

Apparatus:

Method:

Sources Of Error:

Variables:

Dependent -

Independent -

Control -

Risks:

**REQUIRED PRACTICAL
TEMPLATE SLIDE**

PHYSICS REQUIRED PRACTICALS

1. Specific heat capacity
2. Thermal insulation
 - a. Material type
 - b. Material thickness
3. Resistance
 - a. Length of wire
 - b. Series & parallel circuits
4. I-V characteristics
 - a. Filament lamp
 - b. Resistor
 - c. Diode
5. Density
 - a. Regular shaped object
 - b. Irregular shaped object
 - c. Liquid
6. Force & extension
7. Acceleration
 - a. The effect of force
 - b. The effect of mass
8. Waves
 - a. Ripple tank
 - b. Solid
9. Light
10. Radiation & absorption

BIOLOGY REQUIRED PRACTICALS

1. Microscopy
2. Microbiology
3. Osmosis
4. Food tests
 - a. Glucose
 - b. Starch
 - c. Lipids
 - d. Protein
5. Enzymes
6. Photosynthesis
7. Reaction time
8. Plant responses
9. Field investigations
 - a. Random sampling
 - b. Transect
10. Decay

CHEMISTRY REQUIRED PRACTICALS

1. Making salts
2. Titrations
3. Electrolysis
4. Temperature changes
5. Rates of reaction
 - a. Volume of gas
 - b. Colour changes
6. Chromatography
7. Identifying ions
 - a. Flame tests
 - b. Carbonate test
 - c. Sulfate test
 - d. Halide test
8. Water purification
 - a. Analysing a water sample
 - b. Purifying a water sample

**PHYSICS
REQUIRED
PRACTICALS**

Method:

1. Measure & record the mass of the block
2. Wrap the insulation around the block
3. Place the heater in one hole in the block
4. Connect the ammeter, power pack, and heater in series
5. Connect the voltmeter across the heater
6. Put a small amount of water in the other hole
7. Put the thermometer in the hole with the water
8. Set the power pack to 12V & switch it on
9. Record the ammeter & voltmeter readings. They shouldn't change through the experiment
10. Measure the temperature & start the stopclock
11. Record the temperature every minute for 10-20 minutes
12. Calculate the power of the heater with the formula
$$\text{power} = \text{current} * \text{time}$$
13. Calculate the work done by the heater with the formula
$$\text{work done} = \text{energy transferred} / \text{time}$$
14. Plot a graph of temperature (Y-axis) vs work done (X-axis)
15. Calculate the gradient of the straight part of the graph
16. Calculate the **heat capacity** with the formula
$$\text{heat capacity} = 1 / \text{gradient}$$
17. Calculate the **specific heat capacity** with the formula
$$\text{specific heat capacity} = \text{heat capacity} / \text{mass of block}$$

Sources Of Error:

- Parallax error when reading from the thermometer
- Inaccurate gradient calculation
- Not recording data for enough intervals

Risks:

- Metal block / heater get hot
 - Risk of burns
 - Avoid touching
- Water gets hot
 - Risk of scalds
 - Avoid spillings
- Electrical equipment & water
 - Risk of electric shock
 - Dry hands before handling heater or sockets

REQUIRED PRACTICAL #1

SPECIFIC HEAT CAPACITY

Aim:

to investigate the specific heat capacity of different materials

Apparatus:

- 1kg block of aluminium with two holes for the thermometer & heater
- Insulating material
- Thermometer
- Immersion heater
- Power supply
- Stopwatch
- Voltmeter
- Ammeter

Variables:

Dependent - Temperature

Independent - Time

Control - Material of the block, current supplied to heater, potential difference supplied to heater

Aim:

to investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material

Method:

1. Put the small beaker inside the large beaker
2. Use the kettle to boil water. Put 80cm³ hot water into the small beaker
3. Place the cardboard over the large beaker to act as a lid
4. Put the thermometer through the hole in the cardboard lid so its bulb is in the hot water
5. Record the temperature of the water & start the stopclock
6. Record the temperature of the water every 3 minutes for 15 minutes
7. Repeat steps 1-6 using different materials each time to fill the space between the small and large beaker
8. Calculate & record the temperature change with the formula
temperature change = initial temp - final temp

Sources Of Error:

- Parallax error when reading the thermometer
- Varying thickness of insulating material

Apparatus:

- Large beaker
- Small beaker
- Thermometer
- Kettle
- Piece of cardboard with hole in
- Stopclock
- Various insulating materials

Risks:

- Hot water
 - Risk of scalds
 - Be careful when pouring

Variables:

Dependent - Temperature of the water
Independent - Material used as insulator
Control - Volume of water, thickness of insulating material

REQUIRED PRACTICAL #2A

THERMAL INSULATION - MATERIAL TYPE

Aim:

to investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material

Method:

1. Use the kettle to boil water. Put 80cm³ hot water into the small beaker
2. Place the cardboard over the large beaker to act as a lid
3. Put the thermometer through the hole in the cardboard lid so its bulb is in the hot water
4. Record the temperature of the water & start the stopclock
5. Record the temperature of the water every 3 minutes for 15 minutes
6. Wrap two layers of insulating material around the beaker, holding it in place with a rubber band. Do not add insulating material to the bottom
7. Repeat steps 2-6, adding two more layers of insulation each time
8. Calculate & record the temperature change with the formula
temperature change = initial temp - final temp

Sources Of Error:

- Parallax error when reading the thermometer
- Varying thickness of insulating material

Apparatus:

- 100cm³ beaker
- Thermometer
- Kettle
- Piece of cardboard with hole in
- Stopclock
- Insulating material
- Rubber bands

Risks:

- Hot water
 - Risk of scalds
 - Be careful when pouring

Variables:

Dependent - Temperature of the water

Independent - Material used as insulator

Control - Volume of water, type of insulating material

REQUIRED PRACTICAL #2B

THERMAL INSULATION - MATERIAL THICKNESS

Aim:

to investigate the factors that affect the resistance of electrical circuits

Apparatus:

- Battery
- Ammeter
- Voltmeter
- Crocodile clips
- Resisting wire attached to a metre ruler or rheostat
- Leads

Variables:

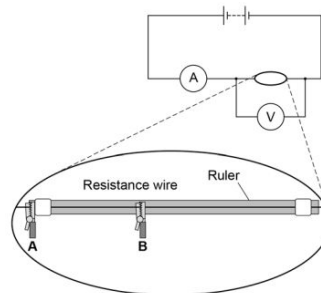
Dependent - Length of wire

Independent - Resistance in the wire (via current & potential difference)

Control - Potential difference & current (same battery), temperature of wire

Method:

1. Set up the apparatus by connecting the battery to the resisting wire & metre ruler using two leads, with an ammeter in series & a voltmeter in parallel across the resisting wire
2. Connect a lead from the negative side of the ammeter to the crocodile clip at the zero end of the ruler. Connect a lead from the other crocodile clip to the negative side of the battery. Use this lead as a switch to disconnect the battery between readings
3. Attach a crocodile clip 10cm away from the clip at the zero end of the wire
4. Ensure the circuit is complete & record the ammeter & voltmeter readings at this distance
5. Move the crocodile clip 10cm further from the clip at the zero end of the wire
6. Repeat steps 2-4 for multiple lengths of wire with intervals of 10cm
7. Calculate the resistance for each length of wire using the equation
$$\text{resistance} = \text{potential difference} / \text{current}$$



Sources Of Error:

- The first crocodile clip may not be connected exactly at 0cm
- Zero errors on ammeter or voltmeter
- Wire changes temperature due to resistive heating

Risks:

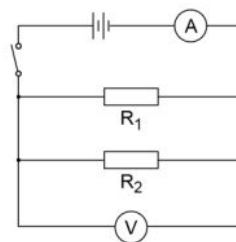
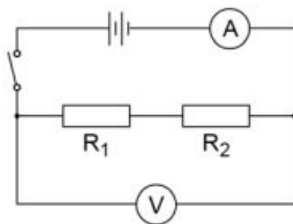
- Wire can get very hot
 - Burns or fires
 - Disconnect the wire between readings
- Liquids could spill on the equipment
 - Electric shock & damages equipment
 - Ensure there are no liquids around the apparatus

REQUIRED PRACTICAL #3A

RESISTANCE - LENGTH OF WIRE

Method:

1. Set up the apparatus by connecting two resistors to the battery in series, with the ammeter & switch in series & the voltmeter in parallel across both resistors
2. Switch on & record the readings of the ammeter & voltmeter
3. Calculate the total resistance of the series circuit using the equation $\text{resistance} = \text{potential difference} / \text{current}$
4. Set up the circuit the same but with two resistors in parallel. Both resistors should be identical, and the voltmeter should still be in parallel across one of the resistors
5. Switch on & record the readings of the ammeter & voltmeter
6. Calculate the total resistance of the parallel circuit using the equation $\text{resistance} = \text{potential difference} / \text{current}$



REQUIRED PRACTICAL #3B

RESISTANCE - SERIES & PARALLEL

Aim:

to investigate the factors that affect the resistance of electrical circuits

Apparatus:

- Battery
- Switch
- Ammeter
- Voltmeter
- Crocodile clips
- Two 10Ω resistors
- Leads

Variables:

Dependent - Number of resistors

Independent - Total resistance in the circuit (via current & potential difference)

Control - Potential difference & current (same battery), temperature of resistors

Sources Of Error:

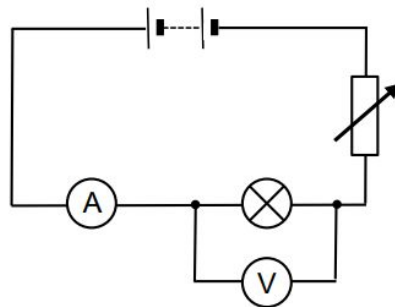
- The first crocodile clip may not be connected exactly at 0cm
- Zero errors on ammeter or voltmeter
- Wire changes temperature due to resistive heating

Risks:

- Wire can get very hot
 - Burns or fires
 - Disconnect the wire between readings
- Liquids could spill on the equipment
 - Electric shock & damages equipment
 - Ensure there are no liquids around the apparatus

Method:

1. Set up the apparatus by connecting a filament lamp, ammeter, variable resistor & battery in series, and a voltmeter in parallel across the lamp
2. Record the readings on the ammeter & voltmeter
3. Adjust the variable resistor & record the new readings on the ammeter & voltmeter
4. Repeat this to obtain several pairs of readings
5. Swap the connections on the battery. The ammeter is now connected to the negative terminal & variable resistor to the positive terminal. The readings on the voltmeter & ammeter should now be negative
6. Continue to record pairs of readings of current & potential difference with the battery reversed
7. Plot a graph of current against potential difference
8. You should be able to draw a line of best fit through the origin. This is the characteristic of a filament lamp



Sources Of Error:

- Zero errors on ammeter or voltmeter
- The voltmeter & ammeter will have some resistance so readings may be slightly inaccurate
- Changes in temperature due to resistive heating

Risks:

- Wire can get very hot
 - Burns or fires
 - Disconnect the wire between readings
- Liquids could spill on the equipment
 - Electric shock & damages equipment
 - Ensure there are no liquids around the apparatus
- Components can get hot especially at higher voltages
 - Burns
 - Be careful when handling

Aim:

to investigate the I-V characteristics of circuit components

Apparatus:

- Ammeter
- Voltmeter
- Variable resistor
- Leads
- Filament lamp
- Battery

Variables:

Dependent - Current

Independent - Potential difference

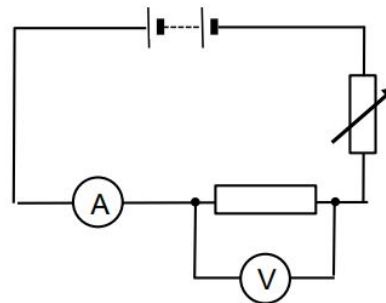
Control - Potential difference of the power supply, use the same leads, variable resistor, ammeter, voltmeter, lamp, and battery

REQUIRED PRACTICAL #4A

I-V CHARACTERISTICS: FILAMENT LAMPS

Method:

1. Swap the leads on the battery back to their original positions
2. Replace the filament lamp with the resistor
3. Record the readings on the ammeter & voltmeter
4. Adjust the variable resistor & record the new readings on the ammeter & voltmeter. Repeat this to obtain several pairs of readings
5. Swap the connections on the battery. The ammeter is now connected to the negative terminal & variable resistor to the positive terminal. The readings on the voltmeter & ammeter should now be negative
6. Continue to record pairs of readings of current & potential difference with the battery reversed
7. Plot a graph of current against potential difference
8. You should be able to draw a line of best fit through the origin. This is the characteristic of a resistor



Sources Of Error:

- Zero errors on ammeter or voltmeter
- The voltmeter & ammeter will have some resistance so readings may be slightly inaccurate
- Changes in temperature due to resistive heating

Risks:

- Wire can get very hot
 - Burns or fires
 - Disconnect the wire between readings
- Liquids could spill on the equipment
 - Electric shock & damages equipment
 - Ensure there are no liquids around the apparatus
- Components can get hot especially at higher voltages
 - Burns
 - Be careful when handling

Aim:

to investigate the I-V characteristics of circuit components

Apparatus:

- Circuit from practical #4A
- Resistor

Variables:

Dependent - Current

Independent - Potential difference

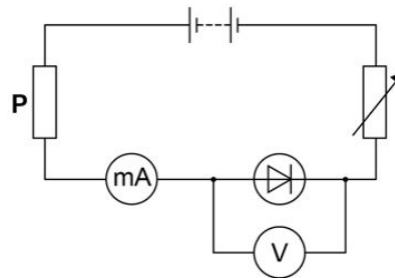
Control - Potential difference of the power supply, use the same leads, variable resistor, ammeter, voltmeter, lamp, and battery

REQUIRED PRACTICAL #4B

I-V CHARACTERISTICS: RESISTORS

Method:

1. Swap the leads on the battery back to their original positions
2. If possible, reduce the battery's potential difference to less than 5V
3. Connect the extra resistor
4. Replace the filament lamp with the diode
5. Record the readings on the ammeter & voltmeter
6. Adjust the variable resistor & record the new readings on the ammeter & voltmeter
7. Repeat this to obtain several pairs of readings
8. Swap the connections on the battery. The ammeter is now connected to the negative terminal & variable resistor to the positive terminal. The readings on the voltmeter & ammeter should now be negative
9. Continue to record pairs of readings of current & potential difference with the battery reversed
10. Plot a graph of current against potential difference
11. You should be able to draw a line of best fit through the origin. This is the characteristic of a diode



Sources Of Error:

- Zero errors on ammeter or voltmeter
- The voltmeter & ammeter will have some resistance so readings may be slightly inaccurate
- Changes in temperature due to resistive heating

Risks:

- Wire can get very hot
 - Burns or fires
 - Disconnect the wire between readings
- Liquids could spill on the equipment
 - Electric shock & damages equipment
 - Ensure there are no liquids around the apparatus
- Components can get hot especially at higher voltages
 - Burns
 - Be careful when handling

Aim:

to investigate the I-V characteristics of circuit components

Apparatus:

- Circuit from practical #4A
- Ammeter
- Diode
- Resistor

Variables:

Dependent - Current

Independent - Potential difference

Control - Potential difference of the power supply, use the same leads, variable resistor, ammeter, voltmeter, lamp, and battery

REQUIRED PRACTICAL #4C

I-V CHARACTERISTICS: DIODES

Aim:

to investigate density of various objects using a range of appropriate apparatus

Method:

1. For each object, record the length, width & height in cm
2. Calculate the volume of each object in cm^3
3. Record your results in a table
4. Measure the mass of each object in g using the balance & record the results
5. Calculate & record the density of each using the equation
 $\text{density} = \text{mass} / \text{volume}$
6. Calculate the density of the liquid in kg/m^3 using the equation
 $\text{density} (\text{kg/m}^3) = \text{density} (\text{g/cm}^3) * 1000$

Sources Of Error:

- Zero error on balance
- Misreading length, width & height (human error)
- Errors when converting units

Apparatus:

- 30cm ruler marked off in mm
- Top pan balance
- Selection of regularly shaped objects

Variables:

Dependent - Density of object

Independent - Object being tested

Control - Use same method to measure length, width & height, ensure measurements are taken to same degree of accuracy

Risks:

- No real risks

REQUIRED PRACTICAL #5A

DENSITY - REGULARLY SHAPED OBJECT

Aim:

to investigate density of various objects using a range of appropriate apparatus

Apparatus:

- Top pan balance
- Displacement can
- Various measuring cylinders
- Beaker of water
- Empty beaker
- Paper towels
- Selection of irregularly shaped objects

Variables:

Dependent - Density of object

Independent - Object being tested

Control - Ensure water does not splash when submerging object, fill displacement can to same level each time

Method:

1. Measure the mass of one of the objects
2. Record your results in a table
3. Set up the displacement can with the empty beaker under the spout. Fill the can to the top with water, and wait until water has stopped dripping from the spout
4. Replace the beaker with a suitable measuring cylinder
5. Carefully lower the object into the can so that it is completely submerged
6. Measure the volume of the collected water. The volume is equal to the volume of the object
7. Calculate & record the density of the object using the formula
 $\text{density} = \text{mass} / \text{volume}$
8. Repeat steps 1-6 for some other objects, being sure to refill the can with water each time

Sources Of Error:

- Zero error on balance
- Parallax error when reading volume
- Errors when converting units

Risks:

- Water near electrical equipment
 - Risk of electric shock
 - Pour water carefully & avoid spillages

REQUIRED PRACTICAL #5B

DENSITY - IRREGULARLY SHAPED OBJECT

Aim:

to investigate density of various objects using a range of appropriate apparatus

Method:

1. Measure the mass of the empty measuring cylinder & record your results
2. Pour approximately 100cm³ of the sugar solution into the measuring cylinder, then record the volume accurately
3. Measure & record the mass of the measuring cylinder & liquid. From this calculate & record the mass of just the liquid
4. Calculate the density of the liquid using the equation
 $\text{density} = \text{mass} / \text{volume}$
5. Calculate the density of the liquid in kg/m³ using the equation
 $\text{density (kg/m}^3\text{)} = \text{density (g/cm}^3\text{)} * 1000$

Sources Of Error:

- Zero error on balance
- Errors when converting units
- Parallax error when reading volume

Apparatus:

- Digital balance
- 100cm³ measuring cylinder
- Sugar solution of unknown concentration

Variables:

Dependent - Density of liquid

Independent - Concentration of sugar solution

Control - Use the same measuring cylinder for all measurements, ensure measuring cylinder is dry before use, measure volume as accurately as possible

Risks:

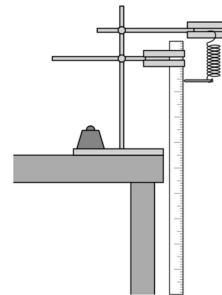
- Water near electrical equipment
 - Risk of electric shock
 - Pour water carefully & avoid spillages

REQUIRED PRACTICAL #5C

DENSITY - LIQUIDS

Method:

1. Set up the apparatus as shown in the diagram, ensuring that the ruler is vertical, the zero on the scale is at the same height as the top of the spring, the splint is attached securely to the bottom of the spring, it is horizontal, and it rests against the scale of the ruler
2. Record the reading on the ruler that the splint points to. This is the length of the unstretched spring
3. Carefully hook the base of the weight stack on to the bottom of the spring. This should weigh 1N. Don't forget that the mass added will have to be converted to newtons, using the formula
$$\text{weight} = \text{mass} * \text{gravitational field strength}$$
4. Record the reading on the ruler that the splint points to. This is the length of the spring when a 1N force is applied to it
5. Add further weights. Measure & record the length of the spring each time
6. Calculate the extension for each weight & record it, using the formula
$$\text{extension} = \text{new length} - \text{original length}$$



Sources Of Error:

- Parallax error when reading measurements
- Spring still moving when taking readings
- Spring may become stretched too far & stop obeying Hooke's law

Risks:

- Spring could snap & hit you
 - Damages eyes
 - Wear goggles
- Masses could fall off
 - Could damage equipment or land on feet
 - Ensure masses are above a soft surface on a desk

REQUIRED PRACTICAL #6

FORCE & EXTENSION

Aim:

to investigate the relationship between force & extension of a spring

Apparatus:

- Spring
- Metre ruler
- Splint & tape
- 10N weight stack
- Two clamps & bosses
- Heavy weight
- Safety goggles

Variables:

Dependent - Extension of spring

Independent - Force applied to spring

Control - Spring constant

Method:

1. Use the ruler to measure intervals on the bench and draw straight lines across the bench at these intervals
2. Attach the bench pulley to the end of the bench
3. Tie a length of string to the toy car or trolley. Pass the string over the pulley and attach the weight stack to the other end of the string
4. Make sure the string is horizontal and is in line with the toy car or trolley
5. Hold the toy car at the start point
6. Attach the full weight stack (1N) to the end of the string
7. Release the toy car or trolley at the same time as you start the stopwatch, press the stop watch (lap mode) at each measured interval on the bench & for the final time at 100cm, and record the results
8. Repeat steps 5-7 for decreasing weights on the stack, for example 0.8N, 0.6N, etc. Make sure to place any masses you remove from the weight stack on to the top of the car each time you decrease the weight
9. Calculate the acceleration between the first and last intervals for each force using the formula
$$\text{acceleration} = \text{change in velocity} / \text{time taken}$$

Sources Of Error:

- Ensure any weights removed from the hanger are moved to the car/trolley to ensure the total mass of the system remains constant
- Not clicking the stopwatch at the exact time the car/trolley passes the checkpoint
- Applying force when releasing the car (e.g. pushing it)

Aim:

to investigate how are force, mass and acceleration related

Apparatus:

- Toy car (or trolley)
- Metre ruler
- Pencil
- Bench pulley
- String
- Small weight stack
- Stopwatch
- Blu-tac

Risks:

- Weights falling off hanger
 - Damage to equipment or could land on feet
 - Don't stand directly beneath the hanger

Variables:

Dependent - Acceleration
Independent - Force applied
Control - Total mass of the system

REQUIRED PRACTICAL #7A

ACCELERATION - THE EFFECT OF FORCE

Method:

1. Set up the bench pulley, weight stack & car as in steps 1-5 of practical #7A
2. Select a weight that will just accelerate the car along the bench (you can use data from practical #7A to select this)
3. Put a 200g mass on the car
4. Hold the car at the start point
5. Attach your chosen weight stack to the end of the string
6. Release the toy car or trolley at the same time as you start the stopwatch, press the stop watch (lap mode) at each measured interval on the bench & for the final time at 100cm, and record the results
7. Repeat steps 5-7 for increasing masses on the car
8. Calculate the acceleration between the first and last intervals for each mass using the formula
$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

Sources Of Error:

- Not clicking the stopwatch at the exact time the car/trolley passes the checkpoint
- Applying force when releasing the car (e.g. pushing it)

Aim:

to investigate how are force, mass and acceleration related

Apparatus:

- Toy car (or trolley)
- Metre ruler
- Pencil
- Bench pulley
- String
- Small weight stack
- Stopwatch
- Blu-tac

Risks:

- Weights falling off hanger
 - Damage to equipment or could land on feet
- Don't stand directly beneath the hanger

Variables:

Dependent - Acceleration

Independent - Total mass of the system

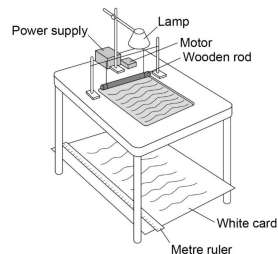
Control - Force applied

REQUIRED PRACTICAL #7B

ACCELERATION - THE EFFECT OF MASS

Method:

1. Set up the ripple tank as shown in the diagram. Make sure there is a large sheet of white card or paper on the floor under the tank
2. Pour water to a depth of about 5mm into the tank
3. Adjust the height of the wooden rod so that it just touches the surface of the water
4. Switch on the overhead lamp & the electric motor
5. Adjust the speed of the motor to produce low frequency water waves
6. Adjust the height of the lamp so that the pattern of waves can clearly be seen on the white card
7. Place a metre ruler at a right angle to the waves shown in the pattern on the card. Measure across as many waves as you can, then divide the length by the number of waves. Record this as the wavelength of the waves
8. Count the number of waves passing a point in 10 seconds, then divide the number of waves counted by 10. Record this as the frequency of the waves
9. Calculate the speed of the waves using the equation
 $\text{wave speed} = \text{frequency} * \text{wavelength}$
10. Repeat steps 5-9 for a variety of frequencies



Sources Of Error:

- Only measuring across one wavelength
- Only measuring frequency in one second

Risks:

- Water near electric equipment
 - Risk of electric shock
 - Pour water carefully and avoid spillages

Aim:

to investigate the properties of waves in liquids & solids

Apparatus:

- Ripple tank plus accessories
- Low-voltage power supply
- Lamp
- Metre ruler

Variables:

Dependent - Wave speed

Independent - Frequency

Control - Depth of water, temperature of water

REQUIRED PRACTICAL #8A

WAVES - RIPPLE TANK

Aim:

to investigate the properties of waves in liquids & solids

Apparatus:

- Vibration generator
- 5 or 6 watt signal generator
- String or elasticated cord
- Set of 100g masses & hanger
- Set of 10g masses & hanger
- Wooden bridge
- Pulley on a clamp

Variables:

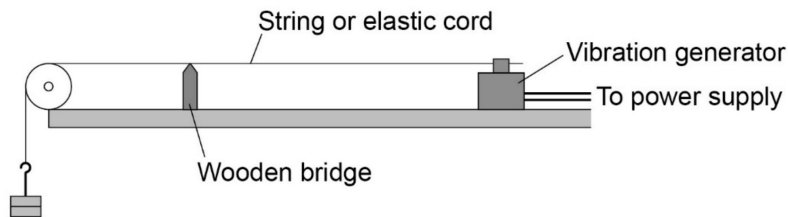
Dependent - Wave speed

Independent - Frequency

Control - String, mass, length of string

Method:

1. Set up the apparatus as shown in the diagram
2. Switch on the vibration generator. The string should begin to vibrate
3. To see a clear wave pattern, adjust the tension in the string or move the wooden bridge to adjust the length of the string. The waves should look like they are not moving
4. Use a metre ruler to measure across as many half wavelengths as possible (a half wavelength is one loop). Divide this length by the number of half waves. Record this number multiplied by two as the wavelength
5. Record the frequency as the frequency displayed of the signal generator
6. Calculate the wave speed using the equation
$$\text{wave speed} = \text{frequency} * \text{wavelength}$$
7. Repeat steps 2-6 for different frequencies



Sources Of Error:

- Mistaking one half-wavelength for a full wavelength

Risks:

- String could snap
 - Risk of eye damage
 - Wear goggles
- Masses could fall off
 - Risk of equipment damage or landing on feet
 - Stand away from the masses & put a soft surface underneath them

REQUIRED PRACTICAL #8B

WAVES - SOLID

Aim:

to investigate the reflection of light by different types of surface and the refraction of light by different substances

Apparatus:

- Ray box & slit
- Power supply
- Two transparent rectangular blocks of different materials
- 30cm ruler
- Protractor
- Sheets of plain A3 paper

Variables:

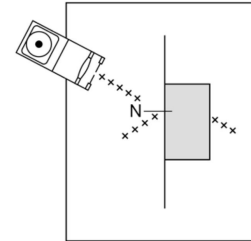
Dependent - Angle of reflection

Independent - Angle of incidence

Control - Width of light beam, frequency & wavelength of light

Method:

1. Place the ruler near the middle of the A3 paper and draw a straight line
2. Use the protractor to draw a second line at a right angle to this line
3. Label this line 'N' for 'normal'
4. Place your block onto the paper so that it is lined up with the normal line & draw around it
5. Set up the ray box and slit so a narrow ray of light is produced
6. Use the ray box to direct a ray of light at the point where the normal meets the block. The ray box needs to be at an angle as in the diagram
7. Mark the centre of the path of incoming & outgoing rays with crosses
8. Join up the crosses with lines to show the pathway of the three different rays
9. Use a protractor to measure:
 - a. The angle of incidence
 - b. The angle of reflection
 - c. The angle of refraction
10. Repeat the experiment for the other transparent block



Sources Of Error:

- Not plotting the crosses in the middle of the graph

Risks:

- Ray box gets hot
 - Burns
 - Avoid touching it
- Bright light from ray box
 - Damage to eyes
 - Don't look directly at the light

REQUIRED PRACTICAL #9

LIGHT

Aim:

to investigate the amount of infrared radiation radiated from different surfaces

Method:

1. Put the leslie cube on to the heat proof mat
2. Fill the cube with very hot water (100 degrees) and put the lid on the cube
3. Use the detector to measure the amount of IR radiated from each surface. Ensure the detector is the same distance from each surface

Sources Of Error:

- Faulty infrared detector
- IR detector held too far away
- Water inside cools down

Apparatus:

- Leslie cube
- Kettle
- Infrared detector
- Heatproof mat

Risks:

- Hot water (100 degrees)
 - Scalds
 - Pour carefully
- Water near electrical equipment
 - Electric shock
 - Avoid spills & pour carefully
- Surface of cube gets hot
 - Burns
 - Don't touch the cube

Variables:

Dependent - Amount of IR radiated

Independent - Surface

Control - Same temperature of water, same infrared detector, distance of infrared detector

REQUIRED PRACTICAL #10 RADIATION & ABSORPTION

BIOLOGY
REQUIRED
PRACTICALS

Method:

1. Put the slide on the microscope stage
2. Turn the nose piece to select the lowest power objective lens (usually 4x). The end of the objective lens needs to **almost** touch the slide
3. Turn the coarse adjustment knob to move the lens towards the slide. Look from the side (**not** through the eyepiece) when you are adjusting the lens
4. Now look through the eyepiece. Slowly turn the coarse adjustment knob in the direction to increase the distance between the objective lens & the slide. Do this until the cells come into focus
5. Slightly turn the fine adjustment knob to bring the cells into a clear focus. Use the low power objective lens (totalling x40 magnification) to look at the cells
6. When you have found some cells, turn the nose piece to switch to a higher power lens (x100 or x400 magnification)
7. Use the fine adjustment knob again to bring the cells back into focus
8. Make a clear labelled drawing of some of the cells. Make sure that you draw & label any component parts of the cells
9. Write the magnification under your drawing, being sure to multiply the objective magnification by the eyepiece magnification

Sources Of Error:

- Focusing issues lead to blurry images
- Air bubbles in slides
- Slide movement when changing magnification
- Too much / little light

Aim:

to use a light microscope to observe, draw & label biological specimens

Apparatus:

- Microscope
- Prepared slides of plant & animal cells

Risks:

- Bright light from microscope
 - Damage to eyes
 - Ensure brightness is not too high
- Glass slides
 - Could break & shatter
 - Handle carefully

Variables:

Dependent - N/A
Independent - N/A
Control - N/A

REQUIRED PRACTICAL #1 MICROSCOPY

Aim:

to investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates & measuring zones of inhibition

Apparatus:

- Nutrient agar plate inoculated with bacteria
- Filter paper discs
- Three antiseptics
- Disinfectant spray
- Forceps
- Clear tape
- Antibacterial hand wash
- Permanent marker
- Ruler

Variables:

Dependent - Clear zone diameter

Independent - Type of antiseptic

Control - Type of bacteria, temperature of incubation, length of incubation time, amount of antiseptic on each disc, agar bacteria is grown on

Method:

1. Make sure your hands & workspace are thoroughly clean before and after the experiment
2. Spray the bench where you are working with disinfectant spray, then wipe with paper towels
3. Use the marker to mark the bottom of the nutrient agar plate (not the lid) by dividing the plate into 3 equal sections & numbering them 1, 2 and 3 around the edges, putting a dot in the middle of each section, and adding your initials, the date & name of bacteria
4. Wash your hands with the antibacterial hand wash
5. Put a different antiseptic on to each of the three filter paper discs, being careful to shake off excess liquid to avoid splashing
6. Carefully lift the lid of the agar plate at an angle away from your face. Do not open it fully
7. Use the forceps to carefully put each disc on to one of the dots you drew with the wax pencil
8. Make a note of which antiseptic is in each section
9. Secure the lid of the agar plate with two small pieces of tape. Do not seal the lid all the way around to ensure oxygen can still reach the bacteria
10. Incubate the plate at 25°C for 48 hours
11. Measure the diameter of the clear zone around each disc. Measure again at 90° to your first measurement, then calculate the mean diameter, recording your results in a table

Sources Of Error:

- Other bacteria growing
- Splashes / other dots of antiseptic on agar plate
- Closing plate completely so bacteria has oxygen

Risks:

- Potentially harmful bacteria
 - Could get ill
 - Wash hands thoroughly & clean workspace thoroughly

REQUIRED PRACTICAL #2

MICROBIOLOGY

Aim:

to investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue

Apparatus:

- Potato
- Cork borer
- Ruler
- 10cm³ measuring cylinder
- Labels
- Five boiling tubes
- Test tube rack
- Paper towels
- Sharp knife or scalpel
- White tile
- Various sugar or salt solutions
- Distilled water
- Top-pan balance accurate to at least 0.01g

Variables:

Dependent - Change in mass of potato

Independent - Concentration of salt solution

Control - Starting mass of cylinder, type of solution, concentration of solution, temperature, time allowed for osmosis to occur, length & diameter of potato cylinder

Method:

1. Use the cork borer to cut 5 potato cylinders of the same diameter
2. Use the knife to trim off any potato skin on each potato cylinder. Then trim each potato cylinder so they are all the same length
3. Measure & record the mass of each potato cylinder
4. Measure & record the length of each potato cylinder
5. Measure 10cm³ of each concentration of sugar or salt solution and put into boiling tubes. Label each tube clearly
6. Measure 10cm³ of the distilled water & put into the fifth boiling tube. Label the tube clearly
7. Add one potato cylinder to each boiling tube
8. Leave the potato cylinders in the boiling tube for a chosen amount of time
9. Remove the cylinders from the tubes & blot them dry with paper towels
10. Measure the new mass & length of each potato cylinder again, recording your measurements
11. Calculate the percentage change in mass of each potato cylinder, using the equation
$$\% \text{ change} = ((\text{new mass} - \text{original mass}) / \text{original mass}) * 100$$

Sources Of Error:

- Potato cylinders in solution for different times
- Different sized potato cylinders
- Some solution left on cylinders when measuring final mass

Risks:

- Cork borer / knife / scalpel
 - Could cut yourself
 - Be careful when cutting potato cylinders
- Boiling tubes
 - Glass could shatter
 - Handle carefully & carry properly, keep in rack

REQUIRED PRACTICAL #3

OSMOSIS

Method:

1. Set up a water bath using a bunsen burner
2. Put some of the food sample to be tested into a test tube
3. Add a few drops of Benedict's solution to the sample in the test tube
4. Put the test tube in the water bath at a minimum of 80°C for at least 5 minutes
5. If glucose is present, the solution should change colour from light blue to green or brick red, depending on how much is present

Sources Of Error:

- Temperature is not high enough
- Sample is too large
- Not enough solution added

Aim:

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

Apparatus:

- Food sample
- Test tube
- Benedict's solution
- Traditional water bath
- Thermometer
- Pipette

Risks:

- Hot water
 - Scalds
 - Avoid touching
- Test tube gets hot
 - Burns
 - Avoid touching until it has cooled down
- Contains copper(II) sulfate
 - Dangerous to eyes
 - Wear goggles

Variables:

Dependent - Colour of solution

Independent - Type of food being tested

Control - Concentration of solution, volume of food sample, time in water bath, temperature of water bath

REQUIRED PRACTICAL #4A

FOOD TESTS - GLUCOSE

Aim:

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

Method:

1. Put some of the food sample to be tested into a test tube
2. Add a few drops of iodine solution
3. If starch is present, the solution should change colour from orange-brown to blue-black

Sources Of Error:

- Sample is too large
- Not enough solution added

Apparatus:

- Food sample
- Test tube
- Iodine solution
- Pipette

Risks:

- Iodine is an irritant
 - Could irritate eyes
 - Wear goggles

Variables:

Dependent - Colour of solution

Independent - Type of food being tested

Control - Concentration of solution, volume of food sample

REQUIRED PRACTICAL #4B

FOOD TESTS - STARCH

Aim:

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

Method:

1. Put some of the food sample to be tested into a test tube
2. Add a few drops of distilled water
3. Add a few drops of ethanol
4. Shake the solution gently
5. If lipids are present, the solution should change from colourless to cloudy white

Sources Of Error:

- Sample is too large
- Not enough solution added
- Water not added

Apparatus:

- Food sample
- Test tube
- Ethanol
- Distilled water

Risks:

- Ethanol is highly flammable
 - Could ignite
 - Keep away from naked flames

Variables:

Dependent - Colour of solution

Independent - Type of food being tested

Control - Concentration of solution, volume of food sample

REQUIRED PRACTICAL #4C

FOOD TESTS - LIPIDS

Aim:

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

Method:

1. Put some of the food sample to be tested into a test tube
2. Add 1cm³ Biuret solution to the test tube
3. Shake the tub gently to mix
4. If protein is present, the colour should change from blue to lilac

Sources Of Error:

- Sample is too large
- Not enough solution added

Apparatus:

- Food sample
- Test tube
- Biuret solution
- 10cm³ measuring cylinder

Risks:

- Solution contains copper sulfate
 - Poisonous
 - Wash immediately if spilled on skin
- Solution contains sodium hydroxide
 - Corrosive
 - Wash immediately if spilled on skin

Variables:

Dependent - Colour of solution

Independent - Type of food being tested

Control - Concentration of solution, volume of food sample

REQUIRED PRACTICAL #4D

FOOD TESTS - PROTEIN

Aim:

to investigate the effect of pH on the rate of reaction of amylase enzyme

Apparatus:

- 10 test tubes
- Test tube rack
- Water bath
- Thermometer
- Spotting tile
- 5cm³ measuring cylinder
- Pasteur pipettes
- Glass rod
- Stopclock
- Starch solution
- Amylase solution
- Iodine solution
- Labelled buffered solutions at a range of pH values
- Labels

Variables:

Dependent - Time taken for the iodine to stop turning blue-black

Independent - pH of solution

Control - Temperature, volume of solutions, concentration of amylase, volume of iodine, time between taking samples

Method:

1. Heat the water bath to 35°C
2. Put 2cm³ of each buffered solution into individual, separate test tubes. Label each tube with the pH of the solution
3. Label 5 test tubes 'Starch' and add 4cm³ of starch solution into each tube
4. Put a thermometer in one of the starch test tubes to monitor the temperature. Leave the thermometer in this tube throughout the experiment
5. Add 10cm³ of amylase solution into another test tube. Label the tube 'amylase'
6. Put all the test tubes into the water bath
7. Allow the solutions to reach 35°C
8. While the solutions are reaching the required temperature, put one drop of iodine solution into each depression on your spotting tile. Put a drop of starch solution into the first depression of the tile. This is your 'zero time' mixture. You will use this as a comparison of colour against your test buffers. Starch gives a blue-black colour with iodine, and the iodine stays brown if all the starch has broken down to glucose
9. When all the tubes have reached 35°C, take one of the tubes of starch from the water bath & add 2cm³ of your first pH buffered solution. Stir the mixture with a glass rod
10. Use the pipette to add 2cm³ of amylase solution to the mixture. Start the stopclock as soon as you add the amylase, and keep stirring the mixture
11. After 10 seconds, remove one drop of the mixture with a glass rod
12. Put this drop on the second depression of your spotting tile
13. Rinse the glass rod with water
14. Every 10 seconds, use the glass rod to remove one drop of the mixture. Put each drop onto the iodine solution in the next depression on the spotting tile. Remember to rinse the rod with water after putting each drop on the tile
15. Keep sampling every 10 seconds until the iodine does not change colour
16. Record your results & repeat for both of the other pH buffered solutions

Sources Of Error:

- Changes in temperature
- Colour change is subjective
- Different volumes of substances used

Risks:

- Lots of glass
 - Could shatter
 - Handle carefully
- Iodine solution
 - Irritant to skin
 - Wear goggles & clean up spillages

REQUIRED PRACTICAL #5

ENZYMES

Aim:

to investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed

Apparatus:

- Beaker
- Filter funnel
- Plasticine
- Measuring cylinder
- 10cm piece of pondweed
- Light source
- Metre ruler
- Stopclock

Variables:

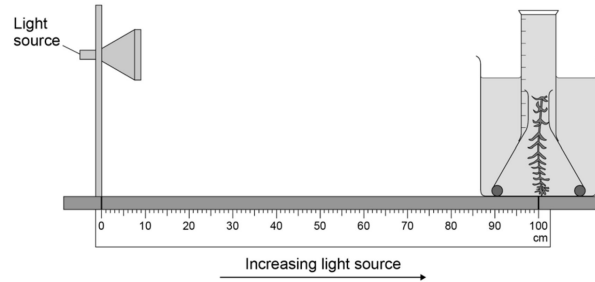
Dependent - Rate of photosynthesis

Independent - Distance of lamp from pondweed

Control - Length of time you are measuring for, brightness & type of lamp used, piece of pondweed used, type of solution the pondweed is in

Method:

1. Put the 10cm piece of pondweed into a beaker of water with the cut edge at the top
2. Cover the pondweed with an inverted filter funnel, raised off the bottom of the beaker with plasticine
3. Fill the measuring cylinder with water & position it as in the diagram
4. Use the ruler to position the beaker of pondweed 1 metre away from the light source
5. Start the stopclock and
 - a. Count & record the number of bubbles released in 3 minutes
 - b. Record the volume of gas produced & collected in the measuring cylinder in the same 3 minutes
6. Record your results in a table
7. Move the light source 20cm closer to the beaker
8. Refill the measuring cylinder with water & position it, then repeat steps 5 & 6
9. Repeat for distances of 60, 40 and 20cm



Sources Of Error:

- Miscounting bubbles
- Counting bubbles from other parts of the plant
- Rate of photosynthesis does not immediately change when light moved closer
- Parallax error when reading measuring cylinder

Risks:

- Lamp can get hot
 - Burns
 - Don't touch the lamp
- Water near electrical components
 - Risk of electric shock
 - Avoid spillages & turn off equipment when not in use

REQUIRED PRACTICAL #6

PHOTOSYNTHESIS

Method:

1. Work with a partner to do this test. Choose one person to be person 1, and the other is person 2
2. Person 1 sits down on the chair, with good upright posture & eyes looking across the room
3. Person 1 puts the forearm of their dominant arm across the table with their hand overhanging the edge
4. Person 2 holds a ruler vertically with the bottom end (with the 0cm mark) in between person 1's thumb & first finger. They will tell person 1 to prepare to catch the ruler
5. Person 1 catches the ruler with their thumb & first finger as quickly as possible when it drops
6. Record the number on the ruler that is level with the top of person 1's thumb
7. Record these results in a table, then have a short rest then repeat the test multiple times
8. Repeat the test with person 2 catching the ruler & person 1 dropping it
9. Record these results in a table
10. Use a conversion table to convert your ruler measurements into reaction times
11. Make the change that you are investigating to change human reaction time
12. Repeat steps 2-10 again for each person & record the results

Sources Of Error:

- Applying a small force when dropping the ruler
- Other environmental distractions
- Fatigue or learning effects

Risks:

- No real risks

REQUIRED PRACTICAL #7 REACTION TIME

Aim:

to plan and carry out an investigation into the effect of a factor on human reaction time

Apparatus:

- Metre ruler
- Chair
- Table
- Any further equipment needed depending on the factor you are changing

Variables:

Dependent - Reaction time

Independent - Presence of a specific factor

Control - Starting position of the ruler, way of holding & dropping the ruler, time between trials, volume of environment / other distracting factors / factors that are not the factor you are testing

Method:

1. Set up three petri dishes containing cotton wool soaked in equal amounts of water
2. Put ten mustard seeds in each dish
3. Put the dishes in a warm place. They must not be disturbed or moved
4. Allow the seeds to germinate. Water every day with equal amounts of water to each dish
5. Each dish should have the same number of seedlings after the seeds have germinated. Remove excess seedlings from any dish that has too many
6. Measure the height of each seedling in mm
7. Move the petri dishes into position
 - a. Put one on a windowsill in full sunlight
 - b. Put the second one in partial light
 - c. Put the third one in darkness
8. Measure the height of each seedling every day for at least 5 consecutive days
9. Record the heights in a table. You will need a table each for full sunlight, partial light & darkness

Sources Of Error:

- Variation in seed quality
- Uneven watering
- Temperature variations
- Inaccurate height measurement
- Accidental movement of petri dishes

Apparatus:

- White mustard seeds
- Three Petri dishes
- Cotton wool
- Ruler
- Water

Risks:

- No real risks

Aim:

to investigate the effect of light or gravity on the growth of newly germinated seedlings

Variables:

Dependent - Height of seedlings

Independent - Light intensity

Control - Number of seeds, type of plant, amount of water given, temperature,

REQUIRED PRACTICAL #8 PLANT RESPONSES

Aim:

to measure the population size of a common species in a habitat, and use sampling techniques to investigate the effect of a factor on the distribution of this species.

Method:

1. Set up two tape measures, perpendicular to each other, to obtain an axis with the 1st and 2nd quadrant
2. Use a random number generator to obtain 2 numbers, which are to be used as coordinates to find a location on the 2 tape measures set up.
3. Set down the quadrat at the coordinates
4. Count & record the number of required plant species in the quadrat
5. Repeat steps 2-4 to take 9 more samples for a total of 10
6. Estimate the population size using the formula
$$\text{population} = (\text{total no. counted} / \text{sampled area}) * \text{total area}$$

Sources Of Error:

- Plants may be misidentified or missed when counting
- Quadrat may not be placed exactly on coordinates
- Uneven distribution of plants
- Small sample size

Apparatus:

- Frame quadrat
- Tape measures
- Clipboard
- Pen
- Paper

Risks:

- Uneven ground
 - Falling
 - Wear appropriate footwear
- Sharp plants / insects
 - Cuts, stings, allergic reactions
 - Wear gloves, be aware of surroundings

Variables:

Dependent - Number of plants per quadrat

Independent - Quadrat position

Control - Quadrat size, sampling method, plant species counted, counting method

REQUIRED PRACTICAL #9A FIELD INVESTIGATION - RANDOM SAMPLING

Aim:

to measure the population size of a common species in a habitat, and use sampling techniques to investigate the effect of a factor on the distribution of this species.

Apparatus:

- Frame quadrat
- Tape measures
- Clipboard
- Light meter / soil moisture meter / pH probe, depending on factor
- Pen
- Paper

Variables:

Dependent - Number of plants per quadrat

Independent - Distance along transect

Control - Quadrat size, sampling method, plant species counted, counting method, interval spacing

Method:

1. Lay a tape measure in a straight line across the habitat to form a transect (e.g. from shaded to unshaded area)
2. Place a quadrat at regular intervals along the tape (e.g. every 1 metre)
3. At each interval, place the quadrat consistently (e.g. with one corner touching the tape).
4. Count & record the number of required plant species in the quadrat
5. Measure the environmental factor at each point (e.g. light intensity, soil moisture, pH).
6. Repeat steps 2-5 along the entire length of the transect
7. Estimate the population size using the formula
$$\text{population} = (\text{number per quadrat} / \text{total area}) * \text{area of quadrat}$$
8. Analyse the distribution patterns along the transect

Sources Of Error:

- Species may be misidentified or missed when counting
- Quadrat placement may not be consistent along the transect
- Environmental measurements may be inaccurate (e.g. faulty probe)
- Transect may not represent the whole habitat
- Uneven distribution of organisms

Risks:

- Uneven ground
 - Falling
 - Wear appropriate footwear
- Sharp plants / insects
 - Cuts, stings, allergic reactions
 - Wear gloves, be aware of surroundings

REQUIRED PRACTICAL #9B

FIELD INVESTIGATION - TRANSECT

Aim:

to investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change.

Apparatus:

- Small beaker of full fat milk
- Small beaker of sodium carbonate solution
- Small beaker of lipase solution
- 250cm³ beaker
- Boiling tubes
- Boiling tube rack
- Marker
- 10cm³ plastic syringes
- Stirring thermometer
- Stopclock
- Phenolphthalein indicator
- Electric kettle
- Ice

Variables:

Dependent - Time taken for colour to change from pink to white

Independent - Temperature of water bath

Control - Volume of lipase / milk / sodium carbonate solution / indicator, colour of the solution when it is considered 'white', type of milk, quality of milk (how much decay has already occurred), starting pH of milk

Method:

1. Label a boiling tube lipase and add 5cm³ of the lipase solution
2. Label another boiling tube 'milk' and add five drops of phenolphthalein indicator
3. Use a calibrated dropping pipette to add 5cm³ milk to the 'milk' boiling tube
4. Use another pipette to add 7cm³ of sodium carbonate solution to the 'milk' boiling tube. The solution should be pink
5. Put a thermometer into the 'milk' boiling tube
6. Set up a water bath to your first chosen temperature
7. Put both boiling tubes into the water bath. Wait until the contents reach the same temperature as the water bath
8. Use another dropping pipette to transfer 1cm³ lipase from the 'lipase' tube to the 'milk' tube. Immediately start the stopclock
9. Stir the contents of the 'milk' boiling tube until the solution turns white (because the indicator has turned colourless)
10. Record the time taken in seconds for the solution to become white
11. Repeat the investigation for a range of different temperatures of the water bath

Sources Of Error:

- Colour is subjective
- Too much indicator added
- Temperature variations
- Not stirring well

Risks:

- Hot water bath
 - Scalds
 - Avoid splashing & handle carefully
- Lots of chemicals
 - Could irritate eyes or skin
 - Wear goggles, avoid spillages

REQUIRED PRACTICAL #10 DECAY

CHEMISTRY
REQUIRED
PRACTICALS

Aim:

to prepare pure dry copper sulfate crystals

Apparatus:

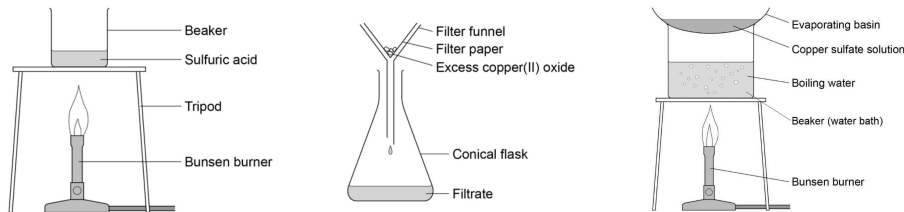
- Dilute sulfuric acid
- Measuring cylinder
- Copper(II) oxide powder
- Spatula
- Glass rod
- 100cm³ beaker
- 250cm³ beaker
- Bunsen burner
- Tripod
- Gauze
- Heatproof mat
- Filter funnel & paper
- Small conical flask
- Evaporating basin
- Crystallising dish

Variables:

- Dependent** - N/A
Independent - N/A
Control - N/A

Method:

1. Measure 40cm³ sulfuric acid (or any acid) and put it into the 100cm³ beaker
2. Set up the Bunsen burner, tripod, gauze & heatproof mat. Put the beaker on the gauze & heat the acid gently until it is almost boiling, then turn off the Bunsen burner
3. Remove the glass beaker from the tripod. Use the spatula to add a small amount of copper (II) oxide powder (or any metal powder) to the hot acid. Stir with the glass rod. The copper (II) oxide will disappear & the solution will turn clear blue
4. Add some more copper (II) oxide & stir again
5. Keep adding the copper (II) oxide until some of it remains after stirring
6. Allow the apparatus to cool completely
7. Set up the filter funnel & paper over the conical flask. Filter the contents of the beaker
8. Pour the filtrate from the conical flask into the evaporating basin
9. Set up a water bath using the 250cm³ beaker on the tripod & gauze
10. Evaporate the filtrate gently using the water bath
11. When crystals start to form, stop heating the water bath
12. Pour the remaining solution into the crystallising dish
13. Leave the crystals in a cool place for at least 24 hours
14. Remove the crystals from the concentrated solution with a spatula. Gently pat the crystals dry between two pieces of filter paper



Sources Of Error:

- N/A

Risks:

- Hot acid
 - Could spit & go in eyes
 - Wear goggles
- Hot glassware
 - Could shatter if it cools down quickly, burns
 - Wait for it to cool down before moving

REQUIRED PRACTICAL #1

MAKING SALTS

Aim:

to determine the reacting volumes of solutions of a strong acid & strong alkali by titrations and the concentration of one of the solutions in mol/dm³ and g/dm³ from the reacting volumes and the known concentrations of other solutions

Apparatus:

- 25cm³ volumetric pipette & pipette filler
- Burette
- Small funnel
- Clamp & stand
- 250cm³ conical flask
- White tile
- Dilute sulfuric acid, unknown concentration
- 0.1 mol/dm³ sodium hydroxide solution
- Phenolphthalein indicator

Variables:

Dependent - Change in colour of indicator

Independent - Volume of acid added

Control - Volume of NaOH, volume of indicator, concentration of NaOH & H₂SO₄

Method:

1. Use the pipette filler to put exactly 25cm³ sodium hydroxide solution into the conical flask
2. Put the flask on a white tile
3. Clamp the burette vertically in the clamp stand. There should be just enough room underneath for the conical flask & tile
4. Close the burette tap
5. Use the small funnel to carefully fill the burette with dilute sulfuric acid. Before it completely fills, put a small beaker underneath the tap, gently open it to allow acid to fill the tap, before closing it again & filling the burette to the 0.00cm³ line. Remove the funnel
6. Put 5-10 drops of phenolphthalein indicator into the conical flask. Swirl the flask to mix & put it under the burette on top of the tile. The contents of the flask will go pink
7. Carefully open the burette tap so that 10cm³ of sulfuric acid slowly flows into the flask. Constantly swirl the flask when adding the acid. Then add the acid dropwise until you see a permanent colour change from pink to colourless in the flask
8. You need to be able to shut the tap immediately after a single drop of acid causes the colour to become permanently colourless
9. Read the burette scale carefully & record the volume of acid you **added** to 2dp
10. Repeat steps 1-9 twice more & record the results

Sources Of Error:

- Parallax error when reading the scale
- Adding acid too quickly
- Inconsistent mixing

Risks:

- Sodium hydroxide and sulfuric acid are corrosive
 - Can damage skin / eyes
 - Wear goggles, handle carefully
- Lots of glassware
 - Could break & shatter
 - Handle with care & work on a stable surface

REQUIRED PRACTICAL #2

TITRATIONS

Aim:

to investigate what happens when two different aqueous solutions are electrolysed using inert electrodes

Apparatus:

- Copper (II) chloride solution
- Sodium chloride solution
- 100cm³ beaker
- Petri dish lid
- Two carbon electrodes
- Two crocodile leads
- Low voltage power supply
- Blue litmus paper
- Forceps

Variables:

Dependent - Elements produced at electrodes

Independent - Solution being electrolysed

Control - Power supply voltage, volume of solution

Method:

1. Pour approximately 50cm³ copper chloride solution into the beaker
2. Add the petri dish lid and insert the carbon rods through the holes. The rods must NOT touch each other
3. Attach crocodile leads to the rods. Connect the rods to the DC terminals of a low voltage power supply
4. Select 4V on the power supply & switch on
5. Look at both electrodes & record your observations
6. Use forceps to hold a piece of blue litmus paper in the solution next to the anode, identify the element produced & record your observations
7. Rinse the electrochemical cell apparatus & collect a new set of electrodes
8. Repeat steps 1-7 using the sodium chloride solution

Sources Of Error:

- Too low/high voltage
- Incorrect observations

Risks:

- Lots of chemicals
 - Could irritate eyes / skin
 - Wear goggles & handle carefully
- Glassware
 - Could break & shatter & damage skin / eyes
 - Handle all glassware carefully

REQUIRED PRACTICAL #3 ELECTROLYSIS

Aim:

to investigate the variables that affect temperature change in chemical reactions such as an acid plus an alkali

Apparatus:

- Dilute hydrochloric acid
- Dilute sodium hydroxide solution
- Polystyrene cup & lid
- 250cm³ beaker
- 10cm³ measuring cylinder
- 50cm³ measuring cylinder
- Thermometer

Variables:

Dependent - Maximum temperature reached

Independent - Volume of sodium hydroxide

Control - Cup used, volume of NaOH added each time,

Method:

1. Measure 30cm³ dilute hydrochloric acid and put it into the polystyrene cup
2. Stand the cup inside the beaker. This will make it more stable
3. Use the thermometer to measure the temperature of the acid and record it
4. Measure 5cm³ sodium hydroxide solution
5. Pour it into the polystyrene cup. Fit the lid & gently stir the solution with a thermometer through the hole
6. Look carefully at the temperature rise on the thermometer
7. When the reading on the thermometer stops changing, record the highest temperature reached
8. Repeat steps 4-7 to add further 5cm³ amounts of sodium hydroxide to the cup each time, recording the maximum temperature reading each time
9. Repeat until a maximum of 40cm³ of sodium hydroxide has been added
10. Wash all the equipment & repeat the experiment

Sources Of Error:

- Heat could escape through the hole in the lid
- Energy could be wasted heating the cup
- Parallax error when reading the thermometer

Risks:

- Chemicals present
 - Could splash & irritate skin / eyes
 - Wear goggles & handle carefully
- Cup could get hot
 - Risk of burns
 - Wait for it to cool before touching

REQUIRED PRACTICAL #4 TEMPERATURE CHANGES

Aim:

to investigate how the concentration of an acid affects the rate of reaction by measuring the volume of gas produced

Apparatus:

- Safety goggles
- 100cm³ conical flask
- Bung & delivery tube
- Water trough
- Two 100cm³ measuring cylinders
- Clamp stand, boss & clamp
- Stopclock
- Magnesium ribbon cut to 3cm lengths
- Two different concentrations of hydrochloric acid, 1mol/dm³ and 1.5mol/dm³

Variables:

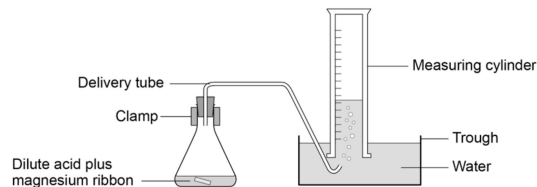
Dependent - Volume of gas produced

Independent - Concentration of acid

Control - Intervals between measuring, surface area of magnesium, volume of acid

Method:

1. Measure 50cm³ of 1mol/dm³ HCl using one of the measuring cylinders. Pour the acid into the 100cm³ conical flask
2. Fit the bung & delivery tube to the top of the flask
3. Half-fill the trough or bowl with water
4. Fill the other measuring cylinder with water. Make sure it stays filled with water when you invert it into the water trough and that the delivery tube is positioned correctly
5. Add a single 3cm strip of magnesium ribbon to the flask, put the bung back into the flask as quickly as possible, and start the stopclock
6. Record the volume of hydrogen gas given off at suitable intervals such as 10 seconds. Continue timing until the volume of gas doesn't change
7. Repeat steps 1-6 using 1.5mol/dm³ HCl



Sources Of Error:

- Apparatus not set up correctly
- Some gas escapes

Risks:

- Acid
 - Could irritate skin / eyes
 - Handle carefully & wear goggles

REQUIRED PRACTICAL #5A

RATES OF REACTION - VOLUME OF GAS

Aim:

to investigate how the concentration of an acid affects the rate of reaction by observing the colour change

Apparatus:

- 40g/dm³ sodium thiosulfate solution
- Dilute hydrochloric acid
- 10cm³ measuring cylinder
- 100cm³ measuring cylinder
- 100cm³ conical flask
- Printed black paper cross
- Stopclock

Variables:

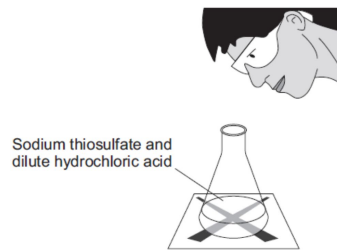
Dependent - Time taken for colour change

Independent - Concentration of sodium thiosulfate

Control - Total volume of solution, concentration of HCl

Method:

1. Measure 10cm³ sodium thiosulfate solution & put it into the conical flask
2. Measure 40cm³ of water. Add the water to the conical flask
3. This dilutes the sodium thiosulfate solution to a concentration of 8g/dm³
4. Put the conical flask on the black cross
5. Measure 10cm³ dilute HCl
6. Put this acid into the flask. At the same time swirl the flask gently & start the stopclock
7. Look down through the top of the flask. Stop the clock when you can no longer see the cross
8. Record the time it takes for the cross to disappear in a table, in seconds
9. Repeat steps 1-7 changing the concentration of sodium thiosulfate each time as below:
 - a. 20cm³ sodium thiosulfate + 30cm³ water (concentration 16g/dm³)
 - b. 30cm³ sodium thiosulfate + 20cm³ water (concentration 24g/dm³)
 - c. 40cm³ sodium thiosulfate + 10cm³ water (concentration 32g/dm³)
 - d. 50cm³ sodium thiosulfate + no water (concentration 40g/dm³)



Sources Of Error:

- Colour change is subjective
- Incorrect concentrations due to poor measuring

Risks:

- Chemicals
 - Could irritate skin / eyes
 - Wear goggles & handle carefully

REQUIRED PRACTICAL #5B

RATES OF REACTION - COLOUR CHANGES

Aim:

to investigate how paper chromatography can be used to separate & identify a mixture of food colourings

Apparatus:

- 250cm³ beaker
- Wooden spill
- Rectangle of chromatography paper
- Four known food colourings labelled A-D
- Unknown mixture of food colouring labelled U
- Five glass capillary tubes
- Paper clip
- Ruler
- Pencil

Variables:

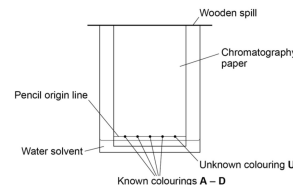
Dependent - Colours in unknown colouring

Independent - Unknown colouring

Control - Volume of colouring on each spot

Method:

1. Use a ruler to draw a horizontal pencil line 2cm from the bottom edge of the chromatography paper. This is your **origin line**
2. Mark five pencil spots at equal intervals across the origin line. Make sure you keep at least 0.5cm away from the edge of the paper
3. Use a glass capillary tube to put a small spot of each colouring on four of the pencil spots. Use the fifth tube & put a small spot of the unknown mixture (**U**) on the fifth spot. Try to make sure each spot is no more than 2-3mm in diameter. Label each spot in pencil
4. Pour water into the beaker to a depth of **no more than 1cm**
5. Clip the top short edge of the chromatography paper to the wooden spill. The top end is the end furthest from the spots
6. Carefully rest the wooden spill on the top edge of the beaker. The bottom edge of the paper should dip into the water solvent. Make sure that the pencil start line is above the water surface & the sides of the paper aren't touching the beaker wall
7. Wait for the water solvent to travel at least $\frac{3}{4}$ of the way up the paper, being sure to not disturb the beaker during this time
8. Remove the paper from the beaker. Draw another pencil line on the dry part of the paper as close to the wet edge as possible. This is called the **solvent front line**
9. Hang the paper up to dry thoroughly
10. Measure the distance in mm between the two pencil lines. This is the distance travelled by the water solvent
11. For each of food colour A, B, C & D, measure the distance in mm from the start line to the middle of the spot, and record your measurements in a table
12. Calculate the R_f value of each of the known colours using the formula
$$R_f = \frac{\text{distance moved by solute}}{\text{distance moved by solvent}}$$



Sources Of Error:

- Too much water on the paper
- Used pen to write on the chromatography paper
- Mismatch in solvent front line vs where the wet part actually stopped

Risks:

- No real risks

REQUIRED PRACTICAL #6 CHROMATOGRAPHY

Aim:

to use chemical tests to identify the ions in unknown single ionic compounds

Method:

1. Dip a nichrome wire in concentrated hydrochloric acid and then heat it in a pale blue Bunsen flame until it gives no colour to the flame. The wire is now clean
2. Dip it in concentrated HCl again, and then in the substance to be tested. Heat the wire in the Bunsen & observe the flame colour

EXPECTED RESULTS:

Metal ion	Lithium	Sodium	Potassium	Calcium	Copper
Flame colour	Crimson	Yellow	Lilac	Orange	Green

Apparatus:

- Bunsen burner
- Concentrated hydrochloric acid
- Substance to be tested
- Nichrome wire

Variables:

Dependent - Observed flame colour

Independent - Metal ion present in solution

Control - Volume of solution used, temperature of Bunsen flame, no other metal ions present in solution

Sources Of Error:

- Other metal ion present in solution
- Some flame colours look similar

Risks:

- Bunsen burner flame
 - Burns
 - Switch to orange flame when not in use & don't put fingers too close to flame

REQUIRED PRACTICAL #7A FLAME TESTS

Aim:

to use chemical tests to identify the ions in unknown single ionic compounds

Method:

1. Place a spatula measure of the substance to be tested into a boiling tube
2. Add 2cm³ HCl and quickly put the bung into the boiling tube & bubble any gas produced through limewater

EXPECTED RESULTS:

If carbonate ions are present, the limewater will turn from clear & colourless to cloudy white

Sources Of Error:

- Limewater only turns slightly cloudy

Apparatus:

- Substance to test
- Hydrochloric acid
- Limewater
- Boiling tube, bung & delivery tube

Risks:

- HCl is an irritant
 - Can irritate skin
 - Pour carefully

Variables:

Dependent - Change in colour of limewater

Independent - Presence of carbonate ion

Control - Volume of HCl

REQUIRED PRACTICAL #7B CARBONATE TEST

Aim:

to use chemical tests to identify the ions in unknown single ionic compounds

Method:

1. Place 1cm³ of the solution to be tested into a test tube
2. Add 1cm³ nitric acid
3. Add a few drops of barium nitrate solution

EXPECTED RESULTS:

If sulfate ions are present, a white precipitate of barium sulfate is produced

Sources Of Error:

- Only a small amount of precipitate is formed

Apparatus:

- Substance to test
- Nitric acid
- Barium nitrate solution
- Test tube

Risks:

- Chemicals present
 - Could irritate skin or eyes
 - Handle carefully

Variables:

Dependent - Formation of precipitate

Independent - Presence of sulfate ion

Control - Volume of nitric acid & barium nitrate

REQUIRED PRACTICAL #7C

SULFATE TEST

Aim:

to use chemical tests to identify the ions in unknown single ionic compounds

Method:

1. Place 1cm³ of the solution to be tested into a test tube
2. Add 1cm³ nitric acid to remove any carbonate ions
3. Add a few drops of silver nitrate solution
4. Record any observations

EXPECTED RESULTS:

Halide	Observation
Chloride	White precipitate
Bromide	Cream precipitate
Iodide	Yellow precipitate

Apparatus:

- Solution to be tested
- Test tube
- Nitric acid
- Silver nitrate solution

Sources Of Error:

- Only a small amount of precipitate is formed

Variables:

Dependent - Formation of precipitate

Independent - Presence of halide ion

Control - Volume of silver nitrate, volume of nitric acid, volume of solution to test

Risks:

- Chemicals present
 - Could irritate skin or eyes
 - Handle carefully

REQUIRED PRACTICAL #7D HALIDE TEST

Method:

1. Use the universal indicator paper to measure the pH of the water sample
2. Accurately weigh an empty evaporating basin & record to two decimal places
3. Pour 10cm³ of water sample 1 into the evaporating basin
4. Heat the basin on a tripod & gauze using a Bunsen burner until the solids start to form and the majority of water has evaporated
5. Weigh the cooled evaporating basin again & calculate the mass of the solids that were dissolved in the water, and record your results in a table
6. Repeat for the other water samples

Sources Of Error:

- Some water could still be left in the basin when measuring

Aim:

to analyse & purify a sample of water and make it safe to drink

Apparatus:

- 10cm³ of each of the water samples to be tested
- Universal indicator paper or solution

Risks:

- Bunsen burner flame
 - Burns
 - Use safety flame when possible & turn off when not in use

Variables:

Dependent - pH of & mass of solids in sample

Independent - Water sample

Control - Volume of water

REQUIRED PRACTICAL #8A ANALYSING A WATER SAMPLE

Method:

1. Place the water sample in the conical flask. Set up the apparatus for distillation as shown in the diagram
2. Heat the water using the Bunsen burner until it boils, then reduce the heat so that the water boils gently
3. The distilled water will collect in the cooled test tube. Collect about 1cm depth of water in this way, then stop heating
4. Analyse the water you have distilled by determining its boiling point

Sources Of Error:

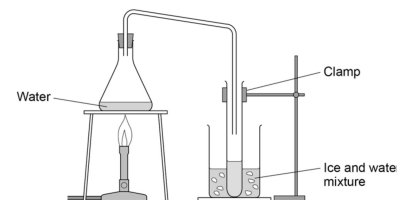
- Not heated for long enough

Aim:

to analyse & purify a sample of water and make it safe to drink

Apparatus:

- 10cm³ of a water sample to be tested
- Bunsen burner
- Tripod
- Gauze
- Heatproof mat
- Clamp & stand
- Conical flask with delivery tube & bung
- Boiling tube
- Ice bath



Risks:

- Bunsen burner flame
 - Burns
 - Use safety flame when possible & turn off when not in use
- Hot water
 - Scalds
 - Handle carefully

Variables:

Dependent - Boiling point of distilled water

Independent - Water sample

Control - Depth of water to test, volume of sample

REQUIRED PRACTICAL #8B PURIFYING A WATER SAMPLE