Physics Revision Notes – Electromagnetism

1. White light can be split into the **visible spectrum** using a prism (violet light bends the most).
2. The **electromagnetic spectrum** contains the following types of waves:
   - **Radio Waves** → Long wave radio waves have a wavelength of about 1-2km, and can travel long distances and down tunnels, as they are able to bend.
     → Medium wave radio waves have a wavelength of about 300m, and the reception is fuzzy due to limited transmitters.
     → Short wave radio waves have a wavelength of about 200m and cannot go through hills – they only have one line of sight.
     → FM radio and TV (VHF or UHF) are shorter than short waves.
   - **Microwaves** → Used by mobile phones and satellites.
     → When used for cooking, microwaves excite water and salt molecules to create heat. This is a danger to living organisms.
   - **Infra Red** → Radiant heat emitted from hot objects.
     → Used to detect heat sources (e.g. night vision), and for TV controls.
   - **Visible light** → Used in fibre optics (e.g. endoscopes and telephone wires).
   - **Ultra Violet** → Penetrating (in sunlight) – can damage internal organs and/or cause skin cancer. Darker skin lets fewer waves penetrate.
   - **X-Rays** → Used to take pictures inside the body (in medicine).
     → Used to destroy cancer cells by overlapping two beams over the cancer.
     → Can cause mutations in sex cells, or tumours in body cells.
   - **Gamma Rays** → Used to treat cancer like x-rays (radiotherapy).
     → Used as tracers (e.g. in the blood).
3. How to **wire a plug** safely – the safety features are the **fuse** and the **earth wire**.
4. Choosing the correct **fuse** for an appliance (e.g. a 13A fuse would be used for an 11A appliance).
5. A **circuit breaker** cuts off the power if the current gets too high, by way of an electromagnet – if the current is too high, it will have a large enough force to attract the catch and break the circuit.
6. **Alternating current (AC)** is when the live wire alternates between a positive and negative voltage, while the neutral wire is close to 0V (e.g. mains electricity – 230V @ 50Hz).
7. **Direct current (DC)** is when the supply is constant and in one direction only (e.g. from a battery).
8. **Electromagnets** are made by wrapping a wire around in a coil (a solenoid).
9. The **strength** of an electromagnet is increased by → Increasing the **number of turns** in the coil.
   → Increasing the **current** through the coil.
   → Using an **iron core**.
10. **DC magnets** need less current and the magnetism lasts longer after the power is removed, whereas **AC magnets** need more current and the magnetism is lost immediately after the power is removed.
11. Uses of electromagnets:
    - **Scrapyard magnet**.
    - **Circuit breaker**.
    - **Loudspeaker** – the direction of the current is continually changed, causing the magnet to move backwards and forwards; thus creating a longitudinal sound wave.
    - **Relay** – a DC current powers an electromagnet which is able to pull two contacts together to turn on a higher voltage AC circuit.
    - **Electric Bell** – an electromagnet attracts the hammer, striking the bell and breaking the circuit. The hammer then springs back to start again. This is called a **make-and-break** circuit.
12. **Electromagnetic induction** is when a magnet move through a coil, or a coil moves through a magnetic field, to create an electric current.
13. The **size** of the induced current is increased by → Increasing the **speed** of the movement.
    → Increasing the **strength** of the magnet.
    → Increasing the **number of turns** in the coil.
14. In a **DC motor**, the current flows through a coil in a magnetic field, producing a **moment**. A **split ring commutator** is used to reverse the current and thus keep the moment in the same direction.
15. The **size** of the moment is increased by → Increasing the **current**.
    → Increasing the **magnetic field strength**.
16. **Transformers** are used to increase or decrease the voltage in a wire, by altering the number of turns in each coil:

$$\frac{\text{Number of primary turns}}{\text{Number of secondary turns}} = \frac{\text{Primary voltage}}{\text{Secondary voltage}} \quad - \quad \frac{N_p}{N_s} = \frac{V_p}{V_s}$$