Conversions Using Moles, Grams, Molecules, and Ions

1. How many moles are in 63.25 g of $Fe_3(PO_4)_2$?

$g \rightarrow$ mols

We have 3 Fe, 2 P, and 8 O
Calculate the molar mass of $Fe_3(PO_4)_2$.
3 x 55.845 g/mol + 2 x 30.974 g/mol + 8 x 15.9994 g/mol = 357.478 g/mol

$$63.25\ g\ \times \frac{1\ mol}{357.478\ g} = \mathbf{0.177\ mol}$$

2. A sample contains 3.26 moles of C_3H_8. How many grams of C_3H_8 does this correspond to?
The molar mass of C_3H_8 is
3 x 12.011 g/mol + 8 x 1.00794 g/mol = 44.096 g/mol
1 mole C_3H_8 = 44.096 g

$$3.26\ mol\ C_3H_8 \times \frac{44.096\ g\ C_3H_8}{1\ mol\ C_3H_8} = \mathbf{144\ g\ C_3H_8}$$

3. How many sodium ions are in one mole of sodium carbonate, Na_2CO_3?
moles $Na_2CO_3 \rightarrow$ moles Na $\rightarrow$ number of ions
There are 2 moles of sodium ions in 1 mole of Na_2CO_3.
1 mole of ions = 6.02 x 10^{23} ions

$$1\ mole\ Na_2CO_3 \times \frac{2\ mol\ Na^+}{1\ mole\ Na_2CO_3} \times \frac{6.02 \times 10^{23}\ ions}{1\ mol\ Na^+} = \mathbf{1.20 \times 10^{24}\ Na^+\ ions}$$

4. How many acetaldehyde (C_2H_4O) molecules are in 232.25 g?
Calculate the molar mass of C_2H_4O.
2 x 12.011 g/mol + 4 x 1.00794 g/mol + 15.9994 g/mol = 44.053 g/mol

$$232.25\ g \times \frac{1\ mol}{44.053\ g} \times \frac{6.02 \times 10^{23}\ molecules}{1\ mol} = \mathbf{3.17 \times 10^{24}\ molecules}$$

5. How many atoms of carbon are in 25.65 g of $C_8H_{10}N_4O_2$ (caffeine)?

Calculate the molar mass of caffeine.

8 x 12.011 g/mol + 10 x 1.00794 g/mol + 4 x 14.0067 g/mol + 2 x 15.9994 g/mol = 194.193 g/mol
g caffeine $\rightarrow$ mol caffeine $\rightarrow$ mol C $\rightarrow$ atoms C
1 mol caffeine = 194.193 g, 1 mol caffeine = 8 mol C, 1 mol C = 6.02 x 10^{23} C atoms

$$25.65\ g\ Caffeine \times \frac{1\ mol\ caffeine}{194.193\ g} \times \frac{8\ mol\ C}{1\ mol\ caffeine} \times \frac{6.02 \times 10^{23}\ C\ atoms}{1\ mol\ C} = \mathbf{6.36 \times 10^{23}\ C\ atoms}$$