Topic 1.1 – Forces and motion

Learning Objectives

Scalars are quantities that have magnitude only. Vectors are quantities that have magnitude and an associated direction.

You should be aware that distance, speed and time are examples of scalars and displacement, velocity, acceleration, force and momentum are examples of vectors.

If an object moves in a straight line, how far it is from a certain point can be represented by a displacement-time graph.

The speed of an object can be determined from the gradient of a distance-time graph. ~~If an object is accelerating its speed at any particular time can be determined by finding the gradient of the tangent of the distance-time graph at that time.~~

The velocity of an object is its speed in a given direction.

The velocity **v** of an object is given by the equation:

v = s / t

where **s** is the displacement and **t** is the time taken.

The acceleration **a** of an object is given by the equation:

a = (v - u) / t

where **u** is the initial velocity, **v** is the final velocity and **t** is the time taken.

The acceleration of an object can be determined from the gradient of a velocity-time graph.

The distance travelled by an object can be determined from the area under a velocity-time graph.

Topic 1.2 – Resultant forces

Learning Objectives

Whenever two objects interact, the forces they exert on each other are equal and opposite.

A number of forces acting at a point may be replaced by a single force that has the same effect on the motion as the original forces all acting together. This single force is called the resultant force.

You should be able to determine the resultant of opposite or parallel forces acting in a straight line and determine the resultant of two coplanar forces by scale drawing.

A resultant force acting on an object may cause a change in its state of rest or motion.

If the resultant force acting on a stationary object is:

- zero, the object will remain stationary
- not zero, the object will accelerate in the direction of the resultant force.

If the resultant force acting on a moving object is:

- zero, the object will continue to move at the same speed and in the same direction
- not zero, the object will accelerate in the direction of the resultant force.

The relationship between force **F**, mass **m** and acceleration **a** is:

$$\mathbf{F = m \times a}$$

3.1 – Kinetic Theory

Kinetic theory can be used to explain the different states of matter.

You should be able to recognise simple diagrams to model the difference between solids, liquids and gases.

The particles of solids, liquids and gases have different amounts of energy.

The specific heat capacity of a substance is the amount of energy required to change the temperature of one kilogram of the substance by one degree Celsius.

The relationship between energy **E**, mass **m**, specific heat capacity **c** and temperature change θ is:
$\mathbf{E = m \times c \times \theta}$

The specific latent heat of vaporisation of a substance is the amount of energy required to change the state of one kilogram of the substance from a liquid to a vapour with no change in temperature.

The relationship between energy **E**, mass **m** and specific latent heat of vaporisation $\mathbf{L_V}$ is: $\mathbf{E = m \times L_V}$

The specific latent heat of fusion of a substance is the amount of energy required to change the state of one kilogram of the substance from a solid to a liquid with no change in temperature.

The relationship between energy **E**, mass **m** and specific latent heat of fusion $\mathbf{L_F}$ is: $\mathbf{E = m \times L_F}$

The melting point of a solid and the boiling point of a liquid are affected by impurities.

You should be able to explain the shape of the temperature-time graph for a substance that is either cooled or heated through changes in state.

3.2 – Energy transfer by heating

Energy may be transferred by conduction and convection.

You should be able to explain, in terms of particles, how these energy transfers take place.

You should understand in simple terms how the arrangement and movement of particles determine whether a material is a conductor or an insulator and understand the role of free electrons in conduction through a metal.

You should be able to use the idea of particles moving apart to make a fluid less dense, to explain simple applications of convection.

Energy may be transferred by evaporation and condensation.

You should be able to explain evaporation, and the cooling effect this causes, using the kinetic theory.

You should be able to discuss the factors that affect the rate of evaporation.

The rate at which an object transfers energy by heating depends on:

- its surface area and volume
- the material from which the object is made
- the nature of the surface with which the object is in contact.

You should be able to explain the design of devices in terms of energy transfer, for example cooling fins.

You should be able to explain animal adaptations in terms of energy transfer, for example relative ear size of animals in cold and warm climates.

The bigger the temperature difference between an object and its surroundings, the faster the rate at which energy is transferred by heating.

Most substances expand when heated.

You should understand that the expansion of substances on heating may be a hazard (for example, the expansion of roofs and bridges) or useful (for example, the bi-metallic strip thermostat).

Topic 3.3 – Infrared Radiation

All objects emit and absorb infrared radiation.

The hotter an object is the more infrared radiation it radiates in a given time.

Dark, matt surfaces are good absorbers and good emitters of infrared radiation.

Light, shiny surfaces are poor absorbers and poor emitters of infrared radiation.

Light, shiny surfaces are good reflectors of infrared radiation.

Topic 4.1 – Electric Circuits

Learning Objectives

a) Electrical charges can move easily through some substances, for example metals.

b) Electric current is a flow of electric charge.

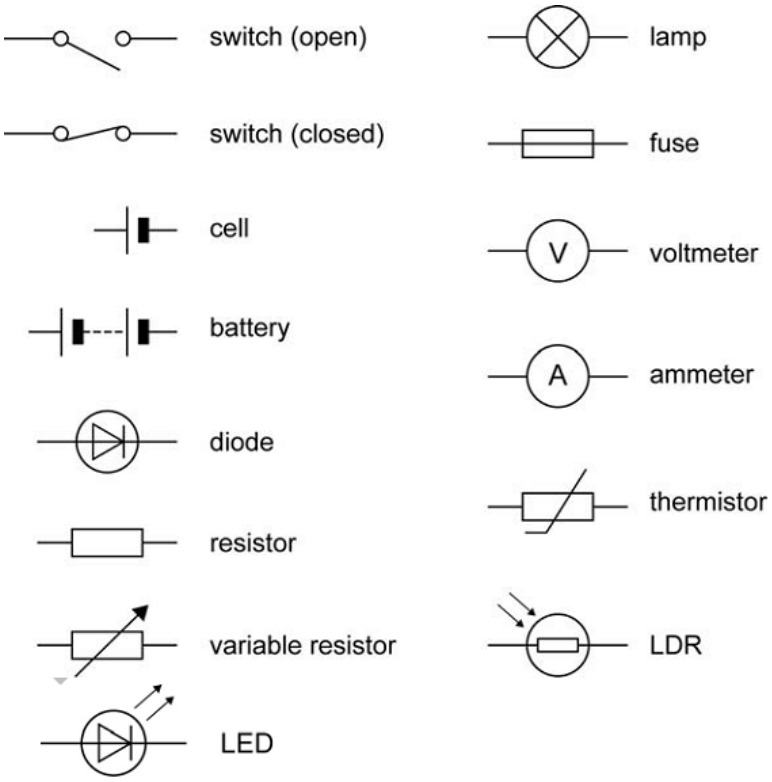
c) The relationship between current **I**, charge **Q** and time **t** is: **I = Q / t**

d) The relationship between potential difference **V**, energy transferred **E** and charge **Q** is: **V = E/Q**

Your teacher may use either of the terms **potential difference** or **voltage**. Questions will be set using the term potential difference. You will gain credit for the correct use of either term.

e) Circuit diagrams use standard symbols.

You will be required to interpret and draw circuit diagrams. You should know the following standard symbols:



You should understand the use of thermistors in circuits, for example thermostats.

You should understand the use of light-dependent resistors (LDRs) in circuits, for example switching lights on when it gets dark.

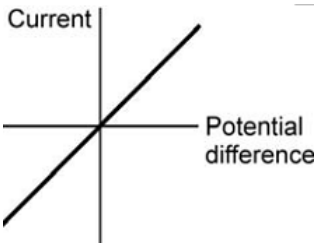
f) Current–potential difference graphs are used to show how the current through a component varies with the potential difference across it.

g) The resistance of a component can be found by measuring the current through and potential difference across, the component.

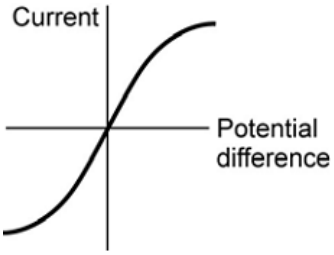
h) The current through a component depends on its resistance. The greater the resistance the smaller the current for a given potential difference across the component.

i) The relationship between potential difference **V**, current **I** and resistance **R** is: **V = I × R**

j) The current through a resistor (at a constant temperature) is directly proportional to the potential difference across the resistor.

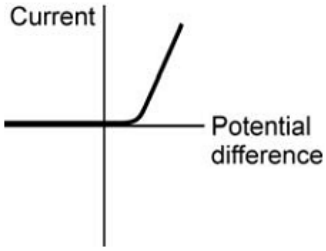


k) The resistance of a filament bulb increases as the temperature of the filament increases.



You should be able to explain change in resistance in terms of ions and electrons.

l) The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction.



m) The potential difference provided by cells connected in series is the sum of the potential difference of each cell (depending on the direction in which they are connected).

n) For components connected in series:

- the total resistance is the sum of the resistance of each component
- there is the same current through each component
- the total potential difference of the supply is shared between the components.

o) For components connected in parallel:

- the potential difference across each component is the same
- the total current through the whole circuit is the sum of the currents through the separate components.

p) An LED emits light when a current flows through it in the forward direction.

You should be aware that the use of LEDs for lighting is increasing, as they use a much smaller current than other forms of lighting.

q) When an electrical charge flows through a resistor, the resistor gets hot.

You should understand that a lot of energy is wasted in filament bulbs by heating. Less energy is wasted in power saving lamps such as Compact Fluorescent Lamps (CFLs).

You should understand that there is a choice when buying new appliances in how efficiently they transfer energy.