WJEC (Wales) Chemistry A-level

Topic 1.2 - Basic Ideas About Atoms

Flashcards

What is the plum pudding model?

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The plum pudding model was J J Thomson's model of an atom and it consisted of a sphere of positive charge, with small negative electrons distributed throughout it.

In terms of an atomic nucleus, what is radioactive decay?

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Radioactive decay is the process that takes place when an unstable atomic nucleus loses energy by emitting radiation.

What is alpha decay?

What is alpha decay?

Alpha decay is a type of radioactive decay, during which an atomic nucleus loses two protons and two neutrons. An alpha particle is equivalent to a helium nucleus. It reduces the atomic number by two and the mass number by four, making the element more stable.

What is beta decay?

What is beta decay?

Beta decay is a type of radioactive decay, during which a beta particle is lost, which is equivalent to an electron, and a neutron turns into a proton or a proton turns into a neutron. This changes the atomic number by one, but the mass number remains the same.

What is positron emission?

What is positron emission?

Positron emission, also known as beta plus decay, is a subcategory of beta decay. A beta plus particle is the antiparticle to an electron, meaning it has the same mass but opposite charge. Therefore, when released, it increases a nucleus' proton number by one and has no effect on mass number.

What is electron capture?

What is electron capture?

Electron capture is a process that can be used by unstable atoms to make them more stable. The process involves an electron being drawn into the nucleus where it reacts with a proton to form a neutron and a neutrino.

Compare the ionising power of alpha, beta and gamma radiation

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Alpha - very strong ionising power

Beta - medium ionising power

Gamma - weak ionising power

Compare the penetrating strength of alpha, beta and gamma radiation

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Alpha - stopped by thin paper

Beta - stopped by thin metal

Gamma - stopped by thick lead

Compare the range in air of alpha, beta and gamma radiation

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Alpha - less than 5 cm range

Beta - less than 1 m range

Gamma - infinite range

How are alpha, beta and gamma particles affected by electric fields?

How are alpha, beta and gamma particles affected by electric fields?

Alpha particles are positively charged and beta particles are negatively charged so alpha and beta radiation can be deflected by an electric field. Gamma radiation is neutral so is not affected by an electric field.

What is radioactive half life?

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Half life is the time it takes for the radioactivity or the number of unstable nuclei present in an sample to halve.

Why should people limit the exposure they have with certain types of radiation?

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When radiation interacts with molecules in living cells, it can damage them and cause a mutation in DNA. The cell can become cancerous if the DNA in the nucleus of a cell is damaged.

Give some uses of radioisotopes

Give some uses of radioisotopes

- Used to examine metal structures like piping to identify any defects.
- Used in tracers for diagnostic purposes.
- Radio-dating (a technique used to date materials like rocks).
- Used medically to treat cancerous tumours.

Define first ionisation energy

Define first ionisation energy

The energy required to remove one mole of electrons from one mole of gaseous atoms to form one mole of gaseous ions.

Is ionisation energy exothermic or endothermic?

Is ionisation energy exothermic or endothermic?

Endothermic

What factors influence ionisation energy?

What factors influence ionisation energy?

- The number of protons in the nucleus.
- The subshell from which the electron is removed.
- Electron shielding.

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How do successive ionisation energies tell you which group an element belongs to?

How do successive ionisation energies tell you which group an element belongs to?

A large increase between two different successive ionisation energies, for example between 7th and 8th ionisation energy, suggests the 8th electron is being taken from a new, full, stable shell (and hence this requires more energy to remove).

There are therefore 7 electrons in its outer shell so the element belongs to Group 7 (new group 17).

What is the trend in ionisation energy across a period?

What is the trend in ionisation energy across a period?

Ionisation energy increases across a period because the number of protons increases and electron shielding remains very similar. This means across the period the electrons require more energy to overcome the strengthening nuclear attraction.

What is the trend in ionisation energy down a group?

What is the trend in ionisation energy down a group?

Ionisation energy decreases down a group. This is because the atomic radius and electron shielding increases so the nuclear attraction with the electron gets increasingly weaker making the electron easier to remove.

What is an orbital?

What is an orbital?

A region within an atom that can hold up to two electrons with opposite spins.

What is a subshell?

What is a subshell?

A division of electron shells separated by orbitals.

Subshells are called s, p, d, and f.

What rules do electrons follow when filling up orbitals?

What rules do electrons follow when filling up orbitals?

Electrons always enter the lowest energy orbital available.

Electrons prefer to occupy orbitals on their own and will only pair up if there is no empty orbital of the same energy available.

How many orbitals (and therefore electrons) are there in each type of subshell?

How many orbitals (and therefore max. no. electrons) are there in each type of subshell?

- s-subshell: 1 orbital (2 electrons)
- p-subshell: 3 orbitals (6 electrons)
- d-subshell: 5 orbitals (10 electrons)
- f-subshell: 7 orbitals (14 electrons)

Which electron shells, from 1-4, contain which subshells?

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Shell	Subshell(s)	Maximum number of electrons present
1	s	2
2	s, p	8
3	s, p, d	18
4	s, p, d, f	32

Why are the 4s orbitals generally filled before the 3p orbitals?

Why are the 4s orbitals generally filled before the 3p orbitals?

The 4s orbitals are at a lower energy level so they are filled first.

What is the electron configuration of calcium?

What is the electron configuration of calcium?

A calcium atom has 20 electrons.

'1' means first shell

'6' means the number of electrons in that subshell

$$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$$

's' means s-subshell

Which two elements in the periodic table are exceptions to the rule that the 4s orbital is filled before the 3p orbital?

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Chromium and copper. The 4s orbital only fills with one electron as this gives them more stable configurations in the 3d orbital.

Chromium: $[Ar]4s^1 3d^5$

Copper: $[Ar]4s^1 3d^{10}$

What determines the chemical properties of an element?

What determines the chemical properties of an element?

The electron configuration.

What shapes are the s- and p-orbitals?

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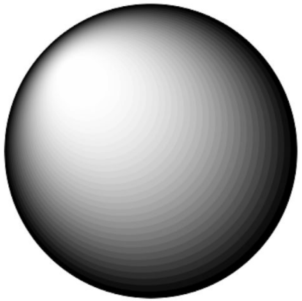
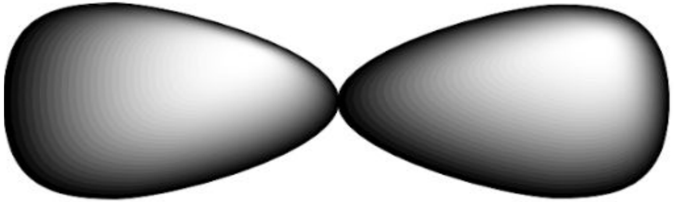
S-orbital → spherical



P-orbital → dumbbell shaped



Explain the origin of emission and absorption spectra in terms of electron transitions

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When an electron experiences a change in energy so that it moves down an energy level, a photon is released to help conserve energy. When an electron gains energy to move up an energy level, photons are absorbed to provide the energy for this.
The specific wavelengths and energies of photons that are involved in the interactions can be seen using emission and absorption spectra.

What is the difference between absorption spectra and emission spectra?

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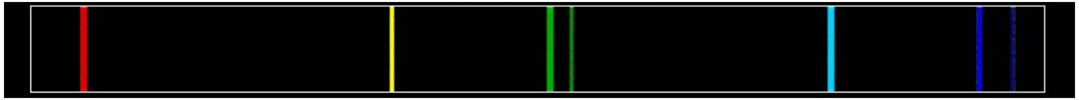
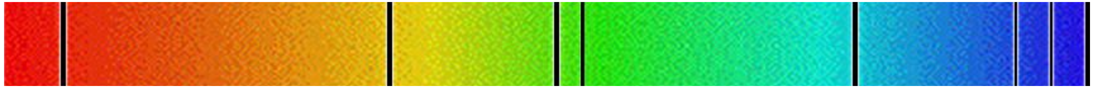
Emission spectra - displays lines at the specific frequencies of emitted photons.



Absorption spectra - displays an entire spectrum with black lines for the 'missing' frequencies of the absorbed photons.



What is the equation that links energy and frequency?

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Energy (J) =

Planck's constant (m^2kgs^{-1}) x Frequency of photon (Hz)

(E = hv)

What is the equation that links frequency and wavelength?

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$$\text{Frequency (Hz)} = \frac{\text{Speed of light (m/s)}}{\text{Wavelength (m)}}$$

Put in order of increasing energy:
UV light, visible light and infrared radiation

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UV light, visible light and infrared radiation

Infrared radiation < visible light < UV light

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The frequency of the convergence limit of the Lyman series can be used in the equation $E=h\nu$ to calculate the first ionisation energy for hydrogen.