Converting Number of Particles to Mass

Find the mass in grams of 2.44×10^{24} atoms of carbon, whose molar mass is 12.01 g/mol.

1 Gather information.
- number of atoms C = 2.44×10^{24} atoms
- molar mass of carbon = 12.01 g/mol
- amount of C = ? mol
- mass of the sample of carbon = ? g

2 Plan your work.
- **Skills Toolkit 3** shows that to convert from number of atoms to mass in grams, you must first convert to amount in moles.
- To find the amount in moles, select the conversion factor that will take you from number of atoms to amount in moles.

$$2.44 \times 10^{24} \text{ atoms} \times ? = ? \text{ mol}$$

- Multiply the number of atoms by the following conversion factor:

$$\frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}}$$

- To find the mass in grams, select the conversion factor that will take you from amount in moles to mass in grams.

$$? \text{ mol} \times ? = ? \text{ g}$$

- Multiply the amount in moles by the following conversion factor:

$$\frac{12.01 \text{ g C}}{1 \text{ mol}}$$

3 Calculate.
Solve and cancel identical units in the numerator and denominator.

$$2.44 \times 10^{24} \text{ atoms} \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}} \times \frac{12.01 \text{ g C}}{1 \text{ mol}} = 48.7 \text{ g C}$$

4 Verify your result.
The answer has the units requested in the problem.

Given molar mass, find the mass in grams of each of the following substances:

1 2.11×10^{24} atoms of copper (molar mass of Cu = 63.55 g/mol)

2 3.01×10^{23} formula units of NaCl (molar mass of NaCl = 58.44 g/mol)

3 3.990×10^{25} molecules of CH_4 (molar mass of CH_4 = 16.05 g/mol)

4 4.96 mol titanium (molar mass of Ti = 47.88 g/mol)

Homework ——— GENERAL

Additional Practice Determine the mass in grams of each of the following quantities:

1. 6.12×10^{14} formula units of rhenium dioxide, 218.21 g/mol
   Ans. 2.22×10^{-7} g ReO$_2$

2. 5.3×10^{23} atoms of molybdenum **Ans.** 84 g Mo

3. 1.299×10^{26} ions of nitrite, 46.01 g/mol **Ans.** 9925 g NO$_2^-$