REQUIRED PRACTICAL

Use a light microscope to observe, draw and label a selection of plant and animal cells.

Sample Method

1. Place a tissue sample on a microscope slide.
2. Add a few drops of a suitable stain.
3. Lower a coverslip onto the tissue.
4. Place the slide on the microscope stage and focus on the cells using low power.
5. Change to high power and refocus.
6. Draw any types of cells that can be seen.
7. Add a scale line to the diagram.

Considerations, Mistakes and Errors

- The scale line can be added by focusing on the millimetre divisions of a ruler.

Equipment list

small piece of onion
microscope slide
cover slip
pointed needle
tweezers
iodine solution
white tile
blotting paper
pipette
microscopes
eyepiece graticule

Why do we use iodine?

____

What happen if the onion sample is too thick?

____

____

What are the main differences between a light and electron microscope?

____

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REQUIRED PRACTICAL

Use qualitative reagents to test for a range of carbohydrates, lipids and proteins.

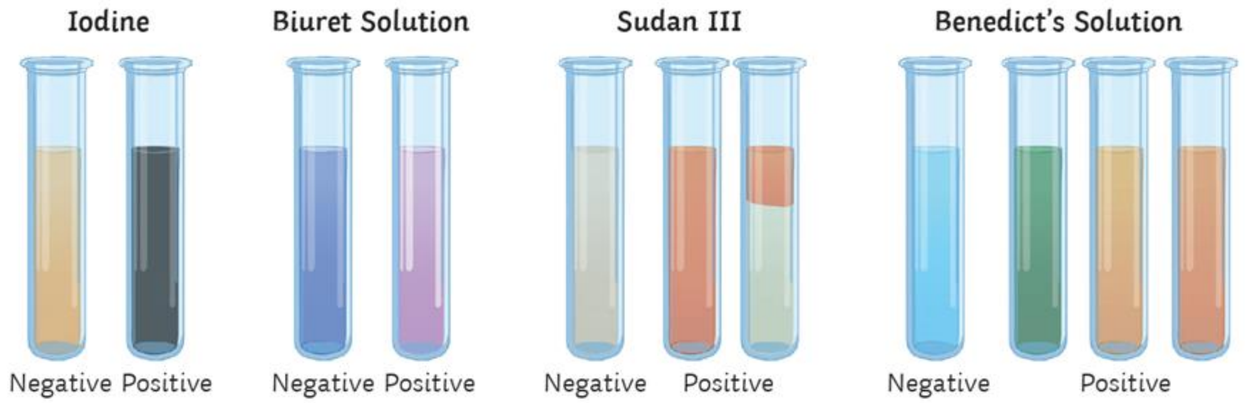
Sample Method

1. To test for sugars, e.g. glucose, add Benedict's reagent and heat in a water bath for two minutes. If sugar is present, it will turn red.
2. To test for starch add iodine solution. If starch is present, it will turn blue-black.
3. To test for protein add biuret reagent. If protein is present, it will turn purple.

Considerations, Mistakes and Errors

- Do not boil the mixture for a long time, because any starch present might break down into sugar and test positive.
- Refer to 'iodine solution' not 'iodine'.
- Sometimes the purple colour is difficult to see. Try holding the test tube in front of a sheet of white paper.

STARCH PROTEIN FAT SUGARS



Describe How you would prepare a solide food for testing?

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Cake is tested for protein and the sample is a blue colour. What does this tell you about the cake?

____

____

Describe how you test for sugars.

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REQUIRED PRACTICAL

Investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue.

Sample Method

Potatoes can be used to measure the effect of sugar solutions on plant tissue:

1. Cut some cylinders of potato tissue and measure their mass.
2. Place the cylinders in different concentrations of sugar solution.
3. After about 30 minutes remove the cylinders and measure their mass again.

Considerations, Mistakes and Errors

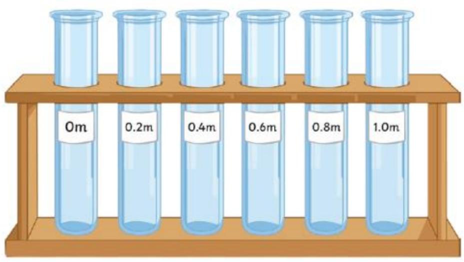
- The cylinders need to be left in the solution long enough for a significant change in mass to occur.
- Before the mass of the cylinders is measured again, they should be rolled on tissue paper to remove any excess solution.
- If the cylinders change in mass, they have gained or lost water by osmosis.

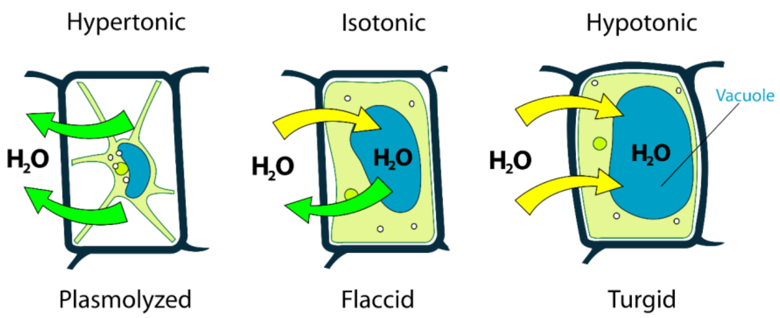
Variables

- The independent variable is the one deliberately changed – in this case, the concentration of sugar solution.
- The dependent variable is the one that is measured – in this case, the change in mass of the potato.
- The control variables are kept the same – in this case, the temperature, the length of time the cylinders were left in the solution and the volume of the solution.

Hazards and Risks

- Care must be taken when cutting the cylinders of potato.





Why do we put lids/bungs on the test tubes?

____

____

Why do some potato chips (or other plant samples) not change in mass?

____

____

REQUIRED PRACTICAL

Investigate the effect of pH on the rate of reaction of amylase enzyme.

Sample Method

1. Put a test tube containing starch solution and a test tube containing amylase into a water bath at 37°C.
2. After 5 minutes add the amylase solution to the starch.
3. Every 30 seconds take a drop from the mixture and test it for starch using iodine solution.
4. Record how long it takes for the starch to be completely digested.
5. Repeat the experiment at different pH values using different buffer solutions.

Considerations, Mistakes and Errors

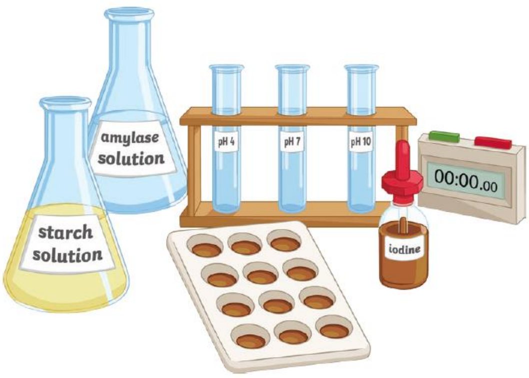
- The solutions need to be left in the water bath for a while to reach the correct temperature before they are mixed.
- After mixing, the tube must be kept in the water bath.
- A buffer solution must be used to keep the reaction mixture at a certain fixed pH.

Variables

- The independent variable is the one deliberately changed – in this case, the pH.
- The dependent variable is the one that is measured – in this case, the time taken for the starch to be digested.
- The control variables are kept the same – in this case, temperature, concentration and volume of starch and amylase.

Hazards and Risks

- Care must be taken if a Bunsen burner is used to heat the water bath.
- Take care not to spill iodine solution on the skin.



How do you know when the starch has been fully broken down?

____

What does optimum mean?

____

What will your results show if the enzyme has been denatured?

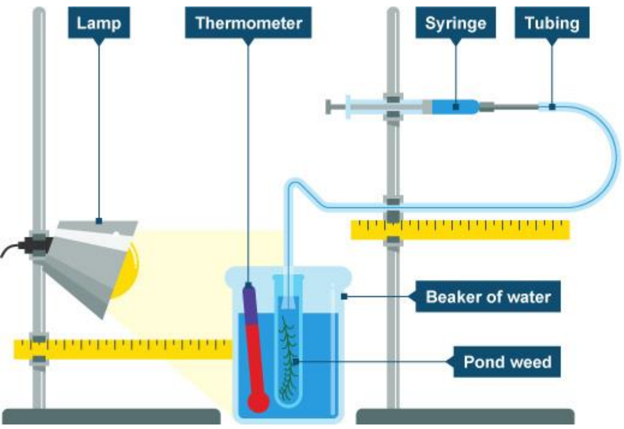
____

____

REQUIRED PRACTICAL

Investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed.

Sample Method 1. Place a piece of pondweed in a beaker and shine a light at it using a lamp a specific distance away. 2. Record the number of bubbles of gas coming out of the pondweed in one minute. 3. Repeat this with the lamp at different distances from the pond weed.	**Considerations, Mistakes and Errors** • It is best to take at least two readings at each distance and calculate the mean of the number of bubbles. • Carbon dioxide is provided by adding a small amount of sodium hydrogen carbonate to the water.
Variables • The independent variable is the light intensity (distance from the light). • The dependent variable is the number of bubbles in one minute. • The control variables are the piece of pondweed, the temperature, and the concentration of carbon dioxide.	**Hazards and risks** • Care must be taken to avoid any water being dropped onto the hot light bulb.



What are you observing during this practical?

____

What is a limiting factor?

____

Why must the temperature be kept the same (REMEMBER you cannot say fair test)?

____

____

REQUIRED PRACTICAL

Investigating the effect of a factor on human reaction time.

Sample Method

Reaction time can be investigated by seeing how quickly a dropped ruler can be caught between finger and thumb:

1. The experimenter holds a metre ruler vertically from the end.
2. The subject has their finger and thumb a small distance apart, either side of the ruler, on the 50cm line.
3. The experimenter lets go of the ruler and the subject has to trap it.
4. The distance the ruler travels from the 50cm line is noted.
5. The experiment is repeated on subjects that have just drunk coffee or cola and subjects that have not.

Considerations, Mistakes and Errors

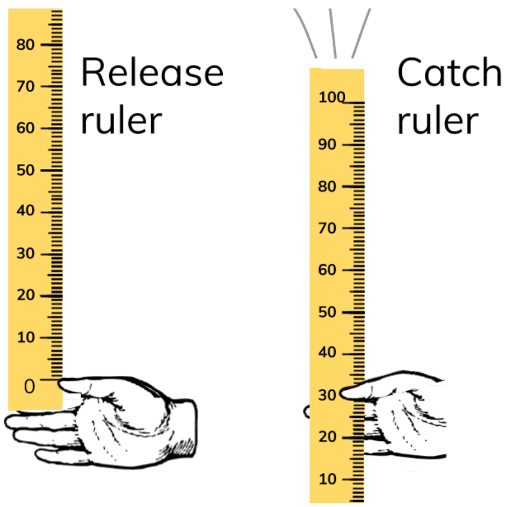
- It is very difficult to control the variables in this experiment.
- To obtain reliable results, large numbers of subjects need to be tested and averages taken.

Variables

- The independent variable is whether the subject has taken in caffeine or not.
- The dependent variable is the distance that the ruler travels.
- The control variables are the age, sex and mass of the subjects.

Hazards and risks

- There are limited risks with this experiment.



If someone has a faster reaction time how will you know?

____

Why must you use the same hands (REMEMBER you cannot say fair test)?

____

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REQUIRED PRACTICAL	
Measure the population size of a common species in a habitat.	
Sample Method 1. Place a quadrat on the ground at random. 2. Count the number of individual plants of one species in the quadrat. 3. Repeat this process a number of times and work out the mean number of plants. 4. Work out the mean number of plants in $1m^2$. 5. Measure the area of the whole habitat and multiply the number of plants in $1m^2$ by the whole area.	**Considerations, Mistakes and Errors** • The main consideration in the experiment is making sure that the quadrats are placed at random. Using random numbers to act as coordinates can help with this. • The more samples that are taken, then the more accurate the estimate should be.
Variables • The dependent variable is the number of plants in the quadrat.	**Hazards and Risks** • Care should be taken to wash hands after ecology work in a habitat. • Care should be taken throwing quadrats – throw low to the ground, not up in the air.

When would you use random sampling and when would you use a transect and WHY?

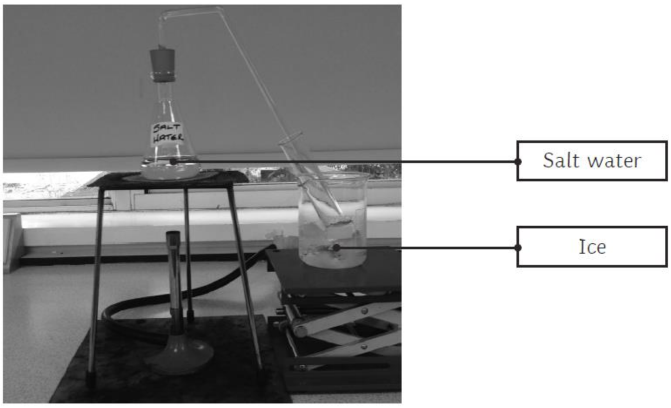
Why do quadrats provide an estimate of biodiversity for an ecosystem?

Trilogy Chemistry Paper 2

REQUIRED PRACTICAL

Analysis and purification of water samples from different sources.

Sample Method	Hazards and Risks
1. Use a pH probe or suitable indicator to analyse the pH of the sample. 2. Set up the equipment as shown. 3. Heat a set volume to 100°C so that the water changes from liquid to gas. 4. The water collects in the condenser and changes state from gas to liquid. Collect this pure water in a beaker. 5. When all the water from the sample has evaporated, measure the mass of solid that remains to find the amount of dissolved solids present in the sample.	• There is a risk of the experimenter burning themselves on hot equipment, so care must be taken during and after the heating process.



What does the boiling point of the samples tell you?

What would your results look like for distilled water?

What would be a sensible volume for each sample?

How does the condenser work?

Trilogy Chemistry Paper 1

REQUIRED PRACTICAL

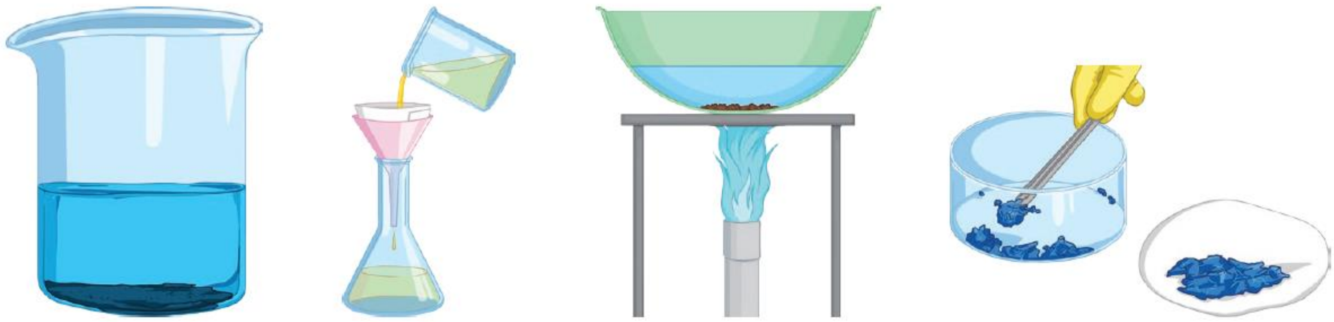
Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate.

Sample Method

1. Add the metal oxide or carbonate to a warm solution of acid until no more will react.
2. Filter the excess metal oxide or carbonate to leave a solution of the salt.
3. Gently warm the salt solution so that the water evaporates and crystals of salt are formed.

Hazards and Risks

- Corrosive acid can cause damage to eyes, so eye protection must be used.
- Hot equipment can cause burns, so care must be taken when the salt solution is warmed.



Why must the acid and copper oxide be heated and stirred?

Why must copper oxide be added in excess?

Explain why we filter the solution (use the terms filtrate and residue).

____

Explain what is happening is picture 3

____

____

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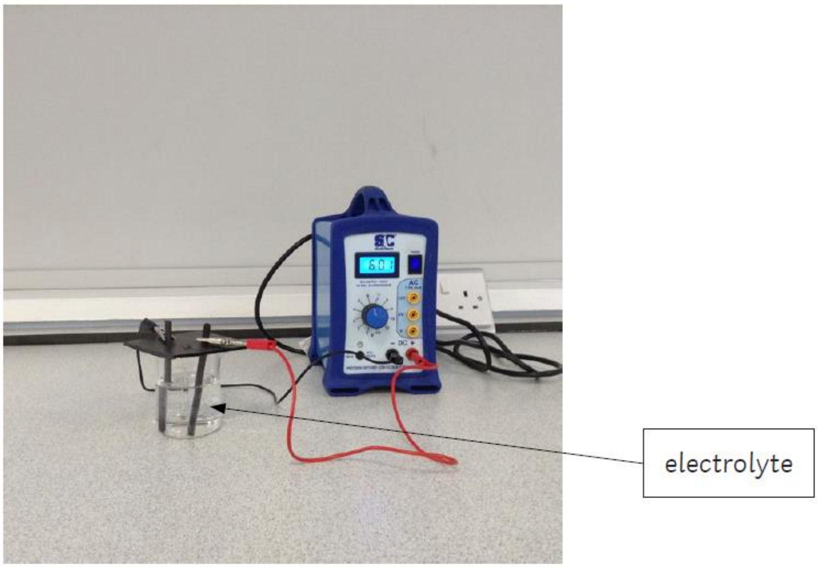
Trilogy Chemistry Paper 1

REQUIRED PRACTICAL

Investigate what happens when aqueous solutions are electrolysed using inert electrodes.

Sample Method	**Hazards and Risks**
1. Set up the equipment as shown in the diagram on page 118. 2. Pass an electric current through the aqueous solution. 3. Observe the products formed at each inert electrode.	• A low voltage must be used to prevent an electric shock. • The room must be well ventilated, and the experiment must only be carried out for a short period of time, to prevent exposure to dangerous levels of chlorine gas.



Why must the electrolyte be molten or in solution?

____

____

Gases often come off electrode, describe how to test for the following gases?

Oxygen -____

Hydrogen -____

Carbon Dioxide -____

Chlorine -____

Trilogy Chemistry Paper 1

REQUIRED PRACTICAL

Investigate the variables that affect temperature changes in reacting solutions.

Sample Method

1. Set up the equipment as shown.
2. Take the temperature of the acid.
3. Add the metal powder and stir.
4. Record the highest temperature the reaction mixture reaches.
5. Calculate the temperature change for the reaction.
6. Repeat the experiment using a different metal.

Considerations, Mistakes and Errors

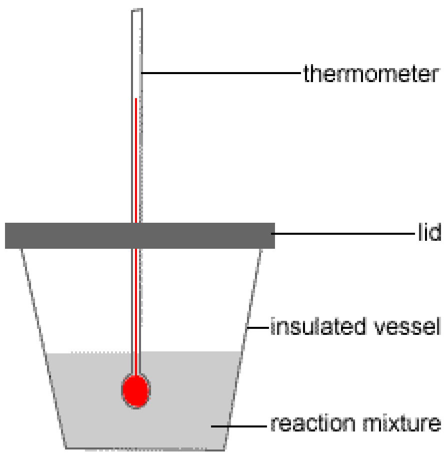
- There should be a correlation between the reactivity of the metal and the temperature change, i.e. the more reactive the metal, the greater the temperature change.
- When a measurement is made there is always some uncertainty about the results obtained. For example, if the experiment is repeated three times and temperature changes of 3°C, 4°C and 5°C are recorded:
  - the range of results is from 3°C to 5°C
  - the mean (average) = $\frac{(3 + 4 + 5)}{3} = 4$°C

Variables

- The independent variable is the metal used.
- The dependent variable is the temperature change.
- The control variables are the type, concentration and volume of acid.

Hazards and Risks

- There is a low risk of a corrosive acid damaging the experimenter's eye, so eye protection must be used.



Trilogy Chemistry Paper 2

Why is an insulated container used?

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____

Why would you expect to see in an exothermic reaction?

____

____

Why is an endothermic reaction?

____

REQUIRED PRACTICAL

Investigate how changes in concentration affect the rates of reactions by methods involving the production of gas or a colour change.

This investigation uses the reaction between sodium thiosulfate and hydrochloric acid.

Sample Method

1. Set up the equipment as shown.
2. Add the hydrochloric acid to the flask and swirl to mix the reactants.
3. Start the timer.
4. Watch the cross through the flask.
5. When the cross is no longer visible stop the timer.
6. Repeat the experiment using hydrochloric acid of a different concentration.

Considerations, Mistakes and Errors

- There should be a correlation between the concentration of the acid and the time taken for the cross to 'disappear'.
- The higher the concentration of the acid, the faster the rate of reaction, and the shorter the time for the cross to 'disappear'.

Variables

- The independent variable is the concentration of the acid.
- The dependent variable is the time it takes for the cross to 'disappear'.
- The control variables are the volume of acid and the concentration and volume of sodium thiosulfate.

Hazards and Risks

- Corrosive acid can damage eyes, so eye protection must be used.
- Sulfur dioxide gas can trigger an asthma attack, so the temperature must always be kept below 50°C.

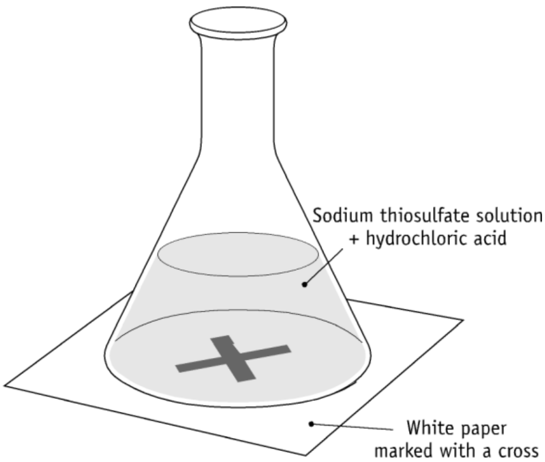
What does concentration mean? Give some sensible concentrations to test.

____

____

Why does a higher concentration result in a higher rate of reaction (mention COLLISIONS)

____



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Trilogy Chemistry Paper 2

REQUIRED PRACTICAL

Investigate how paper chromatography can be used to separate and tell the difference between coloured substances.

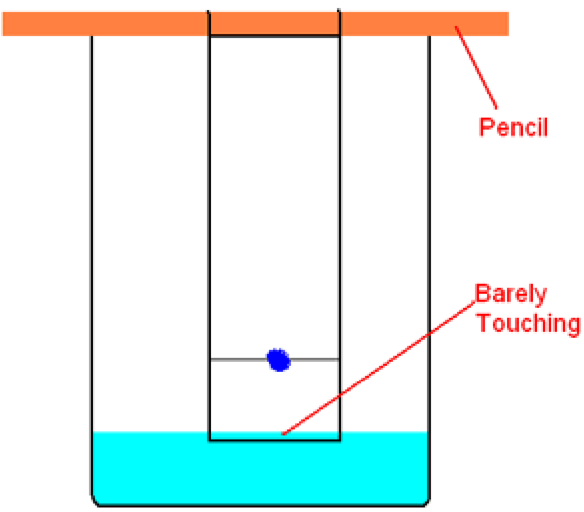
Sample Method

1. Draw a 'start line', in pencil, on a piece of absorbent paper.
2. Put samples of five known food colourings (A, B, C, D and E), and the unknown substance (X), on the 'start line'.
3. Dip the paper into a solvent.
4. Wait for the solvent to travel to the top of the paper.
5. Identify substance X by comparing the horizontal spots with the results of A, B, C, D and E.

Considerations, Mistakes and Errors

- Pure substances produce a single spot in all solvents.
- Only ever use pencil to draw the start line, as ink will dissolve and affect your results.

Paper Strip in Jar



Why is the start line drawn in pencil?

What does the position of the ink tell you about the solubilityl?

What is an Rf value and how do you calculate it?

Why must the solvent be below the ink line?

REQUIRED PRACTICAL

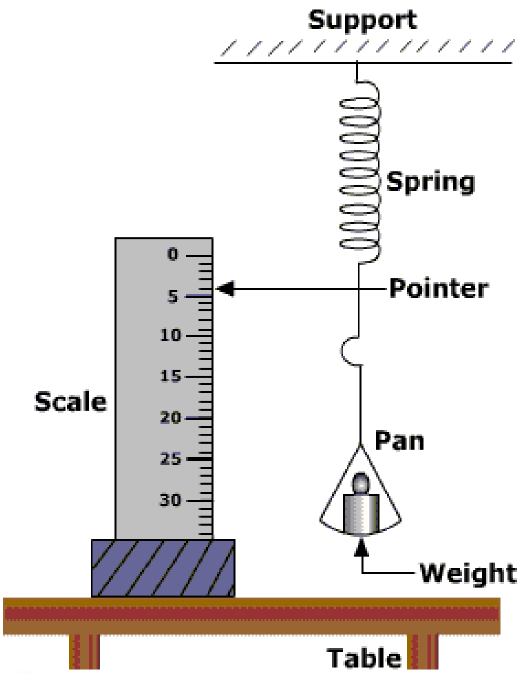
Investigate the relationship between force and extension for a spring.

Sample Method
1. Set up the equipment as shown.
2. Add 100g (1N) to the mass holder.
3. Measure the extension of the spring and record the result.
4. Repeat steps 2 to 3 for a range of masses from 1N to 10N.

Considerations, Mistakes and Errors
- The extension is the total increase in length from the original unloaded length. It is *not* the total length or the increase each time.
- Adding too many masses can stretch the spring too far, which means repeat measurements cannot be made.

Variables
- The independent variable is the one deliberately changed – in this case, the force on the spring.
- The dependent variable is the one that is measured – the extension.

Hazards and Risks
- The biggest hazard in this experiment is masses falling onto the experimenter's feet. To minimise this risk, keep masses to the minimum needed for a good range of results.



Write the equation to calculates force from the spring constant and spring extension.

____

Describe the difference between the length of the spring and extension of a spring.

____

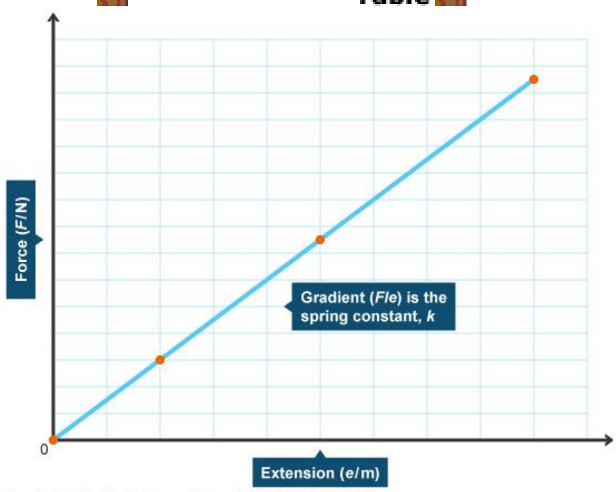
____

Using the graph below, explain the relationship between the force applied and the extension of the spring.

____

____

____



Graph showing Hooke's Law. Extension is plotted against force.

At what point would the shape of this graph change.

____

____

REQUIRED PRACTICAL

Investigate the effect of varying the force and / or the mass on the acceleration of an object.

Sample Method

1. Set up the equipment as shown.
2. Release the trolley and use light gates or a stopwatch to take the measurements needed to calculate acceleration.
3. Move 100g (1N) from the trolley onto the mass holder.
4. Repeat steps 2 and 3 until all the masses have been moved from the trolley onto the mass holder.

If investigating the mass, keep the force constant by removing a mass from the trolley but not adding it to the holder.

Considerations, Mistakes and Errors

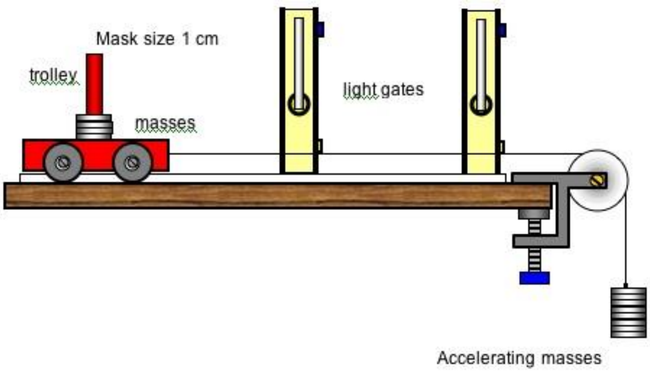
- When changing the force it is important to keep the mass of the system constant. Masses are taken from the trolley to the holder. No extra masses are added.
- Fast events often result in timing errors. Repeating results and finding a mean can help reduce the effect of these errors.
- If the accelerating force is too low or the mass too high, then frictional effects will cause the results to be inaccurate.

Variables

- The independent variable is the force or the mass.
- The control variable is kept the same. In this case, the force if the mass is changed or the mass if the force is changed.

Hazards and Risks

- The biggest hazard in this experiment is masses falling onto the experimenter's feet. To minimise this risk, masses should be kept to the minimum needed for a good range of results.



Why is it important to pass the string over a pulley instead of it just letting it hang over the edge of the desk?

Why is it important to always put the mass that has been removed from the trolley onto the mass holder connected to the pulley?

Why is it important that the mask (card) is at the same height as the light gates?

REQUIRED PRACTICAL

Investigate the specific heat capacity of materials, linking the decrease of one energy store (or work done) to the increase in temperature and subsequent increase in thermal energy stored.

Sample Method

1. Set up the apparatus as shown.
2. Measure the start temperature.
3. Switch on the electric heater for 5min.
4. Measure the end temperature.
5. Measure the voltage and current to find the power.
6. Repeat for different liquids.
7. Calculate the specific heat capacity.
8. Compare your results to another group's. If they get similar answers the experiment is **reproducible**.

Considerations, Mistakes and Errors

- The energy provided by the heater is calculated as power × time. However, it could also be found using a joulemeter.
- The specific heat capacity is calculated from the energy provided, the mass of the liquid and the temperature change.
- If the temperature rise is too high, energy loss to the surroundings will affect the results.

Variables

- The independent variable is the type of liquid.
- The dependent variable is the temperature.
- Control variables are the amount of liquid used and energy provided.

Hazards and Risks

- The electric heater could be very hot so you must *not* touch it directly.
- If the liquids become hot they could boil and spit, so safety goggles must be worn and the heater should not be left on for longer than is necessary.

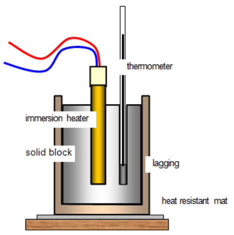


Figure 1

Write the equation that links specific heat capacity, mass, temperature change and energy.

What does specific heat capacity mean?

____

____

The block doesn't heat up as quickly as expected. Why?

____

____

REQUIRED PRACTICAL

Identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank.

Sample Method

1. Time how long it takes one wave to travel the length of the tank. Use this to calculate wave speed using $\text{speed} = \frac{\text{distance}}{\text{time}}$.
2. To find the frequency, count the number of waves passing a fixed point in a second.
3. Estimate the wavelength by using a ruler to measure the peak-to-peak distance as the waves travel.
4. Use a stroboscope to make the same measurements and compare the results.

Considerations, Mistakes and Errors

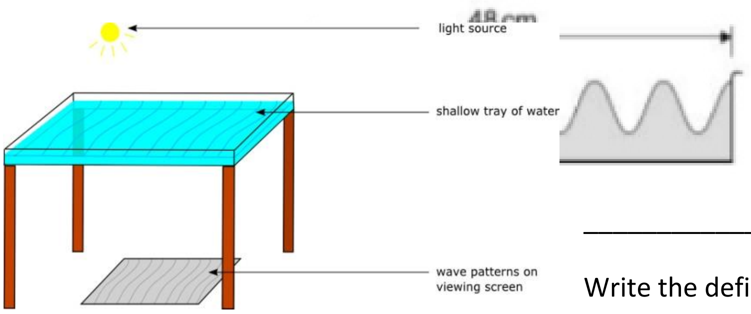
- Using a stroboscope can significantly improve the accuracy of measurements.
- By projecting a shadow of the waves onto a screen below the stroboscope, flash speed can be adjusted to make the waves appear stationary. This makes wavelength measurements much more accurate.
- For high frequencies that are difficult to count, this can be used with the wave speed measurement to calculate the frequency using $f = \frac{v}{\lambda}$.

Variables

- The key control variable is water depth. It important to ensure that the depth of the water is kept constant across the tank as, for a given frequency, the depth will affect the speed and wavelength.

Hazards and Risks

- When using a stroboscope there is a risk to people with photo-sensitive epilepsy. It is important to check that there are no at risk people involved in the experiment or in the area.



The diagram above shows a riplle tank. What is the wavelength of the wave?

_________________________ cm

Write the definition of frequency.

____

____

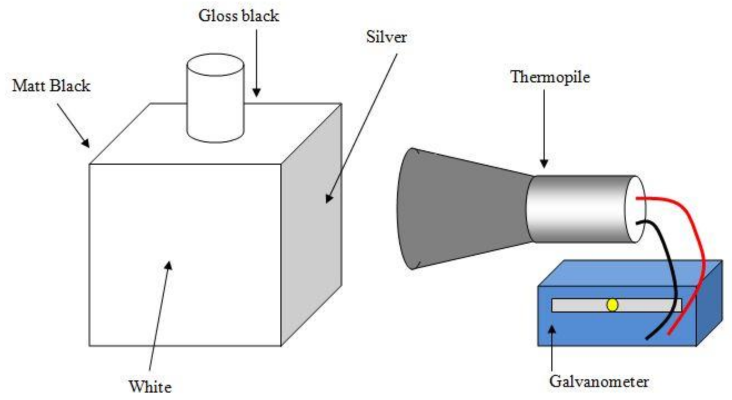
Write the equation that links wavelength, frequency and wave speed.

The frequency of the above wave is 2Hz. Calculate the wave speed and give the correct units.

REQUIRED PRACTICAL

Investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.

Sample Method	Considerations, Mistakes and Errors
1. Take four boiling tubes each painted a different colour: matt black, gloss black, white and silvered. 2. Pour hot water into each boiling tube. 3. Measure and record the start temperature of each tube. 4. Measure the temperature of each tube every minute for 10 min. 5. The tube that cools fastest, emits infrared energy quickest.	• A common error in this experiment is not having the boiling tubes at the same temperature at the start – a hotter tube will cool quicker initially, which can affect results. • Evaporation from the surface of the water can cause cooling too, which will affect the results. To minimise this, block the top of each tube with a bung or a plug of cotton wool.
Variables	**Hazards and Risks**
• The independent variable is the colour of the boiling tube. • The dependent variable is the temperature. • Control variables include volume of water, start temperature and environmental conditions.	• The main hazard is being burned when pouring the hot water and when handling the hot tubes. Using a test tube rack to hold the tubes minimises the need to touch the tubes and means hands can be kept clear when pouring the water into them.



Which surface would you expect to see a higher temperature rise and why?

Why must the thermometer be an equal distance away from the surfaces? (REMEMBER you cannot say fair test)

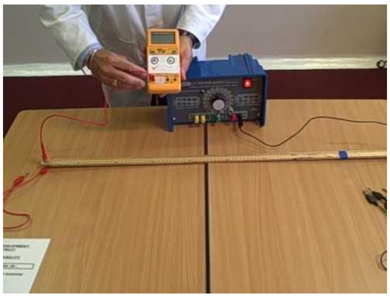
Why are shiny surfaces not good absorbers of infrared radiation?

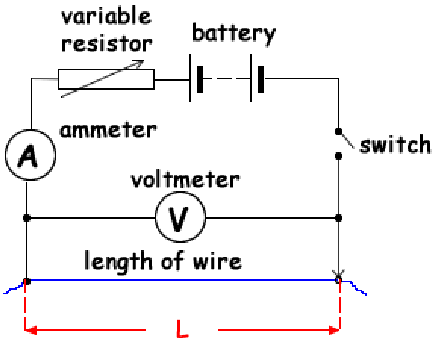
Name some appliances that use infrared radiation.

REQUIRED PRACTICAL

Investigate the factors that affect the resistance of electrical circuits.

Sample Method	**Considerations, Mistakes and Errors**
This example looks at how length affects the resistance of a wire: 1. Set up the standard test circuit as shown. 2. Pre-test the circuit and adjust the supply voltage to ensure that there is a measurable difference in readings taken at the shortest and longest lengths. 3. Record the voltage and current at a range of lengths, using crocodile clips to grip the wire at different points. 4. Use the variable resistor to keep the current through the wire the same at each length. 5. Use the voltage and current measurements to calculate the resistance.	• Adjusting the supply voltage to ensure as wide a range of results as possible is important, as measurements could be limited by the precision of the measuring equipment. • The range of measurements to be tested should always include at least five measurements at reasonable intervals. This allows for patterns to be seen without missing what happens in between, but also without taking large numbers of unnecessary measurements.
Variables	**Hazards and Risks**
• The independent variable is the length of the wire. • The dependent variable is the voltage. • The control variable is the current (which is kept the same, because if it was too high it would cause the wire to get hot and change its resistance).	• Current flowing through the wire can cause it to get very hot. • To avoid being burned by the wire: – a low supply voltage should be used, such as the cell in the diagram – adjust the variable resistor to keep the current low.





State Ohm's law to caluclate resistance

____

____

Describe how you would calculate resistance of the wire in this circuit.

____

____

Describe how resistance changes when the length of wire increases

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Why should the current in the circuit not be set too high?

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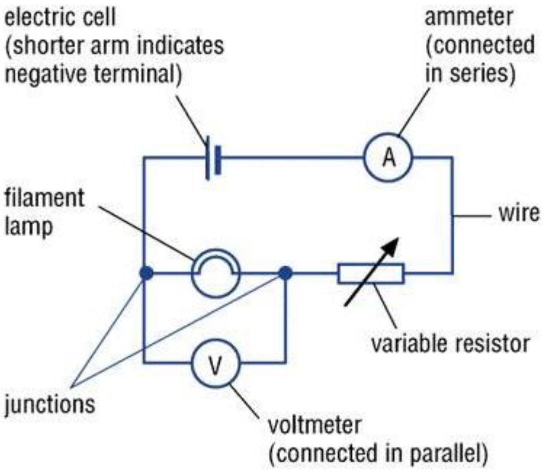
REQUIRED PRACTICAL

Investigate the *V–I* characteristics of a filament lamp, a diode and a resistor at constant temperature.

Sample Method	Considerations, Mistakes and Errors
1. Set up the standard test circuit as shown. 2. Use the variable resistor to adjust the potential difference across the test component. 3. Measure the voltage and current for a range of voltage values. 4. Repeat the experiment at least three times to be able to calculate a mean. 5. Repeat for the other components to be tested.	• Before taking measurements, check the voltage and current with the supply turned off. This will allow zero errors to be identified. • A common error is simply reading the supply voltage as the voltage across the component. At low component resistances, the wires will take a sizeable share of the this voltage, resulting in a lower voltage across the component. This is why a voltmeter is used to measure the voltage across the component.
Variables	**Hazards and Risks**
• The independent variable is the potential difference across the component (set by the variable resistor). • The dependent variable is the current through the component, measured by the ammeter.	• The main risk is that the filament lamp will get hotter as the current increases and could cause burns. If it overheats, the bulb will 'blow' and must be allowed to cool down before attempting to unscrew and replace it.



Describe how you would measure the current and voltage in a series circuit.

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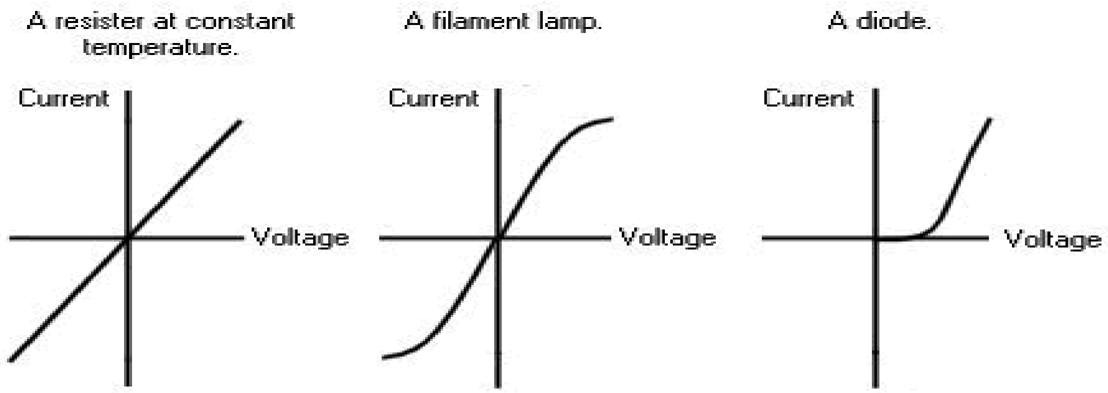

Draw the circuits symbols for a resistor, filament lamp and diode.

Describe the shape of each graph and explain what this means about the resistance in each component.

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REQUIRED PRACTICAL

Investigate the density of regular and irregular solids and liquids.

Sample Method

1. Set the equipment up as shown.
2. Record the height of the water in the measuring cylinder and the mass of the solid / liquid being tested.
3. Add the solid / liquid being tested to the measuring cylinder.
4. Record the new height in the measuring cylinder.
5. Subtracting the original height from the new height gives the volume of the solid / liquid being tested.
6. Now the density can be calculated.

Considerations, Mistakes and Errors

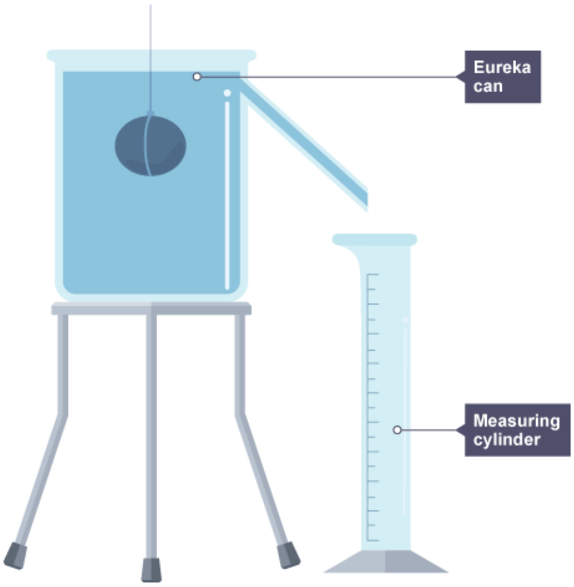
- If a solid that is less dense than water is tested, the volume measurement will be incorrect because the solid will not be fully submerged.
- When reading from the measuring cylinder, the reading should be taken from the bottom of the **meniscus**.
- The temperature of the water must be exactly the same throughout all tests, as an increase in temperature could cause the material or water to change volume slightly through expansion.

Variables

- The independent variable is the material being tested.
- The dependent variables are the volume and mass.
- The control variable is the temperature.

Hazards and risks

- There are very few hazards, unless the materials being tested are hazardous or react with water.
- The main hazard could be a slip hazard if water is spilt.



Write the equation to calculate density. Also draw the triangle for this equation.

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Explain why the water pushed out of the Eureka can is measured.

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Explain why the measuring cylinder is used in this investigation and not a beaker.

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