Electrical Power

Quick recap

- The concepts of energy, work and power are the same across the range of physics

- Power is the rate at which energy is transferred

- Electrical power is the rate at which Electrical Potential (V) is transformed into

  - Light

  - Heat

  - Movement

Consider our simple circuit

- With 5V electrical potential …
- and a 2Ω resistance component …
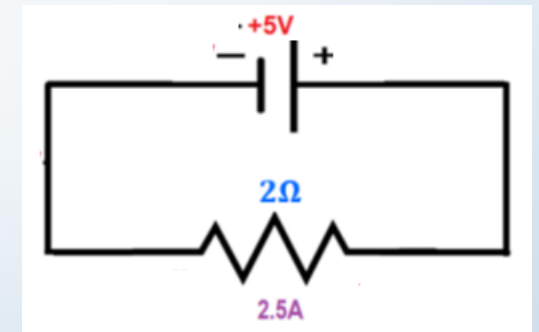- 2.5A of current flows
- Power is given by the formula

$$P = VI$$

- with the units Watts (W)
- Thus the power available at the resistor is

$$P = VI = 5 \times 2.5 = 12.5W$$

Or

12.5 Joules per second in energy terms

This translates directly to …

- Everything else you know about power and energy

- Consider a 1kg brick

- If you lift it $1m$, you increase its $E_p = mgh = 1 \times 9.8 \times 1 = 9.8J$

- Our previous circuit provides $12.5Js^{-1}$, thus if the resistor was an equivalent resistance motor …

- It could raise the brick the $1m$ in $\frac{9.8}{12.5} = 0.78s$

And … that is exactly how electrical motors work

- The Wattage (W) of a motor is a measure of how much energy it puts out every second.

- Note a Kilowatt (kW) is 1000Watts(W) (kilo is '1000')

- Thus the term "kilowatt hours" (kWh) refers to how many kilowatts of energy will be produced over an hour
  - 4 kWh implies that 4kW is produced every hour

A motor in a circuit

- Consider a simple motor circuit as shown on the right

- By Ohm's Law $I = \frac{V}{R} = \frac{12}{8} = 1.5A$

- And $P = VI = 12 \times 1.5 = 18W$

- So it can 'deliver' $18J$ per second