Physics Section 3.3: Keeping Thing Moving

Magnetic Fields

- That a magnetic field is a region where magnetic materials and current-carrying wires experience a force acting on them.
- That when a current flows through a wire, a magnetic field made up of concentric circular field lines is formed in a plane perpendicular to the wire with the wire at the centre.
- That an electromagnet is a magnet that can be turned on and off using a current.
- That electromagnets are used in things like scrap metal cranes and relay switches.

The Motor Effect

- That when a current-carrying wire in a magnetic field experiences a force it's called the motor effect.
- That the force caused by the motor effect can be increased by increasing the current in the wire or increasing the magnetic field strength.
- That if a current-carrying wire is parallel to a magnetic field, it will experience zero force due to the motor effect.
- That the two ways of reversing the direction of the force caused by the motor effect are reversing the current and reversing the magnetic field.
- How to use Fleming's left-hand rule to find the direction of the force caused by the motor effect.

Using the Motor Effect

- That the motor effect can be used to create motion, e.g. in a simple electric motor.
- That a simple electric motor can be made using a current-carrying loop of wire, a magnetic field and a split-ring commutator. The motor effect causes a force that causes the loop of wire to turn, and the split-ring commutator ensures the force is always acting in a direction that keeps the loop turning.

Electromagnetic Induction

- That a potential difference is induced across the ends of a wire (or other conductor) when it moves within a magnetic field or a magnet is moved inside it.
- That an a.c. current can be generated by changing the direction of a magnet moving relative to a conductor, or a conductor moving relative to a magnetic field.
- How to apply knowledge of electromagnetic induction to different electrical appliances that make use of it.

Transformers

- That a transformer consists of a primary coil and a secondary coil, wrapped around an iron core.
- How an alternating current in the primary coil creates a changing magnetic field in the iron core and secondary coil of a transformer. Know that as a result, an alternating p.d. is induced by electromagnetic induction across the ends of the secondary coil.
- That in a step-up transformer the number of turns on the secondary coil and the potential difference across it are greater.
- That in a step-down transformer the number of turns on the primary coil and the potential difference across it are greater.
- How to use the transformer equation:
- $\frac{V_p}{V_s} = \frac{n_p}{n_s}$
- where Vp and np are the potential difference across and number of turns on the primary coil, and Vs and ns are the potential difference across and number of turns on the secondary coil.
- That if a transformer is assumed to be 100% efficient, then its power input is equal to its power output and so:

- $V_p \times I_p = V_s \times I_s$
- where Vp and Ip are the potential difference across and current in the primary coil, and Vs and Is are the potential difference across and current in the secondary coil.

Switch Mode Transformers

- That switch-mode transformers operate at frequencies that are much higher than traditional transformers — often in the range of50–200 kHz.
- That switch mode transformers are small and light, and use very little power if they have no load.
- That switch mode transformers are ideal in situations where they're likely to be plugged in for a long time or carried around, such as the chargers for phones or laptops.