Nuclear

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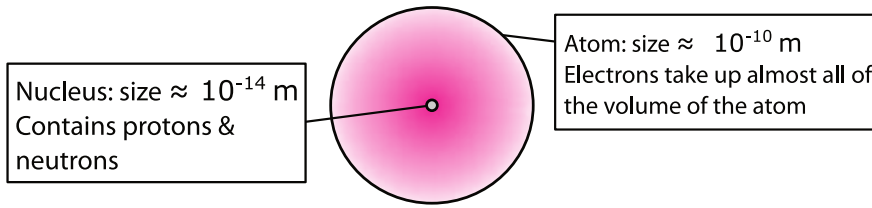
51 Atomic Numbers and Nomenclature ♡

All matter is made up of atoms.



Particles:

Name	Symbol	Relative charge	Relative mass
Proton	${}^{1}_{1}\mathrm{p}$ or ${}^{1}_{1}\mathrm{H}$	$+1$	1.0000
Electron[1]	${}^{0}_{-1}\mathrm{e}$ or ${}^{0}_{-1}\beta$	-1	0.0005
Neutron	${}^{1}_{0}\mathrm{n}$	0	1.0016
Positron	${}^{0}_{1}\mathrm{e}$ or ${}^{0}_{1}\beta$	$+1$	0.0005

No internal structure inside an electron has been found; it is a fundamental particle.
Every particle has an anti-particle of opposite charge but identical mass. The anti-electron is called a positron. If a particle meets its antiparticle, the two annihiliate each other, and their energy is given out as gamma rays.

The atomic number, Z, is the number of protons in a nucleus.

The mass number, A, is the number of protons plus neutrons in a nucleus.

${}^{14}_{6}\mathrm{C}$ (also written as carbon-14) is an isotope of carbon with a mass number of $\mathrm{A} = 14$. It has $\mathrm{Z} = 6$ protons, 6 electrons and $14 - 6 = 8$ (= A - Z) neutrons.

All atoms with the same number of protons belong to the same element. They will behave identically in any chemical process.

[1] Beta (β^-) radiation consists of free electrons moving very quickly. Beta particles are electrons emitted from nuclei- so not all electrons are beta particles.

Two atoms are said to be isotopes of the same element if they have the same number of protons but different numbers of neutrons. They will, consequently, have different masses.

51.1 (a) How many protons are there in a helium atom?

(b) How many electrons are there in a uranium atom?

(c) How many protons are there in a lithium−7 atom?

(d) How many neutrons are there in a lithium−7 atom?

Element	Z
Hydrogen (H)	1
Helium (He)	2
Lithium (Li)	3
Nitrogen (N)	7
Oxygen (O)	8
Uranium (U)	92

51.2 For the atoms in the table, fill in the number of protons, neutrons and electrons they have.

Atom	Protons	Neutrons	Electrons
Uranium−238	(a)	(b)	(c)
Oxygen−16	(d)	(e)	(f)
^{3}He	(g)	(h)	(i)
^{235}U	(j)	(k)	(l)

51.3 State the number of protons, neutrons and electrons in a $^{63}_{29}Cu^{+}$ ion.

♡ Protons and neutrons are made of quarks. Up quarks (u) have charge $+2/3$, while down quarks (d) have charge $-1/3$.

51.4 There are three quarks in a proton. How many of them are up quarks, and how many are down quarks?

51.5 What is a neutron is made of?

51.6 During beta minus decay, a neutron turns into a proton. What happens in terms of quarks?

51.7 During beta plus decay, a proton turns into a neutron. What happens in terms of quarks?

$^{15}/_{20}$