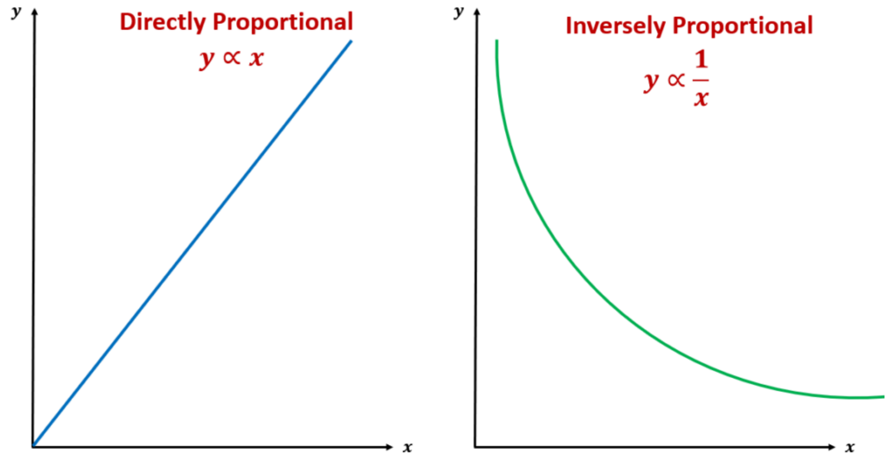


1. **An experiment is repeated with the same equipment, but this time all values are 0.10N higher than the previous time. Suggest a reason for the difference.**
   The equipment used had zero error // had not been set to 0 at the start.

2. **How to decide whether values are within limits of experimental accuracy**
   They are equal/ close/ within 10% / less than 10% difference

3. **f = uv/D (f = focal length). A graph of uv against D is plotted. The gradient of this graph is numerically equal to the focal length. Explain how a graphical method can give a more accurate value.**
   - A straight line is a way of taking average
   - anomalous results can be seen (and repeated or ignored)

4. **A student measures volume to the nearest 1cm3. Suggest why this is appropriate.**
   - Because measuring cylinder can only be read to nearest 1 or 2 cm3

NOTE: when the values in a calculation have 2 s.f, the answer to that calculation should also have 2s.f.
Eg. R = V/I; when V = 2.4V and I = 0.32A, they both have 2s.f.
Therefore R = 7.5Ω

NOTE:
Carefully check if distances have been measured in cm or mm!

GENERAL PHYSICS

1.

A student investigates the balancing of a metre rule.

Fig. 1.1 shows the apparatus.

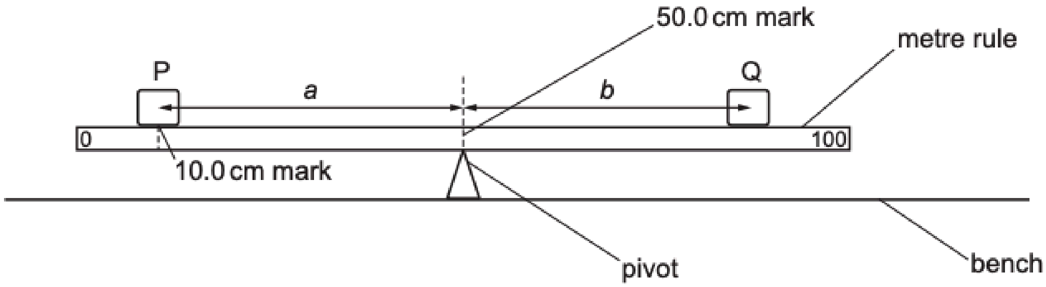


Fig. 1.1

(a) The student places the metre rule on the pivot at the 50.0 cm mark.

She places object P with its centre on the metre rule at the 10.0 cm mark.

The object covers the scale markings on the metre rule, as shown in Fig. 1.2.

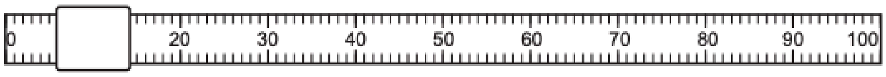


Fig. 1.2

Explain briefly how to place object P as accurately as possible with its centre at the 10.0 cm mark.

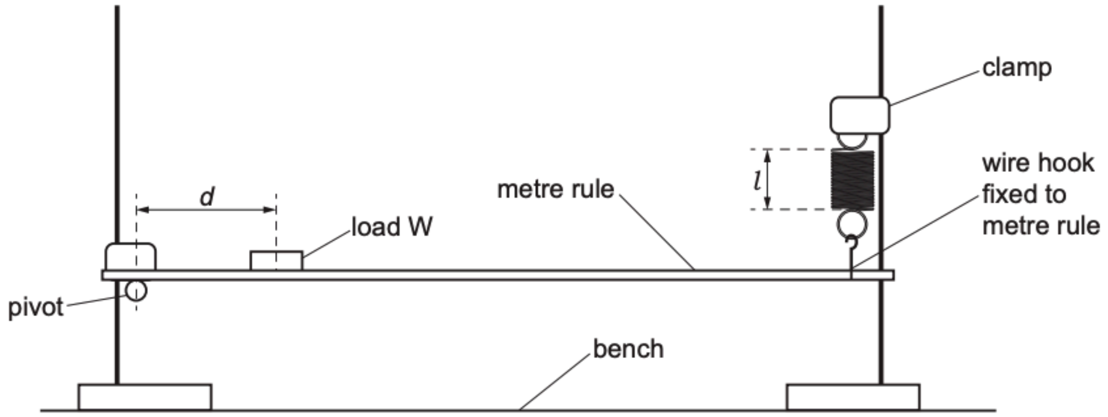
You may add to Fig. 1.2, or draw another diagram, to help your explanation.

Explain briefly how to place object P as accurately as possible with its centre at the 10.0cm mark.

Equal readings on either side of the 10cm mark.

2.

(b) The student attaches a metre rule to the spring with a wire hook, as shown in Fig. 1.3. The scale of the metre rule faces upwards.



It is sometimes difficult to position the load W on the scale of the metre rule at the correct distance d from the pivot. Suggest one change to the apparatus to overcome this difficulty.

Suspend the load from a loop of thread

Sources of inaccuracy for these kind of exerpiments involving springs

- Spring extension is not linear
- Test load is not exactly 1.0 N
- Metre rule not uniform

3. **Explain briefly how to measure the centre of a pendulum bob as accurately as possible**

   Clear use of horizontal aid // bob touching rule

4. **Explain briefly why timing 20 oscillations gives a more accurate result for time period of oscillation.**

   Reaction time/ human error a smaller part of time measured

HEAT

1. **Precaution to ensure that temperature readings are as accurate as possible**
   - line of sight perpendicular to scale // view thermometer at right angles (to scale / reading) / at eye level
     - Explanation: to avoid parallax error
   - wait until reading on thermometer stops rising (at start)
     - Explanation: so that the maximum temperature of the liquid is recorded
   - thermometer not touching the sides / base of beaker
     - Explanation: temperature different to that of the bulk of the liquid

- stir the mixture before taking the reading
    - Explanation: to distribute water evenly / to ensure that all the water is at the same temperature

2. **During an experiment that investigates the rate at which water in a beaker cools, some thermal energy is also lost from the sides of the beaker. The student wishes to find out how much of this loss of thermal energy affects the cooling rate.**
   Briefly describe an additional experiment that can be carried out to investigate this. Explain how the results can be used to determine how much this loss affects the cooling rate.
    - Repeat experiment with a lid
    - calculate the cooling rate with the lid, and subtract this from the cooling rate of the previous experiment to find cooling rate without transfer from sides // compare the cooling rates.

3. **Requirements when reading volume of water in measuring cylinder, in order to obtain accurate results**
    - View scale / value / reading / water level at right angles / perpendicularly
    - take the reading at the bottom of the meniscus
    - place the measuring cylinder on a (horizontal) flat surface / ensure that measuring cylinder is vertical

4. **Explain reason for taking reading at the bottom of meniscus rather than at top**
   negligible / very small volume / amount of water between the bottom and the top of the meniscus

5. **Variables to be kept constant when the effect of starting temperature on cooling rate of water is being investigated.**
    - volume of water
    - room temperature
    - Time interval/ duration of experiment

6.

A student investigates the dimensions of a boiling tube.
She uses the apparatus shown in Fig. 1.1.

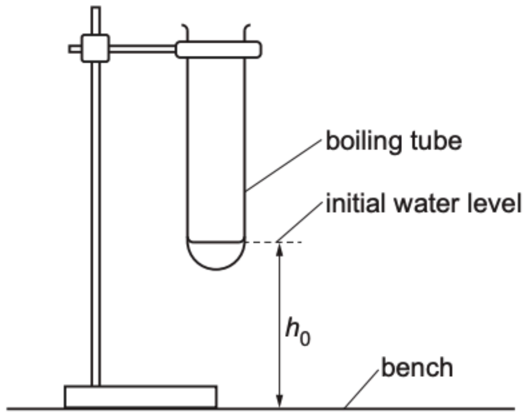


Fig. 1.1

(a) The student pours a small amount of water into the boiling tube and measures the height h_0 from the bench to the initial water level.

h_0 = ...2.6........ cm

Suggest why it was important for the student to add a small volume of water at the start of the experiment.

inside diameter near base not uniform

Another student uses this experiment, with the same apparatus, to measure D (inside diameter) for a small test-tube of diameter approximately 1.2cm. He adds water in volumes of 1.0cm3 at a time. State and explain one reason why this is not an accurate method to use for this test-tube.

- water volumes small – large uncertainty in measuring cylinder
- test-tube diameter small – large uncertainty in answer
- height changes small so unreliable

7. **Methods to increase the rate of cooling of a liquid**
   - remove lid
   - thinner lid
   - paint the beaker black
   - change beaker to container that is a better conductor / named metal
   - increase surface (area of water / beaker)
   - use a wider beaker
   - stir the water
   - blow air over water surface / use a fan
   - use a smaller volume of water

ELECTRICITY

1. **Disadvantage of controlling current in circuit by connecting a range of different resistors rather than using a variable resistor**
   - cannot obtain continuous set of values
   - less straightforward to change current
   - more difficult to obtain a greater number of values

LIGHT

1. **Describe a technique to obtain an image on a screen that is as sharp as possible**
   Move the lens backwards and forwards, slowly

2. **Describe a difficulty when measuring height of an image formed on a screen. Suggest an improvement to overcome this difficulty.**
   Difficulty
   - hand gets in way of light

   Improvement
   - mark on screen and measure later OR
   - use screen with scale OR
   - use translucent screen and measure at rear

3. **Describe a precaution that can be taken to obtain reliable measurements of focal length.**
   - ensure screen, lens and object all perpendicular
   - view rule perpendicularly
   - repeat and take average
   - use darkened room/brighter light
   - mark position of lens on holder
   - clamp/place rule on bench

4. **Suggest which method may be better when trying to calculate focal length:**
   Method 1: Calculations are done on u and v to calculate focal length.

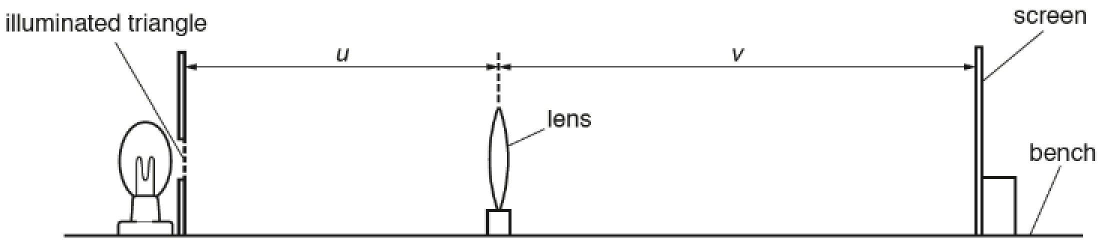


Fig. 2.1

A student sets the distance U between the illuminated triangle and the lens.

She moves the screen until a sharp image of the triangle is seen on the screen.

Method 2: Magnification is calculated using h0 and h1 to calculate focal length.

On Fig. 2.2, the height of the illuminated triangle, h_O is measured to be 1.5 cm.

On Fig. 2.3, the height of the image, h_I, on the screen is measured to be 2.4 cm.

- Method 1 is more accurate because it is difficult to measure height of image in method 2
- Method 1 is more accurate because smaller lengths are measured in method 2 which increases the uncertainty
- Method 2 is more accurate because it is difficult to measure U and V precisely

5. **Suggest a suitable distance between 2 pins for a ray-trace experiment**
   at least 5(.0) cm and no larger than 15(.0) cm inclusive

   State a reason for this suggested distance
   Greater accuracy/ easier to line up pins

NOTE: carefully check whether the question asks you to find angle between line and normal OR angle between line and the mirror/glass surface.

6.

α/	β/	$(\alpha + \beta)$/
30		
45	46	

In order to investigate further a possible relationship between values of (α + β), more values are required. Suggest values of the angle of incidence α that the student could use.

- at least 1 value < 30(°) and 1 value > 45(°)
- all recorded values less than 90°

7. Why results in ray trace experiment may not be accurate/ sources of error

- Pins may be too thick
- Lines drawn may be too thick
- mirror/ glass may be too thick
- difficulty in lining up pins
- Precision of protractor

8. Precautions to take during a ray trace experiment to ensure accurate results

- use thin lines OR sharp pencil
- use thin pins
- ensure pins far apart // place pins as far apart as possible / > 5 cm apart
- view bottom/ base of pins // keep pins upright // ensure pins are vertical / at right angles to ray-trace sheet

INVESTIGATIONS

1.

A student investigates the force required to break different beams made from a mixture of sand and cement. All the beams have the same cross-section.

Plan an experiment to investigate the force required to break the beams.

Fig. 4.1 shows the set-up.

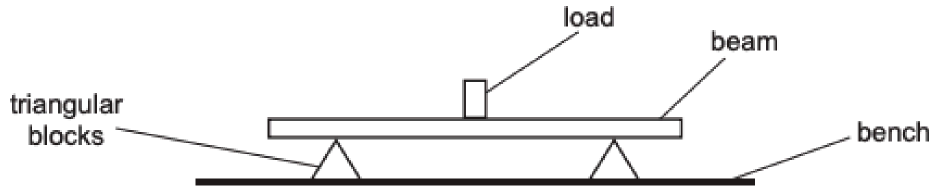


Fig. 4.1

The following apparatus is available:

- a selection of beams made from different ratios of sand and cement and of various lengths
- triangular blocks to support the beams
- a metre rule
- a selection of loads.

You can also use other apparatus and materials that are usually available in a school laboratory.

The student takes all the necessary safety precautions. You are **not** required to write about safety precautions.

In your plan, you should:

- explain briefly how to carry out the investigation (you may add to the diagram if it helps your explanation)
- state the key variables to keep constant
- draw a table, or tables, with column headings, to show how to display your readings (you are **not** required to enter any readings in the table)
- explain how you would use the readings to reach a conclusion.

MP1 **identify variable under test** either distance between supports / length of beam OR composition of beam (proportion of sand / cement)	**1**
MP2 increase load until beam breaks (and record load)	**1**
MP3 repeat for (at least 2 more) different beams or (2 more) different lengths	**1**
MP4 **constant variable** identified (in relation to variable under test) distance between supports position of load composition of beam (if not independent variable) same length of beam (if not independent variable)	**1**
MP5 **table** with columns for distance / length or composition, and (maximum) load with units required for load and distance / length	**1**
MP6 **conclusion** compare breaking load with variable under test OR plot a graph of load against length	**1**
MP7 **additional point** any **one** from: at least 5 sets of results repeats of individual tests and average (rough initial test then) adding small loads near breaking load carefully place loads on beam	**1**

2.

A student investigates insulators.

Plan an experiment to list insulating discs in order from best insulator to worst insulator.

The following apparatus is available:

- five discs made from different insulating materials
- a thermometer
- a stop-watch
- a heated metal cylinder (see Fig. 4.1)
- a second metal cylinder with a hole for the thermometer (see Fig. 4.1).

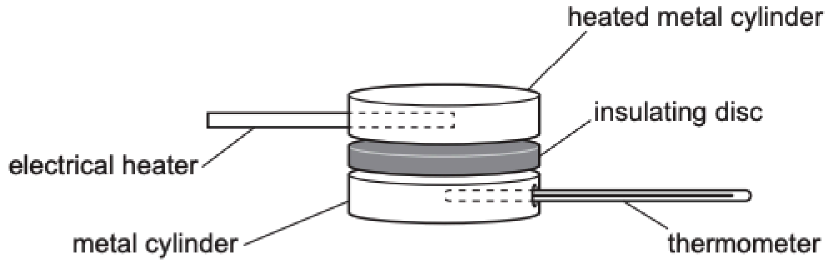


Fig. 4.1

You can also use other apparatus and materials that are usually available in a school laboratory.

In your plan, you should:

- explain briefly how you would carry out the investigation

- state the key variables that you would control

- draw a table, or tables, with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)

- explain how you would use your readings to reach a conclusion.

method: **MP1**	place disc between heated cylinder and metal cylinder / set up apparatus as shown in diagram
MP2	measure the time for lower cylinder to reach a certain temperature (rise) / measure the temperature (rise) reached in a certain time.
MP3	repeat with the other discs
MP4, MP5	**key variables:** any **two** from: thickness of disc temperature of heated cylinder initial temperature of lower cylinder initial temperature of the disc voltage/current/power of heater time (of heating) (if temperature change is measured) OR temperature change (if time of heating is measured)
MP6	**table:** table with columns for (material of) disc, time / temperature difference (depending on MP2) with units in the headings only
MP7	**conclusion:** (draw a graph/bar chart to) compare temperatures reached (in a certain time) / heating times (for a given temperature rise) with the material of the insulator – the disc with the lowest (final) temperature (difference) / takes the longest time, is the best insulator

3.

A student investigates the resistance of a light-dependent resistor (LDR).
The resistance of an LDR changes as the intensity of light falling on it varies.

The resistance R of the LDR is calculated using the equation $R = \frac{V}{I}$
where V is the potential difference (p.d.) across the LDR and I is the current in the LDR.

Plan an experiment to investigate how the light intensity affects the resistance of an LDR.

The apparatus available includes:
an LDR
equipment to connect the circuit, part of which is shown in Fig. 4.1
a lamp with a power supply.

In your plan, you should:

- complete the circuit diagram in Fig. 4.1 to show a voltmeter connected to measure the potential difference across the LDR
- state how the light intensity falling on the LDR will be varied and list any additional apparatus needed
- explain briefly how to do the experiment, including any precautions taken to ensure reliable results
- state **one** key variable to be kept constant
- draw a table, or tables, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

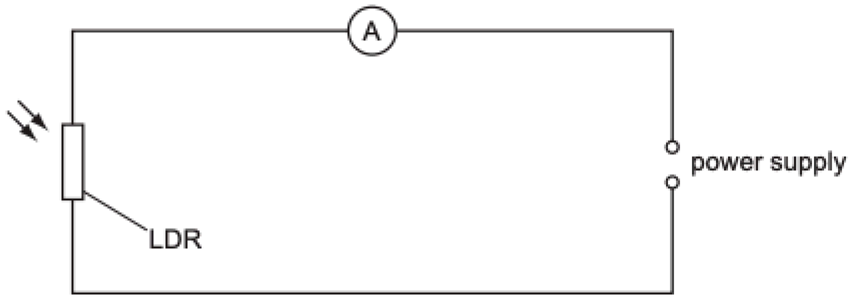


Fig. 4.1

MP1	**apparatus:** voltmeter – correct symbol in parallel with LDR	**1**
MP2	**independent variable:** statement identifying the independent variable e.g. light intensity, distance, current, voltage	**1**
MP3	**method:** measure independent variable (e.g. metre rule to measure distance between lamp and LDR) measure p.d. and current calculate resistance of LDR	**1**
MP4	repeat for new value of independent variable	**1**
MP5	**control variable:** any variable appropriate to independent variable (e.g. distance from lamp to LDR if current through lamp is the independent variable, p.d., power, intensity)	**1**
MP6	**table:** columns, with units, for independent variable, measured dependent variable and resistance (not just resistance without raw measurements)	**1**
MP7	**analysis:** compare resistance values (in table) to see if change in independent variable produces change in resistance plot line graph (with axes specified)	**1**

4.

4 A student investigates the horizontal distance travelled by a metal ball after it rolls off the end of a plastic track. Fig. 4.1 shows the set-up.

The ball rolls down a plastic track. The left-hand side of the track is fixed. The right-hand side can be adjusted so that the ball comes off the track at different angles.

The student measures the horizontal distance that the ball travels from the right-hand end of the track to the point that it hits the floor.

Plan an experiment to investigate how the horizontal distance travelled by the metal ball depends on the angle that the right-hand end of the track makes with the bench.

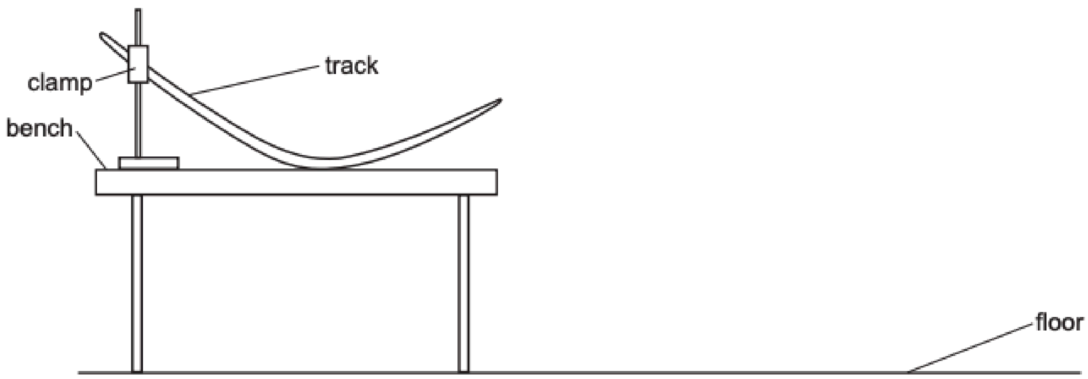


Fig. 4.1

The following apparatus is available to the student:

- track with stand, boss and clamp
- selection of metal balls.

Other apparatus normally available in a school laboratory can also be used.

In your plan, you should:

- list any additional apparatus required
- explain briefly how you would do the investigation, including the measurements you would take
- state the key variables to be kept constant
- draw a suitable table, with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain how you would use the results to reach a conclusion.

MP1 (Metre) rule / tape measure	1
MP2 Release ball to roll down track, measure how far it travels.	1
MP3 Repeat for at least 2 more <u>different angles</u> of right-hand side of track	1
MP4 Clear identification of the correct distance to be measured (e.g. from table leg or other point identified on floor to point of impact with track) OR clear explanation of how to identify point of impact (e.g. using a sand tray)	1
MP5 Constant variable identified Release height for ball Or same ball every time / same weight / mass / size of ball	1
MP6 Table <u>consistent with their method</u> (if method correct with columns for distance travelled and angle of track, with units)	1
MP7 Analysis <u>based on their table</u> Graph of angle against distance travelled, or compare angle with distance travelled (or the equivalents for their method)	1

5.

A student investigates the effect on the resistance of a wire when the tension in the wire is increased. The apparatus is shown in Fig. 4.1. The tension in the wire is increased by adding loads to the hook attached to the wire. The student measures the current I in the wire and the potential difference (p.d.) V across the wire. She determines the resistance R of the wire using the equation $R = \frac{V}{I}$.

The student takes all the necessary safety precautions. You are **not** required to write about safety precautions.

The following apparatus is available:

- resistance wire
- power source, connecting wires and crocodile clips
- ammeter
- voltmeter
- selection of loads and a hanger.

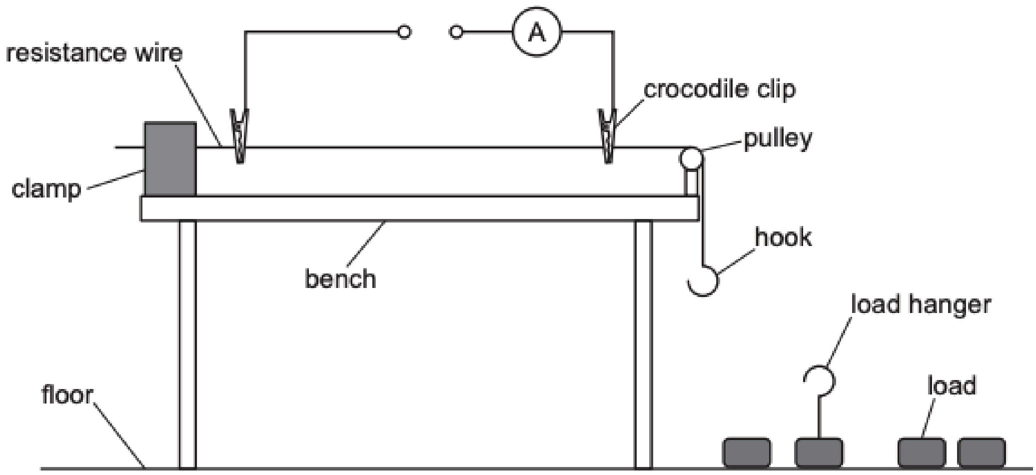


Fig. 4.1

Plan an experiment to investigate the effect on the resistance of a wire when the tension in the wire is increased.

You should:

- complete the circuit diagram in Fig. 4.1 to show a voltmeter connected to measure the potential difference across the resistance wire
- explain briefly how you would carry out the investigation
- state the key variables that you would keep constant
- draw a table, or tables, with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain how you would use your readings to reach a conclusion.

circuit diagram **MP1** voltmeter correctly positioned with correct circuit symbol	1
method **MP2** attach a load, record / note / check V and I (and the value of the load)	1
MP3 calculate / measure / record the resistance of the wire	1
MP4 repeat with at least two <u>other</u> loads	1
control variable **MP5** distance / length of wire <u>between crocodile clips</u>	1
table **MP6** columns for load / tension / mass / number of loads, V, I and R with units at the head of each column	1
conclusion **MP7** compare load with resistance to see if there is <u>an effect</u> / plot graph of load against resistance	1

6.

A student investigates the effect of temperature on the bounce height of a squash ball.
A squash ball is a hollow rubber ball approximately 4 cm in diameter.

Plan an experiment to investigate how the bounce height of the ball changes as the temperature of the ball rises.

The apparatus available includes:

- a selection of squash balls
- standard laboratory heating equipment
- a beaker large enough for the squash ball to fit inside
- a supply of cold water.

In your plan, you should:

- list any additional apparatus needed
- explain briefly how to do the experiment, including any precautions to ensure reliable results (you may draw a diagram below if it helps to explain your plan)
- state the key variables to be kept constant
- draw a table, or tables, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

apparatus **MP1** thermometer, metre rule	1
method **MP2** valid procedure: heat ball in water and measure temperature drop ball measure height ball bounces to	1
MP3 repeat for at least 2 new temperatures	1
control variable **MP4** height of drop	1
table **MP5** columns with units for temperature and bounce height	1
analysis **MP6** **compare** readings in the table to see if change in temperature produces change in dependent variable OR plot line graph of temperature vs bounce height	1
additional point **MP7** any **one** from: keep in water until sure whole ball at same temp as water use of water bath at least 5 sets of data taken repeat each measurement and take average repeat experiment for different variation (e.g. different bounce surface / height of drop) same ball / diameter of ball, bounce surface / type of floor	1

7.

A student investigates the heating of water using an immersion heater.
An immersion heater is an electrical heater that can be placed directly into water.

Plan an experiment to investigate how **one** factor affects the rate at which the temperature of the water rises when heated using an immersion heater.

The apparatus available includes:

- an immersion heater
- equipment to connect the circuit, part of which is shown in Fig. 4.1
- a stop-clock
- a beaker to contain the water.

In your plan, you should:

- state the **one** factor which you have chosen and list any additional apparatus needed to measure the factor

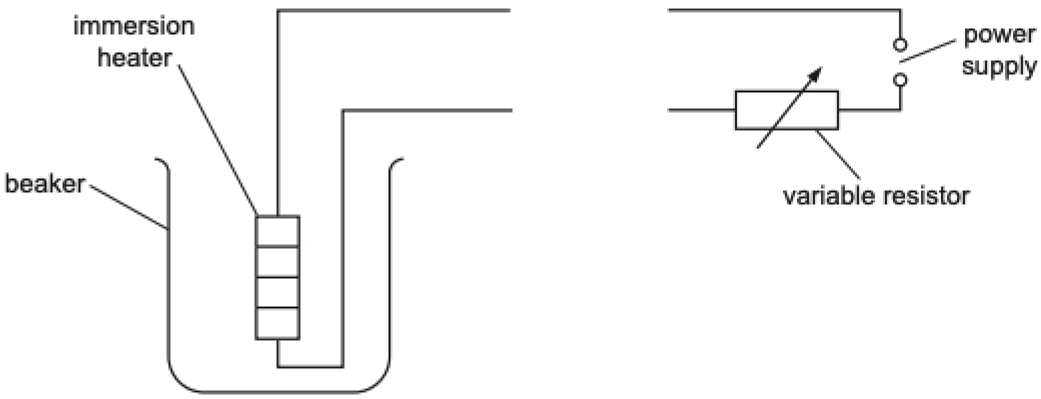
- complete the circuit diagram in Fig. 4.1

- explain how to do the experiment, including any precautions to ensure reliable results

- state the key variables to be kept constant

- draw a table, or tables, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)

- explain how to use the readings to reach a conclusion.



MP1	**factor:** valid factor which may affect rate of temperature rise	**1**
MP2	**apparatus:** <u>thermometer</u> and additional apparatus necessary to measure independent variable	**1**
MP3	**method:** • measure independent variable • measure temperature (change) and / or time appropriate to procedure • repeat for new value of independent variable	**1**
MP4	**control variable:** any significant variable (e.g. volume of water if current is the independent variable)	**1**
MP5	**table:** columns, <u>with units</u>, for independent variable and dependent variable	**1**
MP6	**analysis:** compare readings in the table to see if change in factor produces change in (rate of) temperature rise, plot (line) graph (with axes specified)	**1**
MP7	**additional point** (one from): 2nd valid control variable stated, at least 5 sets of data taken, repeat each measurement <u>and</u> take average,	**1**

8.

A student investigates the change in current in a conducting liquid as the distance between two electrodes is changed. The circuit is shown in Fig. 4.1.

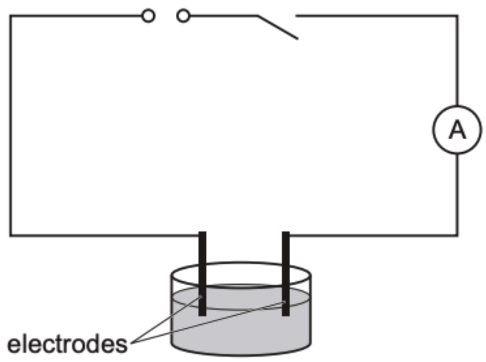


Fig. 4.1

Plan an experiment to investigate the change in current in the liquid as the distance between the electrodes is changed.

You should:

- explain briefly how to do the investigation
- state the key variables to keep constant
- draw a table, or tables, with column headings, to show how to display your readings (you are **not** required to enter any readings in the table)
- explain how to use your readings to reach a conclusion.

MP1	**method:** measure the distance between the electrodes	1
MP2	**method:** measure / record / take / check / note the current or the ammeter reading	1
MP3	**method:** repeat with at least four other distances	1
MP4	**key variables:** potential difference / supply voltage / battery voltage / power supply	1
MP5	**key variables:** any **one** from: • depth of immersion of electrodes • volume / amount of liquid • mass / size / material of the electrodes • room temperature • temperature / concentration of the liquid • type of liquid / electrolyte	1
MP6	**table:** table with columns for distance and (change in) current with appropriate units	1
MP7	**conclusion:** draw a graph of (change in) current against distance **OR** (use results table to) compare distances with currents **OR** (compare results to) see **if** changing the distance has any effect on the current	1