OCR (A) Physics GCSE

Topic P7: Energy

Summary Notes

(Content in bold is for Higher Tier only)

P7.1 Work Done

Energy is never made, created or destroyed, it can only be transferred.

Energy Change Examples

- Object thrown upwards:
  - Kinetic energy transfers to gravitational potential energy (GPE).
  - Then GPE transfers back to kinetic energy (KE) as it falls back down.

- Object projected up a slope:
  - KE transferred to GPE.
  - Reverse when rolling back down.

- Moving object hitting a wall:
  - KE transferred to elastic potential energy (EPE) when it gets squashed.

- Object accelerated by a constant force:
  - The force does work on the object.
  - Transferring energy from whatever applies the force to KE in the object.

- Vehicle slowing down:
  - KE of the vehicle transferred to heat energy from friction between brakes and wheels and the wheels and road.

- Kettle boiling water:
  - Electrical energy transferred to thermal energy in water.

Heating

When heat energy is transferred to an object, the **particles gain more kinetic energy.** The temperature of the object increases as the energy supplied is used to overcome the specific heat capacity.

Work Done

Energy from whatever is applying the force is transferred to the object. The force itself does not give the object energy but the **force** being applied over a distance requires energy – this is the work done.

When current flows, work is done against the **resistance**, so KE from flowing charge is transferred to **heat** due to energy loss from resistance.

These are the **equations** commonly **n**eeded to be able to carry out calculations of how much energy an object has before and after an event:

$$work\ done = force \times distance \qquad voltage = current \times resistance$$

$$power = current^2 \times resistance \qquad energy = power \times time$$

$$KE = \frac{1}{2}mv^2 \qquad GPE = mgh \qquad EPE = \frac{1}{2}kx^2$$

P7.2 Power and Efficiency

Energy Loss

Energy is lost when it is **transferred** into other forms, instead of the desired form. It is not actually lost, just transferred into something **wasteful**.

e.g. Energy dissipated by **heat** by wires heating up.
e.g.2 Energy lost by **sound** when a ball hits a wall.
e.g.3 Energy lost by **light** such as a spark.

Electricity Energy Loss

Energy is typically lost in electrical systems due to **heating of wires**. This is transferred from Mains, AC supply or batteries, DC supply.

Motors heat up when **moving**, losing some energy. They lose energy due to inefficient contacts between the wires and spinning coil.

Power Ratings

Electrical appliances have **power ratings**, showing the power and voltage. This can be used to find current and shows how much energy will be used for the item. The larger the power, the more energy used per second, therefore it indicates efficiency:

$$efficiency = \frac{useful\ energy\ output}{total\ energy\ input}$$

Increasing Efficiency

For electricity, decreasing current will increase efficiency, as power loss in heating wires is due to current and resistance:

$$power\ loss = I^2R\,.$$

- **Recycling waste energy, or preventing it from dissipating, so the energy can be reused is a way of increasing efficiency.**

- **Lubricating mechanical systems reduces friction and heat loss.**
- **Thermal insulation ensures all heat energy is used, and not lost to surroundings.**

Insulation

Heat energy is lost through walls in buildings.

Without insulation, gaps between outer walls and inner walls (cavities) contain air meaning **convection currents** form, losing energy. In this case, the rate of cooling is high.

With insulation, fibreglass or cavity wall insulation, fills the cavity preventing heat from being lost, as convection currents **cannot form**. The material also **weakly conducts** heat so the rate of cooling is low.

Thicker walls also result in a lower rate of cooling.