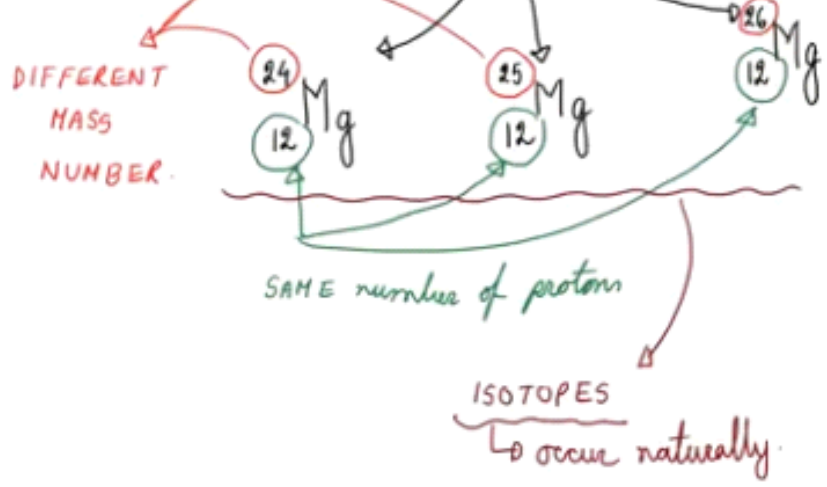
ATOMIC STRUCTURE #3

- ISOTOPES
  - ATOMS of the SAME ELEMENT
    - which have SAME ATOMIC/PROTON number
    - but have DIFFERENT MASS number.

EXAMPLE
- MAGNESIUM element
  - group of MAGNESIUM atoms



ISOTOPES
- occur naturally

	$^{24}_{12}Mg$	$^{25}_{12}Mg$	$^{26}_{12}Mg$
	MAGNESIUM - 24	MAGNESIUM - 25	MAGNESIUM - 26
p	12	12	12
e	12	12	12
n	24 - 12	25 - 12	26 - 12

n	$24 - 12$ $= 12$	$25 - 12$ $= 13$	$26 - 12$ $= 14$

PERIODIC TABLE

↳ a table in which ALL elements are listed:

↳ using their ATOMIC SYMBOL.

$${}^{A}_{Z}X$$

* MAGNESIUM element → ${}^{24}_{12}Mg$ ${}^{25}_{12}Mg$ ${}^{26}_{12}Mg$

→ ${}^{}_{12}Mg$ → we CALCULATE the AVERAGE MASS of ALL ISOTOPES of an element

Average mass is known as Relative Atomic mass.

ISOTOPIC ABUNDANCE CALCULATION

↳ to find the RELATIVE ATOMIC MASS of an atom of an element

* ELEMENT → total percentage : 100 %

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* DIFFERENT isotopes of an element have DIFFERENT MASS number and also, exists in DIFFERENT ABUNDANCE.

ELEMENT Y → has 2 ISOTOPES

↳ 100 %.

ISOTOPE 01 — 40 %.

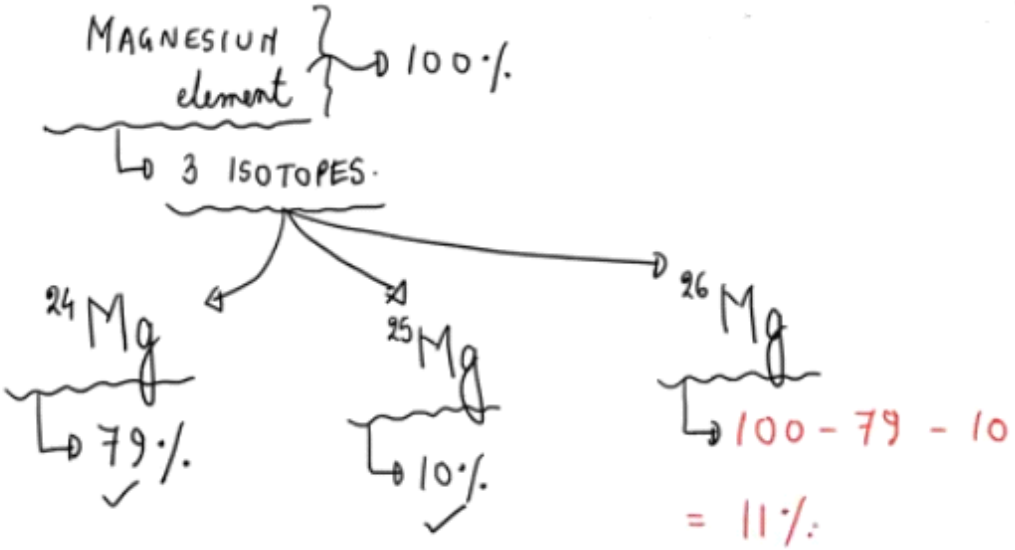
ISOTOPE 02 — 60 %.

CALCULATION :

↳ we multiply the MASS of each isotope with their % ABUNDANCE and then find a TOTAL.

$$R.A.M = \left(\text{Mass of ISOTOPE 01} \times \%\right) + \left(\text{Mass of ISOTOPE 02} \times \%\right)$$

Question :
Calculate the relative atomic mass (RAM / Ar) of the Magnesium element. Magnesium element has 3 isotopes. Magnesium-24 has a percentage of 79% in nature, Magnesium-25 has a percentage of 10% in nature and the rest is Magnesium - 26.



RELATIVE ATOMIC MASS of MAGNESIUM

$= (24 \times 79\%) + (25 \times 10\%) + (26 \times 11\%)$

$= \left(24 \times \frac{79}{100}\right) + \left(25 \times \frac{10}{100}\right) + \left(26 \times \frac{11}{100}\right)$

$= 24.32$

② Calculate the RAM of the Chlorine element which has:

^{35}Cl 75% and ^{37}Cl 25%

SOLUTION

A_r of CHLORINE $= (35 \times 75\%) + (37 \times 25\%)$

$= 35.5$

Practice Problems –

1. Calculate the relative atomic mass of each of the following elements:
   a) Bromine (50.5 % Bromine – 79 & 49.5 % Bromine – 81)
   b) Silver (51.3 % Silver – 107 & 48.7 % Silver – 109)
   c) Chromium (4.3 % Chromium – 50, 83.8 % Chromium – 52, 9.6 % Chromium – 53 & the rest is Chromium – 54).

2.

ISOTOPES	$\overline{^{28}Si}$	$\overline{^{29}Si}$	^{30}**Si**
RELATIVE ABUNDANCY/%	**92.2**	**4.7**	**3.1**

3. Use the following isotopic abundance data for Titanium to calculate its relative atomic mass.

Isotope	^{46}Ti	^{47}Ti	^{48}Ti	^{49}Ti	^{50}Ti
Relative Abundance / %	8.0	7.3	73.8	5.5	5.4

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SOLUTION:

1a) RELATIVE ATOMIC MASS of BROMINE

$= (79 \times 50.5\%) + (81 \times 49.5\%)$

$= 79.99.$

b) RELATIVE ATOMIC MASS of SILVER

$= (107 \times 51.3\%) + (109 \times 48.7\%)$

$= 107.97.$

c) RELATIVE ATOMIC MASS of CHROMIUM

$= (50 \times 4.3\%) + (52 \times 83.8\%) + (53 \times 9.6\%) + \{54 \times (100 - 4.3 - 83.8 - 9.6)\%\}$

$= 52.06.$

(2) RELATIVE ATOMIC MASS of SILICON

$= (28 \times 92.2\%) + (29 \times 4.7\%) + (30 \times 3.1\%)$

$= 28.11$

③ RELATIVE ATOMIC MASS of TITANIUM

$= (46 \times 8\%) + (47 \times 7.3\%) + (48 \times 73.8\%) + (49 \times 5.5\%) + (50 \times 5.4\%)$

$= 47.93$