Determining the number of particles

Avogadro's Number

6.02×10^{23} particles = 1 mole

$\frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ particles}}$

Particle Types:

-- atoms Ag, Cu, He

-- ions Cl^-, NH_4^+, SO_4^{2-}, Ca^{2+}

cov. -- molecules O_2, H_2O, CO_2

ionic -- formula units NaCl, $CaSO_4$

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Converting to number of representative particles and back to moles

How many formula units are in 3.50 moles of NaCl?

$3.50 \text{ mol NaCl} \times \frac{6.02 \times 10^{23} \text{ form. u. NaCl}}{1 \text{ mol NaCl}} = 2.107 \times 10^{24} \text{ form. u. NaCl}$

2.11×10^{24} form. u. NaCl

3.5 x 6.02 2nd EE 23

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Converting to number of representative particles and back to moles

How many molecules are in 5.25 moles of water?

$5.25\ mol\ H_2O \times \frac{6.02\times10^{23}\ molec.\ H_2O}{1\ mol\ H_2O} = 3.1605\times10^{24}$

$3.16\times10^{24}\ molec.\ H_2O$

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Converting to number of representative particles and back to moles

How many moles are in 4.78 x 10^{22} atoms of Ag?

$\frac{10^{22}}{10^{23}} = 10^{-1}$

$4.78\times10^{22}\ atoms\ Ag \times \frac{1\ mol\ Ag}{6.02\times10^{23}\ atoms\ Ag} = .07944019$

$.0794\ mol\ Ag$

$(4.78\times10^{22})/(6.02\times10^{23})$

$7.94\times10^{-2}\ mol\ Ag$

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Molar Mass

Molar mass: mass of a compound or molecule in grams per mole

- use the periodic table to get the atomic mass/molar mass
- represents the number of grams in 1 mole
- converts from grams to moles

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Molar Mass

Determine the molar mass of the following compounds/molecules.

1. $CaCO_3$

Ca = 1 x 40 = 40 g/mol
C = 1 x 12 = 12 g/mol
O = 3 x 16 = 48 g/mol
100 g/mol

2. strontium hydroxide $Sr(OH)_2$

Sr = 1 x 88 = 88 g/mol
O = 2 x 16 = 32 g/mol
H = 2 x 1 = 2 g/mol
122 g/mol

3. chlorine gas Cl_2

Cl = 2 x 35 = 70 g/mol

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Converting with Molar Mass

How many grams are in 3.54 moles of He?

$$3.54 \text{ mol He} \times \frac{4 \text{ g He}}{1 \text{ mol He}} = 14.16 \text{ g He}$$

14.2 g He

He

He = 1 x 4 = 4 g / 1 mol

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Converting with Molar Mass

How many moles are in 238 g manganese (II) oxide?

MnO

$$238 \text{ g MnO} \times \frac{1 \text{ mol MnO}}{71 \text{ g MnO}} = 3.35211 \text{ mol MnO}$$

3.35 mol MnO

MnO

Mn = 1 x 55 = 55 g/mol
O = 1 x 16 = 16 g/mol
71 g/mol

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Calculations using multiple steps:

- Moles can convert you to any other unit.
- To convert between mass and particles, you need to go through moles!

Practice:

How many particles are in 50.0 g of iron (III) oxide? What is the particle type? — formula units

Fe_2O_3 (+3 = 2)

$50.0\ g\ Fe_2O_3 \times \frac{1\ mol\ Fe_2O_3}{160\ g\ Fe_2O_3} \times \frac{6.02\times10^{23}\ form.u.\ Fe_2O_3}{1\ mol\ Fe_2O_3} = 1.88\times10^{23}\ form.u.\ Fe_2O_3$

$Fe = 2 \times 56 = 112\ g/mol$

$O = 3 \times 16 = 48\ g/mol$

$160\ g/mol$

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