Edexcel IGCSE Physics

7 - Radioactivity and Particles

Flashcards

Name the particles that made up atom and state their electrical charges.

Name the particles that made up atom and state their electrical charges.

- Proton : positively charged
- Neutron : neutral , no charge
- Electron : negatively charged

Describe the structure of the atom.

Describe the structure of the atom.

It has a positively charged nucleus which is made up of protons and neutrons. The nucleus is surrounded by negatively charged electrons, which all orbit the nucleus at different distances.

What is meant by an “isotope” of an element?

What is meant by an “isotope” of an element?

Isotopes are atoms of the same element with same atomic(proton) number and different mass(neutron) number.

*Atomic number = number of protons
*Mass number = number or protons + neutrons

What is the relative masses of a proton, neutron and electron?

What is the relative masses of a proton, neutron and electron?

- Proton : 1 unit
- Neutron :1 unit
- Electron : $\frac{1}{1850}$ unit

What is the relative charge of a proton?

What is the relative charge of a proton?

+ 1

Why is an atom neutral?

Why is an atom neutral?

- An atom contains the same number of protons as electrons
- The charge of a proton is +1 and the charge of an electron is -1
- These charges balance, so the atom has no overall charge

How does an atom become a positive ion?

How does an atom become a positive ion?

- By losing its outer electrons
- This means it has more protons than electrons, and so has an overall positive charge

Which types of radiation are emitted from unstable nuclei?

Which types of radiation are emitted from unstable nuclei?

- Alpha Particles
- β^- (beta minus) Particles
- Gamma rays
- Neutron radiation

Which of the following are types of ionising radiation?

Alpha ... Beta ... Gamma rays ... Neutron radiation

Which of the following are types of ionising radiation? (Alpha, Beta, Gamma rays, neutron radiation)

- Alpha
- Beta
- Gamma rays

What is meant by background radiation?

What is meant by background radiation?

- Radiation that is always around
- It is in very small amounts and so not harmful

Describe sources of background radiation.

Describe sources of background radiation.

- Unstable nuclei in rocks (also give out radon gas)
- Radiation used in medicine
- Some is released from food and water
- Living things (plants can absorb radioactive material as they grow and this can be passed on to the animals that eat them)
- Cosmic rays from the sun

State two pieces of equipment which can be used to detect radiation.

State two pieces of equipment which can be used to detect radiation

- Geiger-Müller(GM) Detector
- Photographic Film

How do you measure and detect background radiation?

How do you measure and detect background radiation?

Geiger-Muller (GM) Detector

- When the geiger-muller tube absorbs radiation it produces a pulse, which a machine uses to count the amount of radiation. The frequency of the pulse depends on how much radiation is present. A high frequency would mean the tube is absorbing a large amount of radiation.

Using photographic film

- A photographic film turns dark when it absorbs radiation. This is useful for people who work on radiation as the more radiation they are exposed to, the darker the film becomes. Therefore the workers know when they have been exposed to too much radiation

Order the types of ionising radiations starting with the least ionising to most ionising

Order the types of ionising radiations starting with the least ionising

Gamma → Beta → Alpha

Order the types of ionising radiation, starting with the most penetrating first.

Order the types of ionising radiation, starting with the most penetrating first.

Gamma → Beta → Alpha

*ionising power and penetration are inversely proportional. More ionising means less penerating

What is an alpha particle?

What is an alpha particle?

A helium nucleus (2 neutrons and 2 protons).

What is a beta particle?

What is a beta particle?

An electron which is emitted from the nucleus.

What is a gamma ray?

What is a gamma ray?

High energy carrying electromagnetic wave from the electromagnetic spectrum.

In which process a neutron splits into a proton and an electron and electron is emitted from the nucleus?

In which process a neutron splits into a proton and an electron and electron is emitted from the nucleus?

Beta decay

When alpha decay occurs, what happens to the atomic number and the mass number of the atom?

When alpha decay occurs, what happens to the atomic number and the mass number of the atom?

The atomic number decreases by 2

The mass number decreases by 4

(a new element is made)

What effect does releasing gamma radiation have on the mass number and atomic number of an atom?

What effect does releasing gamma radiation have on the mass number and atomic number of an atom?

No effect

What effect does beta minus decay have on the mass number and atomic number of an atom?

What effect does beta minus decay have on the mass number and atomic number of a atom.

- The mass number stays the same as the combined number of neutrons and protons hasn't changed (one has just turned in the other).
- The atomic number increases since there is one more proton.

What happens in the atom to cause gamma rays to be released?

What happens in the atom to cause gamma rays to be released?

When the nucleus decays some of the nuclei rearranges itself so there is an excess energy. This may lead to it releasing this energy in the form of gamma rays.

How does the activity of a radioactive source decrease over a period of time?

How does the activity of a radioactive source decreases over a period of time?

- It decreases exponentially.
- It decreases by a constant ratio over constant time periods. For example, every 10 minutes a sample of a radioactive substance may quarter its activity

What is meant by “the half-life” of a radioactive source?

What is meant by “the half-life” of a radioactive source?

Half-life is the time taken for a source for half of its initial mass to decay.

(Time taken for activity to drop to half of the initial activity)

What is the unit for activity?

What is the unit for activity?

Becquerel (Bq)

Can you predict when a nucleus will decay?

Can you predict when a nucleus will decay?

No, the process is a random process.

Give examples of uses of radioactivity.

Give examples of uses of radioactivity

- Household fire alarms (smoke)
- Irradiating food
- Sterilisation of equipment
- Tracing and gauging thicknesses of materials
- Diagnosis and treatment of cancer

How do smoke alarms work?

How do smoke alarms work?

- A radioactive substance is in the alarm which emits alpha radiation
- The emitted alpha particle ionise the air in the detector and cause a current to flow between the plates
- When smoke interferes with the radiation, the air is no longer ionised and so no current can flow
- This reduction in current flow triggers the alarm

How is radiation used in medicine?

How is radiation used in medicine?

- To sterilise equipment: Gamma radiation can kill bacteria cells
- To help treat cancer, as it as it can be used to kill cancer cells

What is the role of beta radiation in tracers?

What is the role of beta radiation in tracers?

- The tracer is inserted in your body, and targets a specific part of the body
- The radioactive substance in the tracer releases beta radiation which can be detected by external machines

How is beta radiation used to determine thickness?

How is beta radiation used to determine thickness?

- A beta source is placed above the material and a detector is placed below it
- If a lot of radiation is detected by the detector, too much radiation is passing through the material, and so it is too thin
- If only a little radiation is detected, then the material blocks too much radiation, and so it is too thick

Why is ionising radiation dangerous?

Why is ionising radiation dangerous?

- It can damage tissue and kill cells
- It can cause cell mutations

What precautions should people take when using ionising radiation?

What precautions should people take when using ionising radiation?

- Avoid handling the source directly (use tongs)
- Wear radiation protective clothing
- Keep the radiation in lead containers to reduce the amount of radiation that can escape
- Avoid being exposed to the radiation for long periods of time

Does a long half life or a short half life make a source more dangerous?

Does a long half life or a short half life make a source more dangerous?

If it has a long half life then it would remain highly radioactive for longer therefore making it more dangerous.

What precautions are taken to reduce harm for doctors and patients using ionising radiation?

What precautions are taken to reduce harm for doctors and patients using ionising radiation?

- Only a small dose is given to the patient so they are not exposed to too much.
- The radiation used has a very short half life so it won't remain highly radioactive for long. This reduces the risk to the doctors using it as well as the patient.
- The medical staff would also wear protective clothing

What is the difference between contamination and irradiation?

What is the difference between contamination and irradiation?

- Contamination is when radioactive substances are transferred to objects through processes such as touching the source or breathing it in
- Irradiation is when the object comes in contact with the radioactive source. The source doesn't actually enter your body and the radiation will stop if you move away from the area.

You can treat tumors internally and externally, evaluate these two methods.

You can treat tumors internally and externally, evaluate these two methods.

Both of the methods try to only target specific cancer cells, however some healthy tissue surrounding it is also damaged.

Both methods are designed to keep this to a minimum. The internal method uses a tracer and can use alpha radiation, which is poorly penetrating and cannot reach the healthy cells.

The external method concentrates the beam on specific parts of the body. For the external method a long half life is required, but for the internal method a short half life is required so it doesn't remain in the body for too long.

What is a radioactive tracer used for in medicine?

What is a radioactive tracer used for in medicine?

- The tracer is placed inside the body (it can be in a drink, eaten or injected)
- The tracer releases gamma radiation which is detected by a detector which moves around the body
- This can then be used to produce a picture of the patient's body

Describe the advantages of nuclear power for generating electricity?

Describe the advantages of nuclear power for generating electricity?

- Nuclear fuels do not produce carbon dioxide
- The fuel is readily available, meaning it would reduce pressure of the fossil fuel supplies
- Less nuclear fuel has to be used to produce the same amount of energy as burning fossil fuel
- Does not contribute to global warming

Describe some disadvantages of using nuclear power to generate electricity?

Describe some disadvantages of using nuclear power to generate electricity?

- The public perceive nuclear power as very dangerous and therefore are very against power stations
- There are security risks as the radioactive substances can be useful for terrorists
- A lot of money and time is required to commission and decommission the stations - which may be bad for a country's economy
- The radioactive waste can be difficult to dispose of and will remain radioactive for many years - which can be dangerous to humans and the environment
- Workers have to be regularly checked as the radioactive waste is dangerous
- Can cause widespread disasters such as chernobyl

Explain the process of fission of U-235.

Explain the process of fission of U-235.

The U-235 absorbs a neutron which makes it unstable, this causes it to split into two daughter nuclei and release two or more neutrons, as well as releasing energy.

Why do we refer to the reactions in a nuclear power station as a controlled chain reaction?

Why do we refer to the reactions in a nuclear power station as a controlled chain reaction?

- The neutrons released are absorbed by another nuclei, causing this nuclei to also undergo fission, releasing further neutrons
- It is controlled by a control rod which absorbs excess neutrons

What is the job of a moderator?

What is the job of a moderator?

It slows down the neutrons until they are travelling at a speed slow enough for them to be absorbed.

How are control rods used to ensure a controlled reaction?

How are control rods used to ensure a controlled reaction ?

- They are raised or lowered so that they absorb fewer or greater neutrons
- The number of neutrons that they absorb determines how many reactions can take place

Explain how electricity is produced in a nuclear power station.

Explain how electricity is produced in a nuclear power station

- The reactions release thermal energy
- This energy is used to boil water and then produce steam.
- This steam is then used to turn a turbine which starts the generator.

What is nuclear fusion?

What is nuclear fusion?

When two small nuclei fuse together to form a larger nuclei. This process also releases energy.

Where does fusion occur everyday?

Where does fusion occur everyday?

In the sun - stars use fusion as their energy source

Why can’t nuclear fusion be used as our energy source?

Why can't nuclear fusion be used as our energy source?

- On earth we can't get high temperatures and pressures for nuclear fusion to happen, whilst still being cost effective
- This is because both nuclei are positive therefore a lot of energy is required to overcome the electrostatic repulsion between the two nuclei

Why is fission currently used instead of fusion?

Why is fission currently used instead of fusion?

- Fission can be used for nuclear power and is easily controlled, whereas fusion is harder to control
- Fusion requires very harsh conditions (high temperatures and pressures), whereas fission does not