1 Problem 1

A sample of magnesium phosphate contains x moles of $Mg_3(PO_4)_2$. Express each of the following quantities in terms of x.

a) The number of moles of phosphate ions in this sample
b) The number of moles of oxygen atoms in this sample
c) The number of phosphorus atoms in this sample
d) The mass of the sample, in grams
e) The number of grams of magnesium in this sample

1.1 Solution (a)

There are two phosphate ($PO_4{}^{3-}$) ions in each mole of $Mg_3(PO_4)_2$ (magnesium phosphate). Moles have the same ratio as the individual parts themselves. As such, there would have to be $\boxed{2x}$ phosphate ions.

1.2 Solution (b)

With four oxygen atoms per phosphate ion, there are $\boxed{8x}$ oxygen atoms.

1.3 Solution (c)

There is one phosphorus atom per phosphate ion, so $\boxed{2x}$ phosphorus atoms.

1.4 Solution (d)

Multiply the molar mass by the number of moles.

$$\begin{aligned} m &= x * MM(Mg_3(PO_4)_2) && (1)\\ &= x\,(3 * MM(\mathrm{Mg}) + 2 * MM(\mathrm{P}) + 8 * MM(\mathrm{O})) && (2)\\ &= x\,(3 * 24.31\mathrm{g/mol} + 2 * 30.97\mathrm{g/mol} + 8 * 16.00\mathrm{g/mol}) && (3)\\ &= x\,(72.93\mathrm{g/mol} + 61.94\mathrm{g/mol} + 128.0\mathrm{g/m}) = 262.87x\ \mathrm{g} && (4)\\ &\approx \boxed{262.9x\ \mathrm{g}} && (5) \end{aligned}$$

1.5 Solution (e)

We know there are $3x$ moles of Mg ions, using the strategy from part (a). Multiply this by the molar mass of Mg to get the total molar mass.

2 Problem 2

You have x grams of $Na_2Cr_2O_7$. Express each of the following quantities in terms of x.

a) The number of moles of $Na_2Cr_2O_7$
b) The number of moles of O
c) The number of grams of O
d) The number of O atoms

2.1 Solution