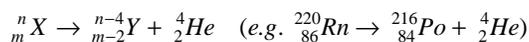
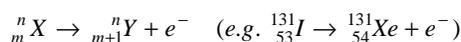


Physics Revision Notes – Space And Radiation

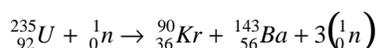
- Background radiation** is present all the time (about one count per second on a **Geiger-Müller tube**). This comes from rocks in the Earth's crust, the Sun, space, and nuclear power plants.
- There are three types of **radiation**:
 - **Alpha particle (a)** – a positively charged helium nucleus, which is highly ionising.
 - **Beta particle (b)** – a negatively charged electron, which is quite ionising.
 - **Gamma ray (g)** – a highly penetrating electromagnetic wave, which is not ionising.
- Alpha radiation can be stopped by **paper**. Beta radiation can be stopped by **thin aluminium**. Gamma radiation can be slowed down by **thick lead**.
- Alpha decay**:



- Beta decay** ($n \rightarrow p + e^- + \bar{\nu}_e$):

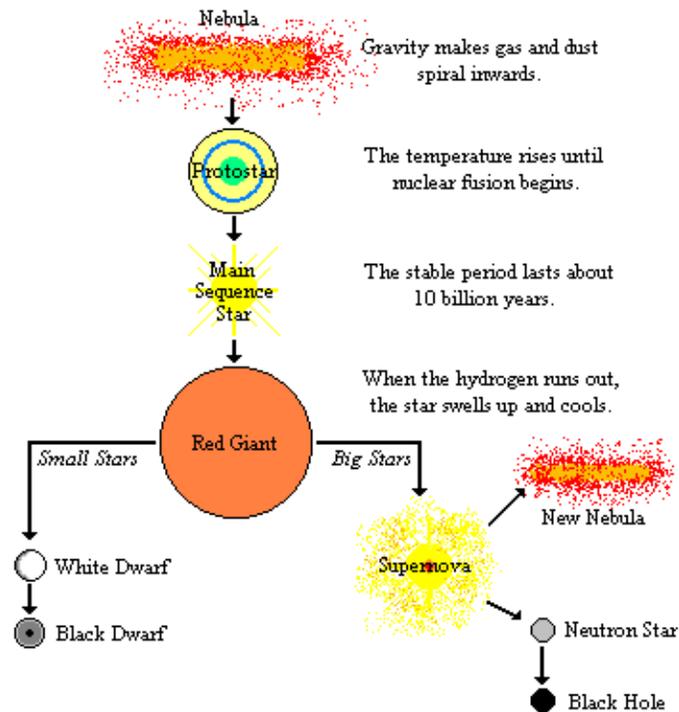


- Some radioisotopes give out **gamma radiation** as well (${}^0_0 \gamma$).
- The **half life** is the time taken for a radioisotope to lose half its radioactivity:
 - To calculate it **from numbers** – divide the figure to begin with by 2 until the specified figure is reached. Then divide the given time by the number of times it took to reach the figure.
 - To calculate it **from graphs** – choose a count rate to go across the y-axis, and also half that rate. Then go down to the x-axis and find the difference between the two points.
- Uses of radiation:
 - **Thickness maintenance** – a beta source is passed through paper, sending a feedback to the rollers (e.g. if there is too much radiation, the paper is made thicker).
 - **Tracers** – radioactive materials can be placed in pipes to measure the flow or to find leaks. This is also used by plant biologists to monitor the flow of water through a plant.
 - **Smoke alarms** – an alpha radiation source is passed to a detector. When smoke particles get in the way the radiation is stopped, thus the buzzer sounds.
 - **Gamma radiation** – low doses can cause cancer, whereas high doses can kill cells. This is used in radiotherapy, whereby the radiation is concentrated on the cancer to kill it.
- Nuclear fission** is a chain reaction that produces masses of heat energy:



- Rutherford's **gold foil experiment** disproved the "plum pudding" model of the atom, and thus helped to develop the modern view of its structure.
- Stars** are balls of gas, producing heat and light energy from **nuclear fusion** reactions.
- Planets** are smaller masses, orbiting around a star – they reflect light from stars.
- The planets in our **solar system** are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.
- Gravity** holds the planets in orbit around the sun (and satellites in orbit around the planets). It acts on all objects, whereby for a force F and a distance d , $F \propto \frac{1}{d^2}$
- The Earth is **tilted** on an axis, rotating once every 24 hours.
- The Earth takes $365\frac{1}{4}$ days to orbit the Sun (the quarters add up, so we have a **leap year** of 366 days every 4 years).
- Seasons** are created because of the Earth being tilted.
- Day and night** are created because of the Earth rotating.
- Asteroids** stay in orbit between Mars and Jupiter. **Meteorites** are those that are knocked off course – entering the Earth's atmosphere as "shooting stars".
- Comets** orbit the Sun in extremely elliptical orbits that can be in any plane or direction. They have a tail behind them, due to their icy core melting as they get nearer to the sun.

21. **Satellites** can be natural (e.g. the Moon, Phobos and Delimos) or artificial:
- **Geostationary satellites** – have high equatorial orbits at the same rate as the Earth's spin. They are used for communication, television, and telephone.
 - **Low polar orbits** – have low orbits around the poles while the Earth spins underneath. Therefore, they can scan the whole Earth in 24 hours. They are used for spying and weather.
 - **The Hubble space telescope** – gets detailed images of space due to the absence of any blurring or distortion that is caused by the Earth's atmosphere.
22. Stars and solar systems form from clouds of dust called **nebulae**, which spiral inwards due to gravity. As the temperature increases, **nuclear fusion** can take place – creating heat and light.
23. Our Sun is in the **Milky Way galaxy**, on one of the spiral arms. Galaxies all rotate slowly. Stars are very far away from one another, but galaxies are even more spread out. There are over a billion galaxies in our universe.
24. A **light year** is the distance that light travels in one year.
25. The **life cycle** of a star:



26. Galaxies are moving away from us very quickly, causing light to be shifted towards the red end of the spectrum (**red shift**), which is called the **Doppler effect**. The universe is therefore **expanding**. Background radiation from the big bang is constant in all directions and all parts of the universe.
27. The **Steady State theory**:
- The universe is the same everywhere and **always has been**.
 - Expansion is due to the **creation of matter** in the spaces.
 - There is **not much evidence** to support this theory.
28. The **Big Bang theory**:
- A **singularity** exploded to create all the matter in the universe, about 15 million years ago.
 - The **expansion** was slowed down by **gravity**.
 - This is the most widely accepted theory, as there is **a lot of evidence** to support it.
29. The fate of the universe:
- If there is enough mass, then there will be a **Big Crunch**.
 - If there isn't enough mass, then the universe will **continue expanding forever**.
 - This is **difficult to prove**, as most matter is 'invisible'.