

Isotopes and Atomic Mass

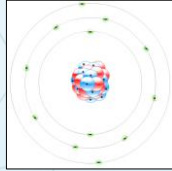
An element is distinguished by always having the same number of protons in the nucleus.

However, there can be a variable number of neutrons.

An isotope of an element has the same atomic number but has a different number of neutrons.

This will affect the average mass of an atom of an element.

If we take a specific example it will become clear.

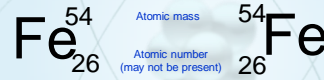


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How to write it

The isotope of an element can be indicated in two ways:

Using the elements symbol (numbers can either be to the left or the right of the symbol):



Using the elements name:

Iron- 54

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Example

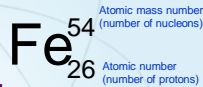
Iron, atomic number 26, has four naturally occurring **isotopes**.

They are:

Fe-54, Fe-56, Fe-57, and Fe-58.

From the table, we can see the number of neutrons in each isotope's nucleus.

A nucleon, is a particle that is in the nucleus (either a proton or a neutron).



	protons	neutrons	nucleons
Fe-54	26	28	54
Fe-56	26	30	56
Fe-57	26	31	57
Fe-58	26	32	58

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Question 1

Carbon has an atomic number of 6. Its two naturally occurring isotopes are carbon 12 and carbon 13. How many neutrons do carbon 12 and 13 have?

	Carbon -12	Carbon -13
A)	6	7
B)	12	13
C)	7	6
D)	13	12

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Abundance of each Isotope of Iron

If a sample of iron was examined with a mass spectrometer, the **abundance** of each isotope could be measured.

Luckily, tables exist giving us this information from previous experiments.

How does this give us the average mass of an atom?



	Abundance in %
Fe-54	5.8
Fe-56	91.72
Fe-57	2.2
Fe-58	0.28

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Question 2

Copper has two naturally occurring isotopes (Cu-63 and Cu-65).

If copper 63 has an abundance of 69.17% what is the abundance of copper 65?

Give your answer as a percentage.

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30.83 (%)

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Calculation of Atomic Mass Number

What is the atomic mass of each isotope?

Again, tables give us that data. (This is the atomic mass relative to 1/12 of a carbon atom).

	Atomic mass
Fe-54	53.93612
Fe-56	55.93439
Fe-57	56.935396
Fe-58	57.933278

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Calculation of Atomic Mass Number

Multiply the mass of each isotope by the abundance, to give the contribution of each isotope.

	Atomic mass	Abundance in %	Atomic mass abundance
Fe-54	53.93612	5.8	3.12829
Fe-56	55.93439	91.72	51.30302
Fe-57	56.935396	2.2	1.25258
Fe-58	57.933278	0.28	0.16221
		Total	55.8461

Summing the individual abundances, gives the total relative (average) atomic mass of iron.

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Calculation of Atomic Mass Number

The periodic table gives the relative atomic mass of iron as 55.85.

If we round up our calculation to 2 d.p. we also get 55.85.

26	Atomic Number
Fe	Symbol
Iron	Name
55.85	Relative Atomic Mass

1	2	3	4	5	6	7	8	9	10	11	12	A
Li	Be	B	C	N	O	F	Ne	Na	Mg	Al	Si	P
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In
Fr	Ra	Ac	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm
Yb	Lu	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm
Yb	Lu	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh

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