

**Student Laboratory
Notebook** 2nd Edition
**Junior Certificate Science
Solutions**



INTRODUCTION

This **Student Laboratory Notebook** allows you to keep a written record or report of the mandatory practical work (Coursework A) that you will carry out as part of the Junior Certificate Science course.

The completed reports on the 30 mandatory activities count for 10% of your final grade in the Junior Certificate examination. It is important therefore, that you take good care of this **Laboratory Notebook**, as neatness and clarity will count when marks are awarded. You will carry out the mandatory activities in small groups (ideally two students per group), however, you should complete your own personal report on each activity, in your own Laboratory Notebook.

The **Student Laboratory Notebook** can be used in conjunction with any of the Junior Certificate Science textbooks currently available. The numbered references next to the title of each activity refer to the possible method described for the activity in **Discovering Science 2nd Edition** (Mentor).

1. You should start each **Activity Report** by putting in the **Date** on which you carried out the activity, in the space provided, next to the **Title**.
2. Complete the **Planning the Activity** section before you carry out the activity. This section is very important as it provides evidence that you have planned your approach to the activity and have decided what you should observe and measure in the course of the activity. Completing this section also ensures that you understand the theory behind the activity.
3. The **Materials and Apparatus Used** section should include a list of the equipment that you will use, and an indication of the quantities of chemicals needed. Use a pencil to draw a labelled diagram, in the space provided, of the apparatus you used to carry out the activity. Your diagrams should always be clear, neat and well labelled. Simple line drawings, as appear in the Line-Drawings section, at the end of this manual, are ideal, but your diagram should always show the apparatus *you* used to carry out the activity.
4. The **Method** section should include a brief, concise summary, in your own words, of how you carried out the activity. You could mention any special precautions you took.
5. What you observed and/or any result(s) you noted should be included in the **Results** section. A sentence or two is sufficient here.
6. Finally, write your conclusion(s) in the **Conclusion(s)** section. A conclusion is what you can deduce from your observations during the activity or the result(s) you obtained.

Experiments should always be carried out with safety in mind. Make sure that you are familiar with the **Laboratory Safety Rules** given in your textbook, before you start any practical work. Plan your approach to the activity carefully before you start by discussing it with your partner. Make sure that you understand the method you choose to carry out the activity and ask your teacher for advice if you are not sure.

Hopefully, you will enjoy carrying out your practical activities in the laboratory. Science is a practical subject, and, by developing your practical skills in the laboratory, you will increase your understanding and appreciation of science and the scientific method.

Have fun, enjoy your practical work, and best of luck with it!

John Cullen

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RECORD OF COMPLETED ACTIVITIES

Mandatory Investigations and Experiments

Activity	Date Completed
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20. Investigate the reaction between zinc and HCl, and test for hydrogen (word and chemical equation)	
21. Identify different forms of energy and carry out simple experiments to show the following energy conversions: (a) chemical energy to electrical energy to heat energy, (b) electrical energy to magnetic energy to kinetic energy, (c) light energy to electrical energy to kinetic energy	
22. Measure the mass and volume of a variety of solids and liquids and hence determine their densities	
23. Investigate the relationship between the extension of a spring and the applied force	
24. Carry out simple experiments to show the transfer of heat energy by conduction, convection and radiation; investigate conduction and convection in water	
25. Investigate the expansion of solids, liquids and gases when heated, and contraction when cooled	
26. Show that light travels in straight lines and explain how shadows are formed	
27. Investigate the reflection of light by plane mirrors, and illustrate this using ray diagrams; demonstrate and explain the operation of a simple periscope ..	
28. Plot the magnetic field of a bar magnet	
29. Test electrical conduction in a variety of materials, and classify each material as a conductor or insulator	
30. Set up simple electrical circuits; use appropriate instruments to measure current, potential difference (voltage) and resistance, and establish the relationship between them	

1. To Investigate the Variety of Living Things (1.1)

2. Planning the Activity:

- (a) What type of area would you chose to visit to see a good variety of living things?
.....*Woodland / Hedgerow / Pond / Zoo etc.*
- (b) Three plants you might expect to find are: ..*Dandelion* , ..*Buttercup* , ..*Dock leaf*
- (c) Three invertebrates you might find are: ..*Beetle* , ...*Centipede* , ...*Wood louse*
- (d) Three vertebrates that live in the area are ...*Hedgehog* , ...*Thrush* , ...*Field mouse*
- (e) Would you expect to see these vertebrates on the fieldtrip? Explain.*No, because they are very cautious and would see / hear you and hide before you could see them*
- (f) Name three items or apparatus that might be useful on the fieldtrip (or back in the laboratory) and state why each might be useful.
 - 1. Item: ..*Net* Why useful ...*To collect invertebrates*
 - 2. Item: ..*Magnifying glass* Why useful ...*To examine plants and invertebrates*
 - 3. Item: ..*Plastic bags* Why useful ...*To collect specimens*

3. Materials and Apparatus Used:

Jotter, pen, sample bags, specimen jars, net

4. Method:

- 1) *On a fieldtrip, write down the names of as many animals and plants as you can identify.*
- 2) *Collect a leaf of each plant you cannot identify and place it in your sample bag.*
- 3) *Collect some invertebrates in the specimen jar.*
- 4) *Back in the laboratory, use keys to identify as many animals and plants as you can.*
- 5) *Draw a few of the animals and leaves you identified in the spaces overleaf.*

.....

5. Results:

- (a) Name 3 plants you identified, and for each, state what feature allowed you to identify it.
 - 1. Plant: *Dandelion* Feature: *Leaf and flower*
 - 2. Plant: *Oak tree* Feature: *Leaf*
 - 3. Plant: *Grass* Feature: *Leaf*

(b) Vertebrate animals identified: *e.g. Blackbird, thrush, robin, rabbit, hedgehog, fox, etc.*

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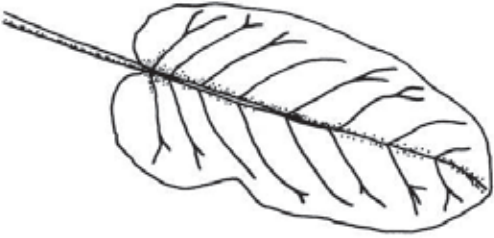
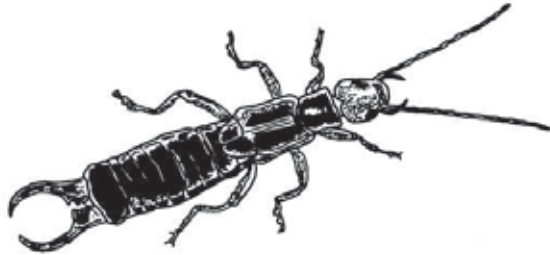

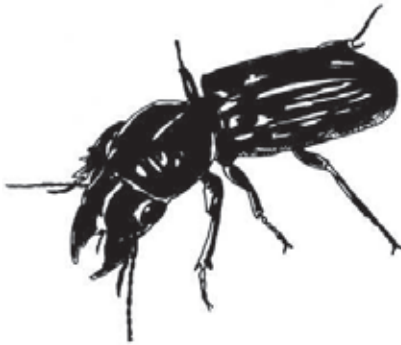
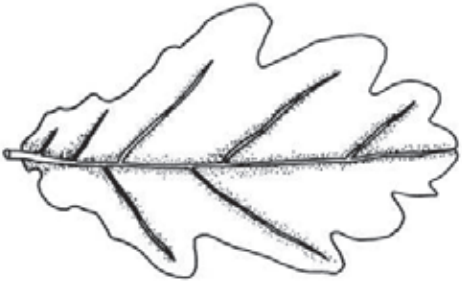
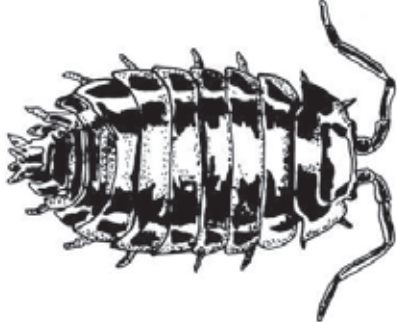
(c) Invertebrate animals identified: *e.g. Beetle, spider, earwig, woodlouse, ladybird, snail, etc.*

.....

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Draw the animals and plants (a leaf or some other identifying feature) that you identified.

Use a tick to indicate whether each animal is a vertebrate or an invertebrate.

PLANTS IDENTIFIED	ANIMALS IDENTIFIED
<p>1)</p>  <p>Name:</p>	<p>1)</p>  <p>Name:</p> <p>Vertebrate <input type="checkbox"/> Invertebrate <input type="checkbox"/></p>
<p>2)</p>  <p>Name:</p>	<p>2)</p>  <p>Name:</p> <p>Vertebrate <input type="checkbox"/> Invertebrate <input type="checkbox"/></p>
<p>3)</p>  <p>Name:</p>	<p>3)</p>  <p>Name:</p> <p>Vertebrate <input type="checkbox"/> Invertebrate <input type="checkbox"/></p>

6. Conclusions:

There is a wide variety of living things, including vertebrates, invertebrates and plants.

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1. To Examine Onion Bulb Cells (Plant Cells) (2.2)

**2. Planning the Activity:**

- (a) Name two instruments that you might use to make things look bigger:

Instrument 1: ..*Magnifying glass*, Instrument 2: ..*Microscope*

- (b) Light must pass through plant tissue so that you can see the cells using a light microscope. Which part of the onion bulb would be best to use and why?

....*The skin, because it is only one cell thick and so would let the light through.*

- (c) Give the reason for the following steps used to prepare the cells for viewing:

- (i) Placing the plant tissue on a glass slide with a few drops of water, and covering it with a cover-slip:

...*So that it can be placed on the stage and is easier to see under the microscope.*

- (ii) Using a needle to gently place the cover-slip over the sample:

...*To avoid trapping air bubbles under the cover-slip.*

- (iii) Using iodine stain on the sample:

...*To make the nucleus easier to see - it stains a brown/orange colour.*

3. Materials and Apparatus Used:

Microscope, slide, cover-slip, needle, dropper, iodine stain, onion

4. Method Used to Examine the Onion Cells:

- (a) The mirror or light of the microscope is adjusted so that
- The maximum amount of light can be directed up through the microscope.*

- (b) The slide is placed on the centre of the stage to allow ...
- Light from the mirror/bulb to come through the hole in the centre of the stage, through the slide and into the eye.*

- (c) Looking from the side, the low power objective lens is lowered very close to the slide, and, then looking through the eyepiece, it is slowly raised. Explain why this is done.

Using the focus knob, the slide can be brought into focus by slowly raising the objective lens.

Always raising the objective lens, to find the focus, makes it impossible to cause damage either to the slide or the objective lens itself.

- (d) Why is the coarse focus knob never used when viewing cells under medium or high power?

The coarse focus could move the objective lens downwards very quickly and it might hit the slide.

- (e) How is the iodine stain added to the sample? ..
- Simply place drops of the stain on the cells when making the slide, or, drag some stain under the coverslip using blotting paper at the other side.*

- (f) Name 4 parts of the microscope and give the function of each part:

1) ..*Eyepiece*..... Function: ... *where you look through, it magnifies the sample*

2) .. *Focus knob*..... Function: ... *moves the objective lens up or down to focus the sample*

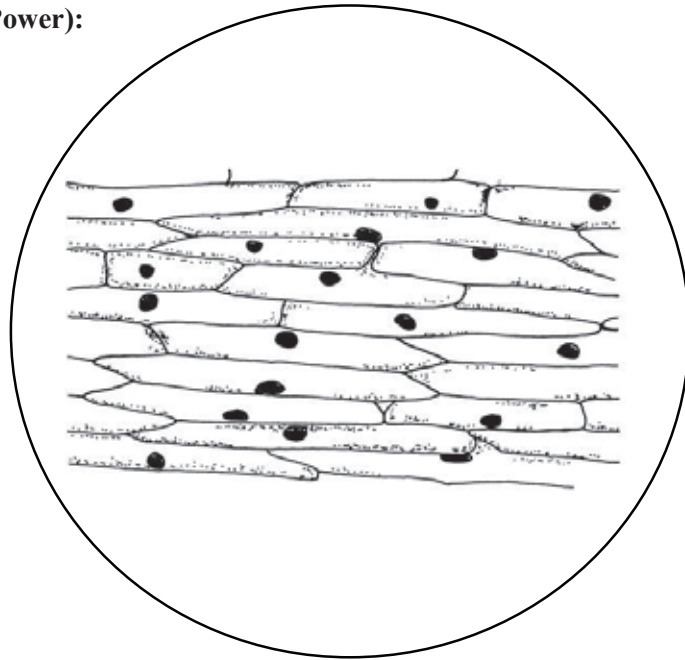
3) .. *Objective lens*.. Function: ... *magnifies the sample*

4) .. *Stage*..... Function: ... *holds the slide in position and allows light up through it*

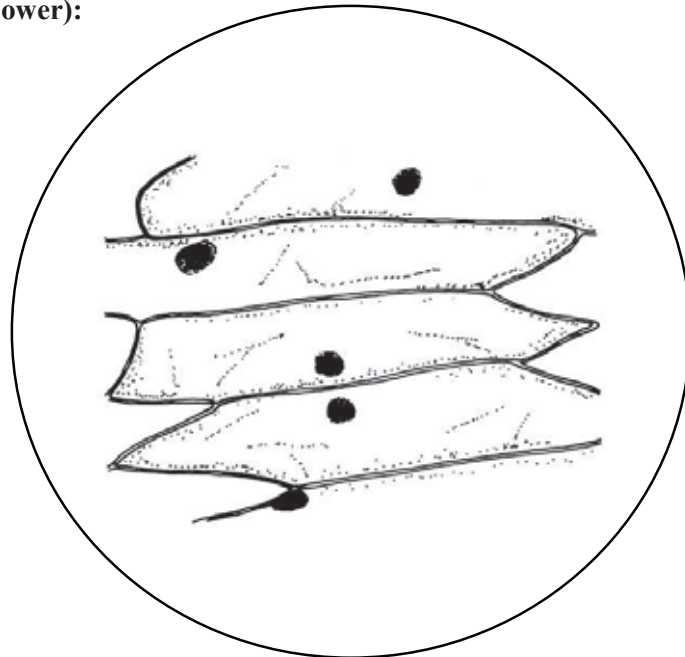
5. **Results:**

Diagrams of Plant Cells (Under Low and High Powers)

Plant Cells (Low Power):



Plant Cells (High Power):



6. **Conclusions:**

The microscope can be used to see plant cells magnified.

The plant cell wall, vacuole and nucleus can be seen clearly, especially when the sample has been stained

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1. To Test for Starch, Glucose, Protein and Fat (3.2 - 3.5)



2. Planning the Activity:

You will use various chemicals that will show, by means of a colour change, whether the substance you are testing for (starch, glucose or protein) is present or absent. What important ability must these chemicals have to be useful in these investigations?

2 points:

- 1) They must change colour when used in the test and
 - 2) they must not change colour when they are used with any other substance.
-
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1. To Test for the Presence of Starch (3.2)

3. Materials and Apparatus Used:

Test tube, dropper, starch solution, iodine solution, various foods.

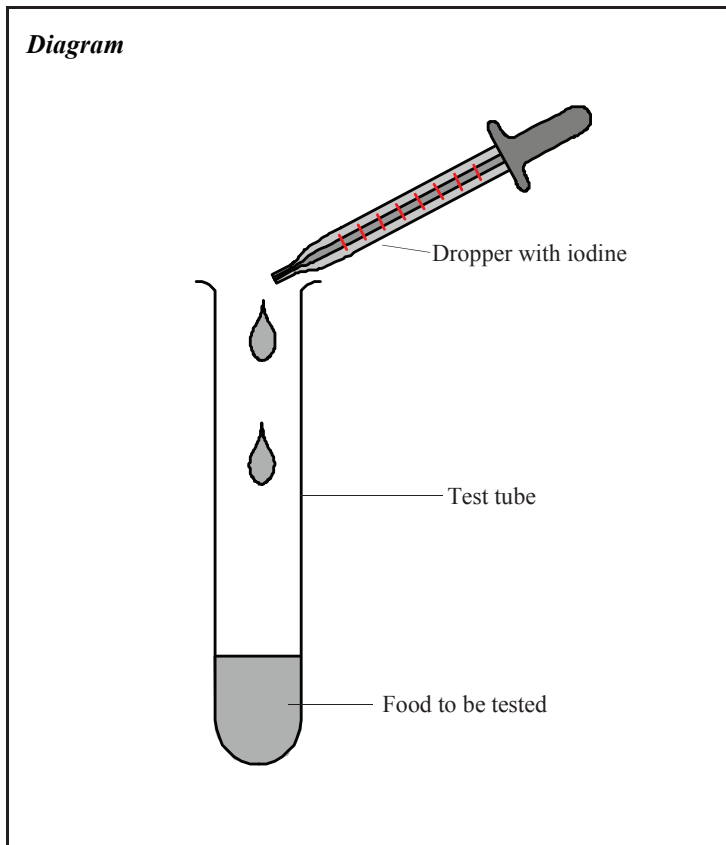
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4. Method:

- 1) Place 2 ml of starch solution in a test tube.
- 2) Add a few drops of iodine, using the dropper.
- 3) Shake the test tube and note any colour change.
- 4) Record your result.
- 5) Grind up the other food samples in 2 ml of water, and test for starch.

5. Results:

The starch solution turns blue/black.



1. To Test for the Presence of Glucose, a Reducing Sugar (3.3)

3. *Materials and Apparatus Used:*

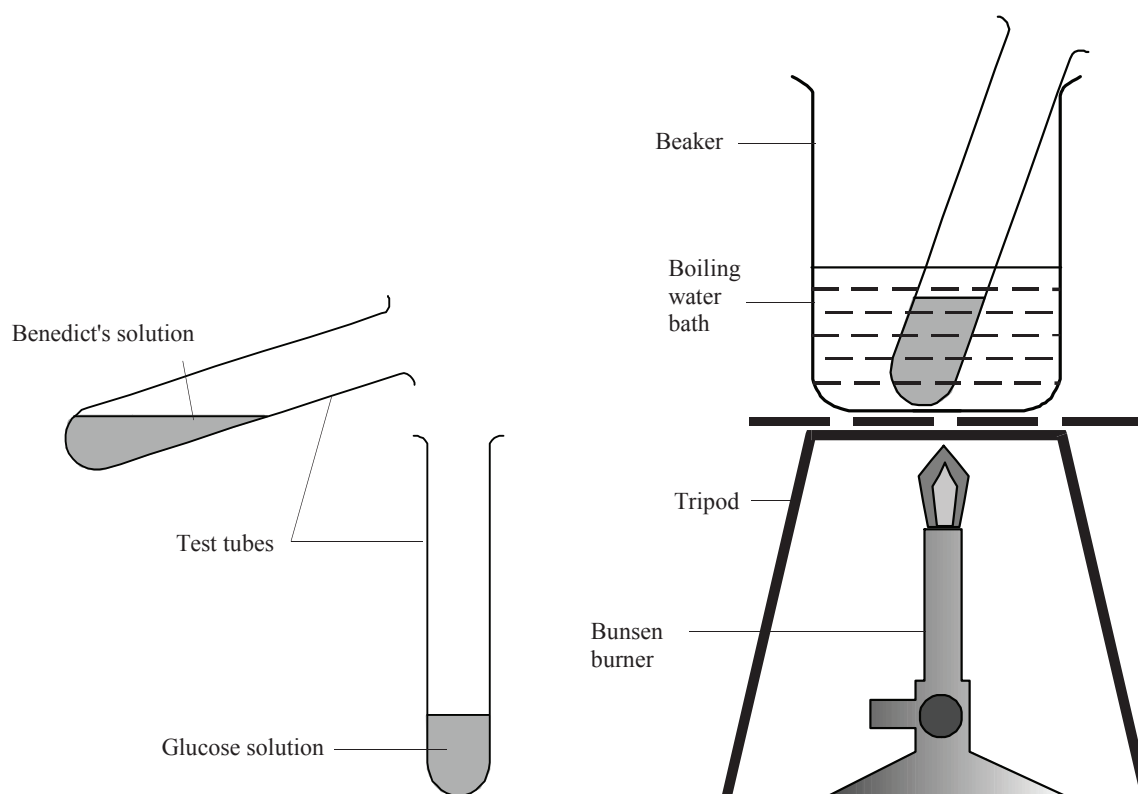
Two test tubes, dropper, beaker, Bunsen burner, tripod, gauze, glucose solution, Benedict's solution, various foods.

.....

4. *Method:*

- 1) *Se up the boiling water bath as shown in the diagram below.*
- 2) *Add equal amounts of glucose solution and Benedict's solution to a test tube.*
- 3) *Place the test tube in the boiling water for about three minutes.*
- 4) *Note and record any colour change in the test tube.*
- 5) *Grind up each of the other food samples in 2 ml of water and test for reducing sugars as above.*

Diagram



5. *Results:*

The glucose solution, or any other reducing sugar in the food samples used, turns brick red.

1. To Test for the Presence of Protein (3.4)

3. Materials and Apparatus Used:

Two test tubes, dropper, milk, sodium hydroxide solution, copper sulfate solution, various foods.

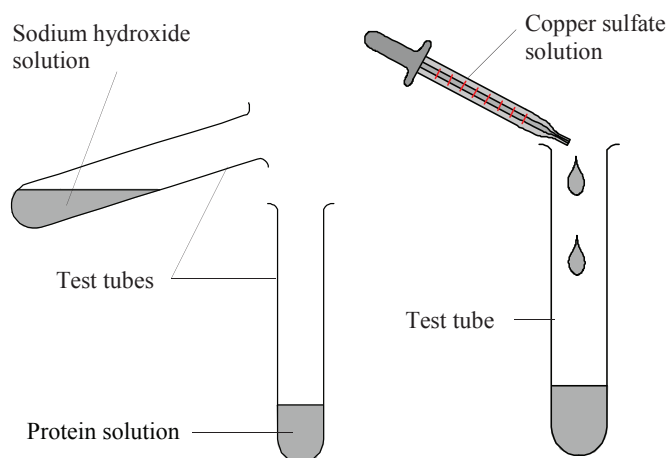
4. Method:

- 1) Place 2 ml of milk into a test tube.
- 2) Add 2 ml of sodium hydroxide solution to the test tube.
- 3) Add a few drops of copper sulfate solution.
- 4) Shake the test tube and note any colour change.

5. Results:

The protein solution turns a violet/ purple colour.

Diagram



1. To Test for the Presence of Fats (3.5)

3. Materials and Apparatus Used:

Brown paper, butter, various foods.

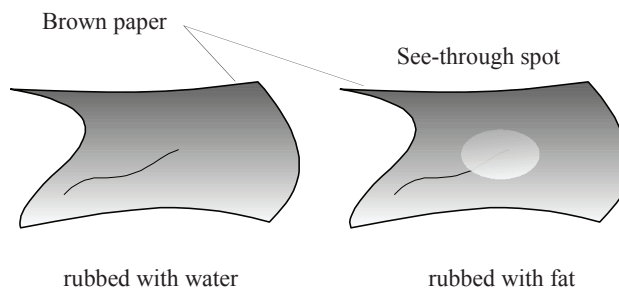
4. Method:

- 1) Rub the fat onto some brown paper.
- 2) Rub water onto another piece of brown paper.
- 3) Allow the paper to dry.
- 4) Note and record your observations.

5. Results:

A see-through spot appears on the paper rubbed with fat.

Diagram



Further Investigations:

Use the food tests you have learned to test each of the following foods for the presence of starch, glucose (or other reducing sugar), protein and fats. Complete the table below:

	Potato	Bread	Pasta	Nut	Soft drink	Egg white	Cooking oil	Cheese	Banana
Starch present?	+	+	+	+	-	-	-	-	+
Sugar present?	-	-	-	-	+	-	-	-	+
Protein present?	-	-	-	+	-	+	-	+	-
Fat present?	-	-	-	+	-	-	+	+	-

1. To Investigate the Conversion of Chemical Energy in Food to Heat Energy (3.6)

2. Planning the Activity:

- (a) Which food type do you think contains the most energy? *Fats*
- (b) You will be burning different types of food. How will you make sure that it is a fair test?
 - 1) *Use equal masses of each food sample burned.*
 - 2) *Heat equal amounts of water with each food sample.*
- (c) State two ways the amount of heat energy in the food could be measured:
 - 1) *Burn each food sample and measure the length of time each sample burns for.*
 - 2) *Use each burning sample to heat a fixed amount of water and measure how much the temperature of the water increases for each food sample.*

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- (d) Which method might be more accurate and why?

Method 2 would be more accurate because:

Some food samples might burn for longer than others, but still might not give out as much heat. The samples that burn 'hotter' might not burn for as long, but might give out more heat than the samples that burn for a longer time with a weaker flame.

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3. Materials and Apparatus Used:

Retort stand, test tube, thermometer, mounted needle, Bunsen burner, graduated cylinder, food samples (e.g. cream cracker, crisp).

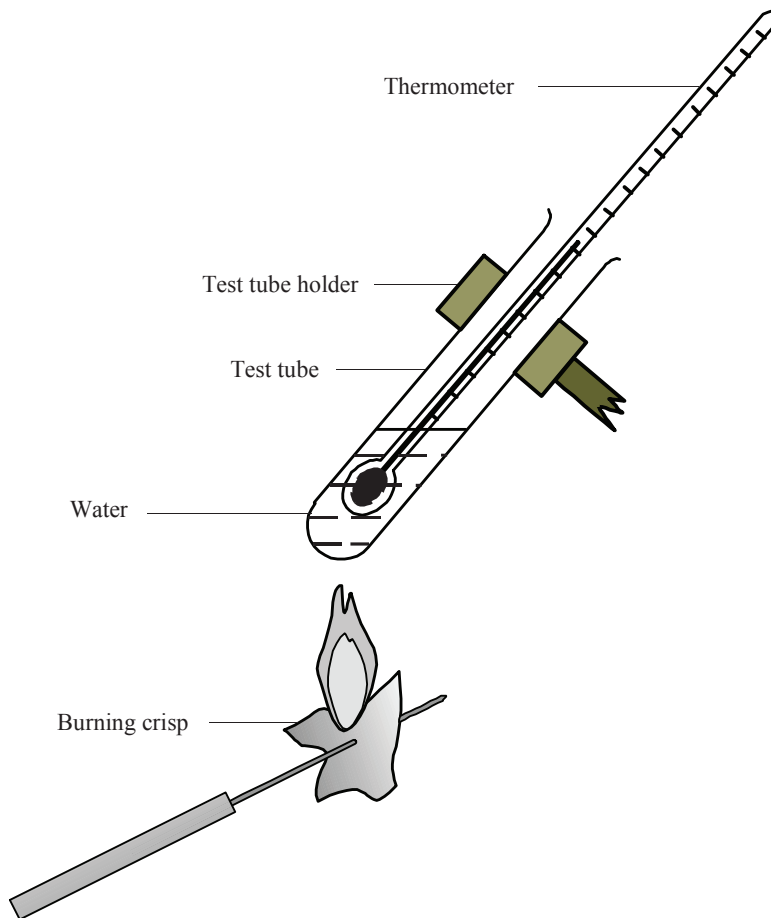
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4. Method:

- 1) *Place 20 ml of water in a test tube.*
- 2) *Record the temperature of the water using a thermometer.*
- 3) *Place the food sample on the mounted needle and light it with the Bunsen burner.*
- 4) *Hold the burning food sample under the test tube until it burns out.*
- 5) *Record the final temperature of the water and subtract the starting temperature from the final temperature to find the temperature increase.*

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.....
.....
.....

Diagram



5. Results:

For the cream cracker, the starting temperature of the water was 17 °C, and the final temperature was 38 °C. This was a change in temperature of the water of 21 °C.

For the crisp, the starting temperature of the water was 17 °C, and the final temperature was 56 °C. This was a change in temperature of the water of 39 °C.

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6. Conclusions:

The temperature gain of the water is a measure of how much heat energy it gained from the burning food sample. In both cases, the chemical energy in the food sample has been changed into heat energy in the water.

In our experiment, the crisp contained much more chemical energy than the cracker did. This might be because the crisp contained more fat (a high energy food) than the cracker.

1. To Show the Action of Amylase on Starch (4.1)



2. Planning the Activity:

- (a) Name the chemical you would use to test for the presence of starch: *Iodine*
- (b) Starch is broken down into sugar by the enzyme called *Amylase*
- (c) Sugar is tested for by using ...*Benedict's*... *solution*... which turns a ...*brick red* colour when it is ... *heated* ... in a hot water bath at .. *37* ... °C.
- (d) What would you expect to find in a test tube containing starch and amylase that was then heated in this water bath for five minutes? Explain your answer.

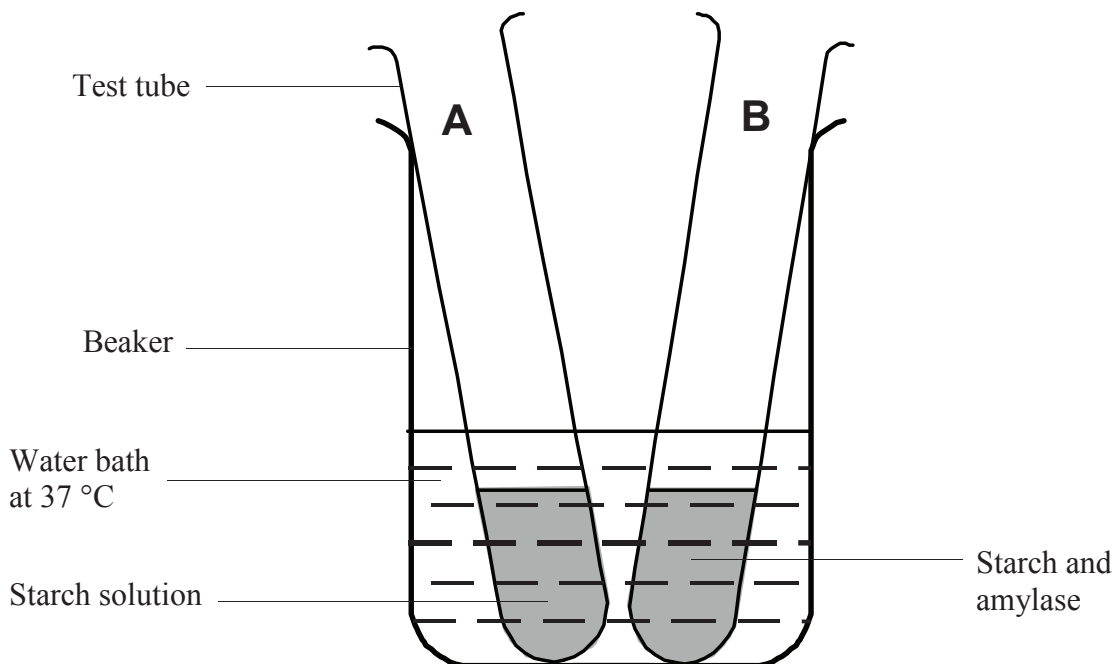
I would expect to find the reducing sugar maltose in the test tube.

The starch would be broken down into maltose by the enzyme amylase.

3. Materials and Apparatus Used:

Beaker of water at 37 °C (hot water bath), three test tubes, dropper, starch solution, iodine solution, Benedict's solution.

Diagram



4. Method:

- 1) Add 2 cm depth of starch solution to each of two test tubes, labelled A and B.
- 2) Add a dropper full of amylase to test tube A, but not to test tube B.
- 3) Leave test tubes A and B in a hot water bath at 37 °C for fifteen minutes.
- 4) Test the solution in test tube A (no amylase) with iodine. Record the result.
- 5) Place half the contents of test tube B into another test tube, labelled test tube C.
- 6) Test B with iodine, and test C with Benedict's solution. Record the results.

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5. Results:

Tube	Containing	Tested with	Results
A	Starch	Iodine	<i>Blue/black colour</i>
B	Starch and Amylase	Iodine	<i>No colour change (stays yellow)</i>
C	Starch and Amylase	Benedict's Solution	<i>Brick red colour</i>

6. Conclusions:

Test tube A had only starch in it - it had no amylase added and therefore there was no breakdown of starch into maltose. When tested with iodine, the starch turned blue/black.

Test tube B had starch and amylase in it - the amylase broke down the starch into the reducing sugar, maltose. When tested with iodine, there was no colour change as there was no starch present.

Test tube C had starch and amylase in it - the amylase broke down the starch into the reducing sugar, maltose. When tested with Benedict's solution, there was a colour change from blue to brick red as there was now maltose in the test tube.

The enzyme amylase breaks down starch to the reducing sugar maltose.

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1. To Show that Expired Air has More Carbon Dioxide than Inspired Air (5.1)

2. Planning the Activity:

- (a) Limewater is turned milky in the presence of carbon dioxide. What other feature must limewater have to make it a true test for the presence of carbon dioxide?

It must not turn milky in the presence of any other gas.

- (b) What type of apparatus would you need to put air containing carbon dioxide through limewater?

Some type of pump that could pull the air through limewater.

- (c) Why is it better to use a test tube, rather than a beaker or conical flask to hold the limewater?

A beaker or conical flask would hold too much limewater. It would take a very long time for the carbon dioxide in the air to turn such a large amount of limewater milky

3. Materials and Apparatus Used:

Two test tubes, two 2-holed stoppers, two long, L-shaped glass tubes, two short, L-shaped glass tubes, limewater.

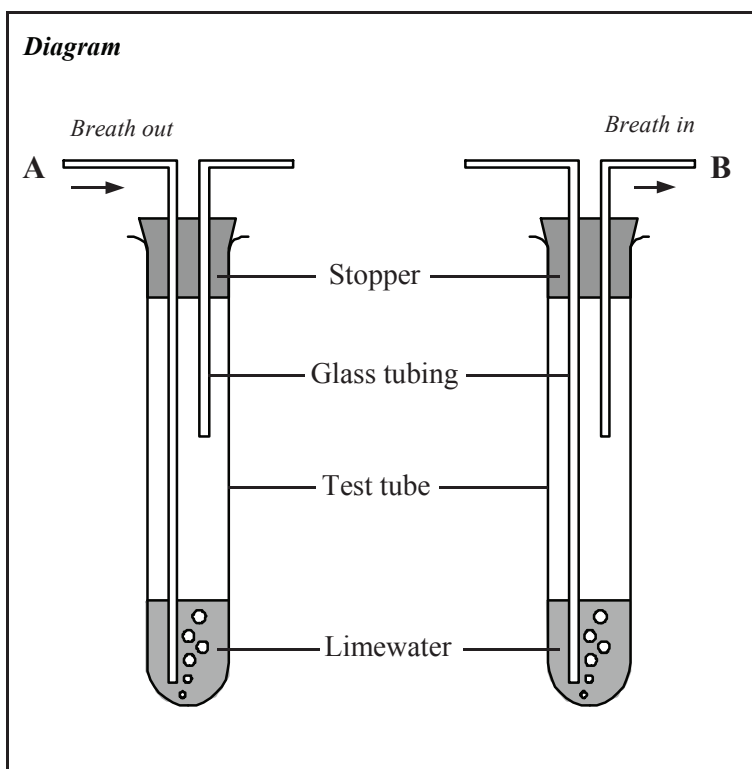
4. Method:

- 1) *Set up the two test tubes as shown.*
- 2) *Breathe out through tube A to bubble expired air through the limewater in the first test tube. Record the result.*
- 3) *Breathe in through tube B to bubble inspired air through the limewater in the second test tube. Again, record the result.*

5. Results:

The limewater in the first test tube turns milky very quickly.

The limewater in the second test tube takes a long time before it starts to turn milky.



	Carbon Dioxide Content (High/Low?)	Colour of limewater
Air blown in through A (Expired Air)	<i>High</i>	<i>Turns milky very quickly</i>
Air sucked through B (Inspired Air)	<i>Low</i>	<i>Stays clear but eventually turns milky</i>

6. Conclusion:

Expired air contains more carbon dioxide than inspired air. Inspired air contains a much smaller amount of carbon dioxide, but does contain a small amount.

1. To Show that Starch is Produced in a Photosynthesising Plant (13.1)



2. Planning the Activity:

- (a) What chemical in a leaf shows that it had been photosynthesising? *Starch*
- (b) This chemical is tested for using *Iodine*.... , which turns a ... *blue/black* colour.
- (c) Give two reasons why it would be very difficult to carry out this test on an untreated leaf.
 - 1) *The iodine would just run off the leaf and not soak into it*
 - 2) *The green colour of the leaf would make it difficult to see any colour change*
- (d) A leaf from a plant that has been kept in darkness for 48 hours should not contain any *starch*, because the plant has not been able to *photosynthesise*

3. Materials and Apparatus Used:

Beaker, hot-plate, test tube, white tile, forceps, methylated spirit, iodine solution, leaf from a photosynthesising plant.

4. Method: (Draw each of the 4 stages of the investigation below)

<p>A</p> <p style="text-align: center;">Leaf in boiling water</p>	<p>B</p> <p style="text-align: center;">Test tube</p> <p style="text-align: center;">Leaf in methylated spirits</p>
<p>C</p> <p style="text-align: center;">Leaf in boiling water</p>	<p>D</p> <p style="text-align: center;">Iodine</p> <p style="text-align: center;">White tile</p>

(a) Why is the leaf dipped in boiling water for one minute (Stage A)?

To kill the leaf and soften it so that the solutions used in the test can get into it

(b) Why is the leaf placed in hot methylated spirit in the test tube (Stage B)?

To remove the chlorophyll from the leaf so that it will be easier to see any colour changes

(c) Describe the condition of the leaf when it is removed from the methylated spirit:

White and brittle

(d) Why does the leaf need to be rinsed in boiling water (Stage C)?

To soften it

(e) Describe the method used in Stage D

The leaf is stretched out on a white tile. It is then covered with iodine solution and left for about five minutes

(f) Why is the experiment repeated with a leaf from a plant kept in darkness for 48 hours?

This plant would not have been photosynthesising and therefore should not contain any starch. This leaf acts as a control for the experiment

(g) Why should a hot-plate, and not a Bunsen burner be used in this experiment?

Methylated spirit (and its vapours) are flammable and therefore should not be near a flame

5. Results:

*The leaf that had been photosynthesising turned blue/black when iodine was added to it.
The leaf that had been kept in darkness (and so was not photosynthesising) stayed the colour of the iodine solution (yellow) after the test*

6. Conclusions:

*The leaf from a plant which has been photosynthesising contains starch.
The leaf from a plant that had not been photosynthesising did not contain starch.
Therefore, a photosynthesising plant produces starch in its leaves.*

1. To Investigate the Conditions Needed for Germination (16.1)

2. Planning the Activity:

(a) Why are cress seeds used for this experiment?

They grow very fast

(b) Why would you place several seeds in each test tube, and not just one?

One might be dead, or just not grow. Using a few reduces the chance of this.

(c) Why is it necessary to include tube A, which has all the necessary conditions for germination - water, oxygen and heat?

Tube A is the control - it shows that cress seeds will grow in a test tube, on cotton wool, when they have all the right conditions of warmth, oxygen and water.

(d) Explain how oxygen is removed from the seeds in tube C?

The water is boiled to remove the oxygen from it. It is then cooled to room temperature and a layer of oil is added to prevent more oxygen from getting in.

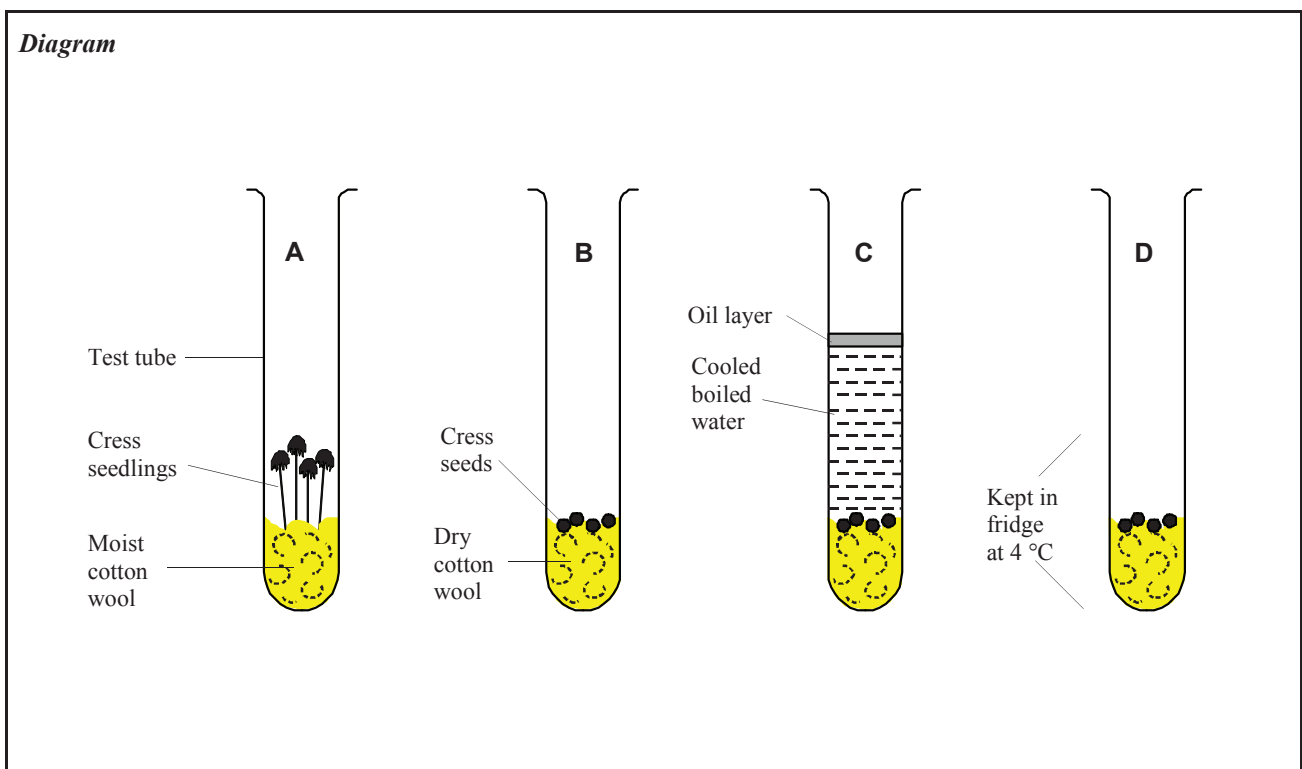
(e) Heat is removed from test tube D by placing it in a *fridge*

3. Materials and Apparatus Used:

Four test tubes, cotton wool, oil, cress seeds.

.....

4. Method: *The four test tubes are set up as shown below:*



Test tube A is the control - it contains moist cotton wool, has oxygen and is kept at room temperature.

Test tube B lacks water - the seeds are placed on dry cotton wool.

Test tube C lacks oxygen - the water has been boiled and then cooled to remove the oxygen and a layer of oil placed on top keeps out any oxygen from the air.

Test tube D lacks heat - it was placed in a fridge.

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5. Results:

Tube	Missing factor (water, oxygen or heat)	Did the seeds germinate?
A	<i>Control - has water, oxygen and heat</i>	<i>Yes</i>
B	<i>Water</i>	<i>No</i>
C	<i>Oxygen</i>	<i>No</i>
D	<i>Heat</i>	<i>No</i>

As seen from the table of results, only the seeds that had water, oxygen and heat were able to germinate. The seeds in the other test tubes were unable to germinate - they lacked water (test tube B), oxygen (test tube C) or heat (test tube D).

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6. Conclusions:

Water, oxygen and heat are needed for seeds to germinate.

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1. To Study a Local Habitat, Using Appropriate Instruments and Simple Keys to Show the Variety and Distribution of Named Organisms (18.2 - 18.4)

2. Planning the Activity:

- (a) Name the habitat that you plan to study: *Woodland, grassland, field, hedge, etc*
- (b) Give two environmental factors that you would measure, and, for each, name the instrument you would need to take the measurements.
 - Factor 1) *Soil temperature* Instrument: *Thermometer*
 - Factor 2) *Light intensity* Instrument: *Light intensity meter*
- (c) Three features that a simple map of the habitat should include are:
 - 1) *Direction north* 2) *Legend* 3) *Scale*
- (d) What part of a plant would you usually use to identify it? *Leaf / flower*
- (e) What is a quadrat and explain how it is used: *A square wooden frame*
It is placed randomly on the ground and the plants inside it are recorded.
- (f) Name four pieces of equipment that you will use to collect animals in the habitat:
 - 1) ... *Pooter* 2) ... *Sweep net* 3) ... *Beating tray* 4) ... *Pitfall trap*
- (g) How will you identify a plant or animal if you do not recognise it in its habitat?
... Bring it back to the laboratory and use a key to identify it

1. Identification of Plants from the Habitat (18.2)

- 3. **Materials Used:** ... *Sample bags, marker, notebook, keys and reference books, various leaves*
- 4. **Method:**
 - 1) *Collect a leaf from each plant in the habitat.*
 - 2) *Try to identify the plants, using a key.*
- 5. **Results:** *(sketch a leaf of each of three plants you identified using a key).*

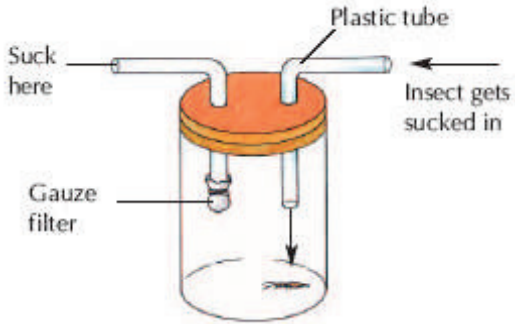
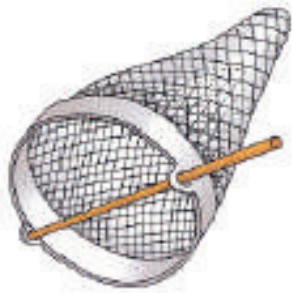

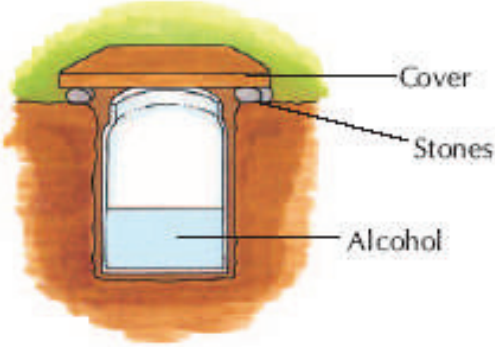
Plant Name: ... <i>Dockleaf</i> 	Plant Name: ... <i>Dandelion</i> 	Plant Name: ... <i>Oak tree</i> 
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1. Collecting and Identifying Animals in the Habitat (18.3)

3. Equipment Used:

Pooter, sweep net, beating tray, pitfall trap

4. Method: (sketch four different methods used to collect animals).

<p>Method: ... <i>Pooter</i></p> 	<p>Method: ... <i>Sweep net</i></p> 
<p>Method: ... <i>Beating tray</i></p> 	<p>Method: ... <i>Pitfall trap</i></p> 

5. Results: (Name 5 animals you found, and give 2 features of each that helped you identify them).

- 1) ... *Beetle* Feature 1) ... *black, shiny body* Feature 2) ... *three pairs of legs*
- 2) ... *Ladybird* Feature 1) ... *red with black spots* .. Feature 2) ... *hard, shiny body*
- 3) ... *Woodlouse* Feature 1) ... *hard, shell-like* Feature 2) ... *body in segments*
- 4) ... *Spider* Feature 1) ... *eight legs* Feature 2) ... *body in two parts*
- 5) ... *Earwig* Feature 1) ... *two pincers at back* .. Feature 2) ... *two long feelers*

6. Conclusions: (comment on the usefulness of each of the collection methods you used).

Method: ... *Pooter* ; ... *very useful in catching small insects on leaves*

Method: ... *Sweep net* ; ... *useful for sweeping through long grass to catch insects*

Method: ... *Beating tray* ; ... *not as useful as other methods - collected too many leaves*

Method: ... *Pitfall trap* ; ... *most useful method - most insects only come out at night*

1. To Estimate the Numbers of Plants Present in the Habitat (18.4)

3. **Equipment Used:** ... *Quadrat, pen, jotter*

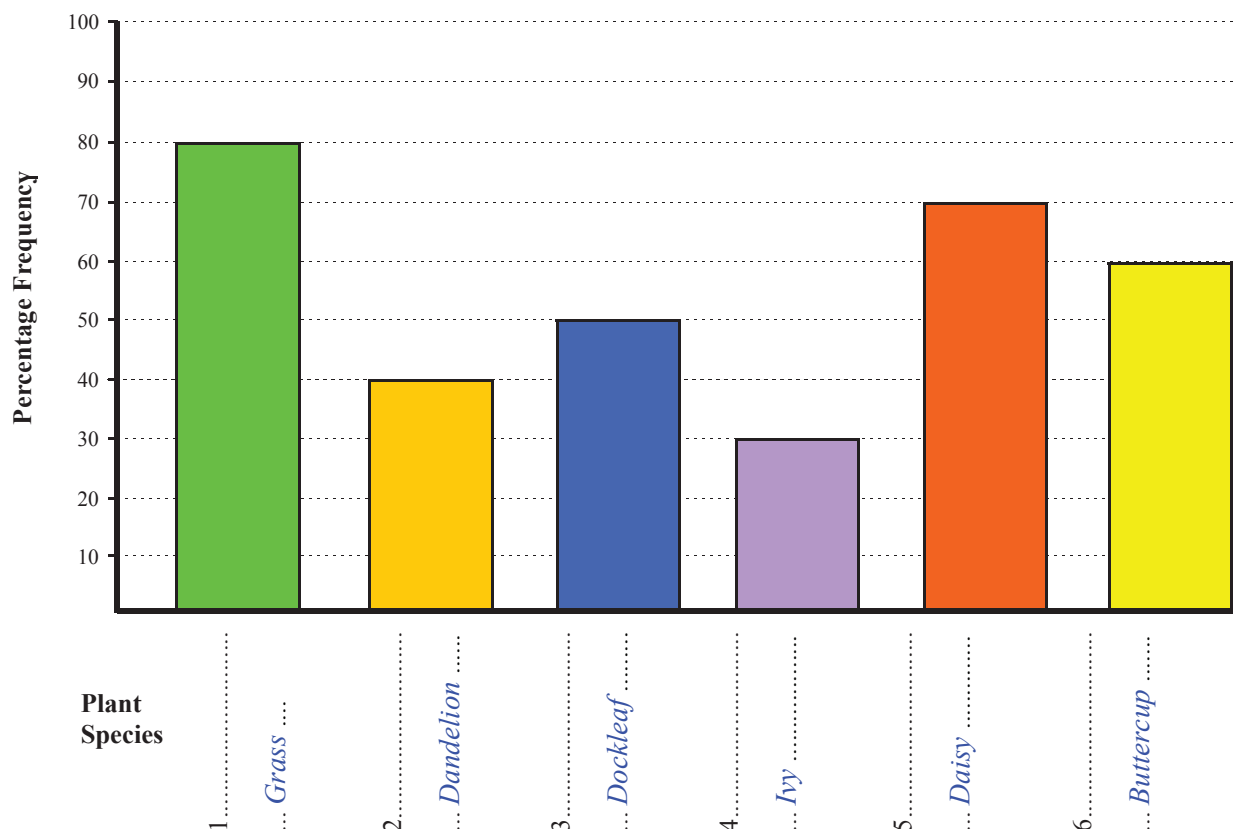
4. **Method:**

- 1) *List the plants already identified in the table below.*
- 2) *Place the quadrat randomly ten times in the habitat.*
- 3) *For each quadrat throw, tick which plants are present in the quadrat.*
- 4) *Calculate the % frequency for each plant and show the results on a bar chart.*

5. **Results:**

Plant Name	Quadrat Number										Total (%)
	1	2	3	4	5	6	7	8	9	10	
1) <i>Grass</i>	+	+		+		+	+	+	+	+	80
2) <i>Dandelion</i>			+	+				+	+		40
3) <i>Dockleaf</i>	+	+	+		+	+					50
4) <i>Ivy</i>		+	+	+							30
5) <i>Daisy</i>	+	+	+	+		+	+	+			70
6) <i>Buttercup</i>		+		+	+	+		+	+		60

Present your results in a bar chart below:



1. To Investigate the Presence of Bacteria and Fungi in Air and Soil (20.1/20.2)
2. Planning the Activity:

- (a) Micro-organisms grow successfully when they have nutrients, moisture and warmth.
How would you provide each of these requirements during this investigation?
- 1) Nutrients: *Put them in or on some substance that has nutrients (food) in it*
- 2) Moisture: *Either put them in a liquid or on a wet substance*
- 3) Warmth: *Put them in an oven that is not too hot, or it would kill them*
- (b) What is the purpose of growing micro-organisms in this investigation?
So that it is possible to see them - they can only be seen if huge numbers are present
- (c) Why must the agar and petri dishes be sterilised before the investigation?
So that only the bacteria and fungi that you want to grow will be growing
- (d) Why would you leave one of the petri dishes unopened during the investigation?
This is the control - it proves that the micro-organisms won't just grow anyway on the agar
- (e) Why is sterilised soil placed on one of the agar petri dishes?
Again, this is the control - it proves that the bacteria on the other dish came from the soil
- (f) How would you sterilise a soil sample?
Heat it very strongly using a Bunsen burner for five minutes
- (g) Why is the incubator (oven) kept at 20°C and not at a higher temperature?
Higher temperatures might encourage human disease causing bacteria to grow (e.g. around 37 °C).
- (h) Why are the petri dishes placed upside-down in the incubator?
So that any condensation forming in the petri-dishes falls onto the lid and not the bacteria
- (i) Why would you tape the petri dishes shut before examining the results?
For safety - all micro-organisms should be treated as if they were disease-causing

3. Materials and Apparatus Used:

Petri-dishes containing nutrient agar, marker, incubator, fresh soil, sterilised soil

4. Method:

- 1) *Inoculate the agar dishes by opening one to the air for 15 minutes and sprinkling fresh soil on the other.*
- 2) *Set up the control for the air experiment by leaving an agar petri-dish unopened.
Set up the control for the soil experiment by sprinkling sterile soil on another petri-dish.*
- 3) *Place all 4 petri-dishes upside down in an incubator at 20 °C for two days.*
- 4) *Remove the petri-dishes, examine without opening them and record your observations.*

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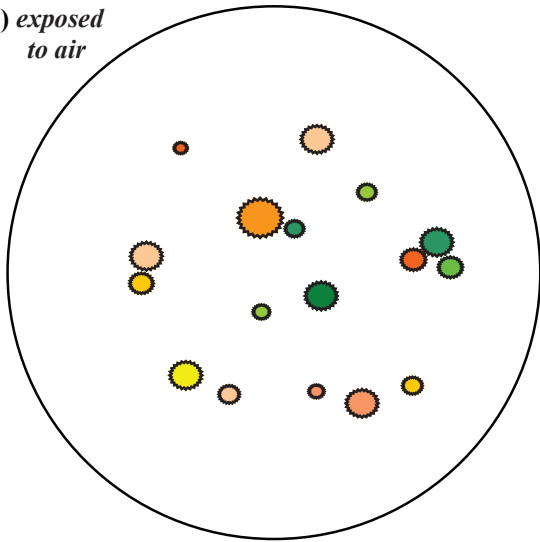
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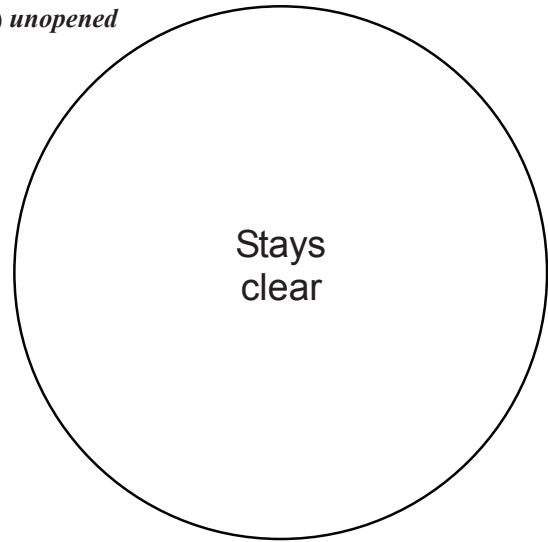
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5. **Results:** (Draw the results for each of the four agar plates below).

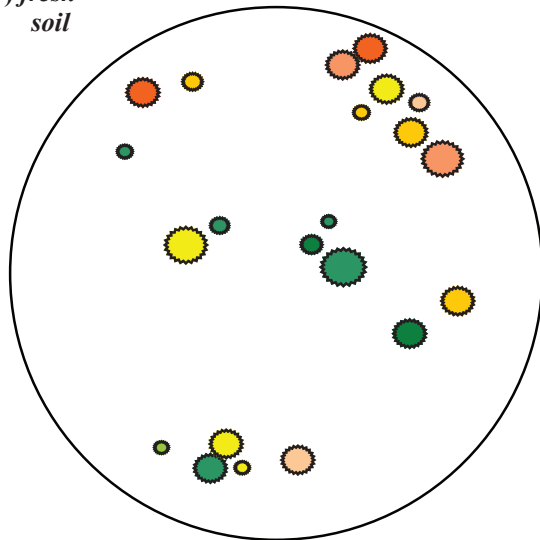
1) *exposed to air*



2) *unopened*



3) *fresh soil*



4) *sterile soil*



6. **Conclusions:**

The air and fresh soil contain micro-organisms. These can be grown on nutrient agar petri-dishes and can be seen as coloured, shiny dots, made up of huge colonies of bacterial cells, or as fluffy growths of fungi.

The controls stayed clear, proving that the micro-organisms came from the soil or air, and were not already in the agar or the petri-dishes before the experiment began.

1. To Grow Crystals of Copper Sulfate (23.3)



2. Planning the Activity:

- (a) How would you make a hot, concentrated solution of copper sulfate?

Add two spatulas full of copper sulfate crystals to a small amount of water (about 20 cm³) in a test tube. Heat the test tube until all the copper sulfate has dissolved.

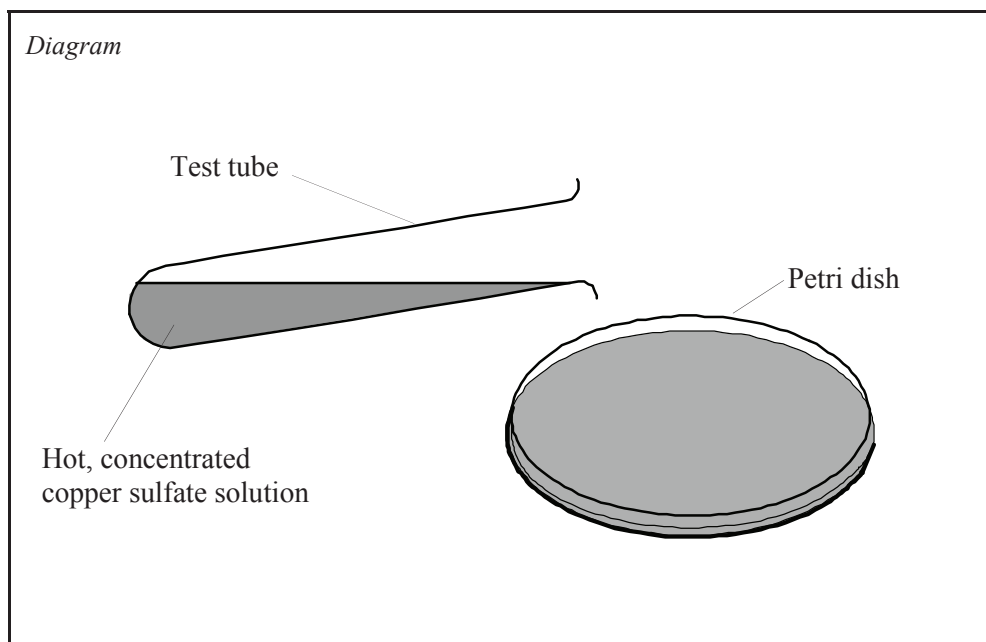
- (b) When this solution is allowed to cool, what would you expect to see in the test tube?

At lower temperatures, all the copper sulfate would not be able to dissolve, so some copper sulfate crystals should fall to the bottom of the test tube.

3. Materials and Apparatus Used:

Test tube of concentrated copper sulfate solution, evaporating basin or petri-dish.

4. Method:



- 1) *Pour the hot, concentrated copper sulfate solution onto a warm evaporating dish.*
- 2) *Allow to cool slowly, over several hours.*
- 3) *Examine the crystals formed.*

5. Results:

- (a) Small crystals are formed when: ... *A hot, concentrated solution is cooled rapidly*
- (b) Large crystals are formed when: ... *A hot, concentrated solution is cooled slowly*
- (c) The solution that remains above the crystals is called a *saturated* solution because it cannot *dissolve any more solute* at that temperature.

6. Conclusions:

When a hot, concentrated solution of copper sulfate is cooled slowly, large crystals are formed

1. To Separate Mixtures by (1) Filtration; (2) Evaporation; (3) Distillation; and, (4) Paper Chromatography (24.1 - 24.4)

2. Planning the Activity:

- (a) Substances in a mixture can be separated if they have a difference in their physical properties. For each of the following mixtures, give a physical difference that allows them to be separated.
- 1) sand and water: *Water, as a liquid, would pass through filter paper; sand, an insoluble solid, would not fit through the holes in a filter paper*
 - 2) salt and water: .. *Water, as a liquid, could be evaporated; salt, a soluble solid, would not evaporate.*
 - 3) alcohol and water: ... *Alcohol has a boiling point of 78 °C; water boils at 100 °C.*
 - 4) different dyes in black ink: ... *Some dyes are more soluble in certain solvents than others, and so some (the more soluble ones) would travel further up chromatography paper*
- (b) How does a tea bag work to keep the tea leaves in but allow the tea out into the pot?
 ... *It acts like a filter or sieve - the large tea leaves can't get through the small holes*
- (c) How might this principle be used to separate sand from water?
 ... *The sand and water mixture could be poured through filter paper; only the water goes through*
- (d) On a sunny day, what happens to a puddle of water caused by a shower of rain?
 ... *The rainwater evaporates*
- (e) What would happen to any substances that were dissolved in the puddle of water?
 ... *They would stay behind where the puddle was*
- (f) If a mixture of alcohol and water was gently heated, which part of the mixture would evaporate first and why?
 ... *Alcohol - because it has a lower boiling point and so, it evaporates before water does*
- (g) What would cause a liquid that has evaporated, and is now a gas, to turn back into a liquid again?
 ... *If it is cooled it would turn back into a liquid*
- (h) Using your reasoning in (f) and (g), describe how a distillery would make brandy (mainly alcohol) from wine (a mixture of water and alcohol).
 ... *The wine is evaporated so that the alcohol evaporates, and then the alcohol is condensed*
- (i) If ten people in your class ran a 5 km race, they would probably end up being separated out. What is the reason for this?
 ... *They have different physical properties - some can run faster than others*
- (j) Some of the coloured dyes in black ink are more soluble than others. How might this physical difference be used to separate them out?
 ... *The more soluble dyes would stay dissolved, even in a very small amount of solvent, so if they traveled up chromatography paper, the most soluble dyes would come out of solution highest up where there is very little solvent*

1. To Separate Sand and Water by Filtration (24.1)



3. Materials and Apparatus Used:

Beaker, filter paper, filter funnel, conical flask, sand

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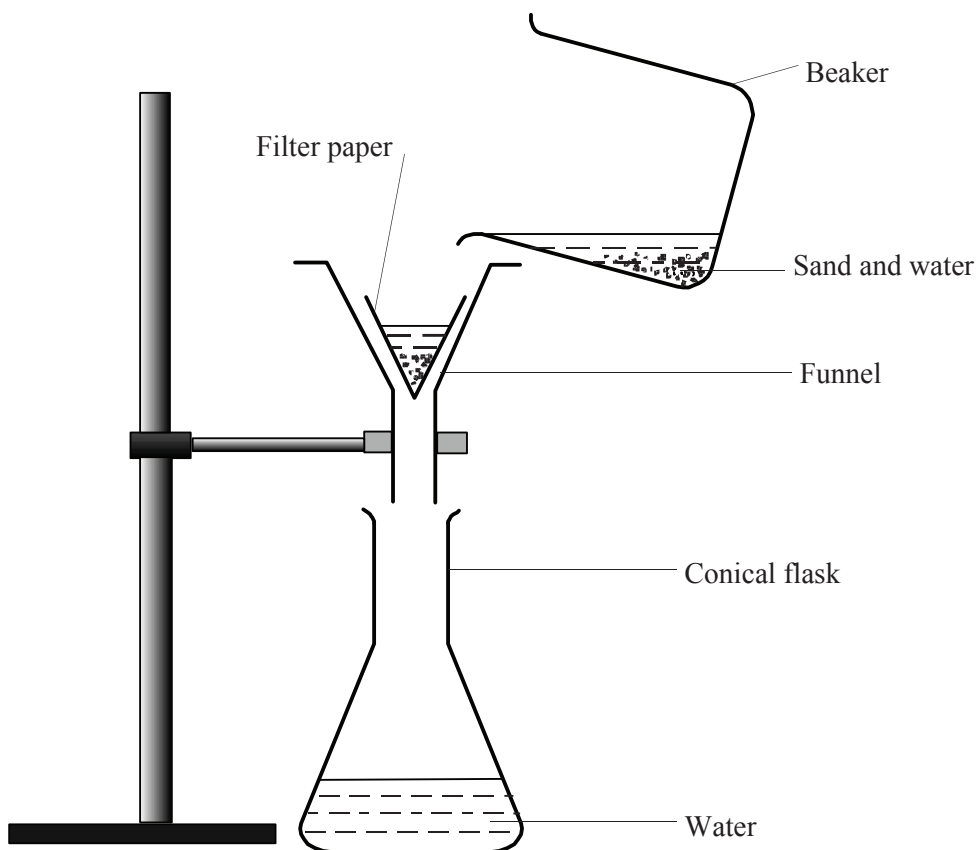
4. Method:

- 1) *Mix sand and water in a beaker,*
- 2) *Fold a sheet of filter paper and place it in the funnel.*
- 3) *Place the funnel in the conical flask as shown.*
- 4) *Swirl the mixture in the beaker and pour it quickly into the funnel.*

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Diagram



5. Result: *The water passes through the filter paper. The sand stays in the filter paper.*

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1. To Separate Sand, Salt and Water by Filtration and Evaporation (24.2)



3. Materials and Apparatus Used:

Beaker, filter paper, funnel, conical flask, clock glass, Bunsen burner, tripod, gauze, sand, salt

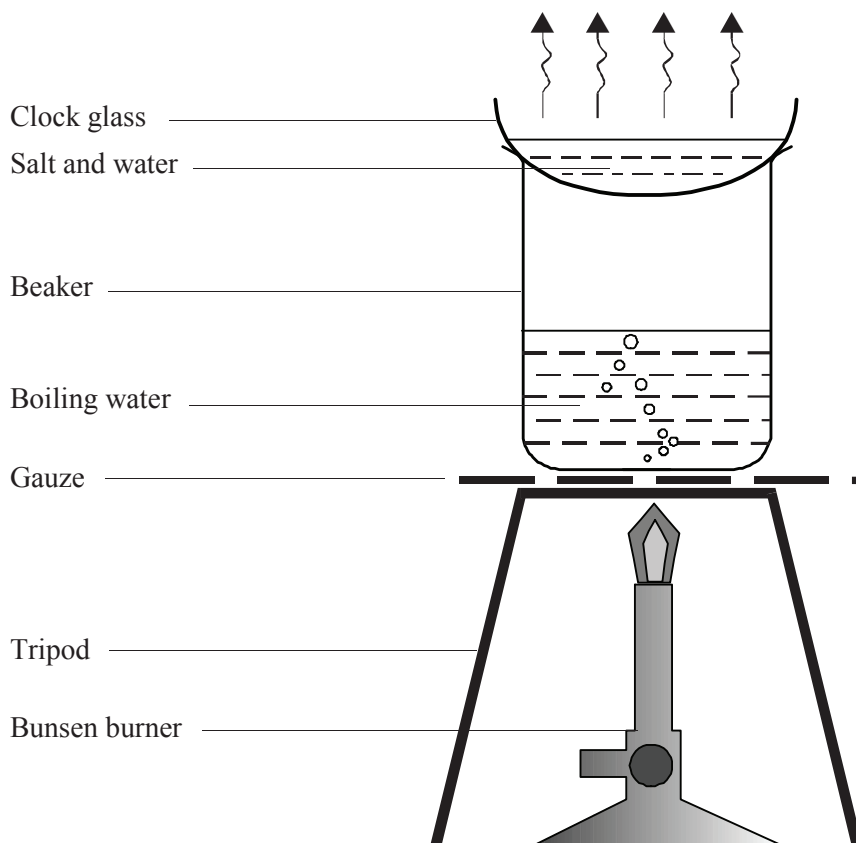
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4. Method:

- 1) *Add some table salt and sand to a beaker a quarter filled with water.*
- 2) *Heat to dissolve the salt and filter to separate the sand from the salt solution.*
- 3) *Place a small amount of the salt solution on the clock glass as shown in the diagram.*
- 4) *Heat to boil the water in the beaker.*
- 5) *Examine the crystals of salt that appear on the clock glass as the water evaporates from it.*

Diagram



5. Result: *Crystals of salt are left on the clock glass*

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1. To Separate Copper Sulfate (or Alcohol) from Water by Distillation (24.3)



3. Materials and Apparatus Used:

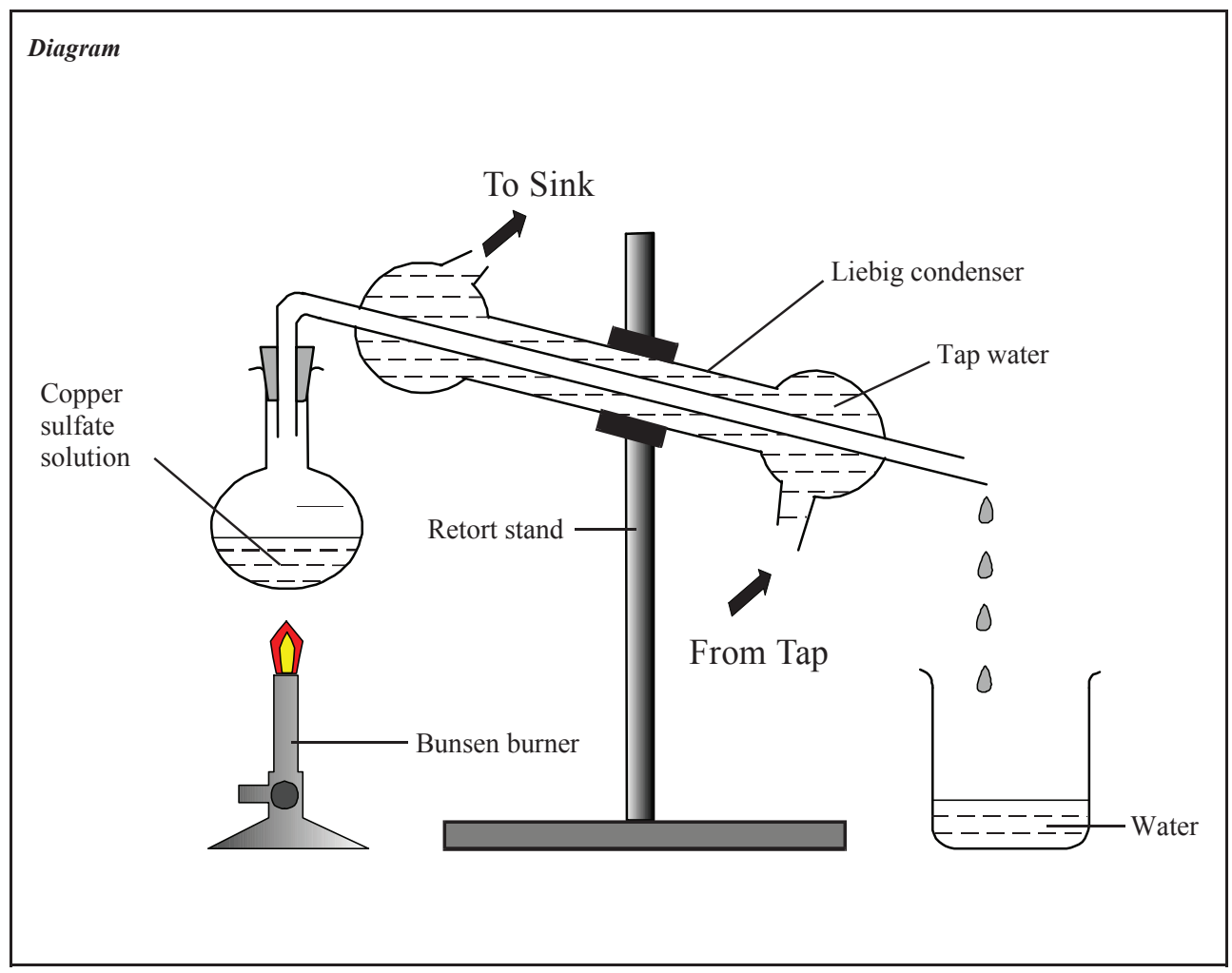
... Beaker, Liebig condenser (quickfit apparatus), Bunsen burner, retort stand, tubing, copper sulfate

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4. Method:

- 1) Place a copper sulfate solution in the flask of the Liebig condenser apparatus as shown.
- 2) Attach the bottom tube of the condenser to the sink tap. Run the top tube to the sink.
- 3) Turn on the tap to allow cold water to run through the outer sleeve of the Liebig condenser.
- 4) Gently heat the copper sulfate solution in the flask.



5. Result: ... Water is collected as the distillate in the beaker. Copper sulfate remains in the flask

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1. To Separate the Dyes in Ink by Paper Chromatography (24.4)



3. Materials and Apparatus Used:

... Graduated cylinder, chromatography paper, water, black fountain pen ink

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4. Method:

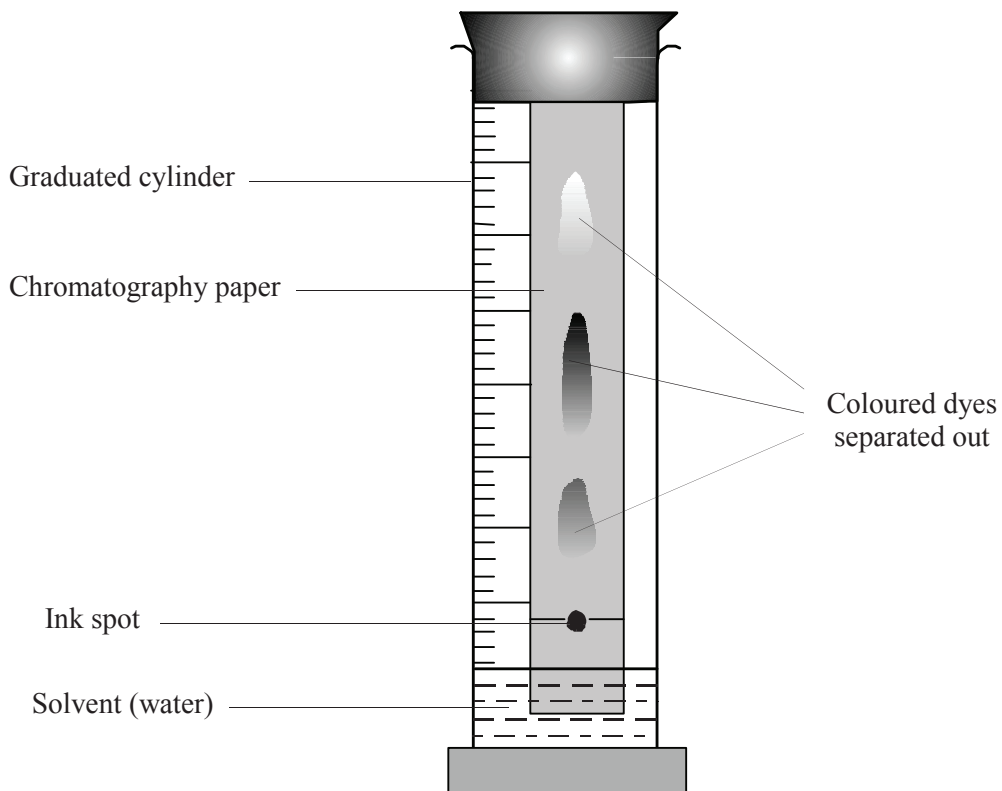
- 1) Place a concentrated dot of black ink near the base of the chromatography paper.
- 2) Place the chromatography paper into the graduated cylinder, containing solvent (water) as shown.
- 3) Leave undisturbed for 20 minutes.

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Diagram



5. Result:

The water travels up the chromatography paper, carrying the mixture of dyes with it. The dyes come out of solution at different points on the chromatography paper, and so are separated.

1. To Test the pH of a Variety of Materials Using the pH Scale (30.1)



2. Planning the Activity:

(a) Name five different substances that you could use that you think *might* be acids:

1) .. *vinegar* .. , 2) .. *orange juice* .. , 3) *tea* , 4) *fizzy drinks* , 5) .. *lemon juice*

(b) Name five different substances that you could use that you think *might* be bases:

1) .. *toothpaste* .. , 2) *soap* , 3) *oven cleaner* , 4) .. *window cleaner* . , 5) *Rennies*

(c) How would you plan an experiment to test if each of the substances you named in (a) and (b) is an acid or a base?

... *Dip red and blue litmus paper into each liquid substance named above. If the substance is a solid, dissolve it in a small amount of water first.*

If the substance turns blue litmus paper red, it is an acid; and, if it turns red litmus paper blue, then it is a base

(d) How would you alter the experiment to find out *how* acidic or *how* basic the substance being tested is?

... *Use universal indicator paper to find the pH of the substance*

(e) How would you ensure that the method you choose is a 'fair test'?

... *Dissolve each substance to be tested in an equal volume of water*

(f) The pH scale is used to measure how acidic or how alkaline a solution is.

A solution whose pH is less than 7 is said to be *acidic*

A solution whose pH is 7 is said to be *neutral*

A solution whose pH is greater than 7 is said to be *alkaline*

(g) The colour of *universal indicator* paper changes in solutions of different pH.

(h) Soaps that are neither acidic nor alkaline are considered to be better for the skin.

Describe how you would carry out a *fair test* on two brands of soap to find out which of them might be better for the skin.

1) *Cut off samples of equal mass from each brand of soap.*

2) *Dissolve these samples in equal volumes of water.*

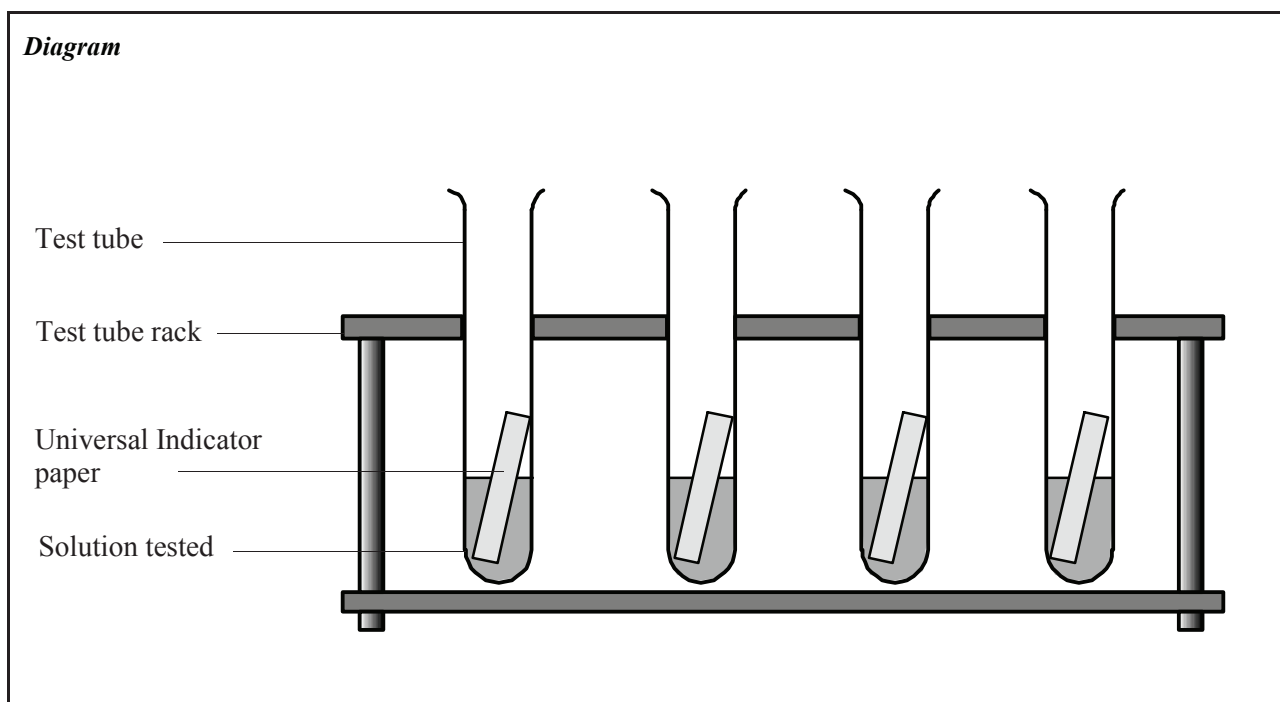
3) *Test each soap solution with universal indicator paper to find its pH.*

4) *Compare the pH values for each soap. The one with pH closest to 7 (neutral) would be best.*

3. Materials and Apparatus Used:

.. *6 test tubes, test tube rack, spatula, universal indicator paper, sodium carbonate, calcium hydroxide, soap flakes, salt, sodium hydrogen sulfate, citric acid (or any other chemicals used).*

4. Method:



- 1) Label the test tubes A - F, and add a spatula full of each chemical to each test tube.
- 2) Add 1 ml of water to each test tube and shake it to dissolve the chemical it contains.
- 3) Place a piece of universal indicator paper into each test tube.
- 4) Note and record the pH (using a pH colour chart) of each chemical.

5. Results:

Substance Tested	Colour Observed	pH
1) Sodium carbonate	blue/green	10
2) Calcium hydroxide	purple/indigo	12
3) Soap flakes	green/blue	9
4) Salt	green/beige	7
5) Sodium hydrogen sulfate	orange/red	2
6) Citric acid	orange	3
7) Vinegar	orange	3
8) Lemon juice	orange	3
9) Toothpaste	green/blue	8
10) Oven cleaner	dark blue/navy	11

6. Conclusions: ... Different substances have different pH's which may be found by using universal indicator paper

1. To Titrate Hydrochloric Acid (HCl) Against Sodium Hydroxide (NaOH) and Prepare a Sample of Sodium Chloride (NaCl) (30.3, 30.4)



2. Planning the Activity:

- (a) An acid and a base neutralise each other to give a *salt* and *water*
- (b) Hydrochloric acid (formula ... *HCl* ...) neutralises sodium hydroxide (formula .. *NaOH* ...) to form the salt, sodium chloride (formula *NaCl*) and water (formula *H₂O*).
- (c) The chemical equation for this reaction is:



- (d) A titration experiment aims to discover what exact volume of an acid is needed to just neutralise a certain volume of an alkali (i.e. a base in solution).

How would you show that a colourless liquid in a conical flask is a solution of a base (an alkali)?

..... *Add litmus solution to it - litmus is blue in an alkali*

- (e) If you were now to slowly add acid to the conical flask, what would you expect to observe?

.... *It should start to turn from blue to red as litmus is red in an acid*

- (f) How would you know when you had added just enough acid to neutralise the base?

... *The litmus indicator would be neither blue nor red, but some colour in between*

- (g) What three substances would then be present in the conical flask?

1) *salt*, 2) *water*, 3) *litmus indicator*

- (h) Why is it important that the volumes of the alkali and acid used are measured very carefully?

.... *So that you would know exactly how much acid is needed to neutralise the alkali*

- (i) Knowing these volumes, the titration could then be repeated, but without using any

..... *litmus indicator*

- (j) In this final titration, what two substances should be present in the conical flask at the end?

1) *salt*, 2) *water*

- (k) How might you go about seeing the dissolved compound which should now be present in the conical flask?

..... *Evaporate some of the solution in the conical by placing it on a clock glass.*

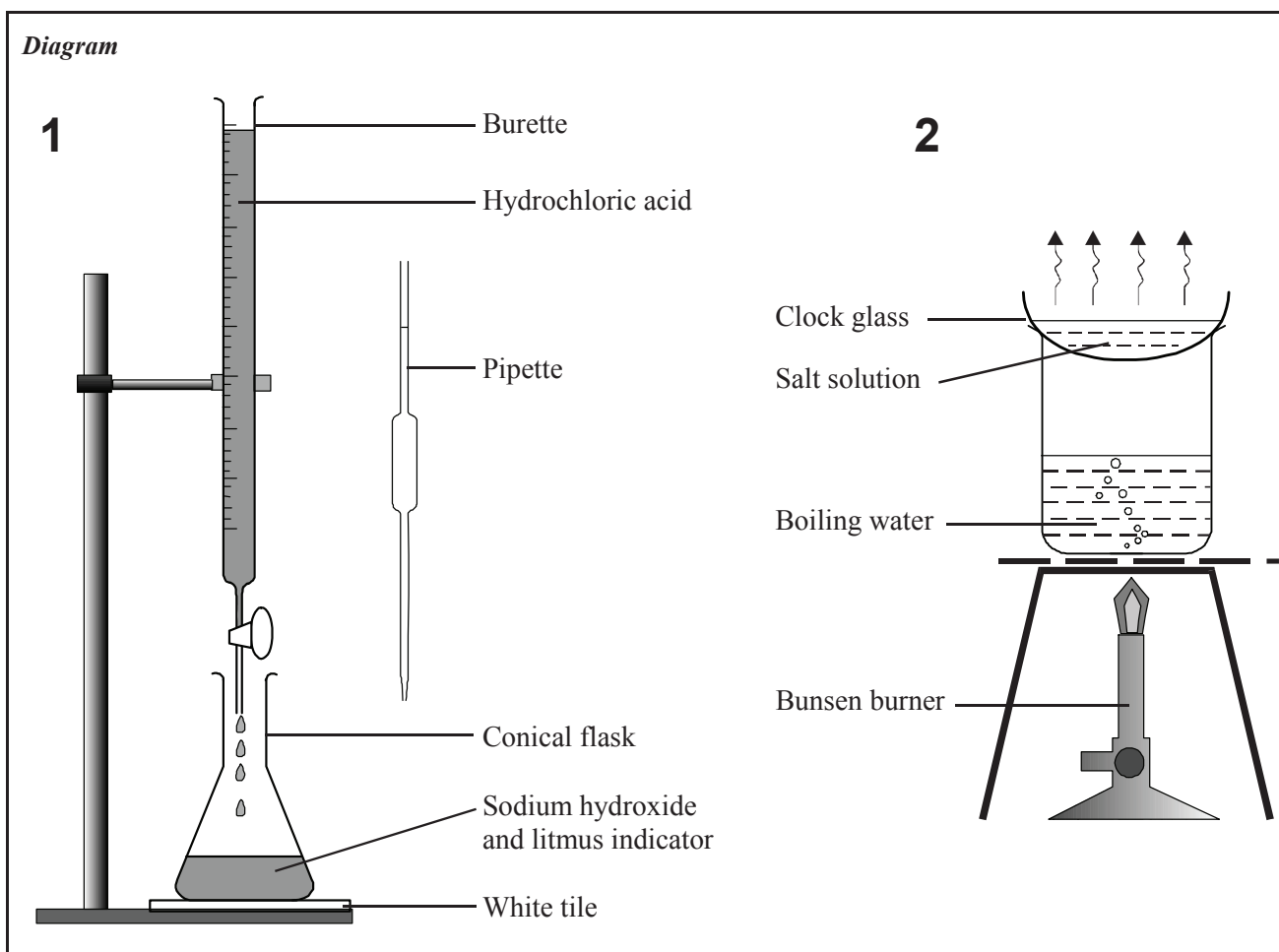
The water evaporates from the solution, leaving crystals of salt on the clock glass.

- (l) What two quantities would you need to measure during the course of this experiment?

1) .. *The volume of alkali used*

2) .. *The volume of acid used to neutralise the alkali*

3. **Materials and Apparatus Used:** ... Burette, pipette, conical flask, white tile, retort stand, dilute hydrochloric acid, dilute sodium hydroxide, litmus indicator solution.



4. Method:

- 1) Use the pipette to measure 20 ml of sodium hydroxide solution into the conical flask.
- 2) Add 4 drops of litmus indicator solution to the conical flask.
- 3) Fill the burette with hydrochloric acid and slowly add the acid to the alkali.
- 4) Stop adding acid when the solution in the flask just begins to turn red. Record the volume of acid.
- 5) Repeat the experiment, then average the two volumes of acid needed for neutralisation
- 6) Using this average value, repeat the experiment, but without using any litmus indicator.
- 7) Evaporate a small amount of the solution in the flask using the evaporation method (page 33).

5. Results:

Titration Number	1	2	Average value
Volume of acid added (ml)	17	19	18

6. Conclusions:

A fixed volume of hydrochloric acid is needed to neutralise a fixed volume of sodium hydroxide. The salt, sodium chloride is formed as a result of this neutralisation.

To Measure the Percentage of Oxygen in Air and Show that there is Carbon Dioxide and Water Vapour in Air (31.1, 31.2)

1. To Measure the Percentage of Oxygen in Air (31.1)

2. Planning the Activity:

- (a) When something burns in air, it uses the *oxygen* in the air to form a compound called an *oxide*
- (b) The effect of this is to remove the *oxygen* from the air.
- (c) If the burning is done inside a closed container, then the volume of air missing at the end, equals the volume of *oxygen* that was in the air.

3. Materials and Apparatus Used:

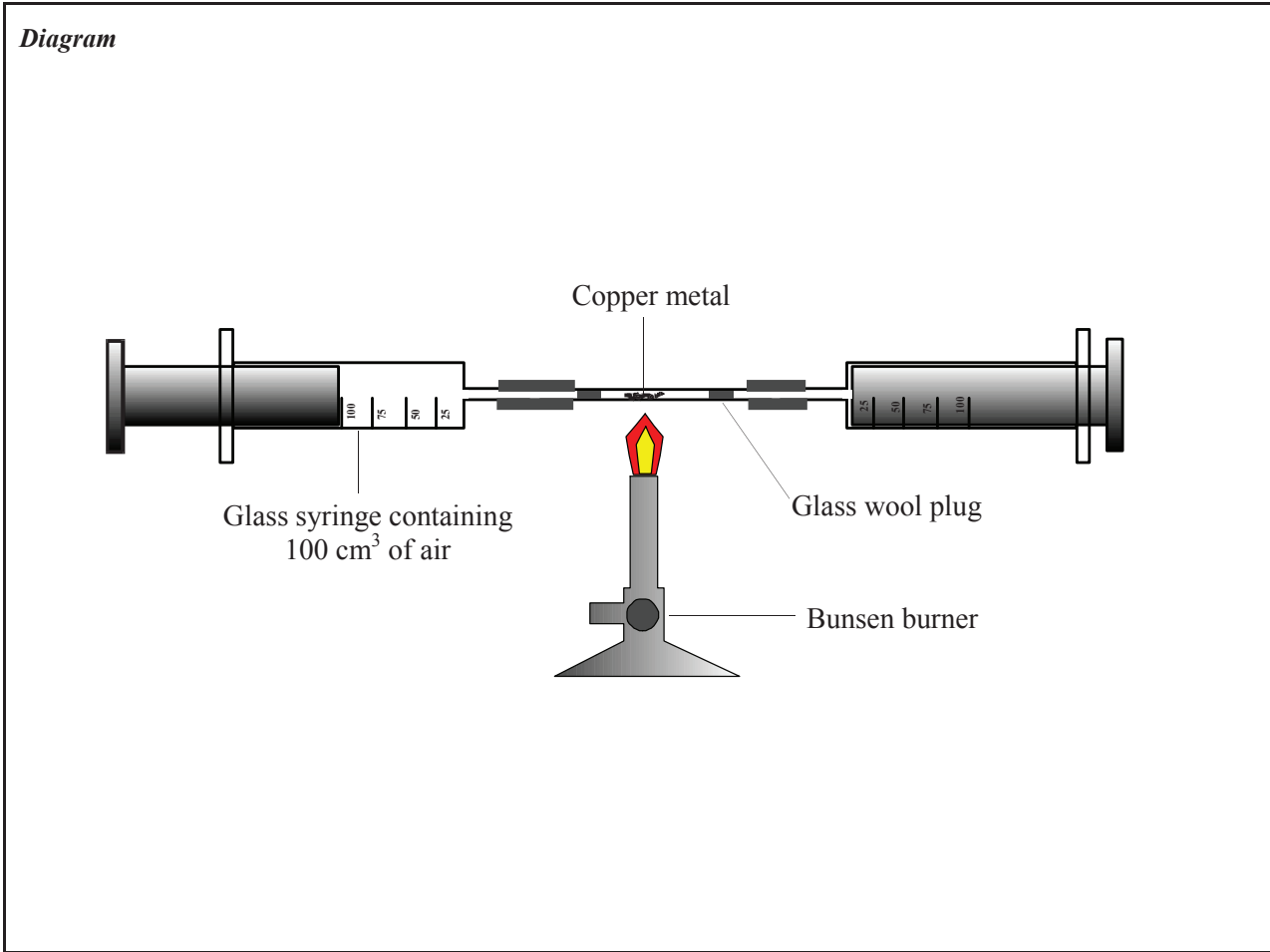
Two gas syringes, two syringe holders, silica glass tube and connectors, Bunsen burner, copper turnings

.....

.....

.....

.....



4. **Method:**

- 1) *Set up the apparatus as shown, with the copper turnings in the silica tube.*
- 2) *Heat the copper in the silica tube strongly using the Bunsen burner.*
- 3) *Pass the 100 cm³ of air backwards and forwards between the syringes.*
- 4) *Allow the tube to cool and then measure the volume of air left in the left hand syringe.*

.....
.....
.....

What changes occurred in the copper metal? Explain.

... The copper turned black. It gained a black coating of copper oxide by combining with the oxygen in the air

.....

5. Results:	Volume of air in the syringe at the start:	= 100 cm ³
	Volume of gas in the syringe at the end:	= 79 cm ³
	Volume of oxygen used up in burning:	= 21 cm ³
	Percentage of oxygen in air:	=21 %

6. **Conclusion:** ... *The air is composed of 21% oxygen*

.....
.....
.....

1. To Show the Presence of Water Vapour and Carbon Dioxide in Air (31.2)

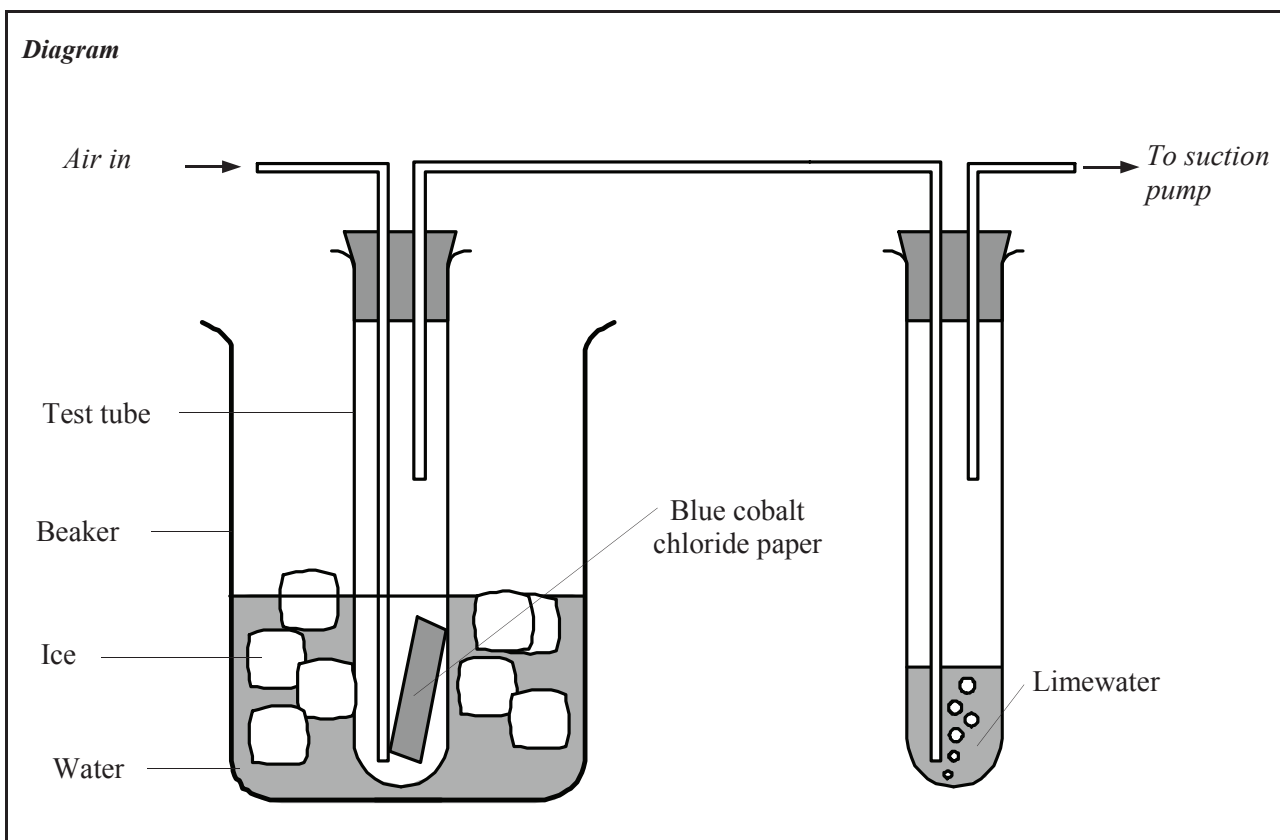


2. Planning the Activity:

- (a) On a cold winter's day, what might you notice on the inside of the window pane? ... *moisture*
- (b) This liquid came from the *air* and formed by the process of *condensation* on the window pane, which provided a *cold* surface, allowing this to happen.
- (c) You could not be sure that this liquid was water, it would need to be tested using a piece of ... *cobalt* *chloride* paper, which would change colour from ... *blue* to ... *pink* if water was present.
- (d) Carbon dioxide is tested for by passing it through ... *limewater* which turns a *milky/cloudy* colour if carbon dioxide is present.
- (e) Air you would breathe out would quickly affect the colour of limewater. Explain why this is so.
Because exhaled air contains a lot of carbon dioxide
- (f) What method would you use to pass air from the room through the limewater?
A suction pump could be used
- (g) Why should limewater be stored in a sealed container?
Because the carbon dioxide present in air would cause it to turn milky

3. Materials and Apparatus Used:

Beaker, two test tubes, two stoppers, suction pump, glass tubing, ice, limewater, blue cobalt chloride paper



4. Method:

- 1) *Set up the apparatus as shown.*
- 2) *Place a strip of blue cobalt chloride paper in the first test tube.*
- 3) *Place limewater in the second test tube.*
- 4) *Turn on the suction pump to draw air through the apparatus.*

.....
.....
.....
.....

- (a) Air is taken into each test tube in the *long* tubes and out in the *short* tubes.
- (b) Ice and water are placed in the beaker so that: .. *Water will condense inside the test tube* ..
.....
- (c) Cobalt chloride paper must be dried before it is used so that its colour is *blue*, it then changes colour to *pink* in the presence of water.

5. Results:

The blue cobalt chloride in the first test tube turned pink. The limewater in the second test tube turned a milky colour

.....
.....

6. Conclusions:

The air drawn through the apparatus contained water vapour (which turned the blue cobalt chloride paper pink), and also contained carbon dioxide (which turned the limewater milky).

.....
.....

1. To Prepare Oxygen Gas (31.3)

2. **Planning the Activity:**

- (a) Hydrogen peroxide (formula H_2O_2) can be broken down into *oxygen* (formula ... O_2 ) and *water* (formula H_2O ...).
- (b) The chemical *manganese* *dioxide* (formula MnO_2 ) speeds up this reaction. A chemical that is used to speed up a reaction is called a *catalyst*
- (c) Explain why mixing the two chemicals in a beaker or test tube would not be a suitable method for carrying out this experiment:
 *There would be no way to collect the gas that would form*

- (d) Describe how the oxygen produced might be collected:
 *It could be collected by running a tube out from the reaction flask and then getting the oxygen to displace the water from a water-filled container*
- (e) How would you fill a gas jar with water and then turn it upside-down without the water spilling out?
 *It would have to be turned upside down with the mouth of it still in the basin of water*.....

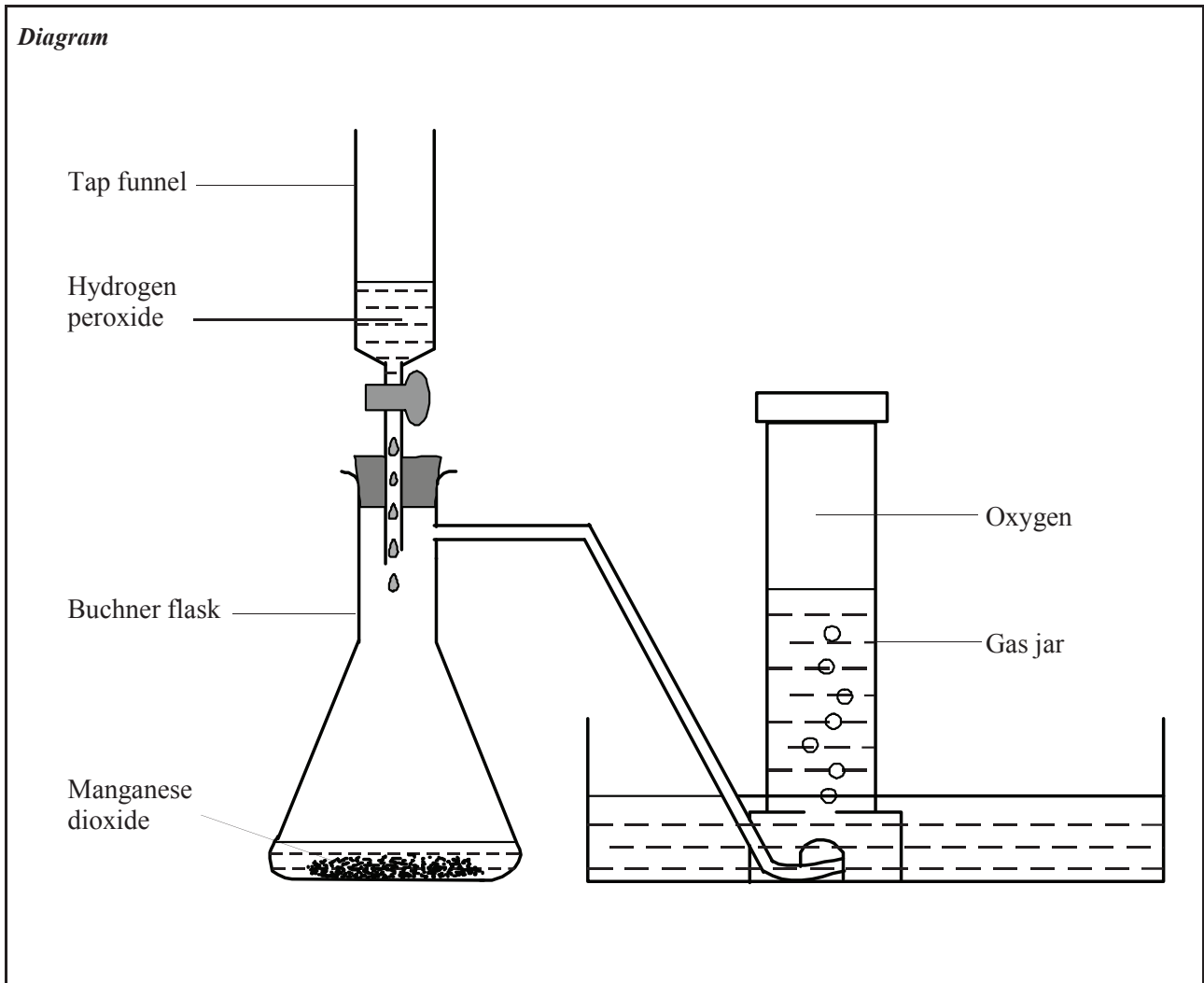
- (f) Why should the basin (or trough) not be filled to the very brim with water at the start of the experiment? *To allow room for the water that gets displaced from the gas jar*
- (g) Why should the first gas jar full of gas be discarded?
 ... *It will only contain air that was in the apparatus from the beginning*
- (h) What precaution is needed when placing the gas jar cover on the gas jar?
 *The cover must be placed on the gas jar while the mouth of the gas jar is still under water, to prevent the oxygen from escaping*
- (i) Give two reasons why a tap funnel and not an ordinary funnel is used in this experiment:
 1) ... *A tap funnel makes it easier to control how much hydrogen peroxide is added*
 2) *An ordinary funnel cannot be closed and therefore, oxygen would escape through it*
- (j) Hydrogen peroxide is a dangerous chemical that can cause burns. Give two safety precautions needed when using it.
 1) ... *Wear protective gloves*
 2) *Wear safety glasses*

3. **Materials and Apparatus Used:**

Buchner flask, tap funnel, stopper, gas jar and cover, tubing, beehive shelf, three test tubes with stoppers, hydrogen peroxide, manganese dioxide.

.....

4. Method:



Say where the chemicals are placed.....

... Hydrogen peroxide is placed in the tap funnel

... Manganese dioxide is placed in the Buchner flask

How is the gas jar set up to collect the gas?

... The gas jar is placed in the trough filled with water and then lifted upside down so that it is filled with water, but the mouth of it does not come above the surface of the water in the trough

Describe the procedure

- 1) Allow the hydrogen peroxide to fall onto the manganese dioxide in the flask.
- 2) When the gas jar is full of oxygen, slip the gas jar cover into place, under the water.
- 3) Turn the gas jar upright, and save it to examine the properties of oxygen.

5. Results:

... Oxygen gas is produced in the flask and collected in the gas jar

6. Conclusions:

... Manganese dioxide breaks down hydrogen peroxide to release oxygen gas

1. To Prepare Carbon Dioxide and Show it Does Not Support Combustion (31.6)

2. Planning the Activity:

- (a) Carbon dioxide is prepared by reacting an acid with a carbonate.

The acid used is ... *hydrochloric* ... acid (formula ... *HCl* ...) and the carbonate used is ... *calcium* ... carbonate, also known as *marble* chips.

- (b) Carbon dioxide is a colourless, odourless, tasteless gas. How would you know if you had collected it? *It can be tested by bubbling it through limewater which it then turns milky*

- (c) The word equation for the preparation of carbon dioxide is:

..... *Hydrochloric acid* + *Calcium* *carbonate* \longrightarrow
 *calcium* *chloride*..... + *water* + *carbon* *dioxide*

- (d) The chemical equation for the preparation of carbon dioxide is:

... *HCl* + ... *CaCO₃* \longrightarrow *CaCl₂* + *H₂O* + *CO₂*

- (e) Where will the salt, calcium chloride, be deposited during the preparation of carbon dioxide?

... *It will get deposited on the surface of the marble chips*

- (f) What problem might this cause during the preparation?

... *It would prevent the hydrochloric acid from getting to the marble chips and this would slow down, or stop, the reaction to produce carbon dioxide*

- (g) How would you get around this problem?

... *When the reaction slows down, rinse the marble chips with water to wash away the calcium chloride*

- (h) Why should the tap of the tap funnel be kept closed when all the hydrochloric acid has been passed through? *So that the carbon dioxide does not escape through the open tap funnel*

- (i) Dilute hydrochloric acid can irritate your skin; give two safety precautions required when using it.

1) ... *Wear protective gloves*

2) ... *Do not allow it to make contact with the skin*

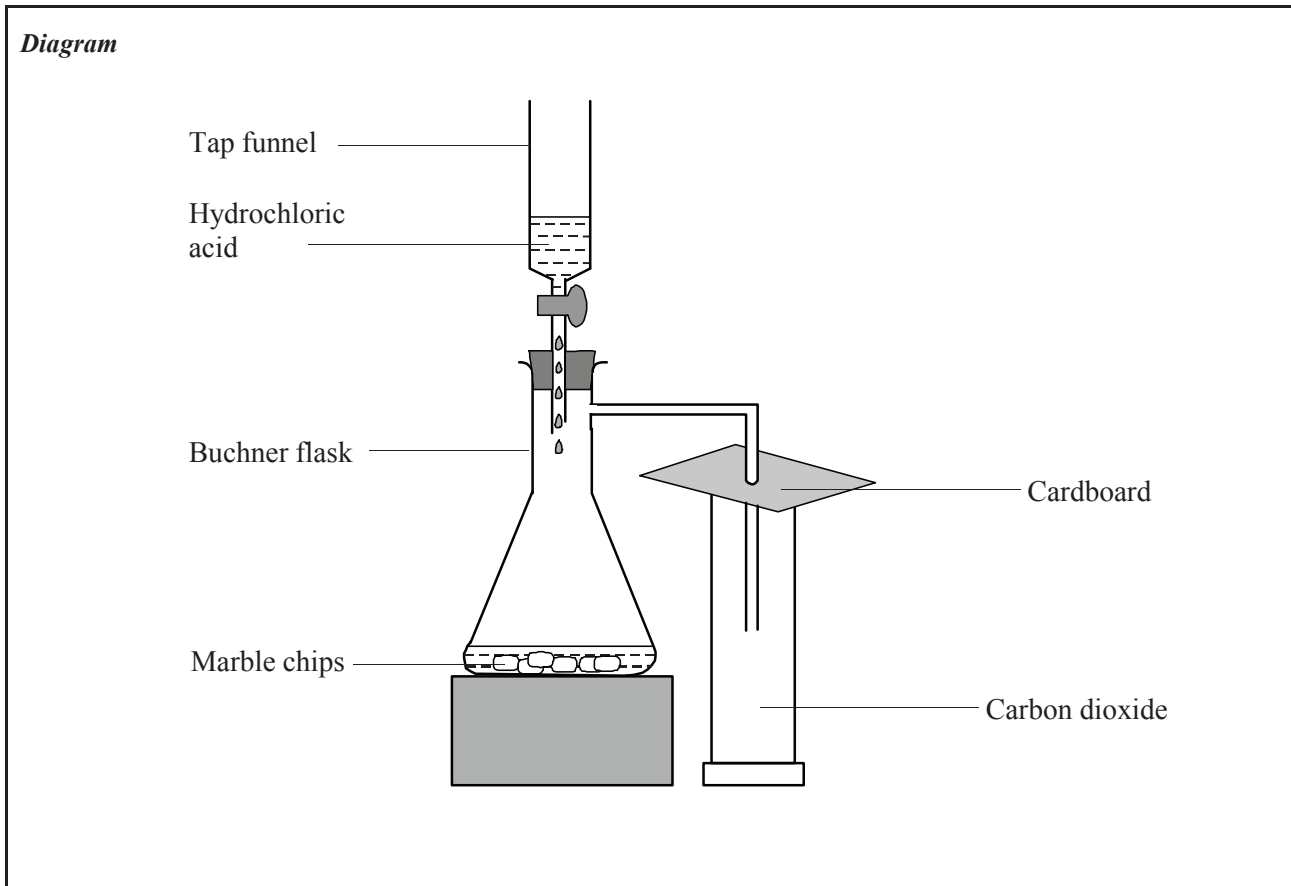
- (j) How would you show that carbon dioxide does not support combustion (burning)?

... *Place a lighting taper into the jar of carbon dioxide - it goes out*

3. Materials and Apparatus Used:

Buchner flask, tap funnel, stopper, gas jar and cover, tubing, cardboard, dilute hydrochloric acid, marble chips, wax taper

4. Method:



Say where the chemicals are placed.....

.... The hydrochloric acid is placed in the tap funnel; and the marble chips are placed in the Buchner flask

How is the gas jar set up to collect the gas?

.... The gas jar is placed upright with a sheet of cardboard on top. A hole in the cardboard lets a tube from the Buchner flask through. As carbon dioxide is denser than air, it is collected like this.

Describe the procedure

... The hydrochloric acid is allowed to fall on the marble chips to release carbon dioxide

Testing for combustion

... A lit taper is placed in the jar of carbon dioxide - it goes out immediately

5. Results:

.... Carbon dioxide gas is produced in the flask and collected in the gas jar

.... A lit taper is extinguished when placed in a jar of carbon dioxide

6. Conclusions:

... Carbon dioxide is produced by the action of hydrochloric acid on marble chips

... Carbon dioxide does not support combustion

To Show the Presence of Dissolved Solids in Water Samples and To Test Water Samples for Hardness (32.2, 32.4)

1. To Show the Presence of Dissolved Solids in Water Samples (32.2)



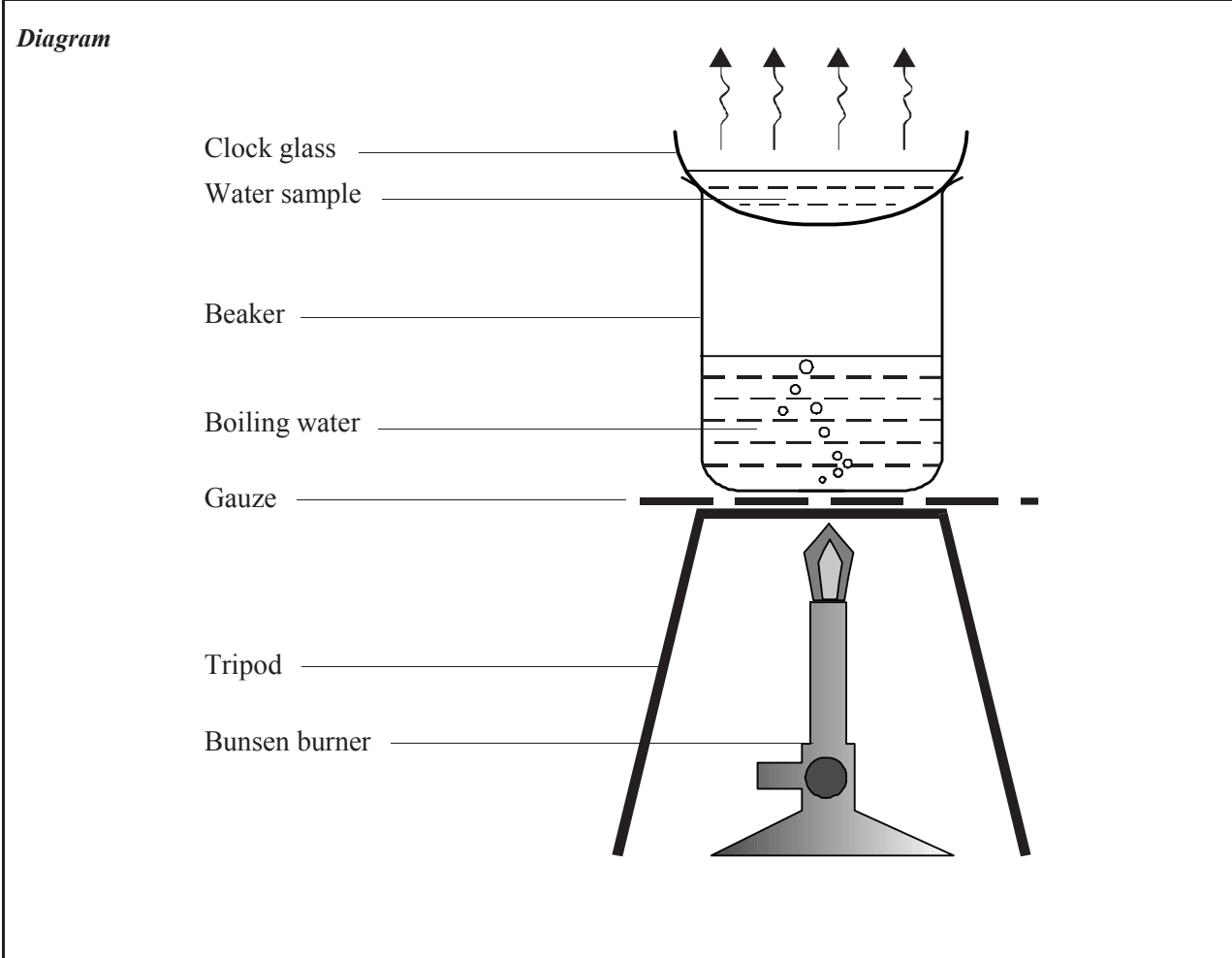
2. Planning the Activity:

- (a) Why, do you think, would tap water, river water, mineral water etc. contain dissolved solids?
They all pass over rocks before reaching our taps
- (b) Would you expect rainwater to contain dissolved solids? Explain.
No, because it has not passed over rocks, soil, etc.
- (c) From your experiments on separating mixtures, can you suggest a method in the laboratory that would allow you to see the dissolved solids?
If the water is evaporated we should see the dissolved solids on a clock glass

3. Materials and Apparatus Used:

Clock glass, beaker, tripod, gauze, Bunsen burner, various water samples, e.g. tap water from different areas (soft water, hard water), seawater, mineral water, river water, rainwater, etc.

.....



4. Method:

- 1) Half fill the beaker with water and set up the apparatus as shown.
- 2) Place a small amount of the water sample on the clock glass.
- 3) Allow the water sample on the clock glass to evaporate off.
- 4) Examine any residue that remains on the clock glass.

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5. Results:

Water Sample Tested	Amount of Dissolved Solids
1) Hard water sample	Large amount of dissolved solids
2) Soft water sample	Very little dissolved solids
3) Seawater	Contained the most dissolved solids
4) Mineral water	Large amount of dissolved solids
5) River water	A fair amount of dissolved solids
6) Rainwater	Very little (if any) dissolved solids
7) Distilled water	No dissolved solids
8) De-ionised water	No dissolved solids

The results are as given in the table of results

.....

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6. Conclusions:

Seawater contained the most dissolved solids - most of which was probably the salt, sodium chloride.

The hard water sample and the mineral water were the next highest in dissolved solids - both were probably from limestone areas where the water picked up the soluble solids.

The soft water sample was from a non-limestone area and therefore had very few dissolved solids.

River water in our (non-limestone) area had very few dissolved solids, but had a small amount.

Rainwater had not yet flowed over rocks so had not collected any dissolved solids from them.

Both distilled and de-ionised water had the solids removed from them and therefore had none.

1. To Test Various Water Samples for Hardness (32.4)



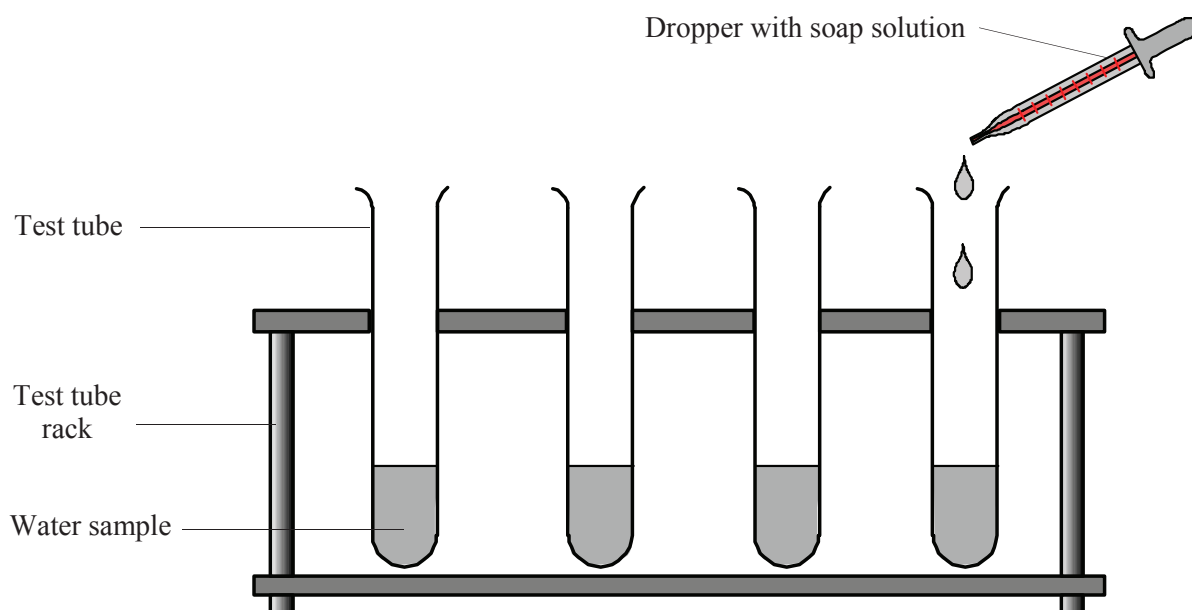
2. Planning the Activity:

- (a) What causes hardness in water? ... *Calcium ions dissolved in it*
- (b) How would you investigate whether a sample was hard water or soft water?
.... *Add soap to it and shake to see how easily it forms a lather*
- (c) How might you modify this investigation to find out how much hardness was in a water sample?
.... *Count how many drops of soap solution or soap flakes are needed to form a lather*
- (d) What measurements would you take to discover how hard various water samples were?
.... *The volume of water used and the number of drops of soap solution needed to form a lather*

3. Materials and Apparatus Used:

Test tubes, test tube rack, dropper, soap solution, various water samples, e.g. rainwater, spring water, distilled water, hard water from a limestone area, soft water from a non-limestone area, etc.

Diagram



4. Method:

- 1) Place an equal amount of each water sample into each test tube.
- 2) Add one drop of soap solution to the first sample, shake the test tube, and see if a lather forms.
- 3) Repeat to see how many drops of soap solution are needed to form a permanent lather.
- 4) Repeat steps 2 and 3 for each of the other water samples.
- 5) Record the number of drops needed to form a permanent lather in each water sample.

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5. Results:

Name of Water Sample (1 - 6)	1) <i>Hard water sample</i>	2) <i>Soft water sample</i>
Number of Drops of Soap Solution	<i>12</i>	<i>4</i>

3) <i>Rainwater</i>	4) <i>Mineral water</i>	5) <i>Spring water</i>	6) <i>Distilled water</i>
<i>3</i>	<i>16</i>	<i>16</i>	<i>2</i>

The results are as given in the table

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6. Conclusions:

The hard water sample from a limestone area, mineral water and spring water were the hardest water samples tested. These samples had a lot of calcium ions dissolved in them.

The soft water sample, rainwater and distilled water had very few calcium ions dissolved in them and so they were the softest water samples tested.

1. To Demonstrate that Oxygen and Water are Necessary for Rusting (34.1)

2. Planning the Activity:

- (a) You are given some iron nails and any equipment and chemicals you might need; how could you arrange it so that one nail has no oxygen available to it?

.... *Maybe put a nail and some chemical that would absorb oxygen into a stoppered test tube*

- (b) How might you arrange it so that another nail has no water (even water vapour in the air) available to it?

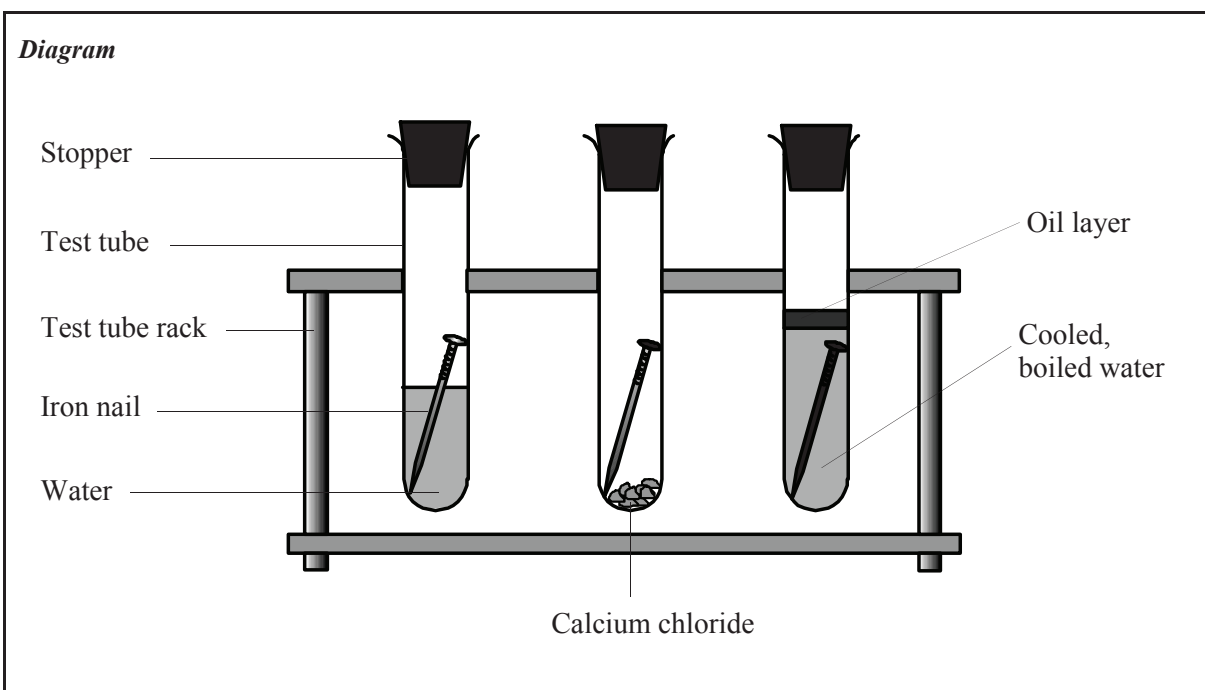
.... *Maybe put a nail and some chemical that would absorb water into a stoppered test tube*

- (c) At the end of one week, if the nails had not rusted, someone might say, 'Well, they wouldn't have rusted in that short a time anyway - it has nothing to do with them having no oxygen or water!'. What would you need to include in your experiment to answer this person?

.... *A nail set up so that it has both oxygen and water available to it. If this nail rusts after one week then you can say that a nail rusts in a week if it has both water and oxygen*

3. Materials and Apparatus Used:

Three iron nails, three test tubes, three stoppers, test tube rack, boiled water, calcium chloride, oil



4. Method:

- 1) Place a nail in each test tube A, B and C as shown. Test tube A has water and oxygen in it.
- 2) Test tube B has calcium chloride in it to absorb any water.
- 3) Test tube has cooled, boiled water in it to remove oxygen, and a layer of oil to keep out oxygen.

5. Results:

After one week, only the nail in test tube A had rusted

6. Conclusion: *For rusting to occur, both water and oxygen must be present*

1. To React Zinc with Hydrochloric Acid and Test for Hydrogen (34.3)
--



2. Planning the Activity:

- (a) Hydrogen is prepared by reacting an acid with a metal.

The acid used is *hydrochloric* acid (formula ... *HCl*) and the metal used is *Zinc*

- (b) The word equation for this preparation of hydrogen is:

..... *Hydrochloric* acid + *Zinc* metal \longrightarrow
 *Zinc* *chloride* + *Hydrogen*

- (c) Why will you not be able to see the compound formed in this reaction?

.... *Zinc chloride is very soluble and would dissolve in the solution*

- (d) The chemical equation for the preparation of hydrogen is:

..... *Zn* + *2HCl* \longrightarrow *ZnCl₂* + *H₂*

- (e) Why would you not use calcium or magnesium as the metal in this experiment?

.... *They would be too reactive and would produce too much hydrogen too quickly*

- (f) Why would you collect the hydrogen gas in test tubes rather than in gas jars?

.... *Because hydrogen is an explosive gas and so it is safer to make only a small amount*

- (g) Why is the test tube full of hydrogen stoppered under water?

.... *So that the hydrogen will not escape out of the test tube*

- (h) Hydrogen is a colourless, odourless, tasteless gas. How would you know if you had collected it?
- Hydrogen causes a lit taper to go 'pop'. This is the test for hydrogen*
-

- (i) Suppose you were supplied with the following items in the laboratory:

Test tube, single holed stopper, glass tubing, rubber tubing, glass funnel, beaker, wax taper, dilute hydrochloric acid, zinc metal, and childrens' 'bubble liquid'.

Describe how you could use these items to show two important properties of hydrogen.

Set up the apparatus to make hydrogen gas as shown overleaf.

Then attach the glass funnel to the end of the delivery tubing.

The bubble liquid is poured into the bottom of a large beaker, and, while the hydrogen is being made, the funnel is dipped into the bubble liquid.

This allows bubbles of hydrogen gas to be made. These will quickly float upwards to the ceiling.

If the hydrogen bubbles are lit with a taper as they rise, they explode.

- (j) What two properties of hydrogen could you show with this experiment that you have designed?

1) ... *Hydrogen is less dense than air - the hydrogen bubbles float in air*

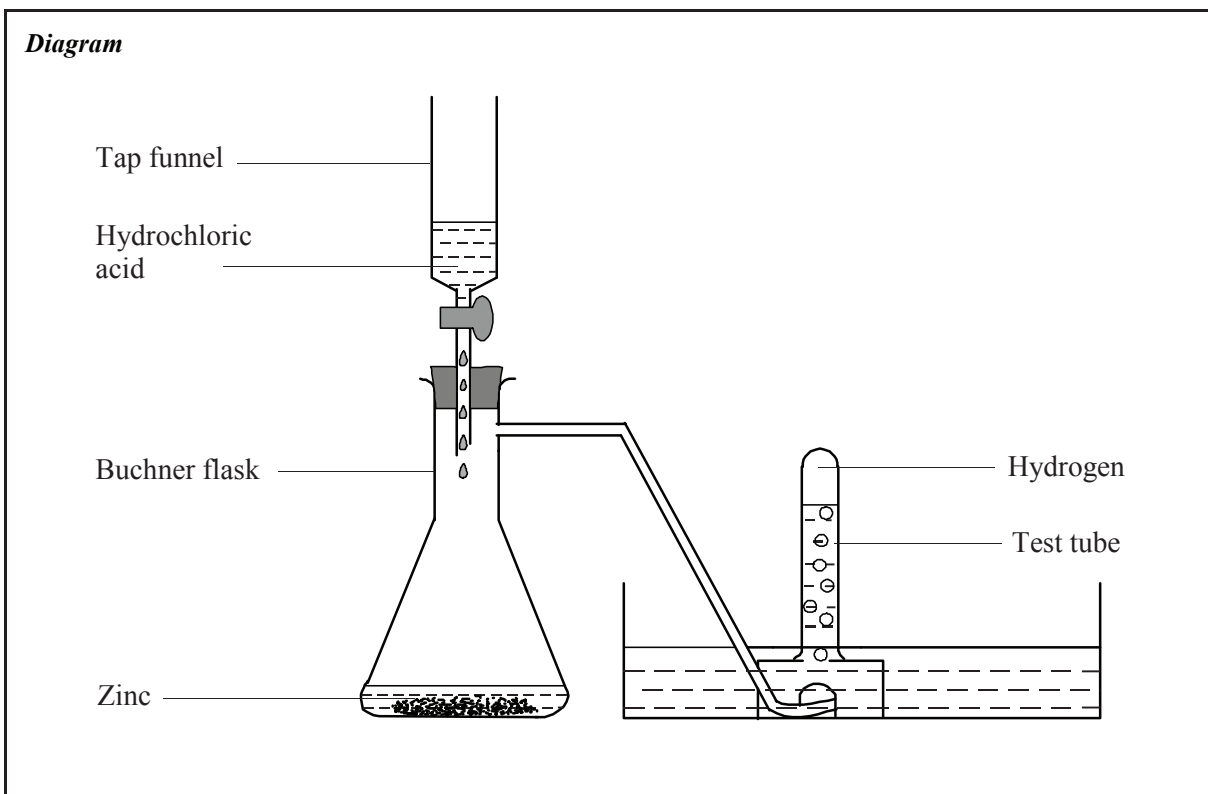
2) *Hydrogen forms an explosive mixture with air - the hydrogen bubbles explode when lit*

- (k) Why is hydrogen not found in the mixture of gases that make up air?

.... *It is so light that it would just float away*

3. **Materials and Apparatus Used:**

Buchner flask, tap funnel, stopper, test tube, tubing, water trough, zinc, dilute hydrochloric acid, wax taper.



4. **Method:** *Setting up the experiment:*.....

Set up the apparatus as shown above. Place dilute hydrochloric acid in the tap funnel and zinc metal in the Buchner flask. Stopper the test tube under water when it is filled with hydrogen gas

Testing for hydrogen:

Remove the stopper and quickly bring a lit taper to the mouth of the test tube

5. **Results:** *(What do you observe?):*

The hydrochloric acid reacts with the zinc, hydrogen gas is formed and collected in the test tube

What was the result of the test for hydrogen?:

The hydrogen gas explodes with a loud 'pop'

6. **Conclusion:**

Hydrogen gas can be made by the reaction between zinc metal and hydrochloric acid.

Hydrogen gas goes 'pop' when it is lit. This is the test for hydrogen.

To Investigate Energy Conversions (37.2 - 37.4)

1. To Convert Chemical Energy to Electrical Energy to Heat Energy (37.2)

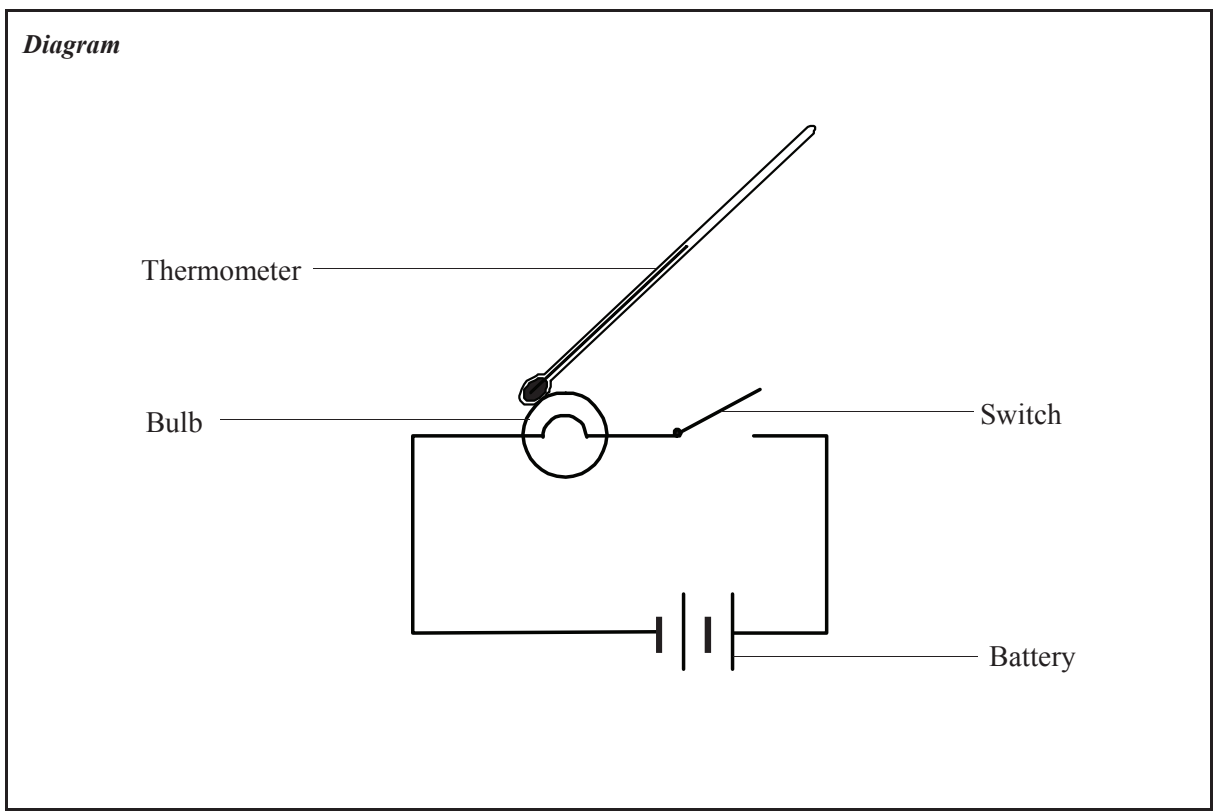
2. Planning the Activity:

- (a) A battery is used to convert *chemical* energy into *electrical* energy.
- (b) An electric bulb can convert *electrical* energy into *light* and *heat* energy.
- (c) How would you know that these energy conversions had taken place in the bulb?

The bulb would light and get hot

3. Materials Used:

6 V battery, bulb in holder, switch, thermometer



4. Method:

- 1) *Connect the circuit as shown above. Close the switch.*
- 2) *Touch the bulb with a thermometer and describe the energy conversions that have taken place.*

5. Results:

The bulb lights and the thermometer shows an increase in temperature.

6. Conclusions: The experiment shows that chemical energy in the *battery* is converted to electrical energy in the *wires* and then to *light* and *heat* energy in the *bulb*

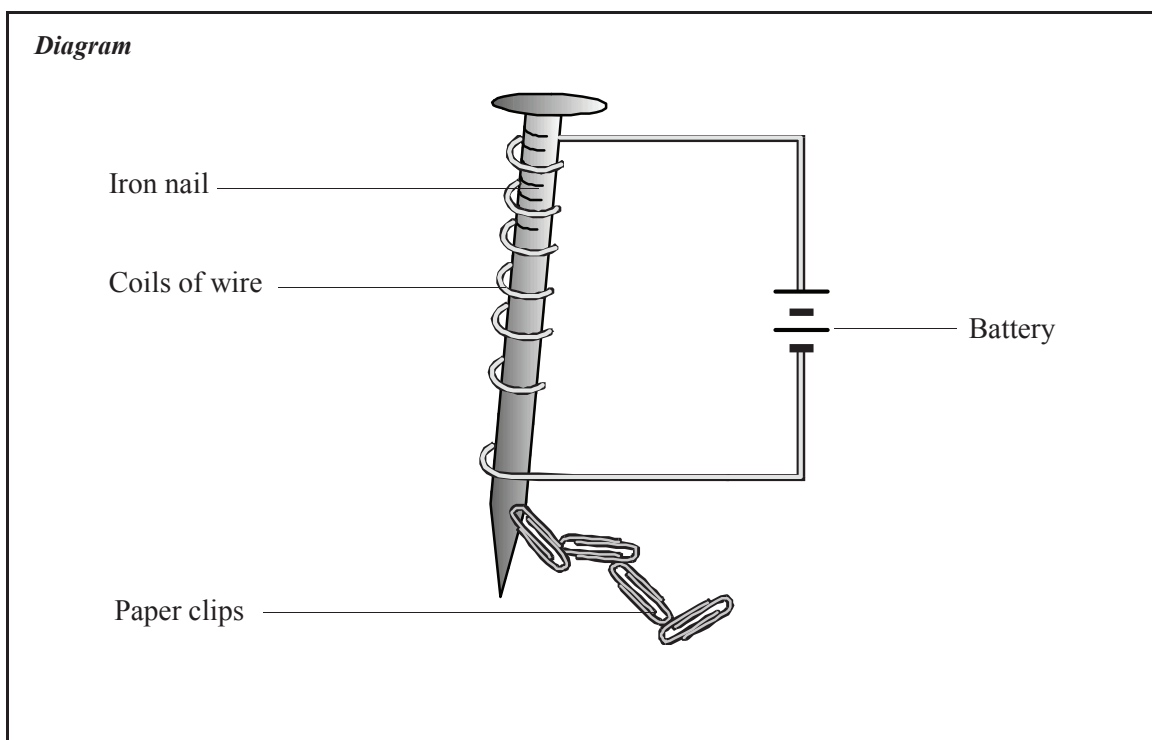
1. To Convert Electrical Energy to Magnetic Energy to Kinetic Energy (37.3)

2. Planning the Activity:

- (a) A wire, with an electric current flowing through it has a *magnetic* *field* around it.
- (b) When the wire is wrapped around an iron *nail* , the *nail* becomes a *magnet* , in other words, it gains *magnetic* energy.
- (c) Electrical energy from the battery or power pack is converted to *magnetic* energy in the iron nail, which is converted to *kinetic* energy in the paper clips.
- (d) What happens to the paper clips when the current is switched off? Explain.
... *They fall off the nail - no electrical energy is available to convert into magnetic energy*

3. Materials Used:

6 V battery, large iron nail, paper clips, insulated wire



4. Method:

- 1) *Wind the wire closely around the nail.*
- 2) *Connect the ends of the wire to the battery and hold the nail over some paper clips.*

5. Results:

... *The paper clips are attracted to the nail*

- 6. **Conclusions:** The experiment shows that electrical energy in the *wire* is converted to magnetic energy in the *nail* and then to kinetic energy in the *paper* *clips*

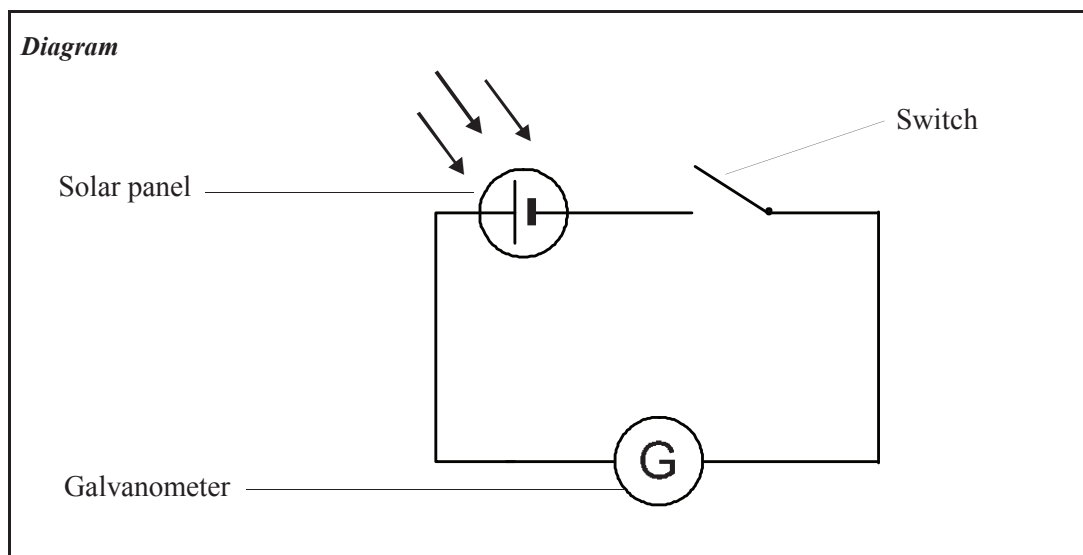
1. To Convert Light Energy to Electrical Energy to Kinetic Energy (37.4)

2. Planning the Activity:

- (a) A solar panel converts *light* energy to *electrical* energy if it is placed in strong sunlight, or if a bright light is shone on it.
- (b) The *electrical* energy in the wires is converted into *kinetic* energy in the needle of a galvanometer, or in a tiny motor.
- (c) How would you increase the amount of light energy received by the solar cell?
..... *Bring the light closer to the solar cell*
- (d) If the light energy was increased what effect would you expect this to have on the kinetic energy?
..... *This should increase the kinetic energy*
- (e) How would you test to see if your theory in (d) is correct?
.... *Bring the lamp closer to the solar panel and see if the galvanometer needle goes further*

3. Materials Used:

Solar panel, table lamp, switch, galvanometer or small electric motor



4. Method:

- 1) *Connect the circuit as shown in the diagram.*
- 2) *Shine the lamp on the solar panel and close the switch. Record what happens.*

5. Results:

The needle of the galvanometer moves

6. Conclusions:

The experiment shows that the solar panel converts *light* energy to *electrical* energy and the *electrical* energy is converted to *kinetic* energy in the galvanometer.

1. To Determine the Densities of Solids and Liquids (39.1 - 39.3)
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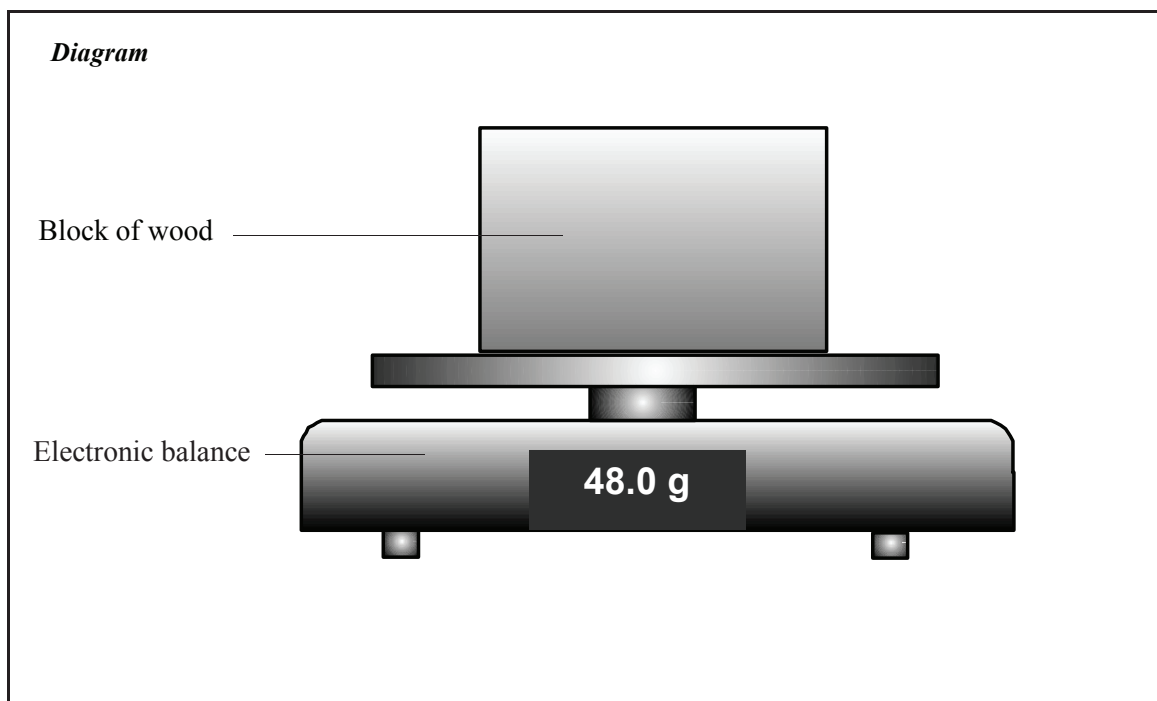
2. Planning the Activity:

- (a) The density of a substance is the mass per unit volume of it.
Therefore, to find the density of a substance, you must measure two things - the *mass*
of it, measured in *g's*, and the *volume* of it, measured in *cm³*
- (b) The ... *mass* is then divided by the *volume* to find the density, measured in ... *g / cm³* ...
- (c) The mass of an object is found by using an *electronic* *balance*
- (d) How would you find the volume of a rectangular block of wood?
.... *Multiply the length by the breadth by the height*
- (e) What two pieces of equipment would you use to measure the volume of an irregularly-shaped object (e.g. a stone)?
1) *An over-flow can*, 2) *A graduated cylinder*
- (f) Describe how you might measure the volume of a stone.
.... *Tie a thread around it and lower it into an over-flow can that is filled with water to the brim. Collect the water that gets displaced from the can in a graduated cylinder. Read the volume of the water in the graduated cylinder - this is equal to the volume of the stone*
- (g) If the irregularly-shaped object floats in water, how would you then measure its volume?
..... *It would have to be pushed under the water in the over-flow can using a long needle*
-
- (h) Why is it important that you would find the mass of the stone *before* finding its volume?
.... *Because if it is wet (after finding the volume) it would show a greater mass*
-
- (i) What *three* measurements would you have to take to find the mass of a liquid?
1) *The mass of an empty beaker*
- 2) *The mass of the beaker and liquid*
- 3) *The mass of the liquid (by subtracting (1) from (2) above)*
- (j) Give two precautions you should take when measuring the volume of a liquid in a graduated cylinder:
1) *Make sure your eye is level with the surface of the liquid*
- 2) *Take the reading from the bottom of the meniscus*
- (k) An object will sink in water if its density is greater than the *density* of *water*
which is *1* *g/cm³*.
- (l) Why do you think, a ship made of steel, of density 7.9 g/cm³ floats on water?
... *Because it is hollow and the combined density of the ship (metal and air) is less than 1 g/cm³* ...

1. To Find the Density of a Regularly-Shaped Solid (e.g. a Block of Wood) (39.1)

3. Materials and Apparatus Used:

... *Electronic balance, ruler, block of wood*



4. Method: *To measure the volume of the block:*

*Measure the length, breadth and height of the block, using the ruler.
Then multiply the length by the breadth by the height to find the volume.*

To measure the mass of the block:

Place the block on the electronic balance to measure its mass.

5. Results:

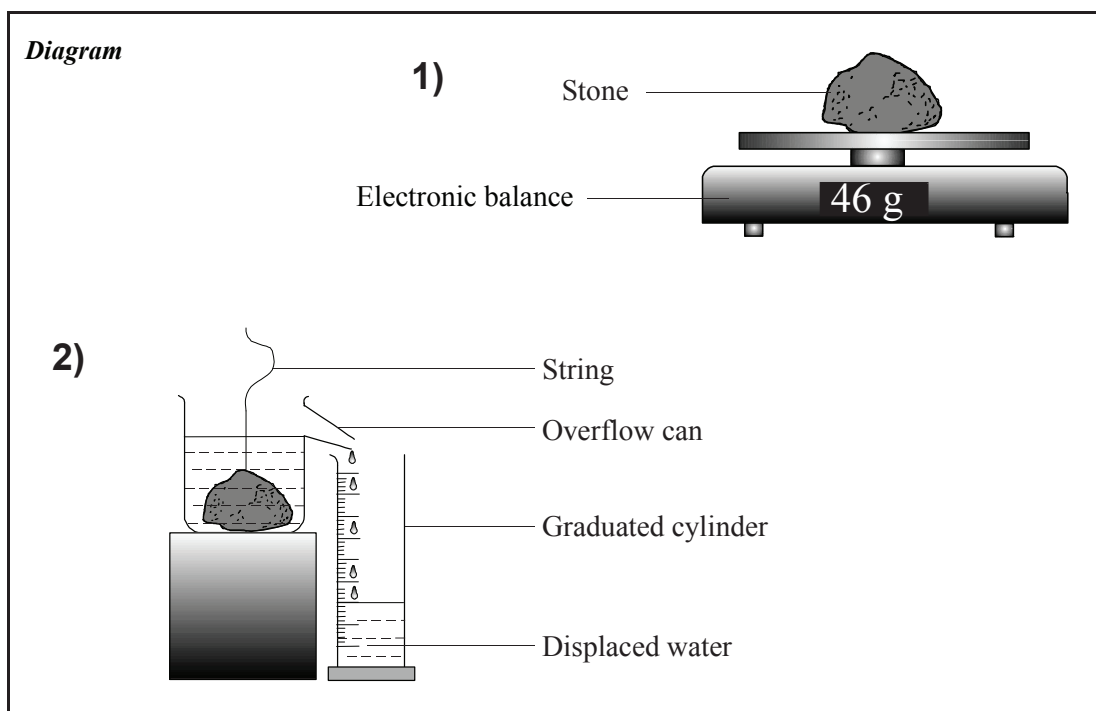
Material of Block Used	Mass of Block (g)	Length (cm)	Width (cm)	Height (cm)	Volume (cm ³)	Density (g/cm ³)
1) <i>Wood</i>	<i>48</i>	<i>10</i>	<i>2</i>	<i>3</i>	<i>60</i>	<i>0.8</i>
2) <i>Aluminium</i>	<i>108</i>	<i>5</i>	<i>4</i>	<i>2</i>	<i>40</i>	<i>2.7</i>
3) <i>Lead</i>	<i>134.4</i>	<i>2</i>	<i>2</i>	<i>3</i>	<i>12</i>	<i>11.2</i>

6. Conclusion: ... *The density of a regularly-shaped block is found by dividing its mass by its volume ..*

1. To Find the Density of an Irregularly-Shaped Solid (e.g. a Stone) (39.2)

3. Materials and Apparatus Used:

Graduated cylinder, overflow can, electronic balance, thread, stone, water.



4. Method: *To measure the volume of the stone:.....*

- 1) *Tie some thread around the stone and lower it gently into the overflow can, filled to the brim.*
- 2) *Collect the water that is displaced from the can in a graduated cylinder.*
- 3) *Read the volume of water in the graduated cylinder - this is equal to the volume of the stone.*

To measure the mass of the stone: Place the stone on an electronic balance

5. Results:

Stone	Mass of Stone (g)	Volume (cm ³)	Density (g/cm ³)
1) Stone 1	265	94.6	2.8
2) Stone 2	378	111	3.4
3) Stone 3	250	100	2.5

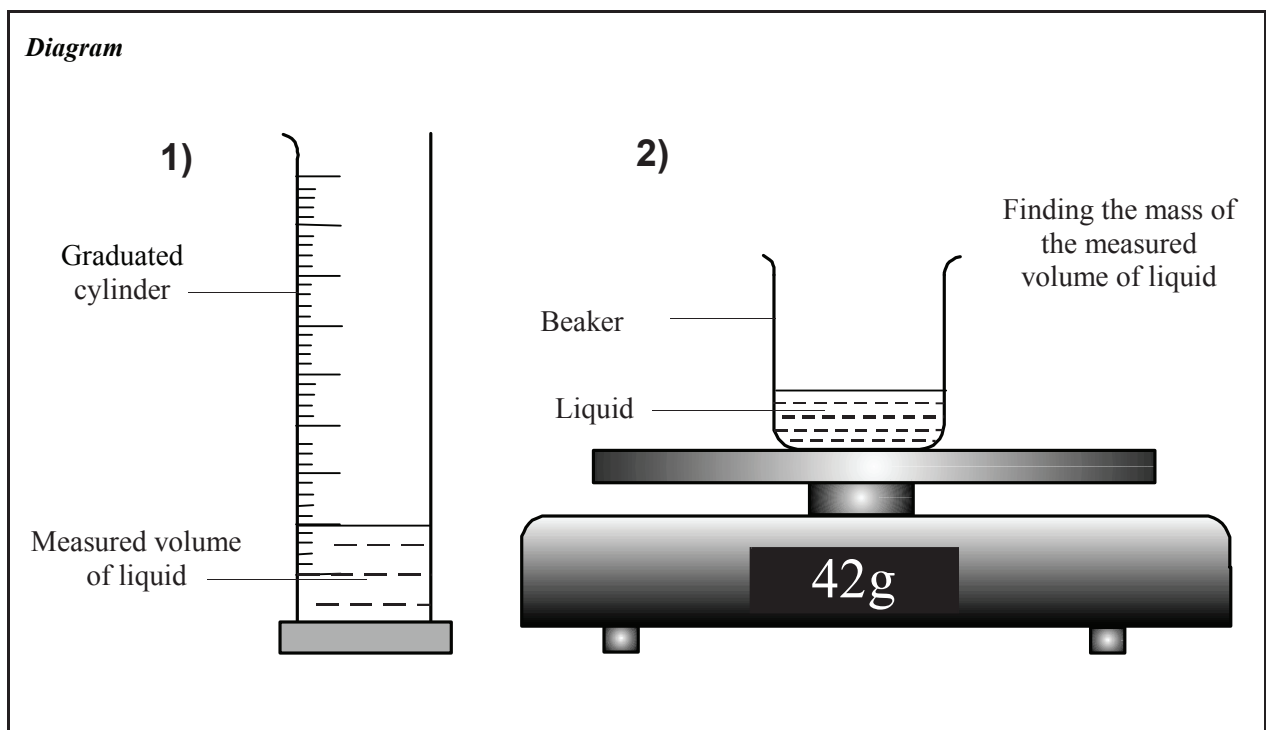
6. Conclusion:

The density of a stone is found by dividing its mass by its volume.

1. To Find the Density of a Liquid (e.g. Water and Methylated Spirits) (39.3)

3. Materials and Apparatus Used:

Graduated cylinder, beaker, electronic balance, water, methylated spirits.



4. Method: *To measure the volume of the liquid:*

...Fill the graduated cylinder to the 100 cm³ mark with water

To measure the mass of the liquid:

... Find the mass of the empty beaker on the electronic balance. Add the 100 cm³ of water and find the mass of the water and beaker. Subtract the mass of the beaker from the mass of water and beaker.

5. Results:

Liquid	Volume of Liquid (cm ³)	Mass of Empty Beaker (g)	Mass of Beaker + Liquid (g)	Mass of Liquid (g)	Density of Liquid (g/cm ³)
1) <i>Water</i>	<i>100</i>	<i>96</i>	<i>196</i>	<i>100</i>	<i>1.0</i>
2) <i>Methylated spirit</i>	<i>100</i>	<i>94</i>	<i>174</i>	<i>80</i>	<i>0.8</i>
3) <i>Paraffin oil</i>	<i>100</i>	<i>102</i>	<i>182</i>	<i>80</i>	<i>0.8</i>

6. Conclusion:

The density of a liquid is found by dividing the mass of the liquid by its volume

1. To Investigate the Relationship Between the Extension of a Spiral Spring and the Force Applied to it (40.1)

2. Planning the Activity:

- (a) If you fixed one end of a spiral spring to a retort stand, and attached a weight to the other end, what, do you think, would happen to the spring?

... It would stretch

- (b) What would happen if you attached a weight that was twice as heavy as the first weight?

... It would probably stretch twice as much

- (c) What would happen if you attached a weight that was three times as heavy as the first weight?

...It would probably stretch three times as much

- (d) What is the relationship between the size of the weight attached (i.e. the force applied) and what you might observe to happen to the spring?

... The stretching of the spring is in proportion to the weight attached to it

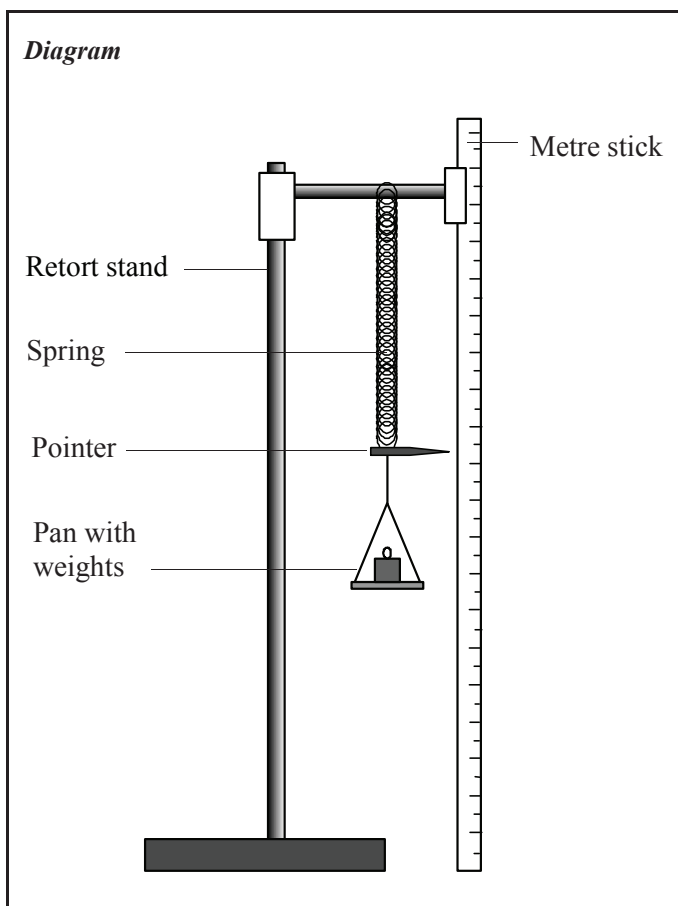
3. Materials and Apparatus Used:

Retort stand, metre stick, spiral spring, pin, weight pan, weights

.....

4. Method:

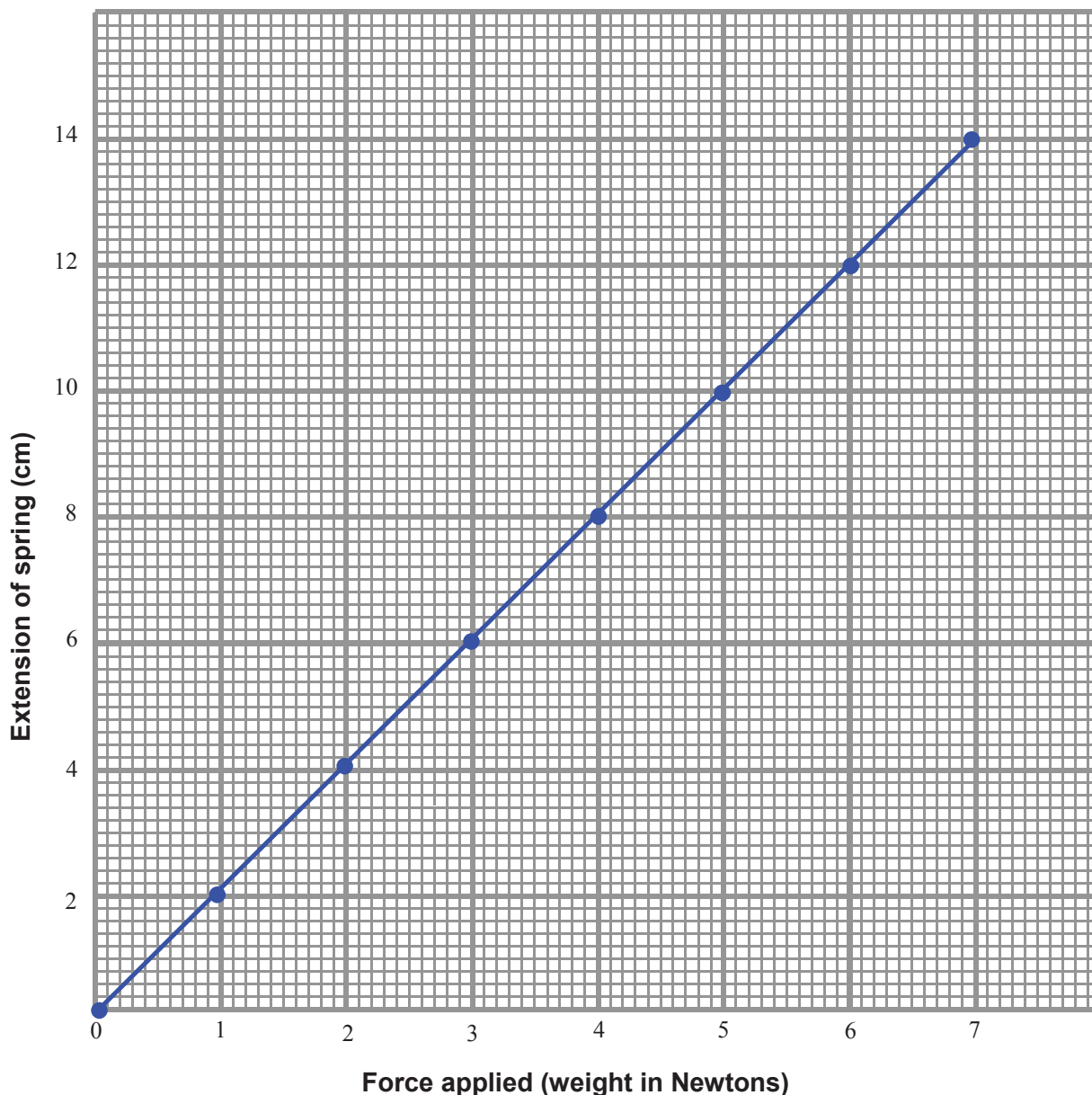
- 1) *Set up the spring and metre stick as shown.*
- 2) *Attach the weight pan and note the position of the pin on the metre stick.*
- 3) *Add various weights to the pan and note by how much the spring stretches each time.*
- 4) *Plot a graph of extension against the weight (force applied).*



5. Results:

Force (weight) in Newtons	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
Extension of Spring (in cm's)	<i>0</i>	<i>2</i>	<i>4</i>	<i>6</i>	<i>8</i>	<i>10</i>	<i>12</i>	<i>14</i>

5. **Results:** (Present your results as a graph, putting Force (in newtons) on the horizontal axis)



6. **Conclusion:**

(a) How would you describe the graph you have drawn?

... *It is a straight line graph that passes through the origin (0,0)*

(b) Where have you seen a graph like this before?

... *In graphs of distance against time, where the speed was constant*

(c) What does a graph like this tell you about the relationship between the extension of the spring and the force applied to it?

... *It tells you that the extension of the spring is in direct proportion to the force applied*

(d) Describe how you could use the equipment and the graph to find the weight of your pencil case.

... *The pencil case should be hung from the spring and the extension of the spring noted.*

Because the weight of the pencil case is in proportion to the extension of the spring, the graph could be used to find the weight that corresponds to that extension

To Show the Transfer of Heat Energy by Conduction, Convection and Radiation; to Investigate Conduction and Convection in Water (44.1 - 44.4)

1. To Compare the Conductivity of Various Metals (44.1)

2. Planning the Activity:

(a) Describe what would happen if one end of a solid rod was heated:

.... *The other end would get hot*

(b) How would you show that this had happened?

... *Put one end of a metal rod in the Bunsen burner flame and hold the other end*

(c) Give three precautions you would take to carry out a fair test to see whether copper or glass was a better conductor of heat.

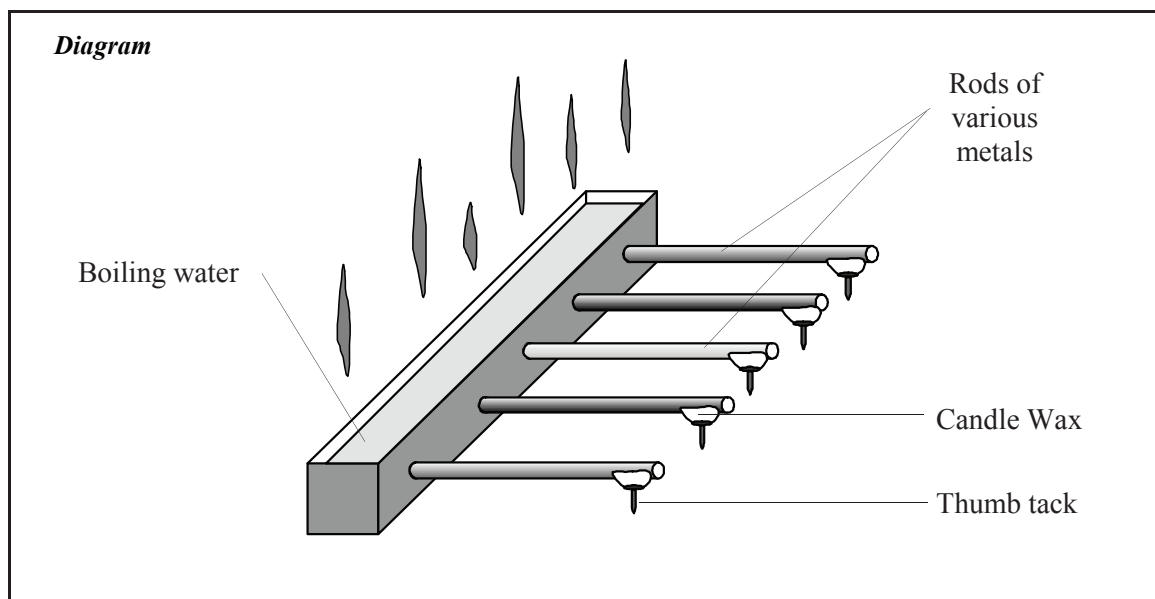
1) *Two rods, one of copper and one of glass, both of equal length would be used*

2) *The rods would be of equal thickness*

3) *The rods would be held in the same burner flame for the same length of time*

3. Materials Used:

Metal trough with holes and stoppers for holding rods, equally sized rods of different metals, candle, drawing pins, boiling water.



4. Method:

- 1) *Set up the apparatus as shown, with pins fixed to the end of each rod by candle wax.*
- 2) *Place boiling water in the trough and time how long it takes for each pin to drop off.*

5. Results:

.The pin falls off the copper rod first, then the iron, aluminium, brass and zinc in that order.

6. Conclusion: *Copper is the best conductor of heat.*

1. To Show that Water is a Poor Conductor of Heat (44.2)

2. Planning the Activity:

(a) The water at the *bottom* of a test tube that is being heated near the *top* is heated by conduction and not by convection. How do you know that this must be so?

.. Hot water rises by convection and so water beneath the flame could not be heated by convection.

(b) Why would you need to add a weight to the test tube? *To keep the ice at the bottom*

(c) If the water at the top of the test tube was made to boil, what would you expect to happen to the ice at the bottom of the test tube?

... I might expect it to melt

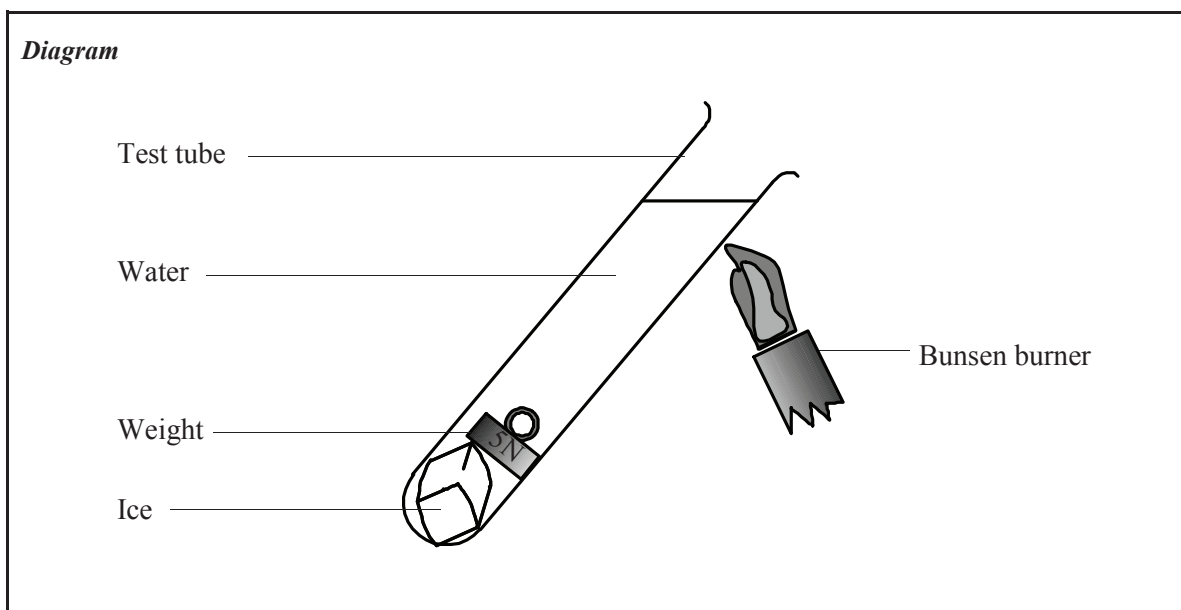
(d) A dual immersion heater has two heating elements, one near the top and one at the bottom. Why is this arrangement suitable for either heating (i) just enough water for the hand basin, or, (ii) enough water to have a bath?

(i) .. *The element heats the water by convection so the element at the top only heats water above it.*

(ii) .. *The element at the bottom will heat all the water above it by convection - enough for a bath.*

3. Materials Used:

Large test tube, weight, Bunsen burner, test tube holder, ice cube



4. Method:

Heat the water near the top of the test tube until it boils, as shown in the diagram.

5. Results:

The ice does not melt even though the water at the top of the test tube is boiling.

6. Conclusions: Water is a very poor *conductor* of *heat*

1. To Show Convection Currents in Water (44.3)

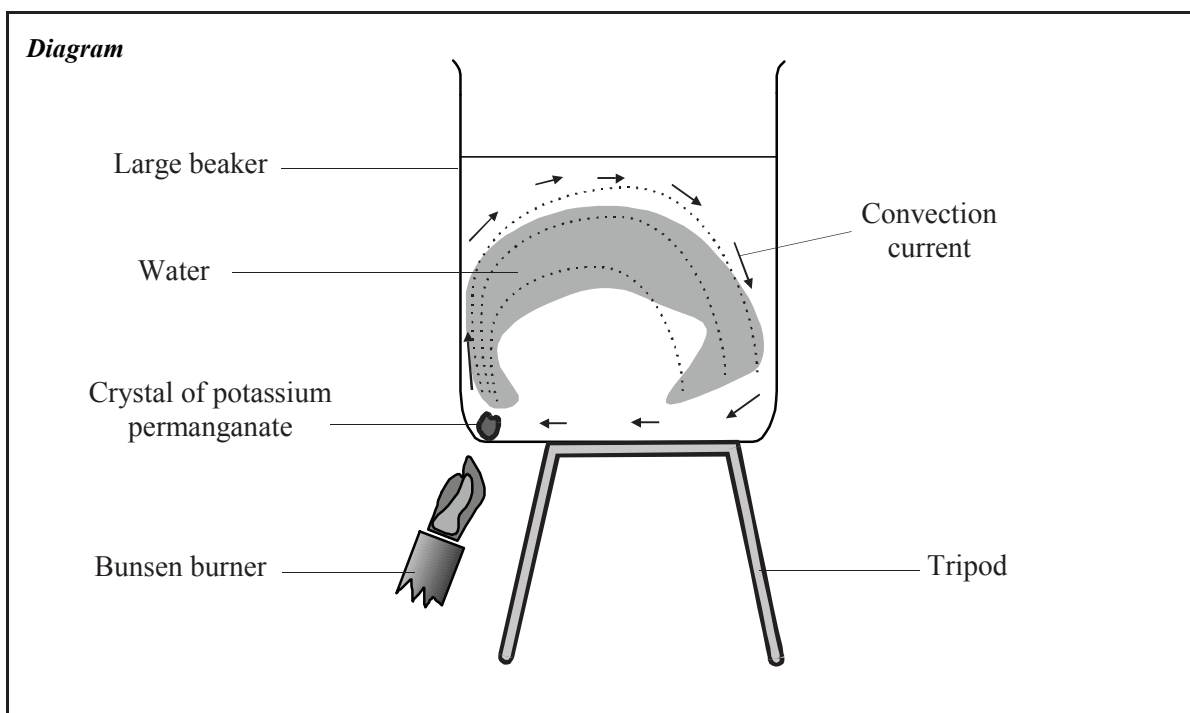


2. Planning the Activity:

- (a) When a liquid is heated it *expands* and therefore becomes less *dense*
The heated liquid will then *rise* in the beaker and be replaced by *cold*
liquid from the top of the beaker. This movement of the liquid is called a *convection*.....
current. It occurs in liquids and *gases*, the molecules of which can *move*
- (b) What needs to be added to the beaker of liquid to allow you to see the convection current?
.... *A crystal that will dissolve and colour the water*
- (c) Why, do you think, should the element of an electric kettle be placed as close to the bottom of the kettle as possible?
.... *So that all of the water can be heated by convection*

3. Materials Used:

Large beaker, tripod, gauze, Bunsen burner, potassium permanganate crystals



4. Method:

- 1) Place some potassium permanganate crystals into the beaker of cold water as shown.
- 2) Heat the beaker, below the crystals, with a weak flame.
- 3) Observe carefully what happens.

5. **Results:** ... *The coloured water moves up one side of the beaker, across and down the other side.*

6. **Conclusions:***The heated water is less dense and rises, and is replaced by colder water.*

A convection current forms in the beaker, as the water gets heated by convection.

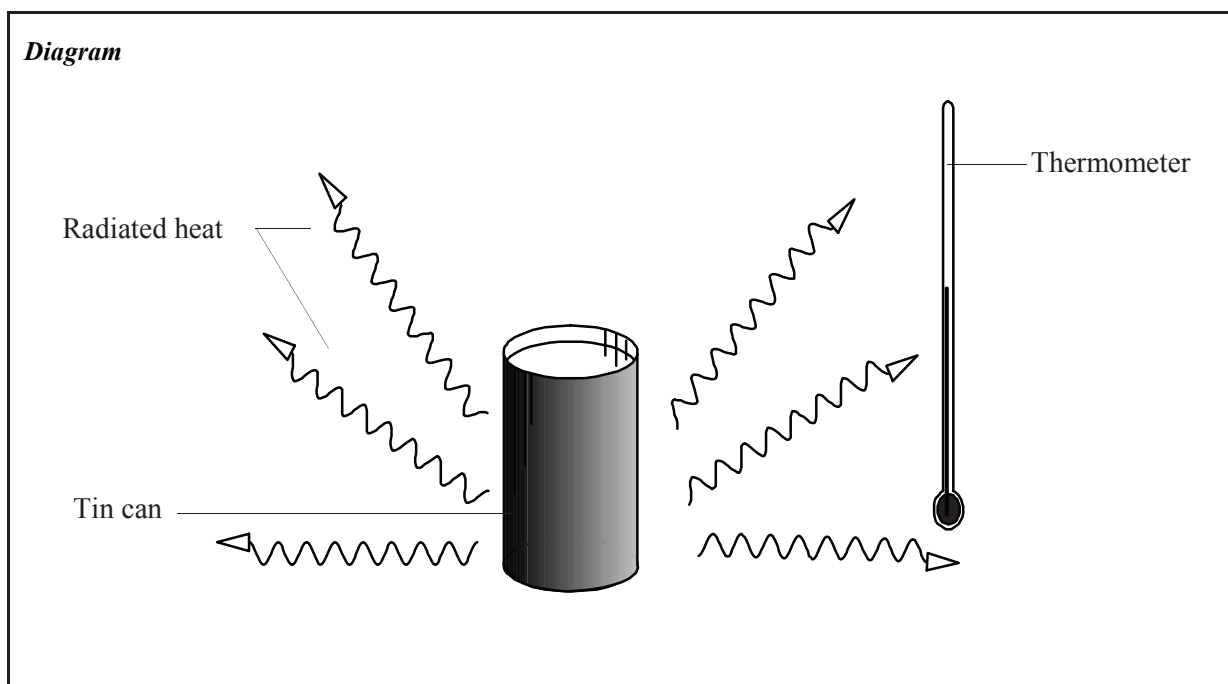
1. To Show Heat Transfer by Radiation (44.4)

2. Planning the Activity:

- (a) A can filled with boiling water loses heat by conduction, convection and radiation. Explain how it loses heat by each of these methods.
 - 1) Conduction: ... *The can loses some heat through the table or bench by conduction*
 - 2) Convection: ... *The hot water heats the air above it by convection*
 - 3) Radiation: *The hot can sends out heat as rays in all directions from it*
- (b) Why is the thermometer placed beside the can and not above it?
..... *So that it is measuring the heat lost by radiation and not by convection to the air above*
- (c) What effect would painting the silver can a matt black colour have on the results of the experiment?
..... *More heat would be radiated as a matt black surface is a very good radiator of heat*

3. Materials Used:

Dark coloured tin can, thermometer, retort stand, boiling water.



4. Method:

- 1) *Place the thermometer, in a retort stand, close to the can as shown in the diagram.*
- 2) *Fill the can with boiling water. Observe any change to the thermometer reading.*

5. Result: *The thermometer shows an increase in temperature.*

6. Conclusions:

Radiated heat from the side of the can causes a rise in temperature.

To Investigate the Expansion of Solids, Liquids and Gases when Heated, and Contraction when Cooled (44.5 - 44.7)

1. To Show that Solids Expand when Heated and Contract when Cooled (44.5)

2. Planning the Activity:

- (a) You are given a metal ball and a ring that it just fits through. If the ball expanded after heating it, how would you show that it had expanded?

.... *If the ball had expanded, it would no longer fit through the ring*

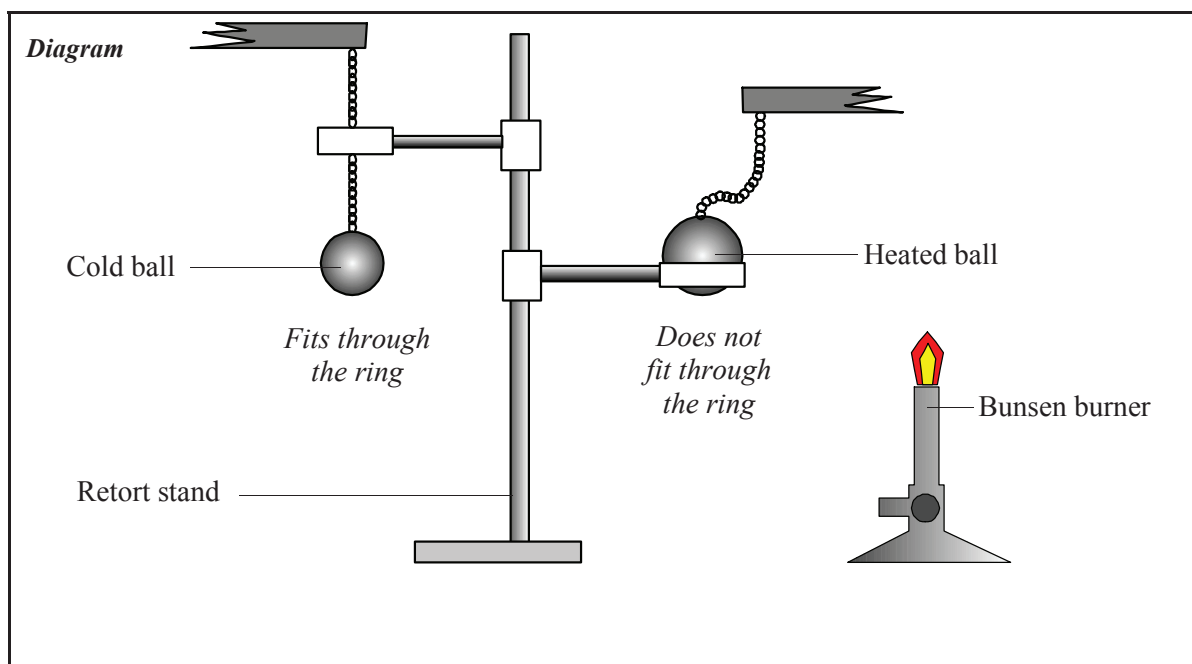
- (b) Why are there gaps left between railway tracks as they are being laid?

... *To allow for the tracks expanding during hot weather*

- (c) Why are electric cables left with some slack as they are hung from pole to pole?

... *In winter, when the weather is cold, the wires would contract and snap if they were too tight*

3. Materials Used: ... *Ball and ring apparatus, tongs, Bunsen burner*



4. Method:

- 1) *Pass the metal ball through the ring to show it fits through when cold.*
- 2) *Heat the ball strongly and try to pass it through the ring. Cool it under water and try again.*

5. Results:

.... *The ball fits through the ring when it is cold, but does not fit through when it is heated*

6. Conclusions:

.... *Solids expand when heated and contract when cooled*

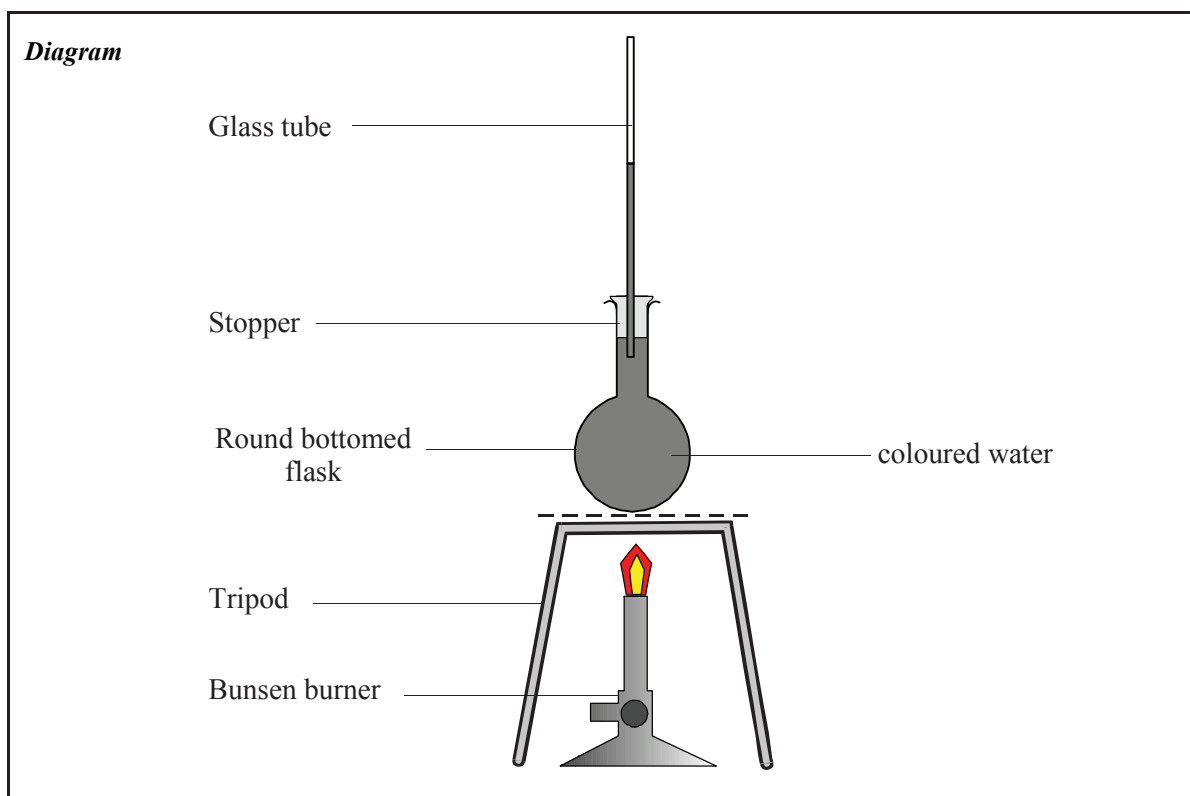
1. To Show that Liquids Expand when Heated and Contract when Cooled (44.6)

2. Planning the Activity:

- (a) Why would you use a long, glass tube in this experiment?
.... *So that the water level in it can be seen to rise when the water is heated*
- (b) Why would you colour the water with food dye or potassium permanganate crystals?
.... *To make it easier to see the water rising in the glass tube*
- (c) If the heated water in the flask was allowed to cool, what would you observe to happen?
.... *The water level in the glass tube would fall*
- (d) Give one practical use for the way a liquid behaves when heated or cooled
... *The liquid in a thermometer expands when heated and contracts when cooled*

3. Materials Used:

Round-bottomed flask, long glass tube, stopper, Bunsen burner, retort stand, coloured water



4. Method:

- 1) *Set up the apparatus as shown in the diagram.*
- 2) *Heat the water in the flask. Observe what happens. Allow the water to cool. Observe what happens.*

5. Results:

....*When heated, the water level in the tube rises; when cooled, the water level in the tube falls.*

6. Conclusions:

.... *Liquids expand when heated and contract when cooled.*

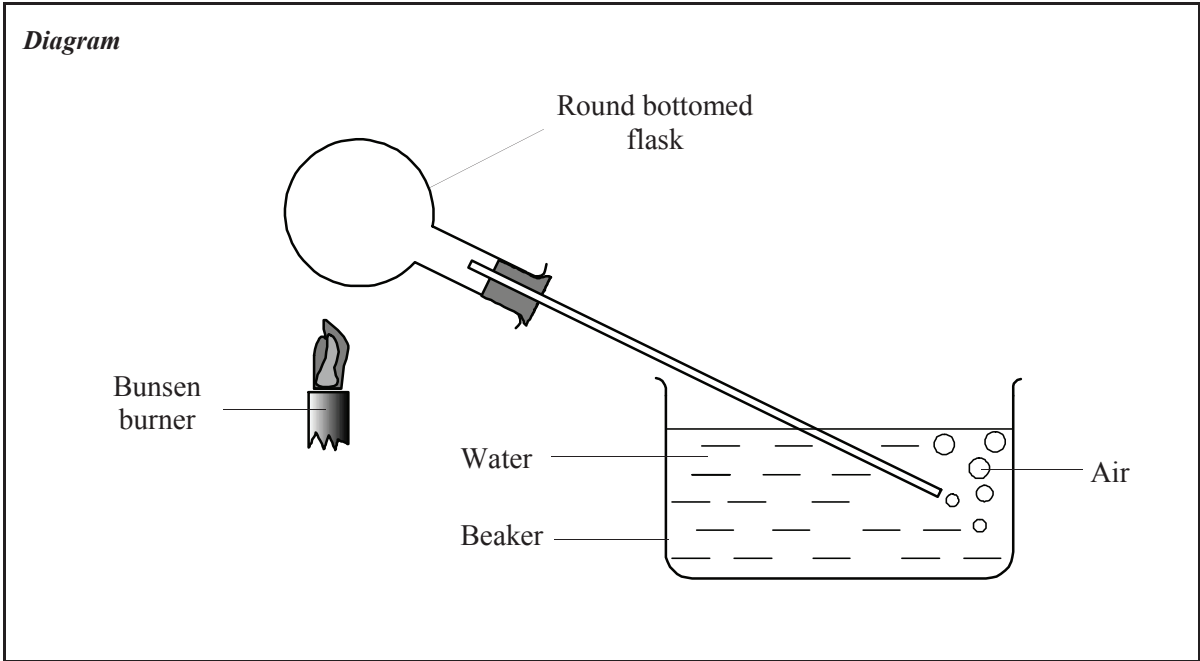
1. To Show that Gases Expand when Heated and Contract when Cooled (44.7)

2. Planning the Activity:

- (a) What gas is being heated and cooled in this experiment? *air*
- (b) Why do bubbles appear in the water in the beaker?
..... *As the gas expands it comes out of the tube and forms bubbles in the water*
- (c) What do you think would happen when the flask is allowed to cool. Why would this happen?
..... *The gas would contract and water would be sucked into the tube to fill the space*

3. Materials Used:

.... *Round-bottomed flask, long glass tube, stopper, retort stand, Bunsen burner, beaker, water.*



4. Method:

- 1) *Set up the apparatus as shown in the diagram.*
- 2) *Heat the flask gently. Observe what happens.*
- 3) *Allow the flask to cool. Observe what happens.*

5. Results:

... *Bubbles of air are seen in the beaker when the gas is heated. When the flask of gas is cooled, water from the beaker enters the tube*

6. Conclusions:

.... *Gases expand when they are heated and contract when cooled*

1. To Show that Light Travels in Straight Lines and Explain how Shadows are Formed (46.1)

2. Planning the Activity:

(a) How do you know that light reaching your eye from an object, has travelled in straight lines?

.... *Because you can't see an object if it is around a corner or behind something else*

(b) A shadow is an area of darkness directly behind an object lit from the front. What information do shadows give about the way light travels?

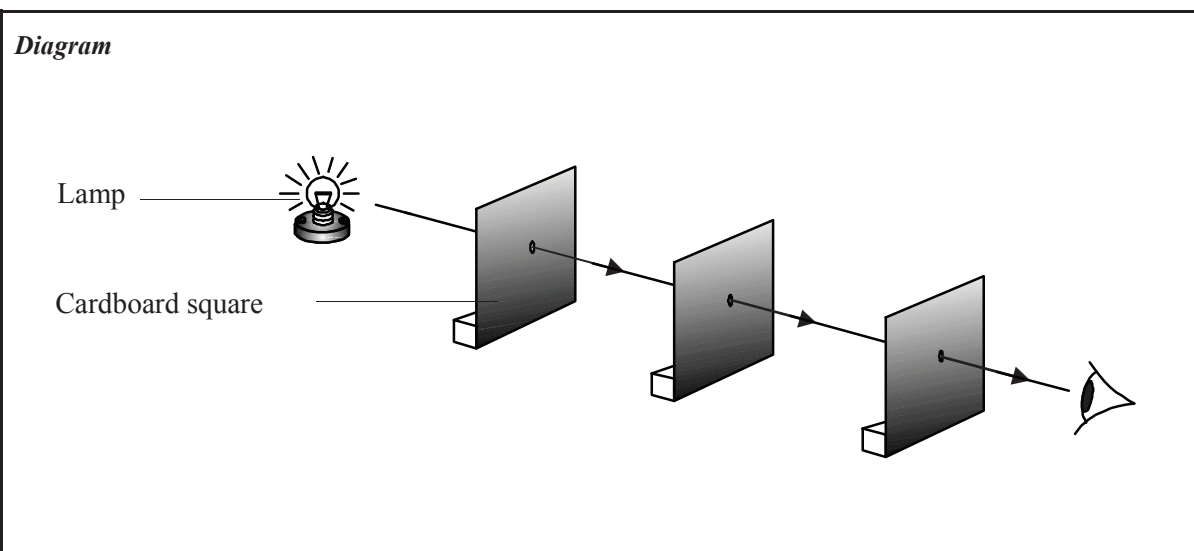
.... *Shadows show that light travels in straight lines*

(c) How would you ensure that the three holes in the cards are in a straight line?

.... *Put a string through all three holes and pull it tight - then all three holes are in line*

3. Materials Used:

.... *Three mounted sheets of cardboard with holes, string, lamp*



4. Method:

- 1) *Set up the apparatus as shown in the diagram.*
- 2) *With the holes in line, look through them to see the lamp. Move one card and look through again.*

5. Results:

.... *The lamp is only seen when all three holes are in line with each other*

6. Conclusion:

.... *Light from the lamp travels in a straight line to reach the eye*

Shadows are formed due to the fact that *light travels in straight lines*

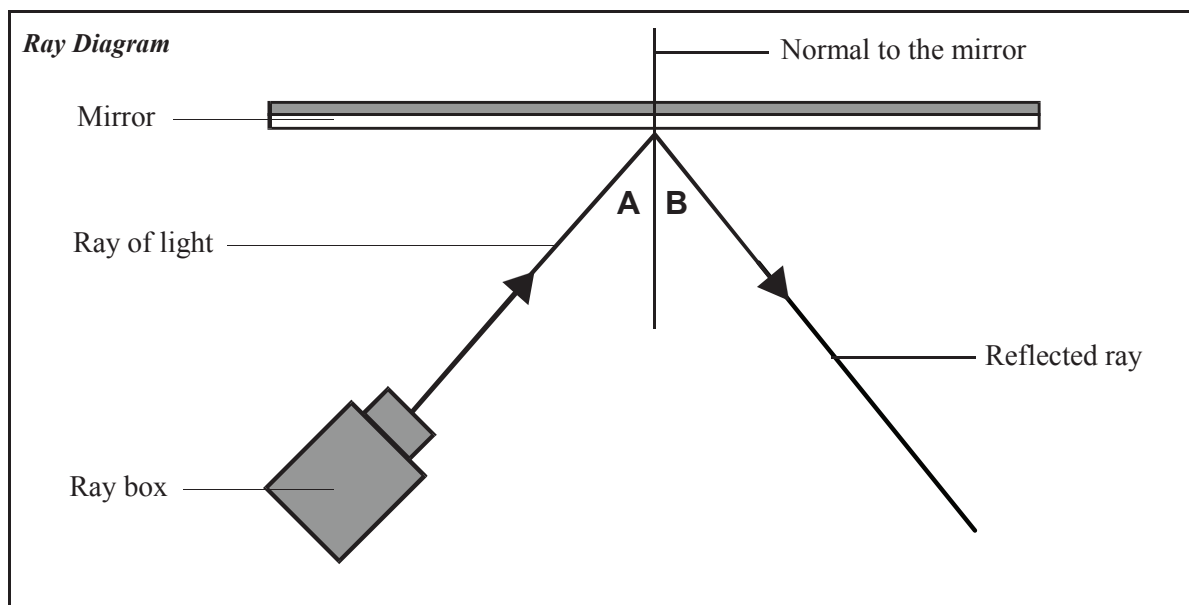
To Investigate the Reflection of Light by Plane Mirrors and Show this Using a Ray Diagram and to Demonstrate the Operation of a Simple Periscope (46.2)

1. To Investigate the Reflection of Light by a Plane Mirror and Draw a Ray Diagram (46.2a)

2. Planning the Activity:

- (a) How would you produce a single light ray using a ray box?
.... By using a slide with a single slit in a darkened room
- (b) Why would you carry out this experiment in a darkened room?
.... So that the light ray is easier to see
- (c) How would you measure the angle the entering light ray makes to the normal, and the angle the exiting light ray makes to the normal? What is always the relationship between these two angles?
.... Use a protractor to measure these angles (see method below)
.... The angles A and B (below) are equal

3. Materials Used: *Light box, mirror, protractor, sheet of paper.*



4. Method: *.... Set up the apparatus as shown above. Trace the positions of the mirror, light ray and reflected light ray on the sheet of paper. Draw the normal. Use a protractor to measure angles A and B.*

5. Results:

.... The angles A and B are equal. The light ray is reflected at the same angle as it entered the mirror ...

6. Conclusion:

The entering (incident) ray always makes an angle to the normal *equal* to the angle made by the exiting (reflected) ray to the normal.

1. To Demonstrate and Explain the Operation of a Simple Periscope (46.2b)

2. Planning the Activity:

- (a) Crouch down behind your desk and hold two plane mirrors, one in each hand, in such a way that you can now see over the top of the desk.
- (b) Given a long, rectangular cardboard box, measuring 50 cm by 8 cm by 8 cm, two plane mirrors, 'Blu-tack' and a pair of scissors, describe how you would make a simple periscope.

.... *Cut two holes in the cardboard box as shown in the diagram. Place two mirrors in the box, facing each other and each at an angle of 45° to the edge of the box. Use the 'Blu-tack' to hold the mirrors in place*

- (c) What angle should the mirrors be to the horizontal? Why is this important?

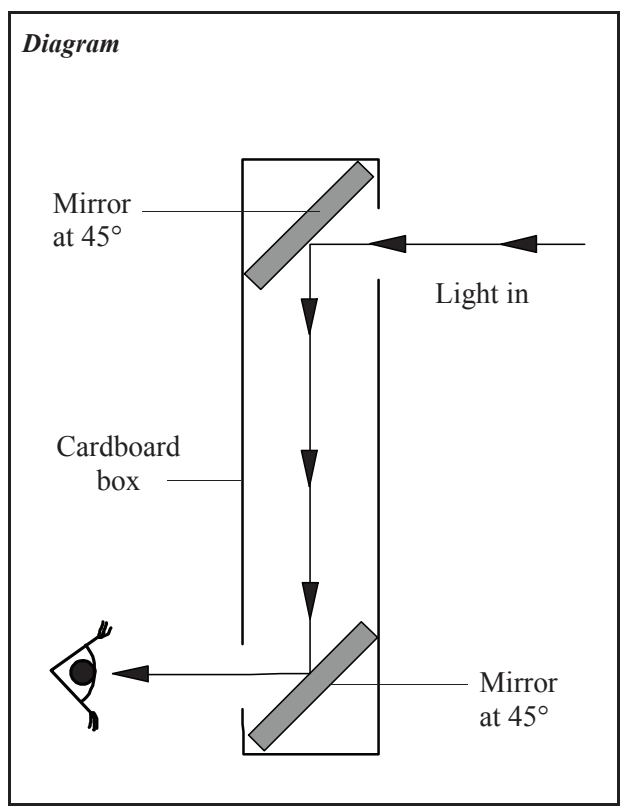
.... *45°, so that the light rays entering the periscope get reflected from one mirror to the other*

3. Materials Used:

Simple periscope

4. Method:

- 1) *Crouch down behind the desk until you can no longer see your teacher.*
- 2) *Use the periscope to see over the desk.*



5. Results:

Things behind the desk can be seen using a periscope.

6. Conclusion:

A periscope can be used to: *see things that are behind tall objects*

1. To Plot the Magnetic Field of a Bar Magnet (48.5)

2. Planning the Activity:

(a) You will use (i) iron filings, and (ii) plotting compasses to investigate the magnetic field of a bar magnet. What information would each of these give about the magnetic field?

(i) iron filings: *Would show the shape of the magnetic field*

(ii) plotting compasses: *Would show the direction of the magnetic field*

(b) Why would you place a sheet of paper over the magnet when using iron filings?

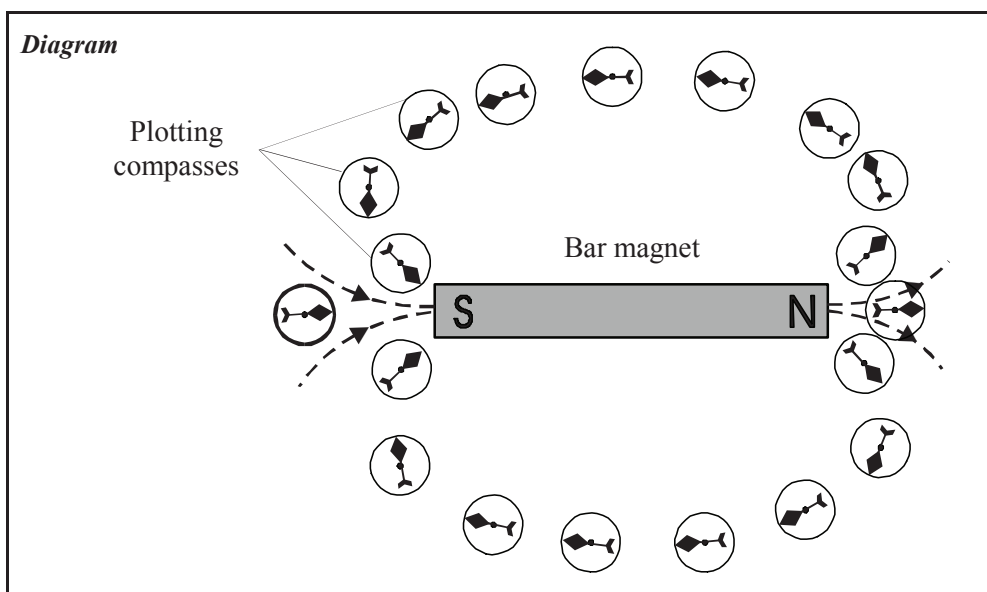
.... *So that the iron filings don't stick to the magnet, as they are difficult to remove*

(c) Why does the needle of a plotting compass always points towards the south pole of the bar magnet?

.... *The needle of a plotting compass is a magnet with a north pole at its tip and a south pole at its tail end. The tip (north pole) is therefore attracted to the south pole of a bar magnet*

3. Materials Used: *Bar magnet, several plotting compasses*

4. Method:



1) *Place the plotting compasses around the magnet as shown above.*

2) *Note the direction of the magnetic field lines as shown by the direction of the compass pointers.*

5. Results:

.... *The plotting compass pointers point from the north pole to the south pole of the bar magnet*

6. Conclusion:

The magnetic field around a bar magnet can be plotted using *iron*..... *filings* and *plotting* *compasses*

The magnetic field lines run from the ... *north* ... pole to the ... *south* ... pole of the bar magnet.

1. To Distinguish Between Conductors and Insulators (50.1)

2. Planning the Activity:

(a) You will use a simple electric circuit to test various substances to see if they are good conductors or insulators of electricity. Name four items each that you think might be made of a substance that is (i) a conductor, and (ii) an insulator.

(i) possible conductors: ... *iron nail, copper wire, pencil 'lead', zinc metal*

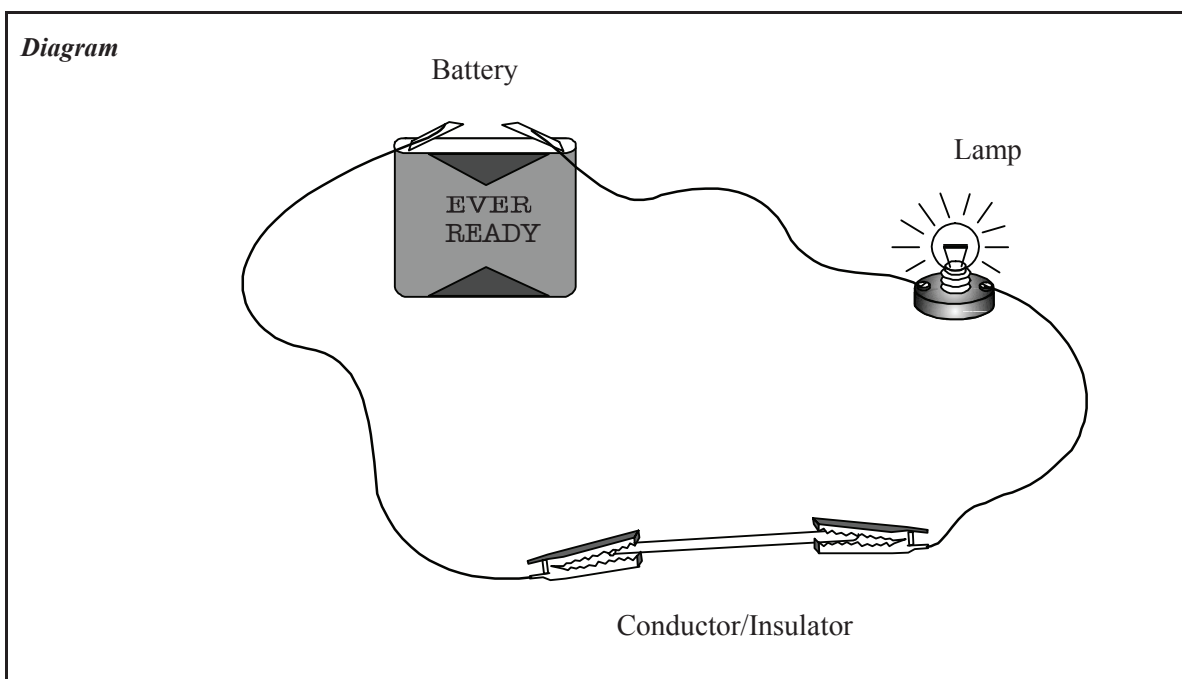
(ii) possible insulators: ... *plastic, glass, wood, air*

(b) Given a battery, a bulb, wires and two crocodile clips, describe how you would go about setting up a circuit that could be used to test for conductors or insulators

... *Make a circuit including the battery and bulb and leave a gap in the circuit for testing different materials to see if they are conductors (bulb lights), or insulators (bulb does not light)*

3. Materials Used:

... *Battery or power pack, wires, two crocodile clips, bulb and holder, various items to be tested*



4. Method:

Set up the apparatus as shown. Place each item to be tested in the gap. Record if the bulb lights.

5. Results: good conductors include: ... *copper, iron, graphite, zinc, aluminium, brass, steel*

good insulators include: *plastic, glass, paper, air, wood, polythene*

6. Conclusion: in general, *metals* are good conductors of electricity, and ... *non* *metals* are good insulators of electricity.

1. To Set up a Simple Electric Circuit To Measure and Show the Relationship Between Current, Voltage and Resistance (50.2)

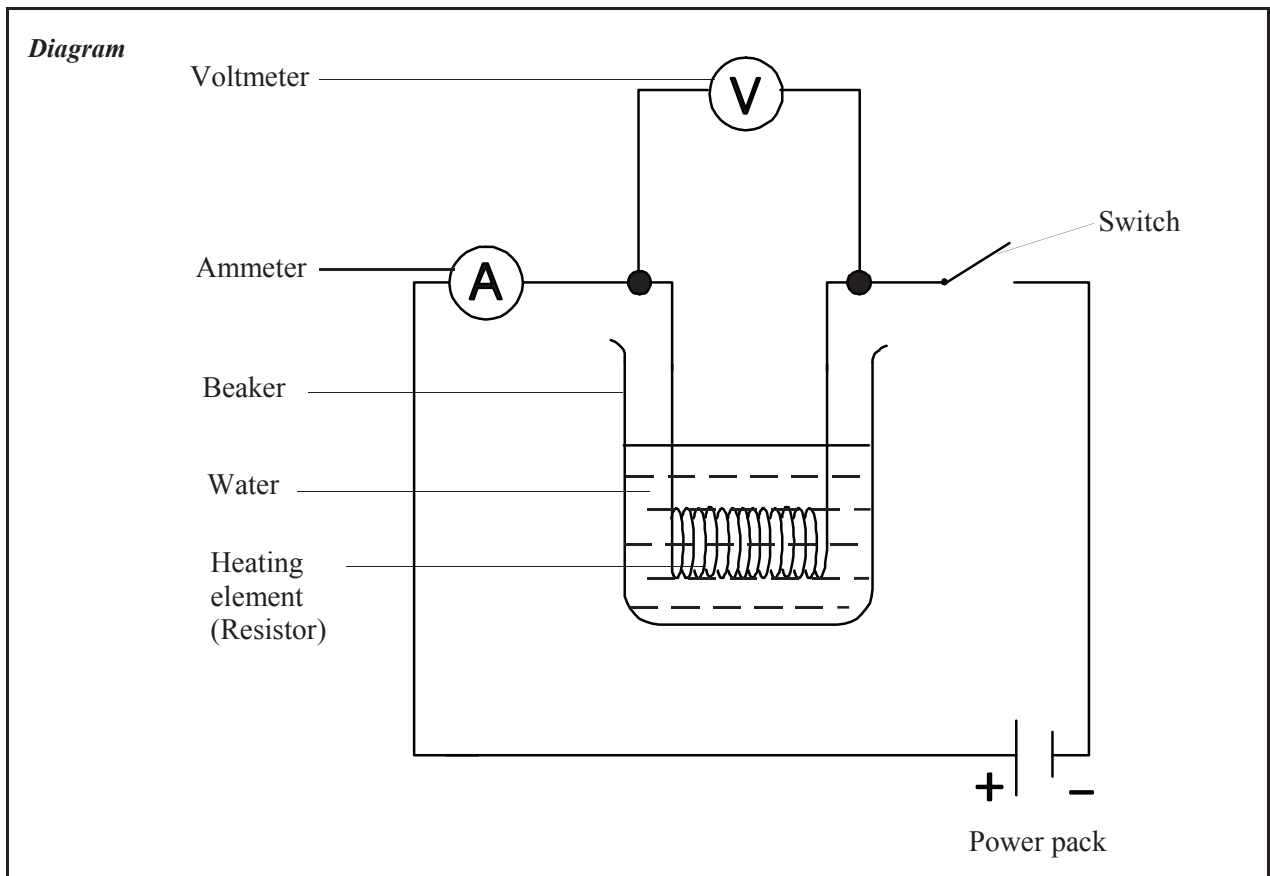
2. Planning the Activity:

- (a) The current in a circuit is measured using an instrument called an *ammeter*, which is wired in *series* in a circuit. Current is measured in units called *amps*
- (b) The voltage in a circuit is measured using an instrument called a *voltmeter*, which is wired in *parallel* in a circuit. Voltage is measured in units called *volts*
- (c) The resistance in a circuit can be found by dividing the *voltage* by the *current* for any given set of values for these. It can also be measured directly using an *ohmmeter*
- (d) If the voltage in the circuit was increased, what effect would this have on the size of the current?
 *The current would also increase*
- (e) The size of the resistance in the heating element depends on the size, shape and the material of which the heating element is made. Provided it does not get too hot, would you expect the resistance to change in size during the experiment? Explain.

No - if the size, shape and material of the heating element doesn't change, neither will its resistance.

3. Materials Used:

... *Power pack, ammeter, voltmeter, heating element (resistor), wires*



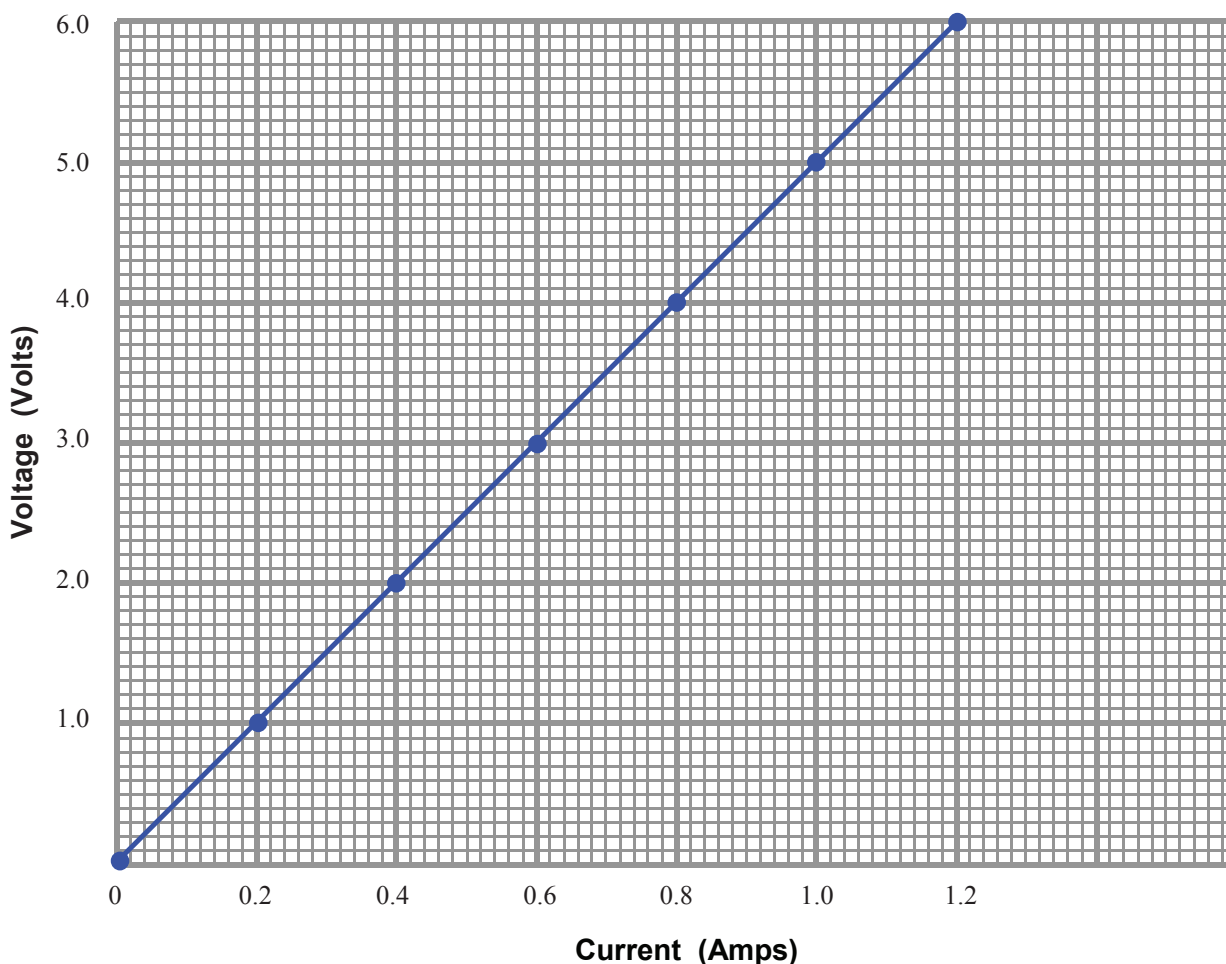
4. Method:

- 1) Set up the apparatus as shown in the diagram.
- 2) Record the current from the ammeter and the voltage from the voltmeter.
- 3) Adjust the power pack voltage and record the current and voltage again.
- 4) Repeat this to find six voltages and corresponding currents.
- 5) Record the results in the table and graph below.

5. Results: Complete the table below to show the corresponding voltages and currents measured:

Voltage (V)	0	1.0	2.0	3.0	4.0	5.0	6.0
Current (A)	0	0.2	0.4	0.6	0.8	1.0	1.2

Draw a graph of Voltage against Current (Voltage on the vertical axis) :



6. Conclusions:

Comment on the shape of the Voltage / Current graph: *straight line through the origin (0,0)*

What is the relationship between voltage and current? *the current is directly proportional to voltage..*

Divide each voltage by its corresponding current. What do you notice about the results?

.... *It gives a constant value each time - always 5*

Voltage divided by current (from Ohm's Law) gives a constant value which is the *resistance*

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