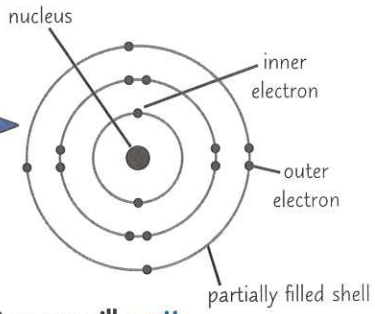
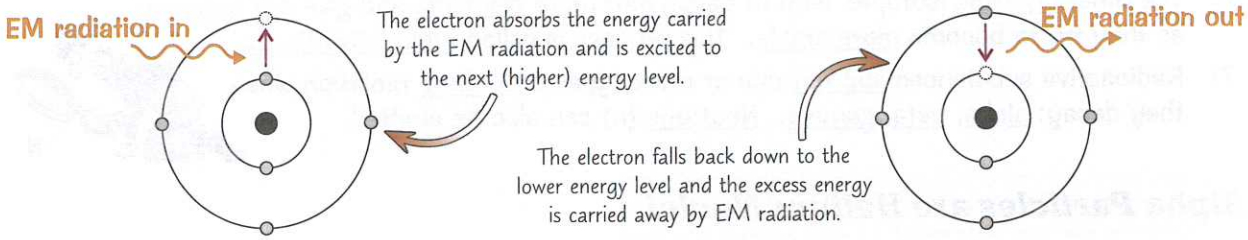
Electron Energy Levels

There's some quirky stuff on this page — and the best part is that you can tell everyone you've been doing a little quantum physics today. Honestly. And if you study physics to a higher level, things get even quirkier.

Electrons Can be Excited to Higher Energy Levels



1) Electrons in an atom sit in different energy levels or shells.
2) Each energy level is a different distance from the nucleus.
3) An inner electron can move up to a higher energy level if it absorbs electromagnetic (EM) radiation with the right amount of energy.
4) When it does move up, it moves to an empty or partially filled shell and is said to be 'excited'.
5) The electron will then quickly fall back to its original energy level, and in doing so will emit (lose) the same amount of energy it absorbed. The energy is carried away by EM radiation.



6) The part of the EM spectrum the radiation emitted from the atom is from depends on its energy. This depends on the energy levels the electron moves between. A higher energy means a higher frequency of EM radiation — p.168. Often, visible light is released when electrons move between energy levels.
7) As you move further out from the nucleus, the energy levels get closer together (so the difference in energy between two levels next to each other gets smaller).
8) This means that an excited electron falling from the third energy level to the second would release less energy than an excited electron falling from the second energy level to the first. So the frequency of the generated radiation decreases as you get further from the nucleus.
9) Changes within the nucleus itself lead to the production of high energy, high frequency gamma rays (p.174).

An Atom is Ionised if it Loses an Electron

1) If an outer electron absorbs radiation with enough energy, it can move so far that it leaves the atom.
2) It is now a free electron and the atom is said to have been ionised.
3) The atom is now a positive ion. It's positive because there are now more protons than electrons.
4) An atom can lose more than one electron. The more electrons it loses, the greater its positive charge.

Nuclear Radiation Ionises Atoms

1) Ionising radiation is any radiation that can knock electrons from atoms.
2) How likely it is that each type of radiation will ionise an atom varies. You can see more about the different types of ionising nuclear radiation on the next page.

Ionising radiation — good for getting creases out of your clothes...

So, an electron absorbs EM radiation and moves up one or more energy levels, then falls back to its original energy level and loses the same amount of energy it absorbed, which is carried away by EM radiation. Simple...

Q1 What is a positive ion and how is one formed? [2 marks]

Electron Energy Levels

Warm-Up

Choose from the labels on the left to fill in the blanks on the right.
You do not need to use all of the words.

other electrons varying the nucleus fixed loops shells

In Bohr's atomic model, electrons orbit ..... at ..... distances called energy levels or ..... .

1 Niels Bohr suggested that electrons can move between energy levels. Grade 4-6

a) Describe how an inner electron can move between energy levels.

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[2]

b) State the name of the type of particle created when an atom loses or gains outer electrons.

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[1]

c) State the relative charge on the particle if it is created by an atom losing an outer electron.

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[1]

[Total 4 marks]

2 A scientist is investigating the radiation emitted from a hydrogen discharge lamp. Inside the lamp, electrons in hydrogen atoms are constantly being excited to higher energy levels and then falling to lower levels. He finds that excited electrons falling back to the first energy level release ultraviolet radiation (frequency ~3×10^{15} Hz). Excited electrons falling back to the second energy level release visible light (frequency ~5×10^{14} Hz). Grade 7-9

Explain why electrons falling to the first energy level of hydrogen release electromagnetic radiation with a higher frequency than those falling to the second energy level.

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[Total 4 marks]