Isotopes and Relative Atomic Mass

The nuclear atom:

property	electron	proton	neutron
charge			
relative mass			
location			

Atomic Number:

Mass Number:
(a.k.a.: nucleon number)

number of neutrons = mass number — atomic number

Atoms of the same element always have the same number of protons, but may have a different number of neutron.

Atoms with the same number of protons but different number of neutrons are called **isotopes**.
A nuclide is an isotope with a specified mass number.
Example: chlorine exists as two isotopes:

	$^{1}_{1}p$	$^{0}_{-1}e$	$^{1}_{0}n$	relative abundance
^{37}Cl				24.2 %
^{35}Cl				75.8 %

The proportion of each isotope in a sample is called **relative abundance**.
The relative abundance of ^{35}Cl is 75.8 % and of ^{37}Cl is 24.2 %.

Most elements exist naturally as two or more different isotopes.
Thus, the mass of an element depends on the relative abundances of all the isotopes present in the sample.
The relative atomic mass, A_r of an element is defined as the mass of one atom of that element relative to 1/12 th the mass of one atom of carbon –12, (i.e. ^{12}C = exactly 12).
The relative atomic mass is the average of the masses of the stable isotopes of the element, weighed to take into account the relative abundance of each isotope.
Hence, the relative atomic mass of chlorine may be calculated as follows:

$$A_r(Cl) = \frac{75.8}{100} \times 35 + \frac{24.2}{100} \times 37 = 35.5$$

Practice

1. Calculate the relative atomic mass of naturally occurring magnesium which has the following isotopic composition: ^{24}Mg = 79.0 %, ^{25}Mg = 10.0 %, ^{26}Mg = 11.0 % [answer = 24.3]
2. Calculate the relative atomic mass of silicon with the following isotopic composition:
^{28}Si = 92.2 %, ^{29}Si = 4.7 %, ^{30}Si = 3.1 % [answer: 28.1]
3. Calculate the relative atomic mass of silver with the following isotopic composition:
^{107}Ag = 51.83 %, ^{109}Ag = 48.17 % [answer: 107.87]