All you need to know about ...

OCR 21st Century Science

Module P3

ATOMIC STRUCTURE

- **elements** are made up of atoms of the same type
- **atoms** have a **nucleus** made up of **protons and neutrons**
- atoms of a particular element have **same number of protons**
- atoms of an element can have **different numbers of neutrons**
- atoms contain **equal numbers of protons and electrons**
- **electrons exist outside the nucleus** in energy levels (shells)

RADIOACTIVITY

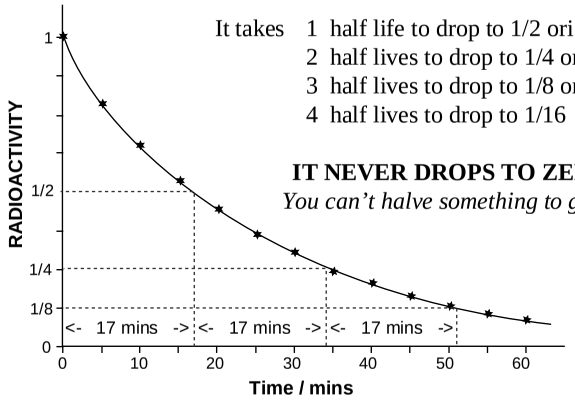
- atoms of some elements are **radioactive**
- radioactive elements **constantly emit ionising radiation**
- radioactive elements have unstable nucleui
- **unstable nuclei emit radiation** to **produce more stable nuclei**
- over time radioactivity decreases (but NEVER TO ZERO)
- decay is **measured in half lives** (can be seconds or years)

HALF LIFE

'The time it takes for half of the nuclei of an atom to decay'

- it is **a measure of the rate of decay** of a radio-isotope
- in one half-life; radioactivity drops to a half of its current value

Half lives	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Fraction remaining	**1**	**1/2**	**1/4**	**1/8**	**1/16**	**1/32**	**1/64**



It takes 1 half life to drop to 1/2 original
2 half lives to drop to 1/4 original
3 half lives to drop to 1/8 original
4 half lives to drop to 1/16 original

IT NEVER DROPS TO ZERO
You can't halve something to get 0

IONISING RADIATION
3 main types

		Penetration	
ALPHA	α	LOW	*absorbed by a few centimetres of air or thin paper*
BETA	β		*passes through air / paper stopped by thin metal*
GAMMA	γ	HIGH	*stopped by many centimetres of lead or metres of concrete*

Ionising radiation can...

- **damage** living cells - kill them
  - make them cancerous
- break molecules into ions
- **treat** cancer
- **sterilise** surgical instruments
- **sterilise** food (kills bacteria)
- **detect cracks** in pipes

GOOD USES

Radiation dose ...

- depends on - the **type** of radiation
  - **how long** you are exposed
- the **larger the dose**, the **greater the risk**
- is **measured in** units called **sieverts**
- can occur naturally (**background radiation**)
- background radiation can come from...
  - rocks - the sun and space
  - \+ - medical uses - nuclear fallout
- can be **higher in certain jobs**...
  - pilots and cabin crew
  - doctors, radiographers and dentists
  - miners
  - nuclear power station workers

GENERATING ELECTRICITY

- from **non-renewable** sources coal, oil, gas, nuclear
- from **renewable** sources wind, tidal, wave, hydro, solar, biomass

Process burn fuel —> heat water —> make steam —> turn a turbine —> generate electricity

Power stations types

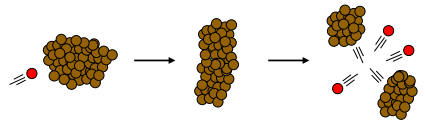
Fossil fuel
- uses non-renewable carbon fuels
- produces lots of CO_2 (greenhouse gas)
- produces sulphur dioxide (get acid rain)

Nuclear
- uses heat produced by radioactive decay
- no CO_2 or SO_2 produced

BUT • **produces radioactive waste**

Nuclear fission in power stations

- unstable nuclei are bombarded with neutrons
- the nuclei undergo fission and split
- two smaller nuclei are formed plus neutrons



- energy is released
- released neutrons cause more nuclei to split
- this produces a chain reaction
- the reaction is controlled using carbon rods
- the rods are lowered to absorb neutrons
- a coolant removes the heat energy
- water is not heated directly to minimise risks

Radioactive waste

Problems
- can be high level, low level or intermediate
- radioactivity never goes, it just gets less
- needs to be stored safely for many years
- method of storage depends on risk
- can be stored - under ground or sea
  - in drums
  - in glass