Physics 0625

Redpen Physics

Planning Investigations

Past paper questions from 2016 to 2023, for practice, with marking schemes

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A student's plastic bottle of water tips over in class.

Plan an experiment to investigate how the quantity of water in a plastic bottle affects its stability.

The plastic bottle holds up to 2000 cm^3 of water and has a height of 42 cm.

(a) Write a plan for the experiment, including:

- the apparatus needed
- instructions for carrying out the experiment
- the values you will use for the quantity of water
- how you will make sure your results are as accurate as possible
- the graph you will plot from your results

A diagram is not required, but you may add to Fig. 4.1, or draw your own diagram, if it helps to explain your plan.

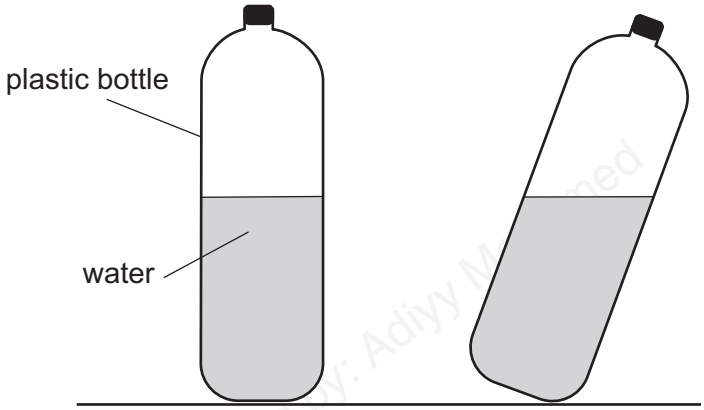

Fig. 4.1

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(b) On Fig. 4.1, measure the angle through which the bottle has been tilted.

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A student suggests that the area of the water surface will affect the rate of cooling of hot water in a container.

Plan an experiment to investigate the relationship between surface area and rate of cooling.

Write a plan for the experiment, including:

- the apparatus needed
- how you will obtain a range of surface areas
- instructions for carrying out the experiment
- the measurements you will take
- the precautions you will take to ensure that the results are as reliable as possible
- the graph you will plot from your results – you should sketch the axes, with appropriate labels.

A diagram is not required but you may draw one if it helps to explain your plan.

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A student is investigating the effect of insulation on the rate of cooling of hot water in a 250 cm^3 container.

The student can choose from the following apparatus:

thermometer
250 cm^3 glass beaker
250 cm^3 plastic beaker
250 cm^3 copper can
250 cm^3 measuring cylinder
three different insulating materials
clamp, boss and stand
stopwatch.

Plan an experiment to investigate the effectiveness of the three insulating materials.

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.

A diagram is not required but you may draw a diagram if it helps your explanation.

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Question 4 **May/June 2016, Paper 62**

A student is investigating how the resistance of a wire depends on the length of the wire. The student aims to plot a graph.

The following apparatus is available to the student:

ammeter
voltmeter
power supply
variable resistor
switch
connecting leads
resistance wires of different lengths
metre rule.

Plan an experiment to investigate how the resistance of a wire depends on the length of the wire.

You should

- draw a diagram of the circuit you could use to determine the resistance of each wire
- explain briefly how you would carry out the investigation
- suggest suitable lengths of wire
- 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.

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[Total: 7]

A student notices that the size of the image produced by a converging lens changes when the lens is moved further away from an object.

Plan an experiment to investigate how the size of the image varies with the object distance for a converging lens suitable for school experiments.

Write a plan for the experiment, including:

- a labelled diagram of the apparatus needed
- instructions for carrying out the experiment
- the factors that will limit the range of object distances
- the graph you will plot
- one precaution you will take to ensure reliable results, explaining what might be the effect of not taking this precaution.

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[Total: 7]

A student is investigating resistors connected in parallel.

The following apparatus is available to the student:

ammeter
voltmeter
power supply
variable resistor
switch
connecting leads
a box of identical resistors.

Plan an experiment to investigate how the combined resistance of the resistors, connected in parallel, depends on the number of resistors.

You should:

- draw a diagram of the circuit you could use to determine the resistance of resistors connected in parallel (show only two resistors in your diagram),
- explain briefly how you would carry out the investigation,
- draw a table or tables, with column headings, to show how you would display your readings. You are **not** required to enter any readings into the table.

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[Total: 7]

A student is investigating whether using a lid reduces the time taken to heat a beaker of water to boiling point.

The student has the following apparatus available:

thermometer
250 cm^3 glass beaker
250 cm^3 measuring cylinder
heatproof mat
lid to fit the beaker
clamp, boss and stand.

Plan an experiment to investigate whether using a lid reduces the heating time.

You should

- list the additional apparatus that you would require
- explain briefly how you would carry out the investigation
- state the key variables that you would control
- draw a 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 your readings to reach a conclusion.

A diagram is not required but you may draw a diagram if it helps your explanation.

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[Total: 7]

A student has noticed that different types of paper have different strengths.

Plan an experiment which will enable you to compare the strengths of different samples of thin paper, prepared as shown in Fig. 4.1.

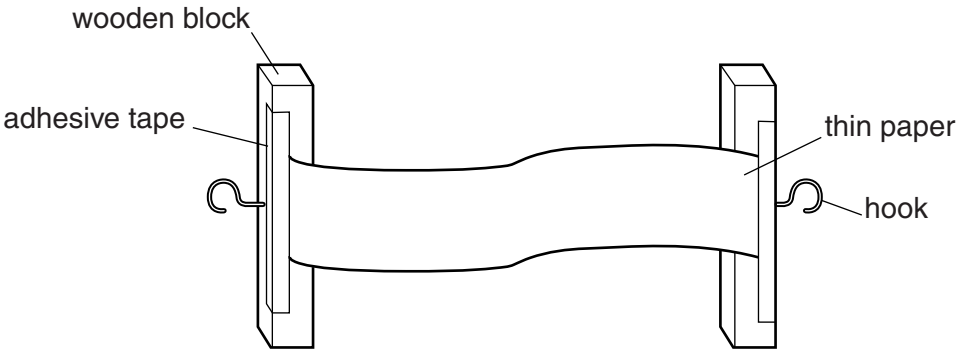

Fig. 4.1

Write a plan for the experiment, including:

- the additional apparatus needed
- instructions for carrying out the experiment, including any precautions you will take
- what you will measure
- how you will present your results
- how you will determine which paper is the strongest
- the variables you will keep the same to ensure the comparison is a fair test.

You may draw a diagram if it helps to explain your plan.

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A student is investigating how the material of a spring affects its behaviour when stretched.

The following apparatus is available to the student:

wires of different thickness, length and material
a set of 10 g masses and a set of 100 g masses, both with hangers
a wooden rod approximately 1 cm in diameter
other standard laboratory equipment.

Plan an experiment which will enable you to test the extension of springs made from different types of wire.

In your plan, you should include:

- instructions for making a spring from the wire that is provided,
- what you will measure,
- instructions for carrying out the experiment,
- the variables you will keep the same to ensure the comparison is a fair test,
- any precaution which should be taken or difficulty which might occur,
- how you will present your results.

You may draw a diagram if it helps to explain your plan.

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[Total: 7]

A student is investigating whether the resistance of a wire depends on the material from which the wire is made.

Resistance R is given by the equation $R = \frac{V}{I}$.

The following apparatus is available to the student:

ammeter
voltmeter
micrometer screw gauge
power supply (0–3 V)
variable resistor
switch
connecting leads
wires of different materials.

Plan an experiment to investigate whether the resistance of a wire depends on the material from which it is made.

You should:

- draw a diagram of the circuit you would use to determine the resistance of each wire
- explain briefly how you would carry out the investigation, including the measurements you would take
- state the key variables that you would control
- 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).

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A student is investigating the effect of draughts (moving air) on the rate of cooling of hot water.

The following apparatus is available to the student:

an electric fan with four speed settings
a supply of hot water
thermometer
250 cm^3 beaker
250 cm^3 measuring cylinder
stopwatch
clamp, boss and stand.

Plan an experiment to investigate the effect of draughts on the rate of cooling of hot water.

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.

You may draw a diagram if it helps your explanation.

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Plan an experiment to investigate how increasing the number of layers of insulation affects the rate of cooling of hot water in a beaker.

Write a plan for the experiment, including:

- the apparatus needed
- what you would measure
- the variables you would keep the same to ensure the comparison is a fair test
- instructions for carrying out the experiment
- how you would present your results
- how you would use your readings to reach a conclusion.

You may draw a diagram if it helps to explain your plan.

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[Total: 7]

A student is investigating whether the diameter of a pendulum bob affects the period of a pendulum. The period is the time taken for one complete oscillation of the pendulum. Fig. 3.1 shows a pendulum.

Fig. 3.2 shows one complete oscillation.

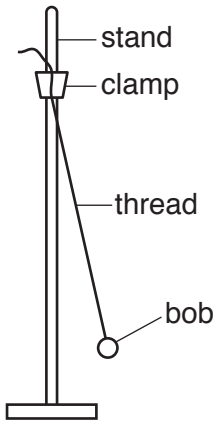

Fig. 3.1

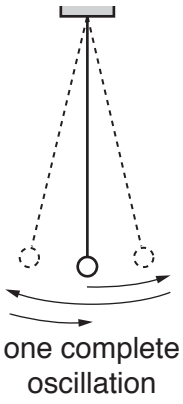

Fig. 3.2

The student has the following apparatus:

pendulum bobs made of polystyrene with diameters 1 cm, 2 cm, 3 cm, 4 cm and 5 cm
a supply of thread and a pair of scissors
clamp and stand.

Plan an experiment to investigate whether the diameter of a pendulum bob affects the period of a pendulum.

You should:

- list additional apparatus that you would require
- explain briefly how you would carry out the investigation
- state the key variables that you would control
- draw a table with column headings, to show how you would display your readings (You are **not** required to enter any readings in the table.)
- explain briefly how you would use your readings to reach a conclusion.

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A student has a selection of rubber bands of different widths. He is investigating the extension produced by adding loads. Fig. 4.1 shows the set-up used.

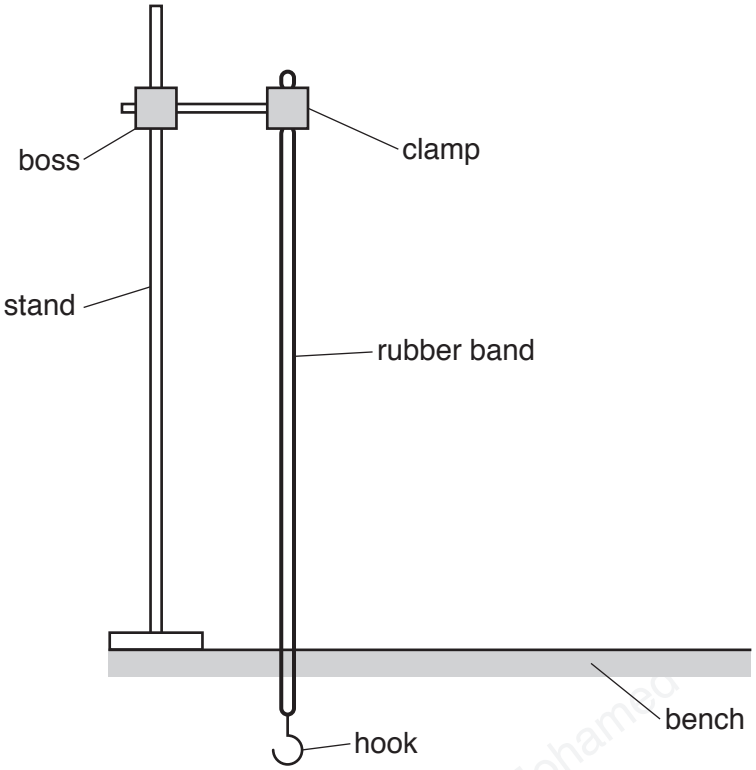

Fig. 4.1

In addition to the apparatus shown in Fig. 4.1, the following apparatus is available to the student:

A metre rule
A selection of different rubber bands
A selection of loads.

Plan an experiment to investigate how strips of rubber of different widths stretch when loaded.

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 briefly how you would use your readings to reach a conclusion.

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[Total: 7]

A student has a box of converging lenses but does not know their focal lengths.

Plan an experiment which will enable her to determine an accurate value for the focal length *f* of one of the lenses, using the equation

$$f = \frac{uv}{(u + v)}$$

where *u* is the distance between an object and the lens and *v* is the distance between the lens and the focused image of the object.

The apparatus available includes:

a lens holder
a 12 V lamp in a holder, with a power supply
a card with a triangular hole covered with tracing paper.

Write a plan for the experiment.

You should:

- list any additional apparatus needed
- draw a diagram of how the apparatus will be arranged, clearly labelling *u* and *v*
- write a method for carrying out the experiment including how *f* will be determined
- state the precautions which should be taken to obtain a clear, focused image
- state the precautions which should be taken to ensure that measurements are accurate once a focused image has been obtained.

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Question 16 **February/March 2018, Paper 62**

A student is investigating the factors that affect the size of the crater (hole) a ball makes when it is dropped into sand.

Plan an experiment which would enable you to investigate one factor which might affect the size of the crater.

The apparatus available includes

metal balls of different sizes
a tray of sand

Write a plan for the experiment.

In your plan you should:

- state which factor is being investigated,
- state the key variables that you would control,
- list any additional apparatus needed,
- explain briefly how you would carry out the experiment including what would be measured and how this would be done,
- state the precautions which should be taken to obtain reliable results,
- suggest a suitable graph which could be drawn from the results.

You may draw a diagram if it helps to explain your plan.

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A student is investigating the effect of double-walled insulation on the rate of cooling of hot water in a copper container. The student places the copper container inside a larger metal container. He is investigating the effect of the size of the air gap between the copper container and larger metal containers.

Plan an experiment to investigate the effect of the size of the air gap between the copper container and larger metal containers on the rate of cooling of hot water.

The following apparatus is available:

a copper container
a number of metal containers of different diameters (all larger than the copper container)
a thermometer
a stopwatch
a measuring cylinder
a supply of hot water.

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.

You may draw a diagram if it helps your explanation.

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A student is investigating whether the distance that a toy truck will travel along a horizontal floor, before stopping, depends on its mass.

The following apparatus is available to the student:

a ramp
blocks to support the ramp as shown in Fig. 4.1
toy truck
a selection of masses
other standard apparatus from the physics laboratory.

Plan an experiment to investigate whether the distance that the toy truck will travel along a horizontal floor, before stopping, depends on its mass.

In your plan, you should:

- explain briefly how you would carry out the investigation
- state any apparatus that you would use that is not included in the list above
- 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).

You may add to the diagram in Fig. 4.1 to help your description.

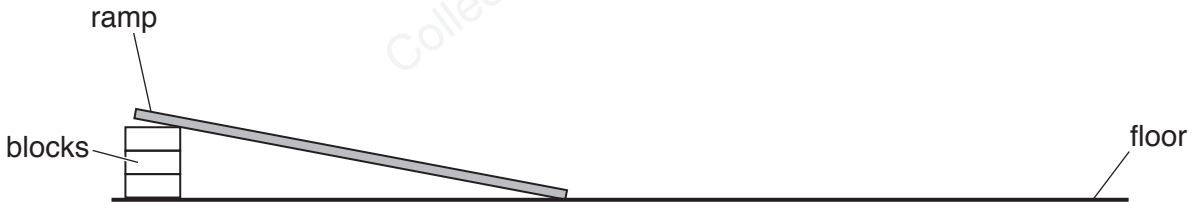

Fig. 4.1

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A student is investigating the force needed to **just** slide a block across a surface.

Plan an experiment that will enable him to investigate how the force needed varies with the mass of the block.

The apparatus available includes:

a light, flat wooden block with a hook fitted as shown in Fig. 4.1

a pulley which can be clamped to a bench.

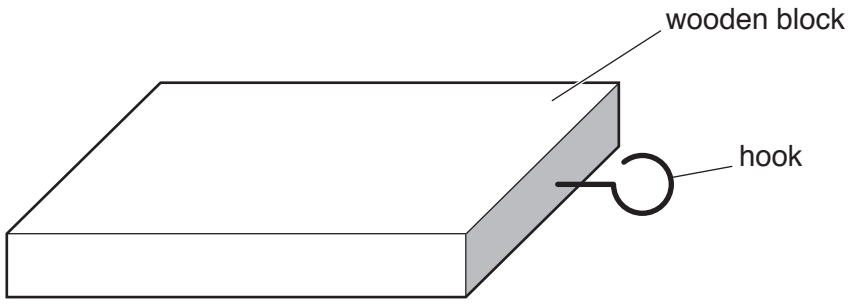

Fig. 4.1

In your plan, you should:

- list any additional apparatus needed
- draw a clearly labelled diagram of how the apparatus will be arranged
- give brief instructions for carrying out the experiment
- describe any precautions which should be taken to ensure reliable results
- suggest a graph which could be drawn.

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A student is investigating the relationship between the power produced by an electrical heater and the time taken to heat a beaker of water. The power of the heater is given by the equation $P = VI$, where V is the potential difference (p.d.) across the heater and I is the current in the heater.

Plan an experiment to investigate the relationship between the power produced by an electrical heater and the time taken to heat a beaker of water.

The following apparatus is available:

ammeter
voltmeter
0–12 V variable power supply
250 cm^3 beaker
heater
thermometer
stopwatch

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

You should:

- complete the diagram in Fig. 4.1 to show the circuit that you would use
- explain briefly how you would carry out the investigation
- state the key variables that you would control
- draw a 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 your results to reach a conclusion.

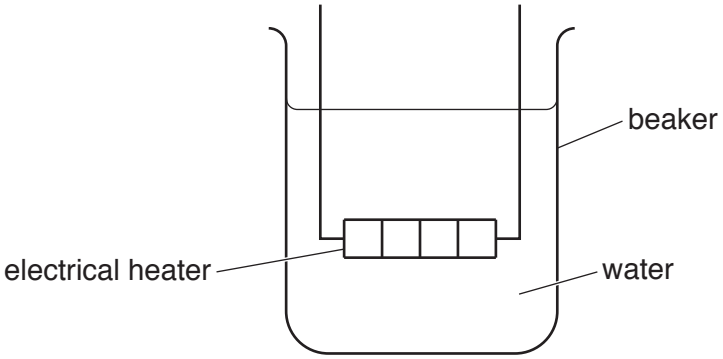

Fig. 4.1

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A student is investigating whether the type of container affects the time taken for water to be heated from room temperature to boiling point.

The following apparatus is available:

250 cm^3 copper can
250 cm^3 aluminium can
250 cm^3 glass beaker
Bunsen burner
measuring cylinder
thermometer
tripod and gauze
stopwatch

Other apparatus normally available in the school laboratory is also available.

Plan an experiment to investigate whether the type of container affects the time taken for water to be heated from room temperature to boiling point.

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 briefly how you would use your readings to reach a conclusion.

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A student is investigating the conduction of thermal energy by metals.

Plan an experiment to compare the rates at which different metals conduct thermal energy.

The apparatus available includes:

strips of different metals, shaped as shown in Fig. 4.1
a test-tube in a clamp stand
a beaker
a supply of cold water
a supply of hot water.

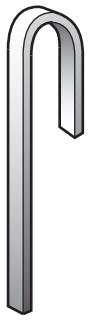

Fig. 4.1

The shorter section of each strip of metal can fit inside a test-tube.

Write a plan for the experiment.

You should:

- list any additional apparatus needed
- draw a labelled diagram of how the apparatus will be arranged
- explain briefly how you will carry out the experiment
- explain how the metals will be compared
- state the precautions which should be taken to obtain reliable results.

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A student wants to investigate the effect of air resistance on the swing of a pendulum.

Plan an experiment which will enable him to investigate how air resistance changes the way in which a pendulum swings.

The apparatus available includes:

a light wooden rod, approximately 80 cm long with a hole at one end, through which a nail will fit
a piece of modelling clay to act as a pendulum bob, as shown in Fig. 4.1
a sheet of thick card which will provide the air resistance when the pendulum swings.

In your plan, you should:

- list any additional apparatus needed
- explain briefly how you would carry out the experiment including exactly which measurements should be taken
- 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.

You may add to Fig. 4.1 or draw an additional diagram if it helps to explain your plan.

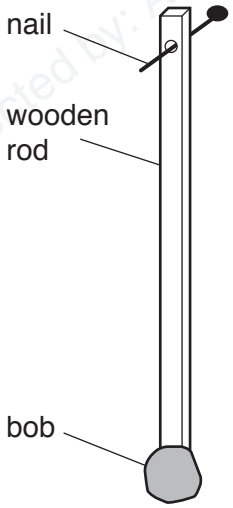

Fig. 4.1

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A student is investigating the work required to pull a box containing some masses up a sloping wooden board. Fig. 4.1 shows the board and the box.

Plan an experiment to investigate how the work required to pull the box up the slope depends on the mass of the box and its contents.

Work done is calculated using the equation:

work done = force × distance moved in the direction of the force.

The following apparatus is available to the students:

a wooden board
a box with a length of string attached
a selection of masses that fit in the box
a metre rule
an electronic balance.

In your plan, you should:

- list any other apparatus that you would use
- explain briefly how you would carry out the investigation, including the measurements you would take
- state the key variables that you would control
- 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.

You may add to the diagram if it helps your explanation.

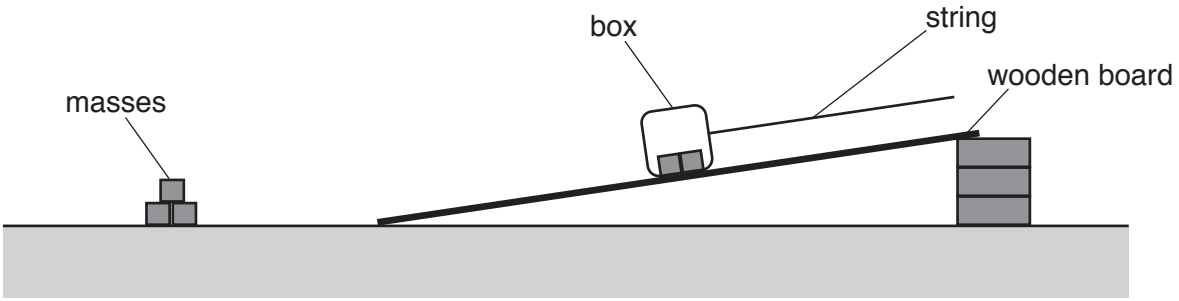

Fig. 4.1

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A student is investigating the relationship between the thickness of a converging (convex) lens and its focal length. Fig. 4.1 shows the cross-section of a converging lens.

The focal length f of a lens can be calculated if u (the distance between the object and the lens) and v (the distance between the lens and the image on a screen) are known.

The equation is: $f = \frac{uv}{(u + v)}$

Fig. 4.1

Plan an experiment to investigate the relationship between the thickness t and the focal length f of converging lenses. You may add to Fig. 4.1 as part of your answer.

The following apparatus is available to the student:

illuminated object
selection of lenses of different thicknesses and a lens holder
screen
metre rule
30 cm ruler
two rectangular wooden blocks with the longest sides longer than the diameter of the lenses.

In your plan, you should:

- draw a diagram to show the arrangement of the apparatus, labelling u and v
- explain briefly how you would carry out the investigation, including the measurements you would take
- explain briefly how you would determine the thickness t of each lens (you may draw a diagram if it helps your explanation)
- draw a suitable table, with column headings, to show how you would display your readings (you do **not** need to use the equation to calculate focal length).

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[Total: 7]

A student wants to investigate the factors that affect the height to which a ball bounces when it is dropped.

Plan an experiment that will enable him to investigate in detail how the height from which a ball is dropped affects how high it bounces.

The apparatus available includes:

balls of different materials and sizes
sheets of different floor coverings.

Write a plan for the experiment.

In your plan, you should:

- list any additional apparatus needed
- explain briefly how you would carry out the experiment
- describe a precaution which could be taken to ensure that measurements of the height of bounce are reliable
- state the key variables that you would control
- draw a 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 could analyse your readings to reach a conclusion.

You may draw a diagram if it helps to explain your plan.

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[Total: 7]

A student is investigating the time taken for metal balls to stop moving after being released on a curved track. Fig. 4.1 shows the shape of the track. The track is flexible, so the shape of the curve can be changed.

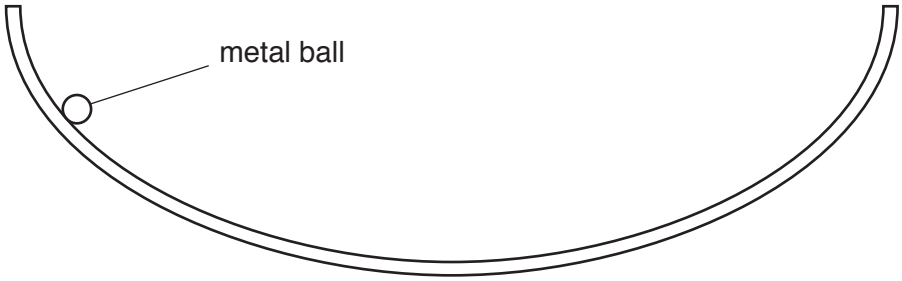

Fig. 4.1

The following apparatus is available:

a selection of metal balls of different masses
the flexible track
clamps to hold the track
a stopwatch
a tape measure
a metre rule

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

Plan an experiment to investigate a factor that affects the time taken for metal balls to stop moving after being released on a curved track.

In your plan, you should:

- state how you would expect the balls to move
- explain how you would carry out the investigation
- state which variables you would keep constant and which variable you would change
- 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.

You may add to the diagram in Fig. 4.1 if it helps your explanation.

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[Total: 7]

A student investigates the time taken for ice cubes in a container to melt using different insulating materials on the container.

The following apparatus is available:

a copper container
a variety of insulating materials that can be wrapped round the copper container
a thermometer
a stopwatch
a supply of ice cubes

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

Plan an experiment to investigate the time taken for ice cubes to melt using different insulating materials.

In your plan, you should:

- draw a diagram of the apparatus used
- 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.

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[Total: 7]

A student is investigating ways of slowing the rate of cooling of hot liquids in a container.
The student knows that a lid will reduce the rate of cooling. He wants to find out if the thickness of the lid makes any difference to the rate of cooling.

Plan an experiment which will enable him to compare the effects of lids of different thicknesses.

In your plan, you should:

- list the apparatus needed
- explain briefly how you would carry out the investigation, including the measurements to be taken
- state any key variables that would need to be kept the same
- draw a suitable table or tables, with column headings, to show how the readings would be displayed (you are **not** required to enter any readings in the table)
- explain how you would use your readings to reach a conclusion.

You may draw a diagram if it helps to explain your plan.

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[Total: 7]

A student's plastic bottle of water tips over in class.

Plan an experiment to investigate how the quantity of water in a plastic bottle affects its stability.

The plastic bottle holds up to 2000 cm^3 of water and has a height of 42 cm.

(a) Write a plan for the experiment, including:

- the apparatus needed
- instructions for carrying out the experiment
- the values you will use for the quantity of water
- how you will make sure your results are as accurate as possible
- the graph you will plot from your results

A diagram is not required, but you may add to Fig. 4.1, or draw your own diagram, if it helps to explain your plan.

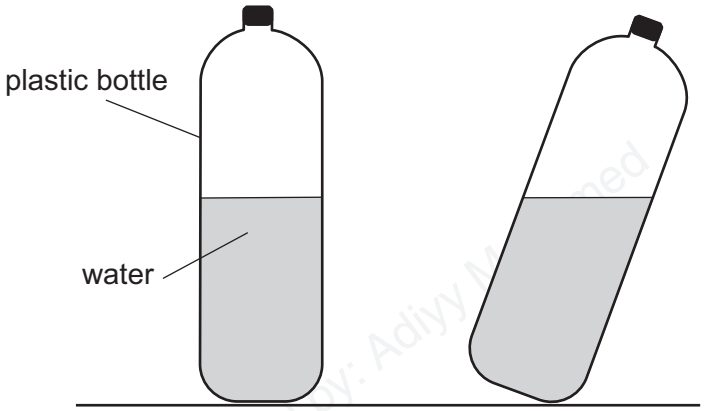

Fig. 4.1

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(b) On Fig. 4.1, measure the angle through which the bottle has been tilted.

angle = ... [1]

[Total: 8]

A student investigates a wind turbine, which is an electrical generator driven by a propeller blade.

Plan an experiment which will enable him to investigate how the current in a resistor connected across the terminals of the turbine varies with the speed of the air flow through the turbine.

The apparatus available includes:

a model wind turbine as shown in Fig. 4.1
an electric fan to provide the moving air to turn the turbine
a device for measuring air speed.

In your plan, you should:

- list any additional apparatus needed
- complete the wind turbine circuit diagram on Fig. 4.1
- state the key variables to be kept constant
- explain briefly how to carry out the experiment, including how the speed of the air flow is to be changed
- explain how to use the readings to reach a conclusion.

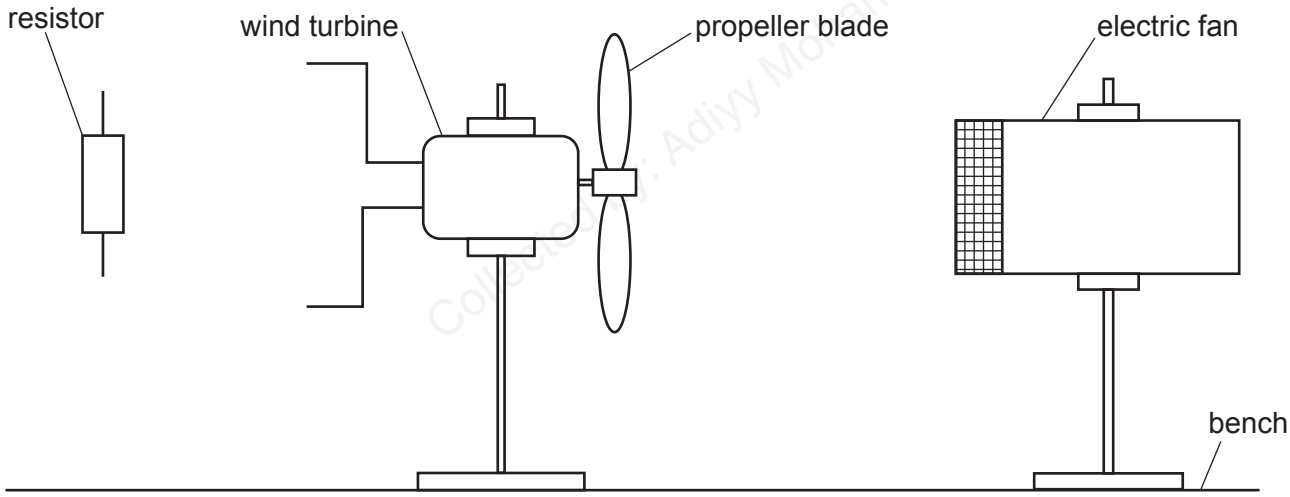

Fig. 4.1

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[Total: 7]

A student investigates the effect of the colour of the surface of a metal container on the rate of loss of heat from the container. She knows that black surfaces are better radiators of thermal energy than white surfaces and wants to investigate the effect of other colours.

The following apparatus is available:

metal containers each with the outer surface painted a different colour
a thermometer
a stop-watch
a supply of hot water.

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

Plan an experiment to investigate the effect of the colour of the surface of a metal container on the rate of loss of heat from the container.

You should:

- draw a diagram of the apparatus used
- explain briefly how you would carry out the investigation
- state the key variables to be kept 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.

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[Total: 7]

A student investigates the bending of 1 m length strips of different materials. She compares how far they bend when loaded at one end.

Plan an experiment to investigate how the material from which the strips are made affects the bending of the strips when loaded at one end.

The following apparatus is available to the student:

strips of wood, plastic, steel and aluminium, each of length 1 m
a set of slotted masses
a metre rule
a G-clamp (used to hold the strips to the laboratory bench).

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

In your plan, you should:

- draw a diagram to show the arrangement of the apparatus
- explain briefly how you would carry out 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.

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[Total: 7]

A student investigates the factors affecting the electrical output of a solar cell. A solar cell is a device which transforms light energy into electrical energy.

Plan an experiment which will enable him to investigate how the potential difference across the terminals of the solar cell varies with the angle of the incident light.

The apparatus available includes:

a solar cell as shown in Fig. 4.1
a laboratory lamp.

In your plan, you should:

- list any additional apparatus needed
- state the key variables to be kept constant
- explain briefly how to carry out the experiment, including any precautions that must be taken to ensure reliable results
- draw a table, 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.

You may add to Fig. 4.1 or draw another diagram if it helps to explain your plan.

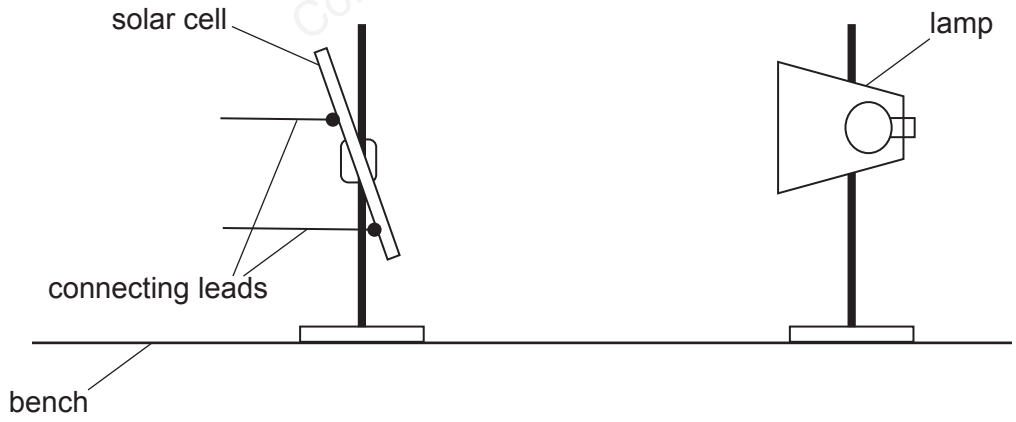

Fig. 4.1

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[Total: 7]

A student investigates the resistances of different wires.

Plan an experiment to investigate the resistances of wires made from different metals.

Resistance is calculated using the equation $R = \frac{V}{I}$.

The following apparatus is available:

ammeter
voltmeter
power supply
metre rule
a selection of wires made from different metals.

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

In your plan, you should:

- write a list of suitable metals for the wires you will investigate
- draw a diagram of a suitable electrical circuit using standard electrical symbols
- explain briefly how to carry out 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).

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A student investigates the length of time taken for ice cubes to melt when they are placed in water. She uses beakers of water at different temperatures to investigate how the initial temperature of the water affects the time taken for the ice cubes to melt.

Plan an experiment to investigate how the initial temperature of the water affects the time taken for the ice cubes to melt.

The following apparatus is available:

thermometer
supply of ice cubes
250 cm^3 beakers
supply of cold water

In your plan, you should:

- write a list of additional apparatus to use
- explain how to carry out the investigation
- state the key variables to keep 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.

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A student investigates the factors that affect the average speed of a ball falling in water.

Plan an experiment which will enable him to investigate the effect of **one** factor on the speed at which a ball of modelling clay falls in water.

The apparatus available includes:

modelling clay that can be made into different sized balls
metal ball bearings that can be embedded in the modelling clay
a long transparent tube, closed at one end
a supply of water

In your plan, you should:

- state clearly the factor to be investigated
- list any additional apparatus needed
- state any key variables to be kept the same
- explain how to carry out the investigation, including the measurements to be made and any precautions that must be taken to ensure reliable results
- explain how to use the readings to reach a conclusion.

You may draw a diagram if it helps to explain your plan.

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[Total: 7]

A student investigates the motion of a ball rolling down a slope.

Plan an experiment which enables him to investigate how **one** factor affects the average speed of the ball.

Average speed can be calculated using the equation:

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

The apparatus available includes:

balls of various sizes and materials
a board which can act as a slope
blocks to support one end of the board.

In your plan, you should:

- state a factor which can be measured
- list any additional apparatus needed
- explain briefly how to carry out the experiment including exactly which measurements are to be taken
- 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.

You may draw a diagram if it helps to explain your plan.

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[Total: 7]

A student investigates the rate of cooling, in air, of heated blocks made of different metals. The temperature of each block is increased by placing it in hot water.

Plan an experiment to investigate how the rate of cooling depends on the metal from which each block is made.

The following apparatus is available to the student:

cylindrical blocks of different metals, each with a hole for a thermometer, as shown in Fig. 4.1
a thermometer.

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 carry out 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.

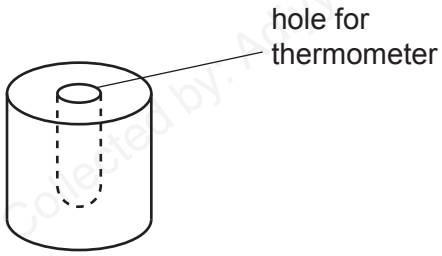

Fig. 4.1

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A student investigates springs made from different metals.

Plan an experiment to investigate the extension of springs made from different metals.

The following apparatus is available:

boss, clamp and stand
metre rule
springs made from different metals
selection of loads with hangers.

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

In your plan, you should:

- write a list of suitable metals for the springs
- draw a diagram of the set up you would use
- explain briefly how to carry out 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 you would use the readings to reach a conclusion.

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A student investigates the factors affecting the deflection of a wooden strip clamped at one end.

Plan an experiment which enables him to investigate how **one** factor affects the distance *D* that the free end of the wooden strip moves downwards when loads are placed on it.

The apparatus available includes:

a variety of wooden strips which can be clamped as shown in Fig. 4.1
a set of masses with a hanger.

In your plan, you should:

- list any additional apparatus needed
- state the key variables to be kept constant
- explain briefly how to carry out the experiment, including how *D* is to be measured and any precautions that must be taken to ensure reliable results
- draw a table, 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.

You may add to Fig. 4.1 or draw another diagram if it helps to explain your plan.

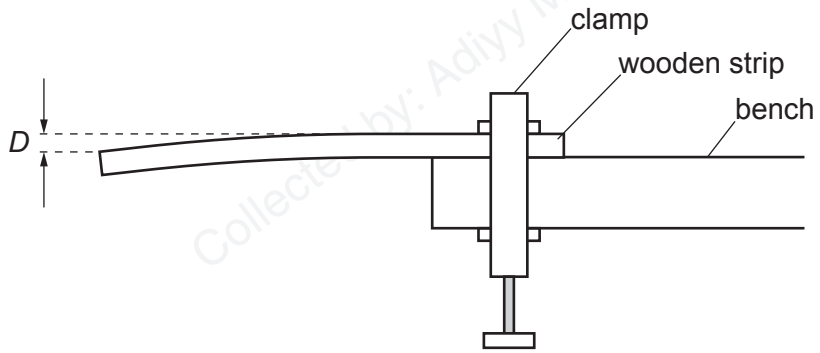

Fig. 4.1

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A student investigates the time taken to heat water in different uninsulated containers. The containers all have the same volume and shape. The water is heated with an electric immersion heater.

The following apparatus is available:

a selection of containers
measuring cylinder
thermometer
supply of cold water
immersion heater with power supply.

Plan an experiment to investigate the time taken to heat water in different uninsulated containers.

You should:

- list any additional apparatus that is required
- 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 briefly how you would use your readings to reach a conclusion.

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A student investigates the strengths of wires made from different metals by measuring the force required to break the wires.

The apparatus is shown in Fig. 4.1. A wire is held by a clamp at one end and a load is suspended from the other end. The load is increased until the wire breaks. The student takes all the necessary safety precautions.

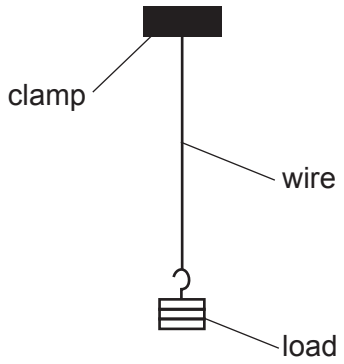

Fig. 4.1

Plan an experiment to investigate the force required to break wires made from different metals.

The following apparatus is available:

clamps and stands
a selection of masses with a suitable hanger
metre rule
a selection of wires made from different metals.

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

In your plan, you should:

- write a list of suitable metals for the wires you would investigate
- explain briefly how you would do 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 the results to reach a conclusion.

You may add to the diagram if it helps your explanation.

You are **not** required to write about the safety precautions that the student should take.

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A student investigates the strength of an electromagnet.

The electromagnet is made from a coil of insulated wire wrapped around an iron rod. When there is an electric current in the coil, the iron rod becomes magnetised. The electromagnet can then attract magnetic materials (e.g. iron and steel).

Plan an experiment to investigate how **one** factor affects the number of steel paper clips the electromagnet can support.

The apparatus available includes:
- an electromagnet, shown in Fig. 4.1
- a power supply
- a selection of steel paper clips.

In your plan, you should:

- state a factor which can be measured and list any additional apparatus needed
- state the key variables to be kept constant
- explain briefly how to do the experiment, including any precautions to ensure reliable results (you may draw a diagram or add to Fig. 4.1 to help your explanation)
- 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.

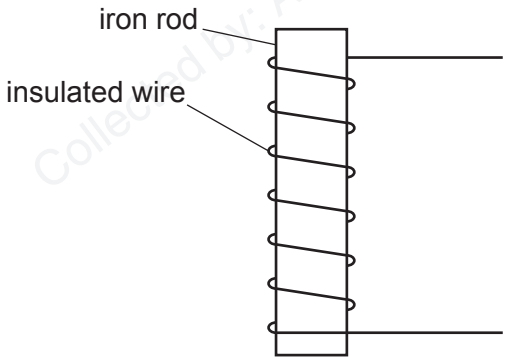

Fig. 4.1

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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.

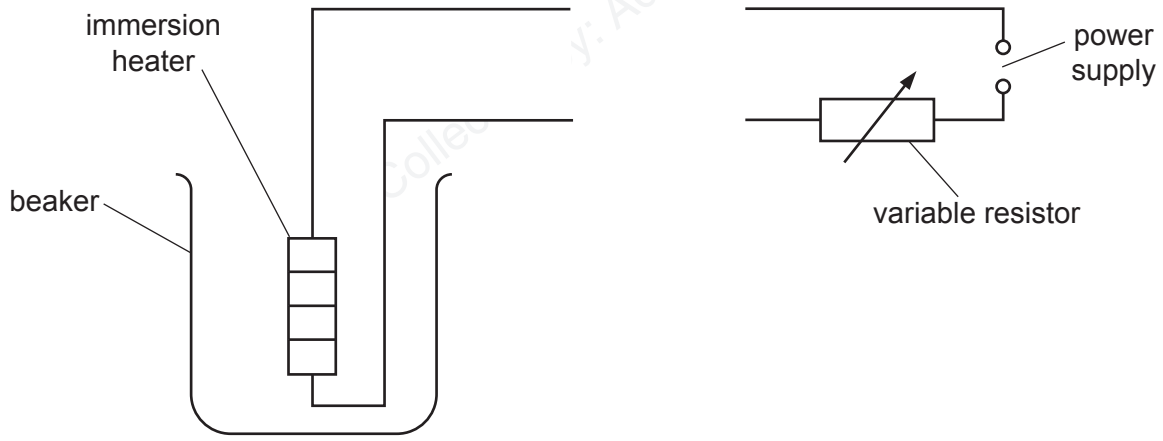

Fig. 4.1

[7]

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.

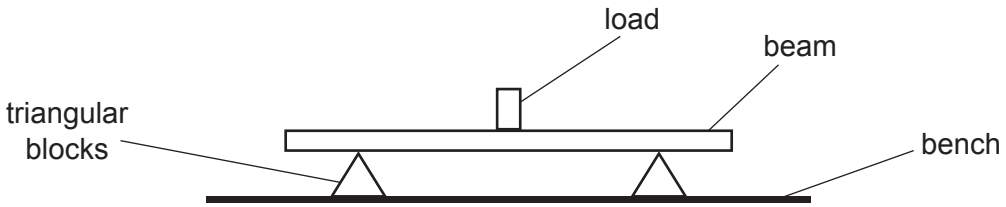

Fig. 4.1

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.

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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).

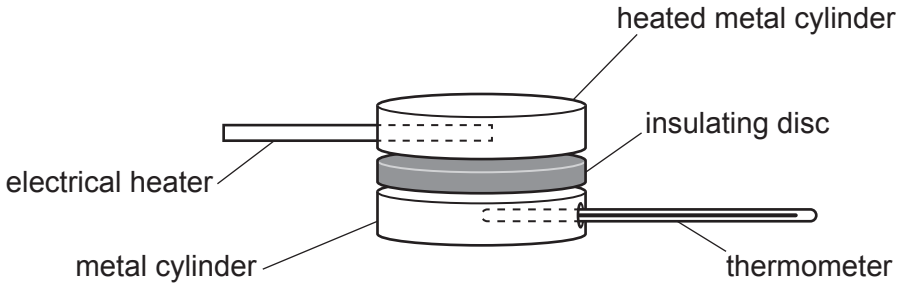

Fig. 4.1

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.

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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.

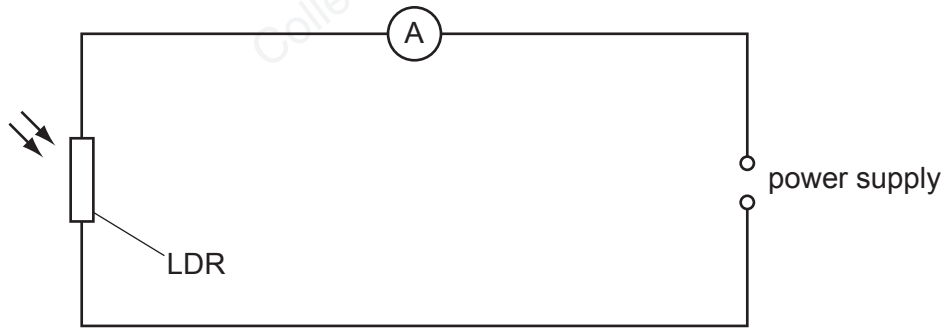

Fig. 4.1

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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.

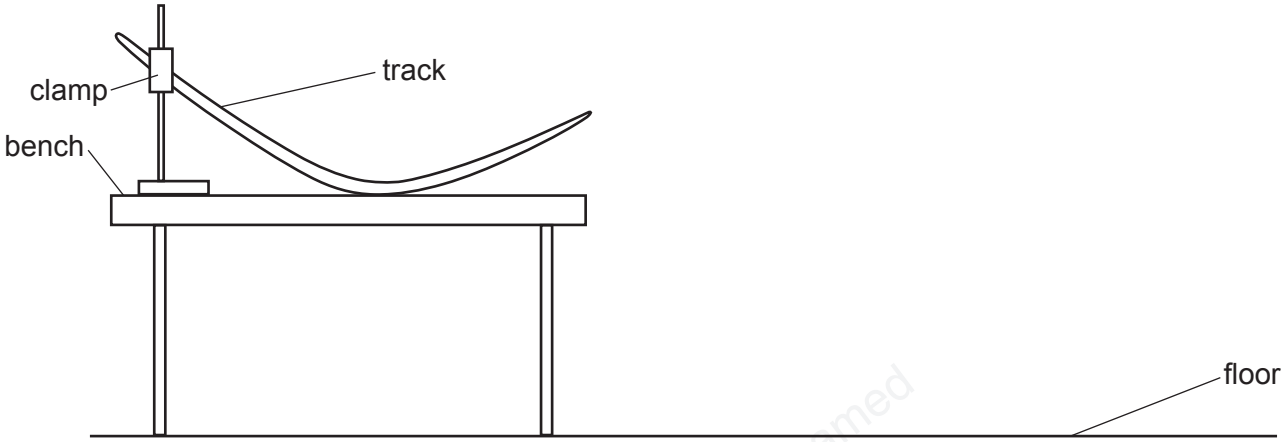

Fig. 4.1

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.

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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.

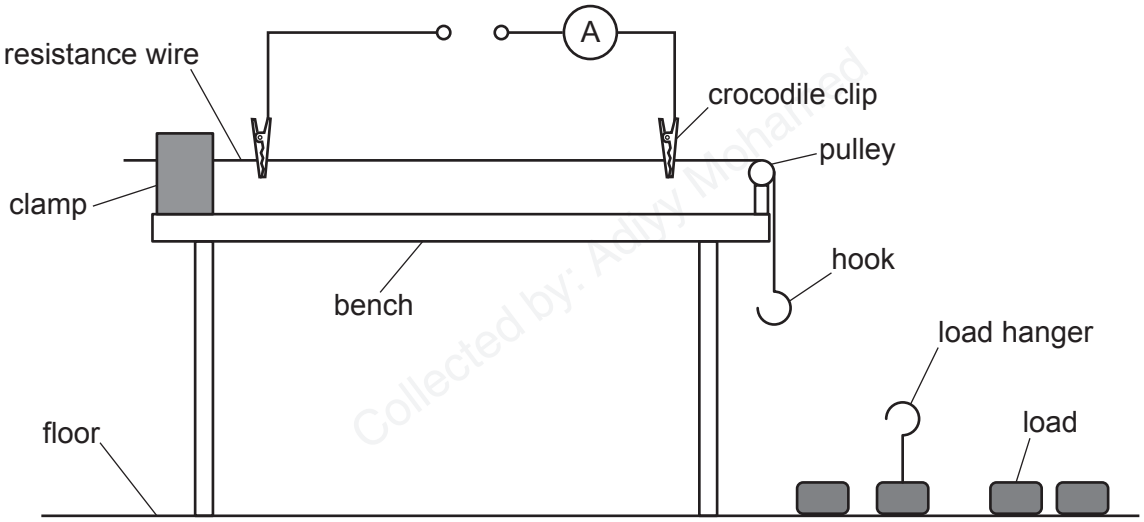

Fig. 4.1

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.

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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.

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A student is investigating the factors that affect the size of the crater (hole) a ball makes when it is dropped into sand.

Plan an experiment to investigate **one** factor that affects the size of the crater.

The apparatus available includes:

metal balls of different sizes
a tray of dry sand.

Write a plan for the experiment.

In your plan, you should:

- state which factor is being investigated
- state a key variable to keep constant
- list any additional apparatus needed
- explain briefly how to do the experiment, including what is measured and how this is done
- state how to obtain reliable results for this experiment
- suggest a suitable graph to be drawn from the results.

You may draw a diagram if it helps to explain your plan.

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[Total: 7]

A student investigates the motion of a ball through the air.

Plan an experiment which will enable him to investigate how the range of the ball depends on the angle at which it is launched.

The range is the horizontal distance that the ball travels after leaving the end of the channel shown in Fig. 4.1 and before hitting the ground.

The apparatus available includes:

- a flexible channel, as shown in Fig. 4.1, which can be bent at different angles
- a selection of balls, each of different diameter and mass.

In your plan, you should:

- list any additional apparatus needed
- explain briefly how to do the experiment – you may add to Fig. 4.1 if it helps your explanation
- state the key variables to keep constant
- draw a table 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 results to reach a conclusion.

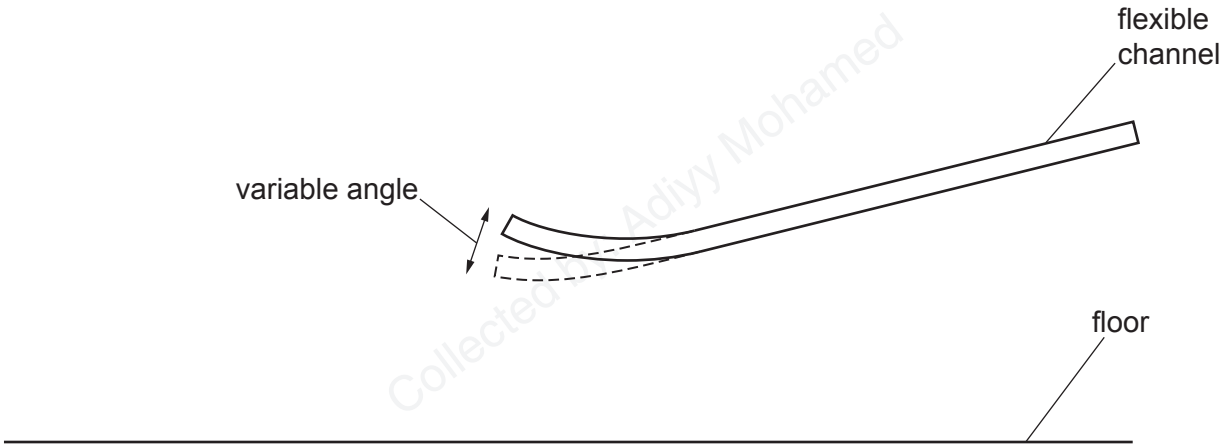

Fig. 4.1

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A student investigates the change in resistance of a lamp filament when the current in the lamp is increased.

The following apparatus is available:

- a power supply
- a low-voltage filament lamp
- an ammeter
- a voltmeter
- connecting wires.

Other apparatus normally found in a school laboratory is also available.

Plan an experiment to investigate the change in resistance of the lamp filament when the current in the lamp is increased.

Resistance R is given by the equation $R = \frac{V}{I}$, where V is the potential difference (p.d.) across the lamp and I is the current in the lamp.

You should:

- draw a diagram of the circuit used
- explain briefly how to do the investigation, including how to change the current
- 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.

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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.

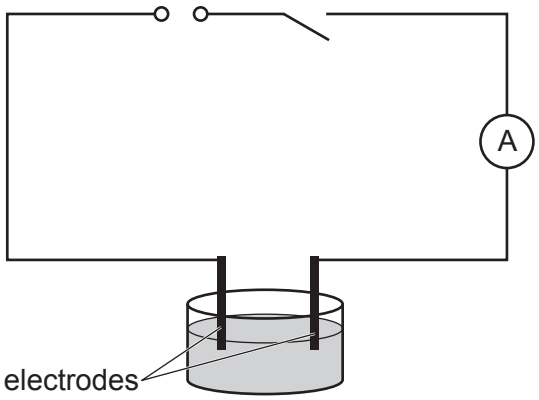

Fig. 4.1

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.

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A student investigates the rate of cooling of hot water in a container which has a lid.

Plan an experiment which will enable him to compare the effect of lids of different thicknesses on the rate of cooling.

The apparatus available includes:

- a beaker
- a supply of hot water
- insulating material from which lids can be cut.

In your plan, you should:

- list any additional apparatus needed
- explain briefly how to do the experiment, including the measurements to take so that the rate of cooling can be determined
- state the key variables to keep 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.

You may draw a diagram if it helps to explain your plan.

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A student investigates the time taken for water to evaporate to dryness when heated from above.

Fig. 4.1 shows the set-up. The power of the heater is constant.

The following is also available:

- supply of water at room temperature
- metre ruler.

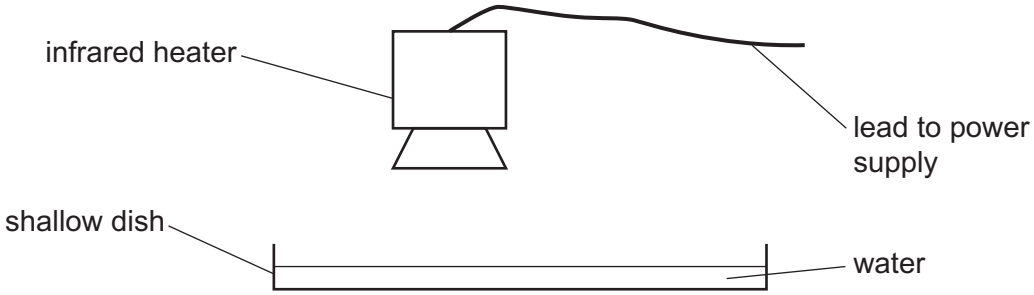

Fig. 4.1

Plan an experiment to investigate how **one** factor affects the time taken for the water to evaporate.

You do **not** need to write about safety precautions.

You should:

- state any additional apparatus required
- explain briefly how you would do 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.

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A student investigates the effect of changing the colour of light on the focal length of a lens.

The focal length f of a lens is given by the equation $f = \frac{uv}{(u + v)}$.

The distance u is the distance between an object and the lens. The distance v is the distance between the lens and the image that is formed on a screen.

Plan an experiment to investigate the effect of changing the colour of light on the focal length of a lens.

The following apparatus is available to the student:

- illuminated object
- a selection of coloured filters to change the colour of the light
- converging lens
- screen
- metre ruler.

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

In your plan, you should:

- draw a labelled diagram to show the arrangement of the apparatus
- explain briefly how you would do the investigation, including the measurements you would take
- 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)
- state how you would use your results to reach a conclusion.

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A student investigates the brightness of a lamp.

Plan an experiment to investigate how the intensity (brightness) of the light produced by the lamp is affected by the current in the lamp.

The apparatus available includes:

- a lamp and power supply
- a light meter which measures the intensity of light arriving at it
- an ammeter
- a variable resistor.

In your plan, you should:

- complete the circuit diagram in Fig. 4.1 to show the variable resistor connected to control the current in the lamp
- state the key variables to be kept constant
- explain briefly how to do the experiment
- draw a table 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.

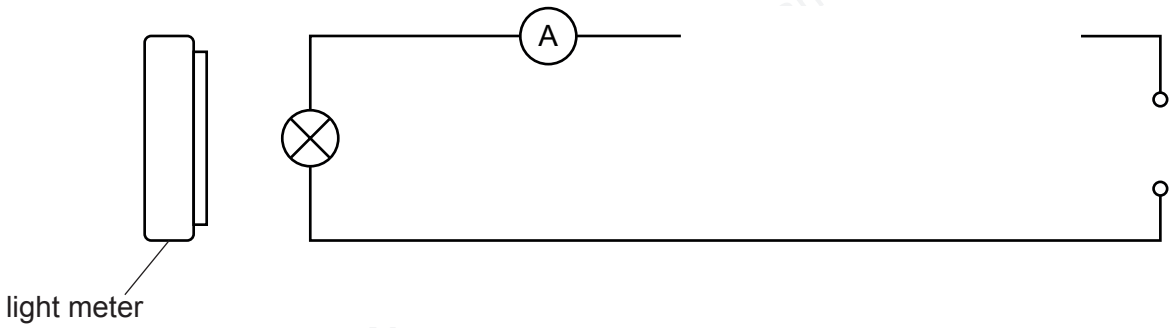

Fig. 4.1

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A student investigates the effect of insulation on the cooling of a liquid.

Plan an experiment which will enable her to investigate how changing the thickness of insulation surrounding a beaker affects the rate of cooling of hot water in the beaker.

The apparatus available includes:

- a glass beaker
- a supply of hot water
- a lid to fit the beaker
- strips of insulation which can be cut to size.

In your plan:

- list any additional apparatus needed
- explain briefly how to do the experiment, including the measurements to take so that the rate of cooling can be determined
- state the key variables to keep 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.

You may draw a diagram if it helps to explain your plan.

[7]

Marking schemes

Marking schemes for 2016

Question 1

Speciment Paper 2016 - Paper 6

(a) apparatus:
measuring cylinder/jug OR ruler OR balance (to measure amount of water) [1]
protractor OR rule to measure height of raised surface
OR other means of measuring angle of tilt
OR newtonmeter to apply variable force
OR other method of applying quantifiable force [1]

instructions:
method of tilting or applying variable force and measuring point at which bottle topples [1]

attention to accuracy, any two from:
just starts to topple
slowly
repeats / more than 10 values for quantity of water
very large protractor
or any other suitable precaution which would improve accuracy of data [max 2]

values:
at least 5 values with range at least 1500 cm^3 or 30 cm or 1500 g, approximately evenly spaced [1]

graph:
plot of measured variable (angle or height or force) against quantity of water (volume or height or mass) (accept vice versa) [1]

(b) 20° [1]

Question 2

February/March - 2016 - Paper 62

apparatus: [1]
(set of) different sized beakers / containers, thermometer and stop clock / watch

method: [1]
pour hot water into container (and allow to cool)
and measure temperature and time

repeat for a second container with a different surface area [1]

precautions:
any two from: [2]
same volume of hot water
same initial hot water temperature
same room temperature or other environmental condition

graph:
temperature change / rate of cooling against surface area, [1]
temperature against time,
time to cool between fixed temperatures against surface area

additional point:

any one from: [1]

- at least 5 different surface areas,
- sensible range of container sizes given,
- sensible amount of water stated,
- use of lagging / insulating material for container walls,
- same type of container
- how surface area may be calculated

[Total: 7]

Question 3

May/June 2016 - Paper 61

	Answer	Marks
MP1	Uses same container throughout	**1**
MP2	Hot water in container (any) and takes temperatures at intervals or at start and after a fixed time OR Hot water in container (any) and takes time for a fixed temperature fall.	**1**
MP3	Repeats with different insulators (all three used)	**1**
MP 4&5	Any two from: Constant room temperature Same starting temperatures (clearly stated) Same volumes of hot water (clearly stated) Same thickness/amount of insulator Use container without insulation Use of a lid Insulates bottom of container Uses the copper can only	**2**
MP6	Table or tables as appropriate to method: Temperatures with unit °C and time with unit s (or min) and different insulators shown	**1**
MP7	Use of readings: graph of temperature against time OR compare results and comment that longest time to cool = best insulator or smallest drop in temperature in fixed time = best insulator (or reverse arguments)	**1**
		Total 7

Question 4

May/June 2016 - Paper 62

	Answer	Marks
	Circuit diagram:	
MP1	Sample of wire must be clearly identifiable by a label on the diagram or by letters on the diagram with an explanation in the text	**1**
MP2	All circuit symbols correct (even if circuit is incorrect)	**1**
	Method:	
MP3	Take readings of V and I	**1**
MP4	For 5 or more lengths	**1**
MP5	Range of lengths must be between 5 cm and 2 m **with the largest length at least twice the smallest**	**1**
	Table drawn with headings:	
MP6	l / m, V / V, I / A, R / Ω	**1**
	Key variables to control:	
MP7	Any one from • Material / resistivity / conductivity / type of wire • Diameter / radius / thickness / cross sectional area • Temperature of wire	**1**

Question 5

May/June 2016 - Paper 63

Answer	Marks
apparatus: diagram – lens, (illuminated) object, screen in suitable order for experiment	1
in line on flat surface	1
instructions: set / measure object distance, move screen to get image, measure image height,	1
repeat for different object distances	1
limiting factor for range of object distances – one from: • image virtual / too big for screen, • image too dim / too small to measure, • must be greater than focal length	1
graph: image size / magnification against object distance	1
precaution: any one suitable precaution and consequence of not taking it, e.g. • dark room / bright light – image might not be distinct, • lens and object at same height – image might not appear on screen, • lens, object and screen perpendicular – image might be distorted, • fix rule – may move and give incorrect distances • mark position of lens on holder – cannot judge correct measurements / owtte • detailed means of obtaining a sharp image – might not be correctly focused • means of measuring image height accurately – might be obscured	1
	Total: 7

Question 6

October/November 2016 - Paper 61

Answer	Mark
MP1 On circuit diagram: one voltmeter in parallel with any component	1
MP2 Circuit diagram correctly shows power supply, ammeter, unless in a branch, two or more resistors in parallel	1
MP3 Circuit diagram: Correct symbols for ammeter, voltmeter and fixed resistor	1
MP4 Repeat with a different number of resistors (in parallel)	1
MP5 Table that includes columns for number of resistors, voltage/V and current/A	1
MP6 & MP7 Then any two from: Resistance calculated (may be shown in table) Use low current (to stop resistors getting too hot)/switch off between readings Use at least 5 different combinations Repeat with different current or voltage or variable resistor setting Drawing a graph of number of resistors against combined resistance	2
Total:	**7**

Question 7 — October/November 2016 - Paper 62

Answer	Marks
clock / stopwatch and source of heat	1
heat to boiling with and without lid	1
measure time taken to reach **boiling point/boil**	1
same volume / mass / amount of water	1
same starting temperature	1
suitable table with column headings and units (seconds or minutes)	1
conclusion drawn	1
Total:	**7**

Question 8 — October/November 2016 - Paper 63

Answer	Mark
apparatus – workable arrangement	1
how applied force is measured	1
suitable table for results / plot a bar graph	1
how to conclude which is strongest	1
one suitable control variable: e.g. same width of sample same thickness / weight / length of paper all samples fixed in same way	1
any 2 from: 2nd control variable, force applied smoothly / no jerking ensure no tears before applying force repeat for each type of sample / repeat with samples of different widths soft mat under weights (to cushion fall) / clamp stand to bench add weight of lower block to value of load any other suitable precaution	2
Total	**7**

Marking schemes for 2017

Question 9

February/March 2017 - Paper 62

Answer	Marks
apparatus: MP1 springs made by winding wire around rod (or similar)	1
method: MP2 apply load, measure length / extension of spring	1
MP3 repeat for spring(s) of different material	1
MP4 record results in suitable annotated table / bar chart / graph	1
control variables: MP5 mark gained for any <u>two</u> of: unstretched length of spring, diameter of wire, coil spacing, load / range of loads used diameter of spring	1
MP6 **precautions / difficulties / additional points:** MP7 any two from: clamp retort stand / might topple, use small loads / spring might overstretch/spring too weak/use loads which don't overstretch spring to support loads need to apply force smoothly / slowly, suggested range of loads, workable arrangement for applying load to spring (e.g. small loop at end of spring) trial experiment to find (range of) loads to use how to determine extension of spring, repeat each reading <u>and</u> take average, at least 5 loads for each sample if producing graph	2
Total:	7

Question 10

May/June 2017 - Paper 61

	Answer	Marks
	MP1 Diagram showing power supply, ammeter, voltmeter and resistance wire correctly connected (variable resistor optional)	1
	MP2 Correct symbols for ammeter and voltmeter. Variable resistor symbol correct if included.	1
	MP3 Measure potential difference (voltage) and current and calculate resistance.	1
	MP4 Repeat with other (types of) wires	1
	MP5 Key variables <u>length</u> AND <u>diameter</u> stated	1
	MP6 One of: Repeat with different voltages (or currents). Repeat and take average (voltage and current) readings. Repeat entire experiment with different length or different diameter. Use low current to prevent wire heating up. Keep temperature of wire constant / switch off between readings Use micrometer screw gauge to measure diameter / thickness of wire.	1
	MP7 Table with columns for type of wire, voltage, current, resistance with correct units (V, A and Ω)	1
	Total:	7

Question 11 — May/June 2017 - Paper 62

Answer	Marks
method to include:	
measurements of temperature of hot water over a period of time/measurement of temperature at start and end of a specified cooling time /measurement of time for a specified temperature drop	1
repeat using variety of fan speeds (blowing air over water surface)	1
two from: room temperature initial/starting temperature of hot water volume/mass/amount of (hot) water distance of beaker to fan for each speed setting time of cooling (for a fixed temperature drop) temperature drop (for a fixed time) same beaker size/material	2
table with columns for fan speed, time and temperature with units in the table headings (not the body of the table) for time and temperature, but fan speed units not required	1
compare readings to find out which fan speed produces the greatest temperature drop / takes least time **or** plot a graph of temperature against time	1
in the same time / for same temperature drop **or** steepest gradient gives the fastest rate of cooling	1
Total:	7

Question 12 — May/June 2017 - Paper 63

Answer	Marks
apparatus beaker with insulation and thermometer and stopclock (or alternative) mentioned	1
method pour hot water into container measure temperature of hot water over period of time	1
repeat for additional layers	1
results: suitable table / graph / cooling curve	1
control variables any pair from: same initial temperature, same volume of water, same size/material/thickness of beaker, same thickness of each layer,	1
additional points any 2 from: how cooling rate calculated/how to compare cooling curves, read thermometer perpendicularly, thermometer at same depth (for repeat) thermometer not touching beaker, stir before reading thermometer, use of lid, minimum of 5 different thicknesses of insulation, repeat experiment with different sized beakers/different amount of water, sensible amount of water (50 cm^3 to 500 cm^3)	2
Total:	7

Question 13

October/November 2017 - Paper 61

	Answer	Marks
MP1	Stopwatch (or equivalent) AND (metre) rule / ruler	1
MP2	Measure time for 5 (□) oscillations	1
MP3	Divide by number of oscillations to find period (*T*)	1
MP4	Repeat for each bob	1
MP5	Variable; one from: Initial amplitude / starting position Length of pendulum / thread Number of oscillations	1
MP6	Table with column headings for *t*, or period (*T*), or both AND *d*, with correct units	1
MP7	Conclusion: Plot graph(s) of *d* against period (*T*) or *t* (or vice versa) OR compare period (*T*) or *t* values for different diameters	1

Question 14

October/November 2017 - Paper 62

Answer	Marks
method: **MP1** measure length of band	1
MP2 hang load, measure new length	1
MP3 repeat with different thicknesses/widths	1
control variable: **MP4** use same (original) length of band each time	1
table: **MP5** table with columns for thickness, (load) and length / extension with units	1
conclusion: **MP6** plot a graph of extension / length against thickness (for the same load) OR load against extension / length for different thicknesses OR comparison via a table e.g. compare extensions / lengths of different thicknesses for the same load	1
one additional point: **MP7** use same load / same range of loads use at least 5 thicknesses / take at least 5 different readings to plot a graph show how to measure extension e.g. $l - l_0$ use same type / material of rubber band	1

	Answer	Marks
MP1	**additional apparatus:** screen AND (metre) rule	**1**
MP2	**diagram:** suitable arrangement of apparatus with *u* & *v* labelled correctly	**1**
MP3	**method:** obtain (clear focused) image AND measure *u*, *v*	**1**
MP4	repeat for other values of *u*	**1**
MP5	**one precaution for clear, focused image:** move screen slowly / backwards and forwards, object AND lens AND screen perpendicular to bench / vertical, object and lens at same height (from bench), use of dark room / bright light	**1**
MP6	**one precaution with measurements:** clamp rule / fix to bench, mark centre of lens on holder avoidance of parallax explained and specific	**1**
MP7	**one additional point:** additional precaution, calculate *f* <u>from given equation</u> at least 3 values obtained, calculate average, mention of at least one appropriate *u* value, mention of preliminary expt to obtain rough *f* value (e.g. light from window)	**1**

Question 16

February/March 2018 - Paper 62

	Answer	Marks
MP1	**factor:** clear statement of appropriate variable to test	1
MP2	**control variable:** named variable which should be kept constant	1
MP3	**apparatus:** metre rule and any apparatus essential to variable under test	1
MP4	**method:** measure factor under test and drop ball and measure diameter / depth of depression	1
MP5	repeat for new value of variable under test	1
MP6	**additional point:** repeat experiment or each value of factor and average / means of measuring depth / diameter of crater accurately / apparatus for measuring diameter of ball accurately / measure diameter of ball / crater in different places (and take mean) / smooth / flatten sand surface / at least 5 sets of data taken / reliable means of releasing ball / sensible values for factor quoted	1
MP7	**graph:** diameter / depth of depression vs appropriate continuous variable	1

Question 17

May/June 2018 - Paper 61

Answer	Marks
Method to include: (Hot) water in copper can, time taken for temperature to drop	1
Correct use of at least 3 larger outer containers, separately	1
Some indication that size of air gap is measured	1
Any **two** from: Use of something to cover air gap Use of lid on copper can Same starting temperature Same room temperature Same volume of hot water Use of 'control' with no outer container Inner container standing on an insulator Uniform air gap all round	2
Table with clear columns for temperature and/or time (to match method) and air-gap, with appropriate units	1
Conclusion: Least temperature drop **OR** longest time for temperature to drop shows lowest cooling rate **OR** best insulation **OR** plot temperature against time and least gradient shows lowest cooling rate (ora)	1

Question 18

May/June 2018 - Paper 62

Answer	Marks
method to include:	
place truck on ramp (and release)	1
measure distance (travelled) from bottom of ramp	1
repeat with different mass(es) (loaded on the same truck)	1
additional apparatus:	
(metre) rule(r) / measuring tape	1
control variables:	
height / angle of ramp / number of supporting bricks	1
release position / height above bench	1
table with clear columns for mass, and distance travelled, with appropriate units in the headings of the table	1

Question 19

May/June 2018 - Paper 63

Answer	Marks
Apparatus: forcemeter, (10 g and 100 g) masses / masses only (if clear they are used to change the mass of the block and as weights to the block via the pulley)	1
Diagram: block, workable means of pulling and measuring force	1
Method (2): measure force required to make block slide / find mass (on pulley) required to make block slide	1
repeat for new value of mass	1
Precautions: any **one** from: same surface to slide on / repeat each measurement and take average / same angle of pulling force	1
Graph: mass on block vs force (needed to slide)	1
Any additional point: at least 5 sets of data taken / keep force horizontal / add mass of block to load / extra precaution	1

Question 20

October/November 2018 - Paper 61

Answer	Marks
MP1 Workable, correct circuit diagram with power source and correct symbols for ammeter and voltmeter.	1
Method to include:	
MP2 Measuring V and I	1
MP3 Repeating with at least two other values of V or power, and / or I	1
MP4 Measuring time to raise water temperature by a specific amount or to a specific value	1
MP5 Any **ONE** from: Same starting temperature Same finishing temperature Same temperature difference Same room temperature Same volume / mass / amount of water	1
MP6 Table with clear columns for time, V and I, with appropriate units and P(or VI)	1
MP7 Conclusion: Plot a graph of power against time.	1

Question 21 — October/November 2018 - Paper 62

Answer	Marks
method: **MP1** measure room / starting temperature	1
MP2 measure time to raise water temperature to boiling point	1
MP3 repeat with the other two containers	1
control variables: **MP4** any two from: same starting temperature / same room temperature same volume / mass / amount of water **MP5** keep Bunsen burner flame constant / keep the distance from the flame to the bottom of the beaker constant	2
table: **MP6** table to show container and heating time	1
conclusion: **MP7** comparison of heating times and suitable comment made	1

Question 22 — October/November 2018 - Paper 63

Answer	Marks
MP1 Apparatus thermometer AND stopwatch / (stop)clock / timer	1
MP2 Diagram workable arrangement	1
MP3 Method hot water in beaker and cold water in test-tube AND measure (start and) end temperatures in test-tube AND over measured time	1
MP4 Method repeat for different metals	1
MP5 Comparison calculation of (rate of) temperature rise / heating curves for different metals	1
MP6 and MP7 Precautions Any **two** from: same start temperatures (of hot / cold water); same duration of experiment; same volume of cold water (being heated); repeat experiment and take average (of calculated values); use of insulation; stir (cold) water; heat to keep water in beaker at constant temperature.	2

Question 23

February/March 2019 - Paper 62

Answer	Marks
MP1 **apparatus:** means of measuring dependent variable (e.g. stop watch / rule / protractor)	1
MP2 **method** (one from): workable means of providing air resistance (e.g. fix card to rod / bob), allow pendulum to swing, suitable measurement (e.g. period, amplitude)	1
MP3 repeat for different value of independent variable (e.g. area of card)	1
MP4 **control variable** (one from): length of pendulum, angle of release, mass of bob	1
MP5 **table:** suitable clear format with column headings and units	1
MP6 **analysis:** compare readings to see if change in air resistance produces change in dependent variable (e.g. change in area of card changes period) / plot graph	1
MP7 **additional point** (one from): time 10 oscillations / swings (and calculate period), small angle of swing, at least 5 sets of data taken, repeat each measurement and take average, adjust mass of pendulum to compensate for changing mass of card, repeat with different length of pendulum / mass of bob, length measured to centre of bob / centre of gravity of pendulum, use of fiducial aid	1

Question 24

May/June 2019 - Paper 61

	Answer	Marks
MP1	Apparatus: Forcemeter/Newtonmeter or pulley and weights arrangement	1
MP2	Method: Pull box up slope, measure force and measure distance moved	1
MP3	Method: Repeat with different masses	1
MP4	Variable: Angle of slope or height of blocks	1
MP5	Variable: Distance moved	1
MP6	Table to include columns for mass and force, both with unit (g or kg for mass and N for force)	1
MP7	Calculate work done and compare with mass. OR Compare work done with mass (if there is a work done column in the table). OR Plot graph of work done against mass	1

Question 25

May/June 2019 - Paper 62

Answer	Marks
Apparatus **MP1** diagram showing object, lens, screen/image in correct order	1
MP2 *u* and *v* correctly labelled on diagram	1
Method **MP3** measure/record/calculate *u* and *v* and lens thickness *t*	1
MP4 repeat with a different lens	1
MP5 method of obtaining a sharp image by moving object, lens or screen….	1
Measuring lens thickness **MP6** use of blocks either side of lens (and measure distance)	1
Table **MP7** table with columns for *u*, *v* and *t* with correct units	1

Question 26

May/June 2019 - Paper 63

Answer	Marks
MP1 Apparatus metre rule / measuring tape	1
MP2 Method drop ball from measured height measure height of bounce repeat for different height of release	1
MP3 Precaution any one from: • repeat (for each height of release) and average • measure to same part of ball each time • measure height of bounce at eye level • release without throwing/impeding • use of video (for height of bounce)	1
MP4 Control variable any one from: • same (diameter/mass/material) ball • type of floor covering	1
MP5 Table columns for release height and bounce height and units	1
MP6 Analysis any one from: • suitable analysis of readings • draw a suitable graph of drop height against bounce height	1
MP7 Additional point any one from: • additional control variable • at least 5 sets of data taken • repeat experiment for different diameter of ball/floor covering • automatic release to eliminate differences	1

Question 27

October/November 2019 - Paper 61

Answer	Marks
MP1 How the ball will move: Back and forth / like a pendulum	1
MP2 Release from a determined position, time until stops	1
MP3 Repeat with at least two more values of independent variable	1
MP4 Statement of variable to be changed	1
MP5 Statement of a variable to keep constant	1
MP6 Table with columns for chosen variable that is changed and time with correct units, s for time.	1
MP7 Compare chosen variable with time. Or plot graph of chosen variable against time	1

Question 28

October/November 2019 - Paper 62

Answer	Marks
MP1 method diagram: container, ice (cubes, thermometer and insulation)	1
MP2 ice (in container), measure time (for all the ice) to melt	1
MP3 repeat with different insulators	1
MP4 control variables (total) mass / volume of ice cubes	1
MP5 any **one** from: thickness / amount of insulation room temperature / other environmental condition size / shape / surface area of ice cubes initial temperature (of ice cubes)	1
MP6 table table with headings of (named) insulator and time with correct units	1
MP7 conclusion (use the table to) compare the insulator with the time taken for the ice cubes to melt	1

Question 29 **October/November 2019 - Paper 63**

Answer	Marks
MP1 Apparatus beaker and (material for) lid and thermometer and stop clock (or alternative)	1
MP2 Method pour (hot) water into container measure temperature of (hot) water over period of time	1
MP3 Method repeat for different thicknesses of lid	1
MP4 & MP5 Control variables any **two** from: • same initial/starting temperature of water ; • same volume of water ; • same size / material / thickness of beaker ; • same material for lid ; • same time for measuring temperature change / same temperature difference for measuring time taken • same room temperature / other environmental condition	2
MP6 Table suitable column headings and units	1
MP7 Analysis any **one** from: • comparison of temperature decrease / rates of cooling with thickness / different lids • draw a suitable graph with axes stated	1

Marking schemes for 2020

Question 30 **Specimen Paper 2020 - Paper 6**

(a) apparatus:
measuring cylinder/jug OR ruler OR balance (to measure amount of water) [1]
protractor OR rule to measure height of raised surface
OR other means of measuring angle of tilt
OR newtonmeter to apply variable force
OR other method of applying quantifiable force [1]

instructions:
method of tilting or applying variable force and measuring point at which bottle topples [1]

attention to accuracy, any two from:
just starts to topple
slowly
repeats / more than 10 values for quantity of water
very large protractor
or any other suitable precaution which would improve accuracy of data [max 2]

values:
at least 5 values with range at least 1500 cm^3 or 30 cm or 1500 g, approximately evenly spaced [1]

graph:
plot of measured variable (angle or height or force) against quantity of water (volume or height or mass) (accept vice versa) [1]

(b) 20° [1]

Answer	Marks
MP1 **circuit diagram:** ammeter in series with resistor and circuit correct	1
MP2 **apparatus:** ammeter and means of measuring candidate's independent variable if other than air speed e.g. (metre) rule if distance is independent variable, protractor if angle of air flow is independent variable	1
control variable (one from)**:** speed of fan (if distance / angle varied) or distance / angle between fan and turbine (if fan speed varied), height of fan / turbine, angle of air flow	
MP4 **method:** measure / record independent variable (allow turbine to turn and) measure / record current,	1
MP5 repeat for different value of independent variable	1
MP6 **analysis:** compare readings (in a table) to see if change in independent variable produces change in current / plot line graph (with correct axes specified)	1
MP7 **additional point** (one from)**:** at least 5 sets of data taken, repeat each measurement and take average, 2nd valid control variable stated, repeat for different resistor and compare pattern preliminary experiment to determine suitable range for independent variable measure air speed at same point each time	1

Question 32

May/June 2020 - Paper 61

	Answer	Marks
MP1	Diagram to show container and thermometer	1
MP2	Hot water in a container. Record initial temperature and take temperature at intervals as it cools	1
MP3	Repeat with at least three other colours	1
	Any **two** from: **MP4** Same starting temperature Same room temperature **MP5** Use of a lid At least three named colours Same thickness of paint	2
MP6	Table with clear columns for temperature and / or time (to match method), with appropriate units	1
MP7	Conclusion: Greatest temperature drop shows best radiator (or reverse argument)	1

Question 33

May/June 2020 - Paper 62

	Answer	Marks
MP1	diagram showing strip clamped to bench with majority overhanging	1
MP2	means to measure bending, e.g. vertical metre rule at end of strip	1
MP3	add load at / near end of strip and measure the amount of depression	2
MP4	repeat with other strips	
MP5	variables any **one** from: all strips to have same width / thickness / profile use of same load(s) allowance for unloaded depression	1
MP6	table with columns for material, load and depression with correct units	1
MP7	strip that bends most with same load is most bendy / alternative wording	1

Question 34

May/June 2020 - Paper 63

	Answer	Marks
MP1	**additional apparatus:** voltmeter, protractor, metre rule	1
MP2	**control variable (one from):** distance of lamp from solar panel height of lamp / height of solar panel brightness of lamp	1
MP3	**method (one from):** measure angle between panel and stand / other fixed datum (switch on lamp) measure potential difference	1
MP4	repeat for different angle	1
MP5	**table:** appropriate columns with clear headings and units	1
MP6	**analysis:** suitable analysis of readings, e.g. calculation of rate of change of potential difference with angle draw a suitable graph with correct axes stated	1

Answer	Marks
MP7 **additional point / precaution (one from):** reading with only ambient light first / subtract ambient light reading make room dark fix protractor keep axis of solar panel and line of lamp perpendicular to each other at least five sets of data taken repeat each reading and take an average repeat for different distance of lamp	1

Question 35

October/November 2020 - Paper 61

Answer	Marks
MP1 Correct circuit diagram to include test wire, power source, ammeter and voltmeter	1
MP2 Correct symbols used for ammeter and voltmeter.	1
MP3 At least 3 different metals (or alloys) suggested	1
MP4 Measure potential difference and current. Work out resistance	1
MP5 Repeat with at least two more wires of different material.	1
MP6 Key variables: Any one from: Length of wire Diameter / thickness / cross-sectional area of wire	1
MP7 Table with columns for material, potential difference, current and resistance with units V, A, Ω.	1

Question 36

October/November 2020 - Paper 62

Answer	Marks
Apparatus: **MP1** method of heating water **and** timer	1
MP2 method: measure the temperature of the water <u>and</u> then place the ice cube(s) in the water <u>and</u> measure the time taken to melt	1
MP3 method: melt repeat with water at different temperature(s)	1
Key variables: Any two from: **MP4** mass / volume of ice cubes **MP5** number / size of ice cubes (per test) temperature of ice cubes / keep ice cubes in freezer volume / amount of water in the beaker room temperature amount of stirring	2
Table: **MP6** table with columns for time / *t* and water temperature with correct units	1

Conclusion: **MP7** explanation of how to reach a conclusion	**1**

Question 37

October/November 2020 - Paper 63

Answer	Marks
MP1 Factor diameter / mass of ball	**1**
MP2 Apparatus stop-watch (or similar)	**1**
MP3 Control variable any suitable control variable, e.g. • mass of ball (if diameter is the factor) • diameter of ball (if mass is the factor) • distance (timed over)	**1**
MP4 Method any **one** from: • measure the chosen factor (i.e. mass / diameter) ; • apparatus used to measure mass / diameter ; • precaution: repeat (procedure) and average	**1**
MP5 Method drop ball in tube of water and time (over fixed distance)	**1**
MP6 Method repeat for different value of chosen factor (i.e. mass / diameter)	**1**
MP7 Analysis any **one** from: • comparison of time / speed with chosen factor • graph of time / speed vs chosen factor	**1**

Question 38

February/March 2021 - Paper 61

	Answer	Marks
MP1	**factor:** named factor	**1**
MP2	**method:** measure time for motion of ball and means of doing so (stopwatch / timer) over measured distance and means of measuring (probably metre rule / tape measure) / mention of between fixed points	**1**
MP3	repeat for new value of the independent variable	**1**
MP4	**control:** any variable appropriate to independent variable e.g. mass of ball if diameter is factor	**1**
MP5	**table:** columns, with units, at least for independent variable, time	**1**
MP6	**analysis:** compare readings in the table to see if change in factor produces change in speed, plot line graph (with axes specified)	**1**
MP7	**additional point** (one from)**:** at least 5 sets of data taken, repeat each measurement <u>and</u> take average, repeat (whole) experiment for same factor but a new condition use of fiducial aid (e.g. mark fixed points to time between) release ball without pushing suitable means of release	**1**

Question 39

May/June 2021 - Paper 61

Answer	Marks
MP1 Apparatus: timer	**1**
MP2 Remove block from water	**1**
MP3 Record temperatures and times OR record temperatures over a fixed time OR record time for a fixed temperature drop	**1**
MP4 Other block(s) used	**1**
MP5 Key variable: One from: Starting temperature of block Room temperature Water temperature Size of block Mass of block	**1**
MP6 Table with columns for metal / block / material (owtte), temperature OR time OR temperature and time as appropriate to the method. Correct quantity and units required	**1**
MP7 Plot graph of temperature against time (for each material) OR Compare rates of cooling OR Compare temperature drops (if fixed time used) OR Compare times (if fixed temperature drop used) OR Equate large temp. drop / short time to a high rate of cooling (or the converse)	**1**

Question 40

May/June 2021 - Paper 62

Answer	Marks
MP1 **apparatus:** diagram: spring attached to a fixed support, (load and metre rule)	1
MP2 at least three metals listed	1
MP3 **method:** measure / record length of the spring and add load(s) and measure / record new length OR add load(s) and measure / record the extension	1
MP4 repeat with other springs of different materials	1
MP5 **key variables:** one from: original length of spring / diameter of spring / number of turns (of the spring) / diameter of the wire (of the spring) / length of the wire (of the spring)	1
MP6 **table:** table with columns for metal and extension / length with correct unit(s) (in headings or in the body of the table)	1
MP7 **conclusion:** plot a graph of extension against load (or axes other way around) for each spring (and compare) OR compare extensions for a fixed load for each spring OR plot a bar chart of extension against metal for a fixed load	1

Question 41

May/June 2021 - Paper 63

Answer	Marks
MP1 **apparatus:** rule or equivalent	1
MP2 **method:** identify independent variable detail of deflection measurement and how it is measured	1
MP3 repeat for new independent variable	1
MP4 **control variable:** any variable appropriate to independent variable e.g. width of strip if thickness is the factor	1
MP5 **table:** columns, with units, for independent variable, deflection	1
MP6 **analysis:** compare readings in the table to see if change in factor produces change in deflection plot line graph (with axes specified)	1
MP7 **additional point** (one from)**:** at least 5 sets of data taken repeat each measurement and take average 2nd appropriate control variable stated repeat experiment for different variation (e.g. different mass if thickness is factor) use of fiducial aid	1

Question 42

October/November 2021 - Paper 61

Answer	Marks
MP1 Apparatus: (stop)watch / clock / timer	1
MP2 Method: Heat water in a container to a specified temperature or to boiling point	1
MP3 Method: Repeat for at least two additional containers	1
MP4 Constant Variable: Volume of water	1
MP5 Constant Variable: Starting temperature (of water) OR room temperature OR power of heater	1
MP6 Table with columns to match their method. If MP2 correct, this needs type of container and time with unit (s)	1
MP7 Compare times / durations (for the various containers) OR see which takes longer.	1

Question 43

October/November 2021 - Paper 62

Answer		Marks
MP1	**method** names of at least three metals / named alloys suggested	1
MP2	add loads / masses to test wire until it breaks	1
MP3	repeat with the other metals	1
MP4	repeat for each individual metal wire (and take an average)	1
MP5	**control variable** diameter / cross-sectional area/thickness of the wire	1
MP6	**table** columns for metal / wire and load / mass / weight, with unit	1
MP7	**conclusion** compare breaking force / load / weight to metal OR plot a bar chart of metal and breaking force / load weight	1

Question 44

October/November 2021 - Paper 63

Answer	Marks
MP1 **apparatus:** factor stated and apparatus appropriate to its measurement e.g. ammeter, voltmeter, coils (no apparatus for measuring required)	1
MP2 **control variable:** any variable appropriate to independent variable (e.g. current if number of coils is the independent variable, number of coils if current is the independent variable. Same size / mass of paper clips)	1
MP3 **method:** measure independent variable check number of paper clips supported	1
MP4 repeat for new value of independent variable	1

MP5 **table:** columns, with units, for independent variable and number of paper clips	**1**
MP6 **analysis:** compare readings in the table to see if change in factor produces change in strength, plot line graph (with axes specified)	**1**
MP7 **additional point** (one from)**:** at least 5 sets of data taken, repeat each measurement <u>and</u> take average, 2nd appropriate control variable stated, repeat experiment for different variation (e.g. different no of coils if current is factor) arrangement of paper clips	**1**

Marking schemes for 2022

Question 45

February/March 2022 - Paper 62

	Answer	Marks
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**

Question 46

May/June 2022 - Paper 61

Answer	Marks
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

Question 47

May/June 2022 - Paper 62

Answer		Marks
method: **MP1**	place disc between heated cylinder and metal cylinder / set up apparatus as shown in diagram	1
MP2	measure the time for lower cylinder to reach a certain temperature (rise) / measure the temperature (rise) reached in a certain time.	1
MP3	repeat with the other discs	1
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)	2
MP6	**table:** table with columns for (material of) disc, time / temperature difference (depending on MP2) with units in the headings only	1
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	1

Question 48

May/June 2022 - Paper 63

	Answer	Marks
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

Question 49

October/November 2022 - Paper 61

Answer	Marks
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 different angles 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 consistent with their method (if method correct with columns for distance travelled and angle of track, with units)	1
MP7 Analysis based on their table Graph of angle against distance travelled, or compare angle with distance travelled (or the equivalents for their method)	1

Question 50

October/November 2022 - Paper 62

Answer	Marks
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

Question 51

October/November 2022 - Paper 63

Answer	Marks
apparatus **MP1** thermometer, metre rule	1
method **MP2** valid procedure: heat ball in water <u>and</u> measure temperature <u>drop</u> 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 <u>and</u> 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

Question 52

Specimen Paper 2023 - Paper 6

Answer	Marks
MP1 **factor:** clear statement of appropriate variable to test, e.g. mass of ball	1
MP2 **control variable:** named variable which should be kept constant, e.g. height of drop, depth of sand	1
MP3 **apparatus:** metre rule and any apparatus essential to variable under test, e.g. balance	1
MP4 **method:** measure factor under test **AND** drop ball **AND** measure diameter / depth of depression	1
MP5 repeat for new value of variable under test	1
MP6 **additional point:** repeat experiment or each value of factor **AND** average / means of measuring depth / diameter of crater accurately / apparatus for measuring diameter of ball accurately / measure diameter of ball / crater in different places (and take mean) / smooth / flatten sand surface / at least 5 sets of data taken / reliable means of releasing ball / sensible values for factor quoted	1
MP7 **graph:** diameter / depth of depression vs appropriate <u>continuous</u> variable (**NOT** 'size' of ball without qualification)	1

Question 53

February/March 2023 - Paper 62

	Answer	Marks
MP1	**factor:** named factor	1
MP2	**method:** measure time for motion of ball and means of doing so (stopwatch / timer) over measured distance and means of measuring (probably metre rule / tape measure) / mention of between fixed points	1
MP3	repeat for new value of the independent variable	1
MP4	**control:** any variable appropriate to independent variable e.g. mass of ball if diameter is factor	1
MP5	**table:** columns, with units, at least for independent variable, time	1
MP6	**analysis:** compare readings in the table to see if change in factor produces change in speed, plot line graph (with axes specified)	1
MP7	**additional point** (one from)**:** at least 5 sets of data taken, repeat each measurement <u>and</u> take average, repeat (whole) experiment for same factor but a new condition use of fiducial aid (e.g. mark fixed points to time between) release ball without pushing suitable means of release	1

Question 54

May/June 2023 - Paper 61

	Answer	Marks
MP1	circuit diagram – power supply, lamp and ammeter in series, voltmeter in suitable position to read *V* across lamp	1
MP2	measure the current and potential difference	1
MP3	**calculate** resistance	1
MP4	repeat with at least two other currents / voltages / settings of variable resistor / power supply	1
MP5	a way to change the current/voltage (e.g. adjusting / using variable resistor **OR** changing **voltage** of power supply **OR** adding batteries)	1
MP6	table with columns for potential difference, current and resistance, headed with quantities and appropriate units	1
MP7	plot graph of resistance against current **OR** compare values of resistance and current in table	1

Question 55

May/June 2023 - Paper 62

	Answer	Marks
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

Question 56

May/June 2023 - Paper 63

Answer	Marks
MP1 **apparatus:** thermometer <u>and</u> stop-watch	1
MP2 **method:** measure independent variable <u>and</u> measure temperature <u>and</u> time	1
MP3 repeat for new value of independent variable	1
MP4 **control variable:** any **one** from: • volume of water • initial temperature	1
MP5 **table:** columns, with units, for independent variable, temperature, time	1
MP6 **analysis:** compare readings to see if change in lid thickness produces change in (rate of) temperature change (owtte) plot line graph (with axes specified)	1
MP7 **additional point** any **one** from: • at least 5 sets of data taken • repeat for each value of independent variable <u>and</u> take average • 2nd appropriate control variable stated • description of calculating rate of cooling from results	1

Question 57

October/November 2023 - Paper 61

	Answer	Marks
MP1	(stop)watch / clock / timer / chronometer	1
MP2	Measure / record time for evaporation / for water to disappear / for dish to become dry.	1
MP3	Repeat with a different volume / depth of water **OR** different distance of heater from water / different height of heater	1
MP4	**One** from: Volume / depth of water (if not chosen variable) OR Height / distance of heater from water (if not chosen variable)	1
MP5	**One** from: Room temperature / (initial) water temperature Reference to avoiding draughts owtte Surface area of water Second variable from MP4 if wrong investigation	1
MP6	Table with clear columns for time and chosen variable with appropriate units. These must be headed with both a quantity (or a recognised symbol for it) and unit.	1
MP7	Plot graph of chosen variable against time **OR** an answer which suggests comparing values of chosen variable and time in table	1

Question 58

October/November 2023 - Paper 62

	Answer	Marks
MP1	**labelled diagram** diagram with lens between object and screen, and filter anywhere between the illuminated object and the lens or between the source of illumination and the object, with a least 1 label	1
MP2	**method** **move** object / lens / screen to obtain focused / sharp / clear image	1
MP3	measure / record / find / calculate / note *u* and *v*	1
MP4	calculate / determine / find the focal length	1
MP5	repeat with different colours / filters	1
MP6	**table** table with clear columns for (filter) colour, *u* and *v* **AND** with appropriate units	1
MP7	**how to reach conclusion** plot bar chart of focal length and colour **OR** compare results to see if / how the change of colour affects the focal length **OR** compare results to determine the effect of a change in colour on the focal length	1

Question 59

October/November 2023 - Paper 63

	Answer	Marks
MP1	**apparatus:** correct variable resistor symbol in series	1
MP2	**method:** measure current OR measure AMPS measure light intensity	1
MP3	repeat for different current OR different resistance	1
MP4	**control variable** (one from)**:** ambient light level OWTTE distance from lamp to light meter	1
MP5	**table:** columns for current (with unit) and light intensity	1
MP6	**analysis:** compare readings in a table to see if change in current produces change in light intensity/ plot line graph with axes specified or draw labelled axes	1
MP7	**additional point** (one from)**:** at least 5 sets of data taken, repeat each measurement and take average, 2nd control variable stated,	1

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Question 60

	Answer	Marks
MP1	**apparatus:** thermometer and stopwatch	1
MP2	**method:** measure independent variable measure initial and final temperatures measure time	1
MP3	repeat for new value of independent variable	1
MP4	**control variable:** one (explicitly stated) from: volume of water, initial temperature	1
MP5	**table:** MUST be appropriate for method with: columns, with correct units, for independent and dependent variables any other quantity mentioned must have correct units	1
MP6	**analysis:** compare readings in the table to see if change in insulation thickness produces change in (rate of) temperature change (owtte), plot line graph (with axes specified)	1
MP7	**additional point** (one from)**:** at least 5 sets of data taken, repeat for each value of independent variable and take average correct description of how to calculate rate of cooling from results	1