Calculate the mass percent of hydrogen in 0.692 g of water?

MW of H_2O = (2 x 1.008 g/mol) + 16.00 g/mol = 18.02 g/mol

mol of H_2O = 0.692 g x (1mol/18.02 g) = 0.03840 mol

mol of H = mol of H_2O x 2 = 2 x 0.03840 mol = 0.07680 mol

mass of H = 0.07680 mol x 1.008 g/mol = 0.07741 g

mass % of H = (0.07741 g/0.692) x 100 = 11.2%

Is this the easiest way to do this calculation?
Hint: Do we have extra information?

The molecular formula can give us mass percent directly!!

H_2O implies that there are two moles of H for every mole of O.

2 mol of H x (1.008 g/mol) = 2.016 g
1 mol of O = 16.00 g
1 mol of H_2O = 18.02 g

mass % of H = (2.016 g/18.02 g) x 100 = 11.19%

The mass % is <u>independent</u> of the weight of the compound it only depends on the molecular formula.

Thus, the mass % and the molecular formula are related.

Given that a molecule containing H and O has the following mass percent,

mass % of O = 94.1%

mass % of H = 5.93%

calculate the molecular formula.

Assume 100 g and convert to moles.

mol O = 94.1 g x (1 mol/16.00 g) = 5.88 mol
mol H = 5.93 g x (1 mol/1.008 g) = 5.88 mol

mol O/mol H = 1.00 = 1

Thus the molecular formula is OH. No that is the emprical formula which may or may not be the molecular formula.

What information is needed to determine if an empirical formula is a molecular formula?

The molecular weight
For this problem = 34.02 g/mol

If molecule was OH
1 mol H = 1.008 g
1 mol O = 16.00 g
1 mol OH = 17.01 g

Molar mass/Empirical formula mass =
34.02 g/17.01 g = 2.000 = 2

Thus molecule is H_2O_2 which is more in line with our chemical intuition.

An analysis of a chromium containing compound gives the following mass percentages: 17.5% Na, 39.7% Cr, and 42.8% O. What is the emiprical formula of this compound? (It is ionic so it has no molecular formula)

Assume 100. g and find number of moles of each element

17.5 g Na → 0.761 mol Na
39.7 g Cr → 0.763 mol Cr
42.8 g O → 3.52 mol O

Divide all the mole numbers by the smallest one.

Na → 1.00
Cr → 1.00
O → 3.52

Empirical Formula?
$Na_{1.0}Cr_{1.0}O_{3.5}$

No, formula must have all whole number subscripts.
$Na_2Cr_2O_7$

What is the name of this compound?
Sodium dichromate

Three Simple Steps for Balancing Reactions:

0) Write the molecular formula of each reactant of the left and each product on the right.

1) Assign a coefficient of 1 (which is <u>not</u> written explicitly) to the species which the largest number of elements.

2) Pick, one by one, those elements which appear in only one other species, and choose the coefficient of that species so that the number of moles of that element is the same on both sides of the equations.

3) (optional) Multiply all of the coefficients by a common factor to eliminate fractional values.

Balancing Chemical Reactions: Some Examples

___$KClO_3$ → ___KCl + ___O_2

___O_2 + ___PCl_3 → ___$POCl_3$

___P_4 + ___N_2O → ___P_4O_6 + ___N_2

___C_5H_{12} + ___O_2 → ___CO_2 + ___H_2O