<u>Power</u>

Power is the rate that energy is transferred.

Rates:

A rate is how much something changes in a certain time period. It can be summarised by the equation:

$$rate = \frac{something}{time}$$

An example of a rate you will have studied already is speed. Speed is the rate at which distance changes:

$$speed = \frac{distance}{time}$$

Another example in physics is acceleration. Acceleration is the rate at which velocity changes:

$$acceleration = \frac{change\ in\ velocity}{time}$$

An example in biology is the rate of photosynthesis. This could be measured by how much O_2 is produced in a certain time:

$$rate\ of\ photosynthesis = \frac{volume\ of\ O_2}{time}$$

An example in chemistry is the rate of reactions. This could be measured by how much mass of product is produced in a certain time:

$$rate\ of\ reaction = \frac{mass\ of\ product}{time}$$

As power is the rate that energy is transferred:

$$power = \frac{energy\ transferred}{time}$$

$$P = \frac{E}{t}$$

E= energy (measured in Joules, J)

P = power (measured in Watts, W)

t = time (measured in seconds, s)

1W is 1J of energy transferred per second. 2W is 2J of energy transferred per second, and so on. If a kettle has a power rating of 2500W, that means it transfers 2500J every second.

This equation can be rearranged to tell us how much energy is transferred if we know the power of something and how long it has been used for:

$$energy\ transferred = power\ x\ time$$

$$E = Pt$$

If a hair dryer is used for longer, it will transfer more energy.

Current

Current is the rate of charge flow.

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$$rate\ of\ reaction = \frac{mass\ of\ product}{time}$$

As current is the rate of charge flow:

$$current = \frac{charge\ flow}{time}$$

$$I = \frac{Q}{t}$$

I= current (measured in Amps, A)

Q = charge flow (measured in Coulombs, C)

t = time (measured in seconds, s)

1A is 1C of charge flowing past a point per second. 2A is 2C of charge flowing past a point per second, and so on.

This equation can be rearranged to tell us how much charge flows if we know the current and how long it has been been flowing for:

$$charge\ flow = current\ x\ time$$

$$Q = It$$

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Speed

Speed is the rate of change of distance.

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As speed is the rate of change of distance:

$$speed = \frac{distance}{time}$$

$$v = \frac{s}{t}$$

v = speed (metres per second, m/s)

s = distance (metres, m)

t = time (seconds, s)

1m/s means that distance is changing by 1m per second. 2m/s means that distance is changing by 2m per second., and so on.

This equation can be rearranged to tell us how much the distance changes if we know the speed and how long it has been been travelling for:

$$distance = speed\ x\ time$$

$$s = vt$$

Acceleration

Acceleration is the rate of change of velocity.

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Since acceleration is the rate at which velocity changes:

$$acceleration = \frac{change\ in\ velocity}{time}$$

$$a = \frac{\Delta v}{t}$$

- a = acceleration (metres per second squared, m/s^2)
- Δv = change in velocity (metres per second, m/s)
    - Δ (the Greek letter delta) means "change of", so Δv means change in velocity
- t = time (seconds, s)

Change in velocity can be calculated by subtracting the initial (starting) velocity from the final velocity:

$$change\ in\ velocity = final\ velocity - initial\ velocity$$

$$\Delta v = v - u$$

- v = final velocity (metres per second, m/s)
- u = initial velocity (metres per second, m/s)

$$acceleration = \frac{change\ in\ velocity}{time} = \frac{final\ velocity - initial\ velocity}{time}$$

$$a = \frac{\Delta v}{t} = \frac{v - u}{t}$$

If an object is slowing down, the change in velocity will be a negative number. This gives a negative value for the acceleration. A negative acceleration is also called "deceleration".