The Atom

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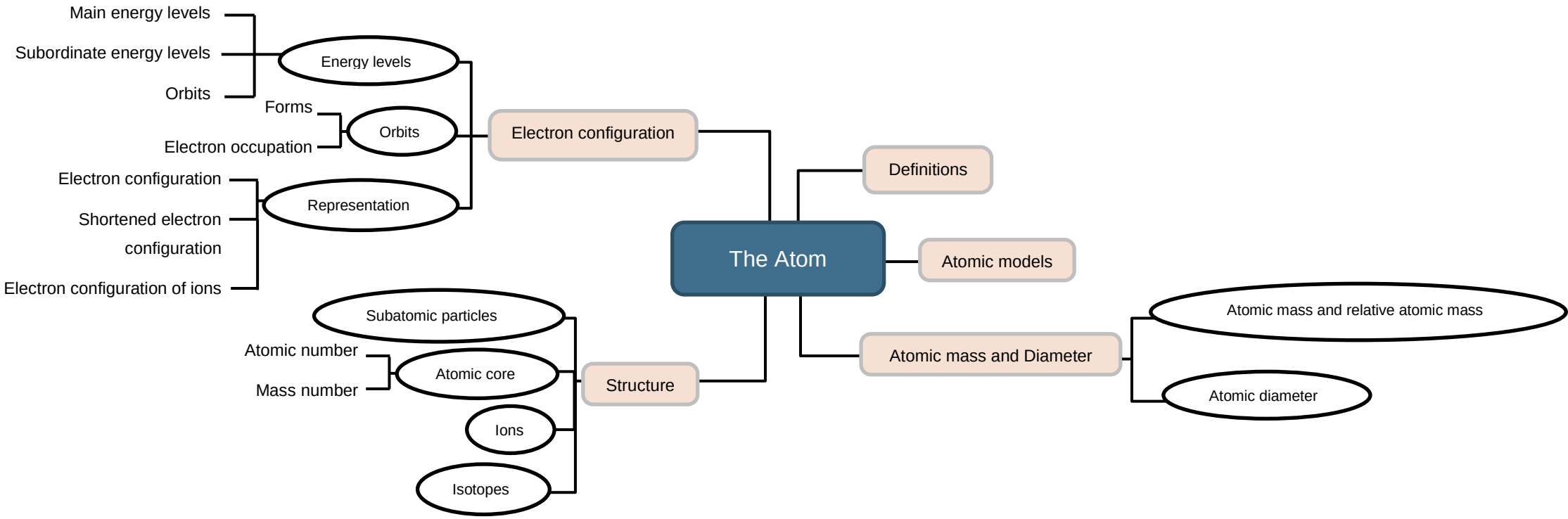
The Atom: Basic Building Blocks of Matter

1. DEFINISIES

TERM	DEFINITION
Model	The representation of a theory, an abstract concept, relationships or imperceptible phenomena in order to make it more understandable.
Relative Atomic mass (A_r)	The number which indicates how many times the average mass of an atom - of a specific element – is larger than one twelfth of the mass of carbon-12. The mass of the carbon-12 atom is chosen as 12 atomic-mass-units (amu).
Proton	The positive, subatomic particle in the core of an atom.
Neutron	The neutral, subatomic particle in the core of an atom.
Electron	The Negative, particle around the core of an atom.
Atomic number	The number of protons in the core of an atom
Mass number	The total number of protons and neutrons (nucleons) in the core of the atom.
Ion	A particle (atom or molecule) that is charged (positive or negative).
Cation	A positive ion.
Anion	A negative ion.
Isotope	An atom of the same element with the same atomic mass but with different mass numbers because of a difference in the amount of neutrons.
Orbit	The most probable area where an electron in an atom will be found.
Aufbau-principle	The series of procedures according to which electrons in an atom are arranged
Pauli's exclusion principle	Any orbital can have a maximum of two electrons provided that they spin in opposite directions.
Hund's rule	If all three p-orbitals are available, each orbital receives only one electron before the electrons can be paired.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2. ATOMIC MODELS

JAAR	PERSOON	BYDRAE
420 B.C.	Democritus	• "all particles are made of matter", calls it "atomos"
1803	Dalton	• Billiard ball-model • "matter are made up out of undividable atoms" • "atoms of the same element are identical" • Formulates the Law of Multiple Relations: Atoms binds in simple, integer relationships with one another. • Chemical reaction = the rearranging of atoms. • atoms ≠ created or destroyed, ≠ change element.
1833	Faraday	• Matter (like ionic matter) has an electric nature.
	~~Stoney~~	• Predicts that electricity consists of separate parts "electrons".
1897	Thompson	• Raisin cake model. • Electrical discharge consists of negative particles. • All electrons have the same mass and charge.
1911	Rutherford	• 1ste core model • Core = positive and contains most of the cores mass, surrounded by an empty space through which the electrons move. • α-particles and gold foil experiment.
1913	Bohr	• Electrons can only have a certain energy, and moves in orbits around the core. • ∴ quantization of electrons.
1924	De Broglie	• Small, moving particles also has a wave nature.
1925	Schrödinger	• A moving electron forms a space wave (orbit) around the core.
1932	Chadwick	• Discovers the neutron.

3. ATOOMMASSA EN DEURSNEE

	TRUE MASS	STANDARD MASS
H	1,67 x 10^{-27} kg	1
C	1,99 x 10^{-26} kg	12

3.1 Atomic mass

Mass spectrometer = measures the mass of atoms.

Standard mass (because the real mass is big, clumsy numbers)

- $\frac{1}{12}$ of a carbon atom, ∴ is 1,67 x 10^{-27} kg = atomic mass constant
- Measured in atomic mass units (a.m.u.)

3.2 Relative Atomic Mass A_r

Has no unit, is only a number that indicates relationship.

Can be used to calculate the true mass of an element's atom.

$$\boldsymbol{True\ mass = Ar \times Atomic\ mass\ constant}$$

3.3 Atomic diameter

Rutherford = atoms consists mostly of empty spaces (99.95% of the mass is in the core)
∴ volume/size of an atom is very large in comparison to the mass.

Diameter of an atom ≈ 10^{-10} m and the diameter of the core ≈ 10^{-15} m

To visualize:
A marble in the middle of a stadium = core,
with the full stops of the sentences on the
programmes in the audience = electrons.

4. STRUCTURE OF THE ATOM

4.1 Subatomic Parts

Protons (p^+)
- in the core
- has + charge

Neutrons (n^0)
- in the core
- has no charge

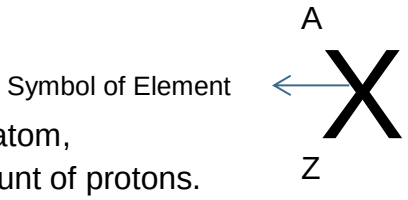
- Known together as *nucleons*
- ≈ mass
- Together responsible for the mass of the atom

Electrons (e^-)
- Around the core
- has - charge

- mass is insignificant
- responsible for the volume of the atom
- charge is the same size as (but opposite of) the proton's charge.
- Same amount as protons **<u>in a neutral atom.</u>**

4.2 Atomic core

4.2.1 Atomic number (Z)



- Is the amount of protons and determines the identity of the atom,
  ∴ each atom of the same element will have the same amount of protons.
- Agrees with the position on the periodic table.
- For neutral atoms, it also indicates the amount of electrons around the core.
- Determines the chemical attributes of the atom.
- It is the smallest number found with the symbol of the element on the periodic table.

4.2.2 Mass number (A)

- Is the amount of nucleons in the core of the atom.
- Is the largest number found with the element's symbol on the periodic table.

4.3 Ions of Atoms

- Forms when an atom receives a charge by gaining or losing electrons.
  Negative charge = electrons gained
  Positive charge = electrons lost
- *Therefore, shall the amount of electrons of an ion not be the same as it's atomic number or amount of protons and also not the same as the neutrons in a neutral atom.*