Physics Knowledge Organiser

P5 - Conservation and dissipation of energy

Power

You should recall that power is **the rate of energy transfer**, or the rate at which work is done. In electrical components, including any electrical appliance, the power relates to the potential difference across the component and the current through it. If either p.d. or current increases, the power increases. In other words, the rate of energy transfer increases. This should be clear from the first equation.

The second equation also finds the power. The equation comes from substituting in *V = IR*. The second equation is useful if you don't know the p.d. across a component.

Energy transfers in electrical appliances

The whole point of electrical appliances is to transfer energy, the amount. The electrical potential energy from the supply is transferred to something useful – such as light and sound in your TV. The other way of saying this is that **work is done** when **charge flows** in a circuit.

Some examples of energy transfers in electrical appliances:

- In your mobile phone, electrical potential energy from the dc supply (the battery) is transferred to light, sound and thermal energy. This means the energy from the battery is **dissipated** to the surroundings.
- A washing machine transfers electrical potential energy from the ac mains supply to kinetic energy in the electric motor (that's why it spins), along with heat. Eventually, all the energy of the input is dissipated to the surroundings.
- An electric heater transfers the electrical potential energy of the supply to thermal energy. The energy stored in the supply ends up stored in the air, the walls, the floor and so on around the heater: stored in the heat of the materials.

The amount of energy transferred by an appliance depends on the **power** of the appliance and the **time** it is switched on for. To find the amount of energy transferred, simply multiply the power of the appliance by the time it is on for (see third equation).

Furthermore, since p.d. is a measure of how much work is done per coulomb of charge, you can find out how much work is done (aka energy transferred) by a circuit by multiplying the charge flow by the p.d. (see fourth equation).

Key Terms	Definitions
Power	The rate of energy transfer. In electrical components, the power is found by multiplying p.d. by current.
Work	Transfer of energy.
Appliance	Any device that transfers electrical energy to other forms. The supply of electrical energy can be a cell, battery, or the mains ac supply.

Equation	Meanings of terms in equation
* $P = V\,I$	*P = power (watts, W)* *V = potential difference (volts, V)* *I = current (amps, A)*
* $P = I^2 R$	*P = power (watts, W)* *I = current (amps, A)* *R = resistance (ohms, Ω)*
* $E = P\,t$	*E = energy transferred (joules, J)* *P = power (watts, W)* *t = time (seconds, s)*
* $E = Q\,V$	*E = energy transferred (joules, J)* *Q = charge flow (coulombs, C)* *V = potential difference (volts, V)*

High power, low power

The power of an appliance determines how much energy is transfers in a given length of time. If an appliance has a high power (e.g. a washing machine), it transfers lots of energy in a given time. If it has a low power (e.g. a lamp), it doesn't transfer much energy in a given time, in comparison.

The other way of looking at it is how long the appliance takes to transfer a given amount of energy, e.g. 1000 J. A washing machine will transfer the energy in a very short length of time, whereas a lamp will take much longer to transfer this energy.