Rafa Muñoa
Lizardi Institutua
Zarautz

# Amount of matter in a sample

**mass (in grams)**

**“g”-”u” equivalence**

$1\ g = 6.02*10^{23}\ u$

**Molar mass (M)**

$M = \ldots \frac{g}{mole}$

**Molecular mass (Mr)**

$Mr = \ldots \frac{u\ (amu)}{molecule}$

**# of moles (in moles)**

**Avogadro # (N)**

$1\ mole = 6.02*10^{23}\ molecules$

**# of molecules**

**Formula**

1 molecule = … atoms

**# of atoms**

Rafa Muñoa
Lizardi Institutua
Zarautz

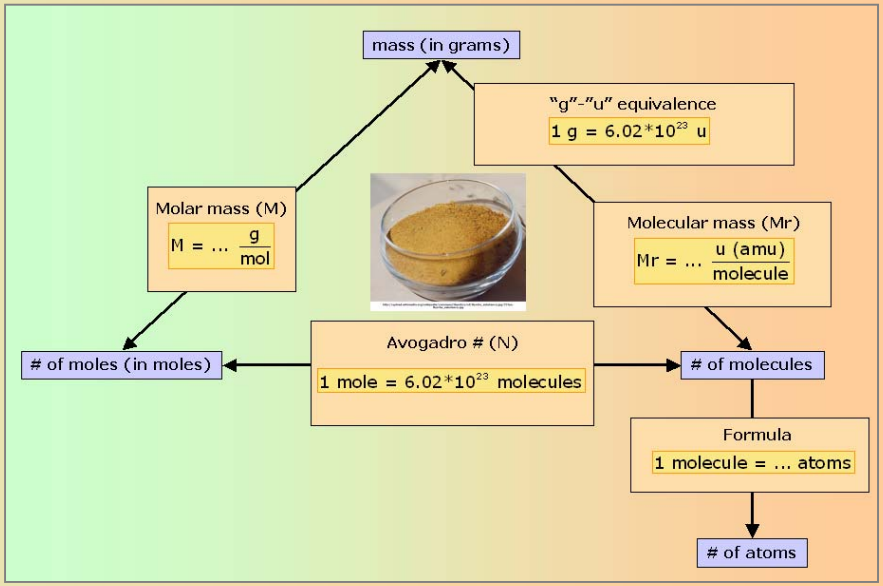
# Amount of matter in a sample: example

**How many**

- **moles,**
- **molecules**
- **atoms**
- **atoms of nitrogen**
- **grams of nitrogen**

**are in a sample of 85 grams of $NH_4NO_3$?**

Atomic weights: N=14; H=1; O=16




In order to convert grams to moles, we need the **molar mass**, which we can calculate using the chemical formula and atomic weights

$$M = (2*14) + (4*1) + (3*16) = 80 \ \frac{g}{mole}$$

The number of moles in the sample is:

$$x = 85 \ \cancel{g \ NH_4NO_3} \ \frac{1 \ mole \ NH_4NO_3}{80 \ \cancel{g \ NH_4NO_3}} = 1.06 \ moles \ of \ NH_4NO_3$$

Rafa Muñoa
Lizardi Institutua
Zarautz

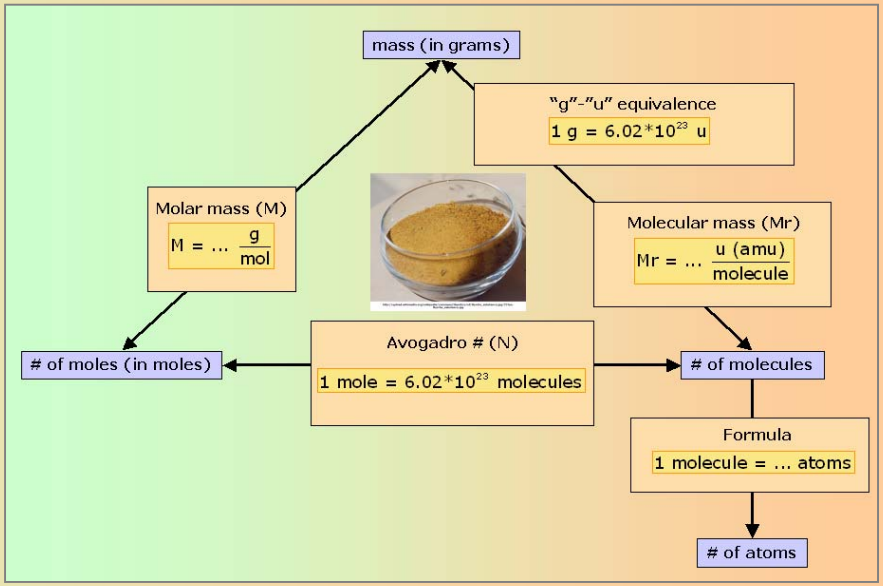
# Amount of matter in a sample: example

**How many**

- **moles,**
- **molecules**
- **atoms**
- **atoms of nitrogen**
- **grams of nitrogen**

**are in a sample of 85 grams of $NH_4NO_3$?**

Atomic weights: N=14; H=1; O=16




The number of molecules can be calculated from the number of moles:

$$x = 1.06 \text{ moles of } NH_4NO_3 \frac{6.02*10^{23} \text{ molecules}}{1 \text{ mole}} = 6.38*10^{23} \text{ molecules}$$

The number of atoms can be calculated from the chemical formula:

$$x = 6.38*10^{23} \text{ molecules} \frac{9 \text{ atoms}}{1 \text{ molecule}} = 5.74*10^{24} \text{ atoms}$$

$$x = 6.38*10^{23} \text{ molecules} \frac{2 \text{ atoms N}}{1 \text{ molecule}} = 1.28*10^{24} \text{ atoms N}$$

Rafa Muñoa
Lizardi Institutua
Zarautz

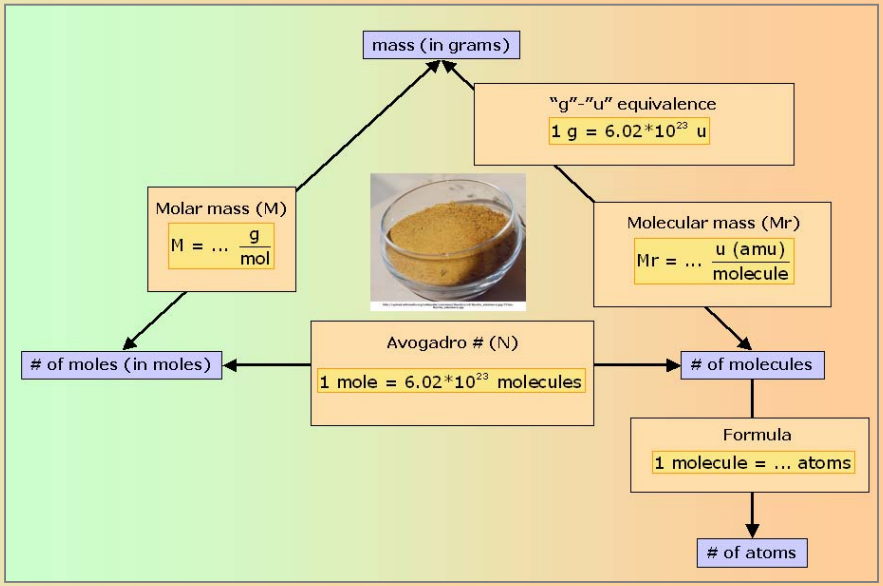
# Amount of matter in a sample: example

**How many**

- **moles,**
- **molecules**
- **atoms**
- **atoms of nitrogen**
- **grams of nitrogen**

**are in a sample of 85 grams of $NH_4NO_3$?**

Atomic weights: N=14; H=1; O=16




The grams of nitrogen can be calculated from the molar mass:

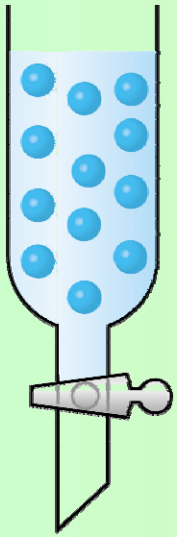
$$M = \boxed{(2*14)} + (4*1) + (3*16) = 80 \ \frac{g}{mole}$$

This is the contribution of the nitrogen to the molar mass

$$x = 85 \ \cancel{g\ NH_4NO_3} \ \frac{28 \ g\ N}{80 \ \cancel{g\ NH_4NO_3}} = 29.75 \ g\ N$$

Rafa Muñoa
Lizardi Institutua
Zarautz

# Amount of matter in a sample: exercises

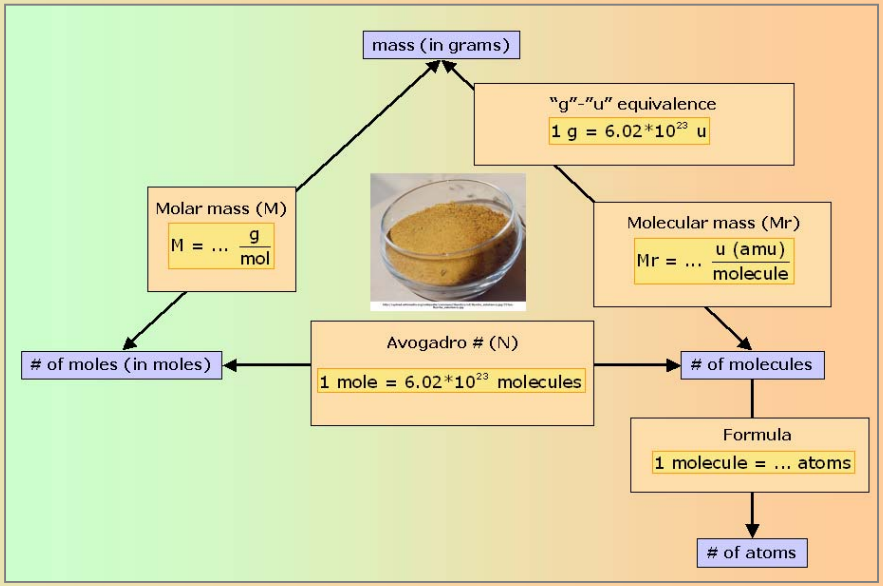


**Exercise**

**A sample of nitric acid ($HNO_3$) has a mass of 120 g. Calculate:**

**a) molecular weight**
**b) molar mass**
**c) number of moles**
**d) number of molecules**
**e) number of atoms**
**f) number of O atoms**
**g) number of grams of nitrogen**

Atomic mass: N=14; O=16; H=1
N = $6{,}02.10^{23}$




SOLUTIONS

- 63 u / molecule
- 63 g / mole
- 1.9 moles
- $1.14*10^{24}$ molecules
- $5.7*10^{24}$ atoms
- $3.42*10^{24}$ atoms O
- 26.67 grams of N