

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

$$1.2\,mol\,H_2O \times \frac{22.4\,L}{1\,mol} = \boxed{27\,L\,H_2O}$$

Mixed Mole Conversions

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

$$3.36\,L\,O_2 \times \frac{1\,mol\,O_2}{22.4\,L} \times \frac{6.022 \times 10^{23}\,molec\,O_2}{1\,mol\,O_2} = \boxed{9.03 \times 10^{22}\,molec\,O_2}$$

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

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

$$2.00\times10^{23}\ molec\ F_2 \times \frac{1\ mol}{6.022\times10^{23}\ molec\ F_2} \times \frac{38.00\ g}{1\ mol\ F_2} = \boxed{12.6\ g\ F_2}$$

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

MM N_2
$28.02\ g/mol$

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

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

$$1.00\times10^{23}\ molec\ N_2 \times \frac{1\ mol}{6.022\times10^{23}\ molec\ N_2} \times \frac{28.02\ g\ N_2}{1\ mol} = \boxed{4.65\ g\ N_2}$$

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

molar mass →

$$1.43\ g \times \frac{1\ mol}{233\ g} \times \frac{6.022\times10^{23}\ particles}{1\ mol} = \boxed{3.70\times10^{21}\ particles}$$

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.

14 C	×	12.01 g	= 168.14 g
18 H	×	1.01 g	= 18.18 g
2 N	×	14.01 g	= 28.02 g
5 O	×	16.00 g	= 80.00 g

} Add

$\boxed{294.34\ g/mol\ C_{14}H_{18}N_2O_5}$

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

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

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

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

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

$$5\ mg \times \frac{1\ g}{1000\ mg} \times \frac{1\ mol}{294.34\ g} \times \frac{6.022\times10^{23}\ molec}{1\ mol} = \boxed{1\times10^{19}\ molec\ C_{14}H_{18}N_2O_5}$$

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

$$1.2\ g\ C_{14}H_{18}N_2O_5 \times \frac{1\ mol}{294.34\ g} \times \frac{6.022\times10^{23}\ molec\ C_{14}H_{18}N_2O_5}{1\ mol} \times \frac{2\ atoms\ N}{1\ molec\ C_{14}H_{18}N_2O_5}$$

$$= \boxed{4.9\times10^{21}\ atoms\ N}$$