- The **mole** is the unit of measurement in the International System of Units (SI) for amount of substance.
- It has the unit symbol "**mol".**

- **Same as: [**A **dozen** (**doz)** is a grouping of twelve entities.]
  Is analogous to saying:
  A mole is a grouping of 6.022×10^{23} entities.

Where: the Avogadro constant is: N_A = 6.022 141 79 (30) x 10^{23} mol^{-1}

- By definition:
  A mole of $^{12}_{6}C$ has exactly 12 grams mass.

  It means: 12 g of carbon-12 contains 6.022×10^{23} atoms of carbon-12

- By definition:
  One "atomic mass unit" = $\frac{1}{12}$ mass of one atom of $^{12}_{6}C$

  Or: 1 atom of $^{12}_{6}C$ weighs 12.000 amu, "u"

Note about the mole: i.e. Glucose: $C_6H_{12}O_6$

- 1 molecule of glucose contains 6 atoms of C, 12 atoms of H, and 6 atoms of O
- 1 mole of glucose contains 6 moles of C atoms, 12 moles of H atoms, and 6 moles of O atoms.
- 10 moles of glucose contains 60 moles of C, 120 moles of H, and 60 moles of O atoms.
- N_A molecules of glucose contains 6 x N_A atoms of C, 12 x N_A atoms of H, and 6 x N_A atoms of O.

1) What is the mass of 1 atom of carbon?

We know:
1 mole ≡ 6.022×10^{23} carbon atoms ≡ 12 g of carbon-12

$$mass\ of\ 1\ atom\ carbon = \frac{12\ g}{6.022 \times 10^{23}} = 1.993 \times 10^{-23}\ g$$

2) How many moles of Fe are in 5.6 g Fe? How many Fe atoms are contained in the sample?

By definition we know:
1 mole of Fe is 55.85 g per mole {see the periodic table}.

$$5.6\ g \times \frac{1\ mol}{55{,}85\ g} = 0.10\ mol$$

$$0.10\ mol\ \times \frac{6.022\times10^{23}\ atoms}{1\ mol} = 6.04 \times 10^{22}\ \ Fe\ \ atoms$$

3) What mass of sulfur contains the same number of moles as are in 10.0 g of Fe?

First: Find the number of moles of Fe.

$mol = \frac{mass}{molar\ mass} = \frac{10.0}{55.85} = 0.1791\ mol$ of Fe

mol of "S" = mol of "Fe" = 0.1791 mol

$$mass\ = mol \times molar\ mass$$

$$mass\ of\ sulfur = 0.1891 \times 32.06 = 5.74\ g\ sulfur$$

4) Hemoglobin is the oxygen-carrying protein of most mammals. Each molecule of hemoglobin contains 4 atoms of iron. The molecular weight of hemoglobin is about 64000 g/mol. How many moles of iron are contained in 0.50 moles of hemoglobin? Calculate the number of iron atoms in 0.128 g of hemoglobin.

1 mole of hemoglobin contains 4 X (moles) of iron.
0.5 mole of hemoglobin contains 4 X (0.5 moles) of iron = 2.00 moles of iron.

$$mol = \frac{mass}{molar\ mass} = \frac{0.128\ g}{64000\ g/mol} = 2.00^{-6}\ mol$$

$$2.00 \times 10^{-6}\ mol\ Hemoglobin\ \times \frac{4\ \ mol\ Fe}{1\ mol\ Hemoglobin} = 8.00 \times 10^{-6}\ \ moles\ Fe$$

$$8.00 \times 10^{-6}\ mol \times \frac{6.022\times10^{23} atoms}{1\ mol} = 4.82 \times 10^{18}\ \ Fe\ atoms$$