

# Graveney School Year 11 Physics Checklist

## P4 Radioactivity & Nuclear Power

---

### Treatment:

- X-rays and gamma rays are electromagnetic waves;
- Nuclear radiation is used to sterilize medical equipment;
- Radiographers use nuclear radiation and X-rays in hospitals;
- **X-rays produced from high energy electrons fired at a target;**
- **X-rays are easier to control than gamma rays;**
- beta and gamma emitters used as tracers in the body - **ingested and allowed to flow around the body followed with a radiation detector;**
- gamma rays used to treat cancer - **focused onto a tumour.**

### What is radioactivity?:

- the activity of a source is the number of decays occurring per second;
- the activity decays with time;
- a radioactive atom has an unstable nucleus which decays emitting alpha, beta or gamma radiation;
- alpha - helium nucleus;
- beta - fast electron;
- gamma - electromagnetic wave;
- **half-life - time for half the radioactive atoms to decay (activity to reduce by half)**
- **alpha decay equation - lose two neutrons and two protons from nucleus;**
- **beta decay equation - gain a proton but lose a neutron;**
- **gamma decay - no change to the nucleus.**

### Uses of radioisotopes:

- Background radiation is present in the environment - due to radioactive substances in rocks, soil and cosmic rays - natural - and from man made sources in industry and hospitals;
- Radioactive tracers can be used to
  - track the dispersal of waste;
  - find leaks in blocked/underground pipes;
  - find the route of underground pipes;

- **Gamma sources are used so it can penetrate to the surface, progress tracked with a detector, reduction in radioactivity signals a leak;**
- Smoke detectors use an alpha source (Americium 241). Smoke absorbs the alpha particles setting off the alarm;
- Carbon dating can be used to find date of old materials;
- **Carbon-14 has remained at the same level in the atmosphere for thousands of years;**
- **When an object dies carbon exchange with the atmosphere no longer happens;**
- **As Carbon-14 in wood decays its radioactivity decreases;**
- **The ratio of current to Carbon-14 activity to that in dead matter gives a reasonable estimate of its age;**
- **The ratio of uranium to lead gives an estimate of the age of rocks.**

### Fission:

- Nuclear power stations use uranium as a fuel;
- Electricity is produced by
  - nuclear fission releasing heat;
  - producing steam by heating water;
  - turning a turbine;
  - turning a generator;
- **Nuclear fission is the splitting of a uranium-235 atom when it absorbs a neutron. Fission releases energy in the form of heat;**
- A nuclear chain reaction releases energy in a bomb and a nuclear power station;
- **A chain reaction occurs because the fission of a uranium-235 atom releases several neutrons;**
- **Each neutron can induce another fission quickly accelerating the process;**
- The decay products of nuclear fission become radioactive waste;
- Boron control rods are used to absorb neutrons and control the chain reaction;
- **The number of neutrons absorbed must lead to a steady rate of nuclear fission occurring in a nuclear reactor;**

---

Do not keep saying to yourself, if you can possibly avoid it, 'But how can it be like that?' because you will get 'down the drain' into a blind alley from which nobody has yet escaped. Nobody knows how it can be like that.

Richard Feynman

