Bentley Wood
High School for Girls

Year 10-11 Bridging Work

Physics

Summer 2026

Name: ………………………………….

Form: ……………………………….

Teacher: ………………………………..

Introduction

Congratulations on completing Year 10 and entering the final stage of your physics journey! This bridging work will help you review and reinforce key ideas from Year 10, ensuring a smooth transition into Year 11. If you want to succeed next year, the hard work starts *now*.

This bridging work booklet is divided into **three** sections:

PART 1*: Required Practical Revision*

PART 2*: Exam Question Practice*

PART 3*: Educake Quiz on Numeracy and Working Scientifically Skills*

Alongside this bridging work, you are also expected to complete your pink end-of-year exam analysis worksheet, as well as the relevant follow up questions – choose either the D/S or E tasks depending on how you performed in each question in the end-of-year exam. This exam follow-up work must be completed using a purple pen.

You are welcome to use your CGP and Kerboodle textbooks to help you complete this bridging work, as well as any of the resources listed below:

- ✓ Physics and Maths Tutor: https://www.physicsandmathstutor.com/physics-revision/
- ✓ Save My Exams: https://www.savemyexams.com/subjects/physics/
- ✓ Cognito Science: https://cognitoedu.org/home
- ✓ Classroom 42: https://www.classroom42.com/courses/aqa-gcse-physics/
- ✓ Physics Online: https://www.physicsonline.com
- ✓ Seneca: https://senecalearning.com/en-GB/
- ✓ Educake: https://my.educake.co.uk/login
- ✓ Kerboodle: https://www.kerboodle.com/users/login
- ✓ BBC Bitesize: https://www.bbc.co.uk/bitesize/subjects/zrkw2hv

This is the first piece of work you will be assessed on in Year 11 and will set the tone for the rest of the academic year. Your new class teacher will check that this bridging work has been completed during your first physics lesson and will follow up if any part of it is incomplete or not completed to a high standard. Use this bridging work as an opportunity to showcase the knowledge, skills, and progress you have made since the beginning of your physics learning journey. Work hard, stay focused, and demonstrate what you are capable of achieving!

The Science Department

PART 1: *Required Practical Revision*

To complete this section of your bridging work, choose at least **three** of the required practicals listed below. Revise your three chosen practicals and complete the follow-up questions in this booklet for those practicals. You may use the videos linked below to help you:

Required Practical 1 – Specific Heat Capacity
https://www.youtube.com/watch?v=CpEdfQUAxZ4

Required Practical 2 – Thermal Insulation
https://www.youtube.com/watch?v=PRX_LXyCSWk

Required Practical 3 – Resistance
https://www.youtube.com/watch?v=m_3JrA-sDEg
https://www.youtube.com/watch?v=51mSWRfAsAw

Required Practical 4 – I/V Characteristics
https://www.youtube.com/watch?v=bp4T1Vqma3M

Required Practical 5 – Density
https://www.youtube.com/watch?v=q4qhPs2U5S4

Required Practical 6 – Force and Extension
https://www.youtube.com/watch?v=QQCJeAqBumE

Required Practical 7 – Force and Acceleration
https://www.youtube.com/watch?v=i33CDBpZG9U

For each required practical, you should aim to be able to answer the following questions:

1. *What is the dependent variable and the independent variable?*
2. *Therefore, what other factors could affect the results and need to be controlled?*
3. *What will I measure or record?*
4. *What would an appropriate experimental control be?*
5. *How could I improve the accuracy of my experiment/investigation?*
6. *How could I improve the precision of my experiment/investigation?*
7. *How could I improve the validity of my experiment/investigation?*
8. *What else could I do with this experiment? What could I change to investigate something else?*
9. *What is my greatest source error?*
10. *What pattern or trend do my results show and how do I explain this?*

It is important to note that not all the investigations have all of these characteristics, so not every question can be answered for every required practical. Remember that you may be assessed on variations of these practicals.

Learning Objectives -

- Heat up blocks of different metals using an electric heater
- Measure the mass and temperature of the block
- Calculate the work done by the heater
- Plot a graph of temperature change against work done and use the gradient to calculate specific heat capacity of the metal.

Links the decrease of the metal energy store (work done) to the increase in temperature and subsequent thermal energy stored.

Equipment & Apparatus

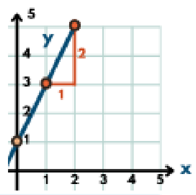
REQUIRED PRACTICAL 1
SPECIFIC HEAT CAPACITY

Method:

1) Measure the mass of the copper block in kg.
2) Wrap the insulation around the block.
3) Place the immersion heater into the larger hole of the block.

4) Connect ammeter, power pack and heater in series.
5) Connect the voltmeter across the heater.
6) Use the pipette to put a small amount of water in the other hole.

7) Put the thermometer in the same hole.
8) Set the power back to 12V. Switch it on. — This will turn on the heater
9) Record the ammeter and voltmeter readings. — These shouldn't change
10) Take the starting temperature reading and start the stopwatch.
11) Record the temperature every minute for 10 minutes.
12) Calculate the power of the heater in watts. — Power (watts) = potential difference (V) x current (I)
13) Calculate energy transferred (work done, J) by the heater.
    - Work done (joules, J) = Time (seconds, S) x Power (watts, W)
14) Plot a graph of temperature (°C) against work done (J).
15) Draw a line of best fit. — The beginning of the graph may be curved
16) Calculate the gradient of the straight part of the graph.
    - Gradient = $\frac{\text{change in temperature rise (°C)}}{\text{work done (J)}}$
    - $\frac{\text{change in y}}{\text{change in x}}$



17) Calculate the heat capacity of the copper block.
    - Heat capacity = 1 / gradient — The amount of heat energy (J) needed to increase the temperature by 1°C
18) Calculate the specific heat capacity of the copper block.
    - The amount of heat energy (J) needed to increase the temperature of 1kg copper by 1°C
    - Specific heat capacity = $\frac{\text{Energy transferred (J)}}{\text{mass (kg) x temperature change (°C)}}$
19) Repeat steps 1-18 with aluminium and iron blocks.

Type of metal block	Specific heat capacity (J/Kg/°C)
Copper	385
Aluminium	913
Iron	500

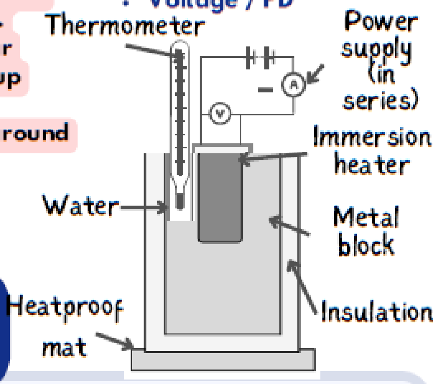
Safety:

- Do not touch the block or heater when hot - if burnt, run area under cold water for at least five minutes.
- Keep the block on the heatproof mat and allow time for equipment to cool before deconstructing.
- Avoid water spills near power supply - clean up spills.
- Wear eye protection around hot water

Independent variable
- Time

Dependent variable
- Change in temperature

Control variables:
- Block materials
- Current
- Voltage / PD



Conclusion

From AQA: "'William thinks that denser materials have higher specific heat capacities. Using the density values of the metals below and the values of specific heat capacity that you have calculated, do you agree with him?'

Type of metal block	Density (g/cm^3)
Copper	8.96
Aluminium	2.70
Iron	7.87

Example: No - copper has the highest density of 8.96g/cm³ but the lowest specific heat capacity of 385J/Kg/°C. Also, aluminium has the lowest density of 2.70g/cm³ but the lowest specific heat capacity of 913 J/Kg/°C. So, this hypothesis would be rejected as results suggest the less dense materials have a higher specific heat capacities.

Evaluation

Random errors
- Some heat will dissipate into the surroundings
  - Insulation minimises loss,
  - Actual specific heat capacity is likely higher
- Errors in measurements from ammeter, voltmeter and stopwatch
  - Use a joulemeter to calculate energy directly
- Human error of temperature reading

Systematic errors
- Zero error - could occur if the ammeter and voltmeter are not initially set to zero.

Exam Style Questions - Specific Heat Capacity

1. What is the independent variable in this experiment? (1 mark)

2. State two control variables in this experiment. (2 marks)

3. Why is the block wrapped in insulation? (1 mark)

4. What measurements are needed to calculate power? (2 marks)

5. Describe how to calculate the energy transferred by the heater. (2 marks)

6. A student records a voltage of 12 V, a current of 2.0 A, and heats for 600 seconds. Calculate the energy transferred. (2 marks)

7. A graph is plotted with temperature (°C) on the y-axis and energy transferred (J) on the x-axis. What is the gradient of the straight-line section used for? (1 mark)

8. Give one source of random error in this experiment and how it can be reduced. (2 marks)

9. A student wants to compare the specific heat capacity of copper and aluminium using the same method. Describe the method they would use and explain how they would ensure the comparison is valid. Include how they would use the results to calculate the specific heat capacity. (6 marks)

Learning Objectives -

Measure the rate of cooling of a beaker of hot water that is insulated with different materials.

Use your results to plot cooling curves to determine which is the best thermal insulator.

Method:

1) Put the small beaker inside the larger beaker.

2) Use the kettle to boil water.
Put 80 cm^3 of this hot water into the small beaker.

3) Use a piece of cardboard as a lid for the large beaker - there must be a hole for the thermometer.

4) Put the thermometer through the hole in the cardboard lid so that its bulb is in the hot water.

5) Record the temperature of the water and start the stopwatch.

6) Record the temperature of the water every 3 minutes for 15 minutes.

7) Record your results in a table.

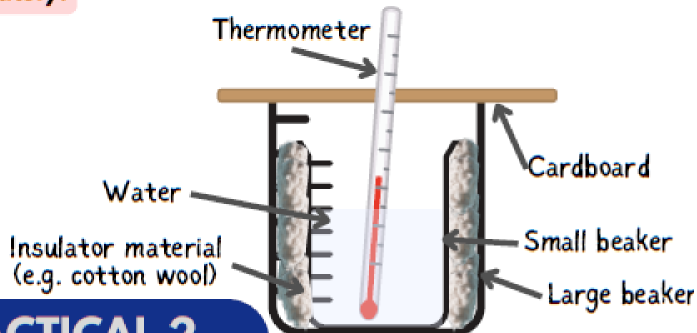
8) Repeat steps 1–6 using different materials each time to fill the space between the small and large beaker.

Make sure you use the same volume of water each time.

You might find it easier to set up your beakers at the start.

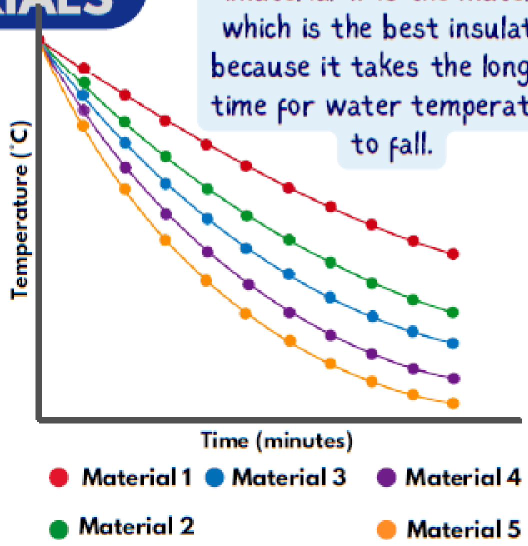
Safety:

- Do not touch the beakers when hot - if skin is scalded, run area under cold water for at least five - ten minutes.
- Keep the beakers on the heatproof mat and allow time for equipment to cool before deconstructing.
- Wear eye protection around hot water.
- If there is cracked or broken glass, inform a supervisor immediately.



REQUIRED PRACTICAL 2
THERMAL INSULATION P1 - DIFFERENT MATERIALS

Time (mins)	Material used for insulation			
	No insulation	Bubblewrap	Cottonwool	Newspaper
	Temperature (°C)			
0				
3				
6				
9				
12				
15				
Change in temperature (°C)				



The shallowest curve (material 1) is the material which is the best insulator because it takes the longest time for water temperature to fall.

Temperature fall is quicker at higher temperatures than lower temperatures
- When water temperature is high, there is a greater temperature difference between it and room temperature, so there is a higher rate of energy transfer.

Random errors

- Some heat will dissipate into the surroundings
  - Make sure the hole in cardboard is a small as possible.
- Errors in measurements from thermometer
  - Use a joulemeter to calculate energy directly
- Human error of temperature reading
  - Take repeated readings and obtain a mean.
  - Read values at eye level.

Independent variable - type of material
Dependent variable - temperature, T (°C)
Control variables - volume of water, temperature at the start, thickness of each material

Systematic errors

- If the starting temperature of the water is different for each material, this will affect the rate of heat loss - work in pairs to coordinate the starting of the stopwatch and point at which the temperature gets to the starting point used in the control.
- Make sure only the top of the beaker is covered so energy is transferred through the glass.
- A thermometer has a resolution of 1°C, a data logger connected to a digital thermometer would get more accurate readings.

Exam Style Questions - Thermal Insulation P1

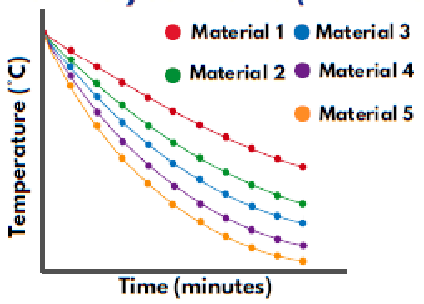
1. What is the independent variable in this experiment? (1 mark)

2. Why is a lid with a hole used during the experiment? (1 mark)

3. Describe how you would compare the effectiveness of five insulating materials using this setup. (3 marks)

4. A student finds that the temperature of the water drops fastest with newspaper and slowest with bubble wrap. What conclusion can they make about the effectiveness of these two materials? (2 marks)

5. Look at the graph. Which line shows the best insulator and how do you know? (2 marks)



6. Explain why it is important to use the same starting temperature of water in each beaker. (2 marks)

7. The student notices the thermometer readings vary slightly each time they insert it. Suggest one reason why this happens and how it could be reduced. (2 marks)

8. A student finds that the temperature of the water drops quickly in the first 3 minutes, then more slowly afterwards. Explain why this happens using ideas about temperature difference and energy transfer. (3 marks)

Learning Objectives -

- Measure the rate of cooling of a beaker of hot water that is insulated with different thicknesses of the same material
- Use your results to plot cooling curves to determine the effect of changing the thickness of the insulator.

Method:

1) 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 of the beaker.

2) Put 80 cm^3 of this hot water into the beaker.

3) Use a piece of cardboard as a lid for the large beaker - there must be a hole for the thermometer.

4) Put the thermometer through the hole in the cardboard lid so that its bulb is in the hot water.

5) Record the temperature of the water and start the stopwatch.

6) Record the temperature of the water every 3 minutes for 15 minutes.

7) Record your results in a table.

8) Repeat steps 2-6 using adding 2 more layers of insulation each time.

Make sure you use the same volume of water each time.

You can use the 'no insulation' results from P1 for '0 layer' to save time.

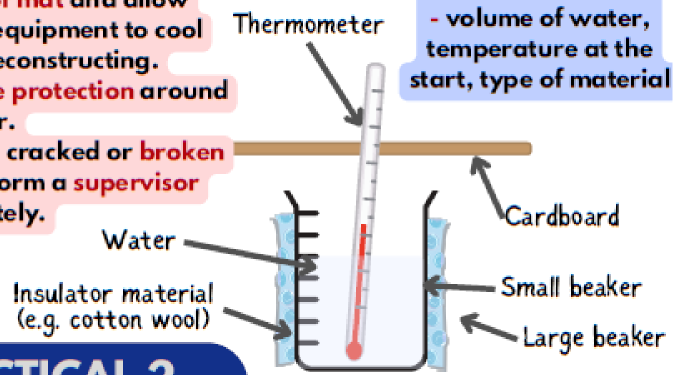
Safety:

- Do not touch the beakers when hot - if skin is scalded, run area under cold water for at least five - ten minutes.
- Keep the beakers on the heatproof mat and allow time for equipment to cool before deconstructing.
- Wear eye protection around hot water.
- If there is cracked or broken glass, inform a supervisor immediately.

Independent variable - thickness of material

Dependent variable - temperature, T (°C)

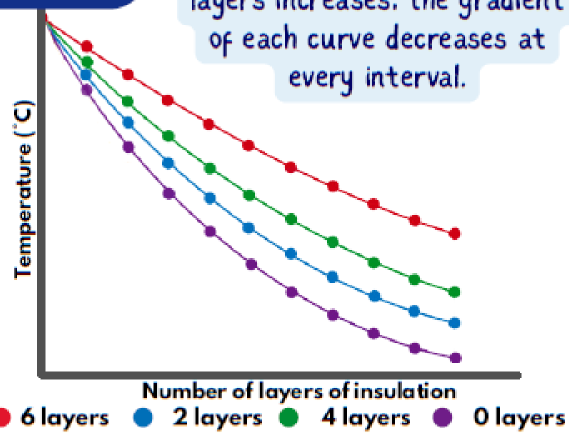
Control variables - volume of water, temperature at the start, type of material



REQUIRED PRACTICAL 2
THERMAL INSULATION P2 - DIFFERENT THICKNESS

Time (mins)	Material used for insulation (layers of bubblewrap)			
	0 layers	2 layers	4 layers	6 layers
	Temperature (°C)			
0				
3				
6				
9				
12				
15				
Change in temperature (°C)				

The curve for zero layers of insulation has the steepest gradient. As the number of layers increases, the gradient of each curve decreases at every interval.



Random errors

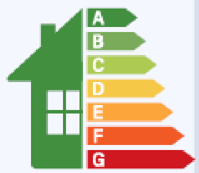
- Make sure the hole in cardboard is a small as possible to minimise heat dissipation
- Human error of temperature reading
  - Take repeated readings and obtain a mean.
  - Read values at eye level.

More layers of bubble wrap increases, insulation increases which means the temperature falls more slowly.
Also, similarly to part 1, the temperature falls faster at higher temperatures than at lower temperatures.

Systematic errors

- Make sure the starting temperature is the same every time.
- Make sure only the top of the beaker is covered so energy is transferred through the glass.
- A data logger connected to a digital thermometer would get more accurate readings.

Energy is transmitted by conduction, convection or radiation. Comparing the time taken to transfer energy from the inside from the house to the environment by conduction helps us decide the most energy efficient materials which are suitable and affordable for different parts of a house.



It is essential to combine the knowledge of which materials and thickness create energy efficient homes without being so expensive to install it doesn't outweigh money saved from energy loss.

Exam Style Questions - Thermal Insulation P2

1. What is the independent variable in this experiment? (1 mark)

2. A student finds that the temperature change over 15 minutes is 16˚C with 0 layers and 6˚C with 6 layers. What does this suggest about the effect of thickness? (2 marks)

3. Explain why energy is transferred more slowly with more layers of insulation. (3 marks)

4. What is the purpose of using the same lid and beaker type each time? (1 mark)

5. Suggest one way to improve the accuracy of this experiment. (1 mark)

6. Why does the temperature drop more slowly when more layers of insulation are used? (2 marks)

7. The experiment is repeated using water at 100˚C instead of 80˚C. Explain how this might affect the results. (3 marks)

8. The student is told to repeat each test three times. Why is this good experimental practice? (2 marks)

9. A student finds that the temperature drop between 0 and 15 minutes was 17˚C with 0 layers, 12˚C with 2 layers, and 8˚C with 4 layers. They then add a 6th layer but find the temperature only drops by 7˚C. Explain why adding more layers becomes less effective at reducing heat loss. (3 marks)

Learning Objectives -

- Set up a circuit which can measure the potential difference and current across a wire at different lengths along the wire.
- Calculate the resistance of different lengths of the wire and state the relationship between resistance and length.

Equipment & Apparatus

Voltmeter - measure potential difference through the resistors

Ammeter - measure current through the circuit

Connecting leads

Metre ruler

Resistance wire

12V power supply - source of potential difference

Crocodile clips

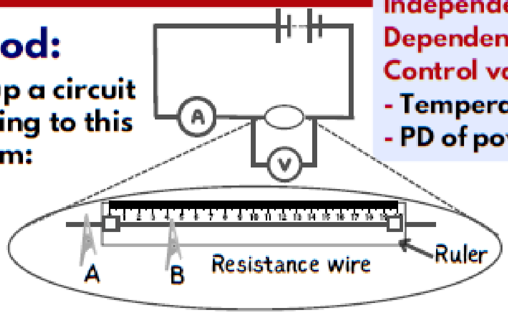
Independent variable - length of wire (cm)

Dependent variable - resistance (Ω)

Control variables
- Temperature of the wire
- PD of power supply

Method:

1) Set up a circuit according to this diagram:



2) Connect a lead from the **negative side** of the **ammeter** to the **crocodile clip (A)** at the **zero end** of the ruler.

Connect a **lead** from the other **crocodile clip (B)** to the **negative side** of the **battery**.

Use this **lead as a switch** to disconnect the battery between readings.

3) Decide the **interval distance** (e.g. 10cm) you will investigate and connect the first distance to be tested **between crocodile clips A** and **B**.

4) Measure the readings on the **voltmeter** and **ammeter** at this distance.

Record in a table.

Length of wire in cm	Potential difference in volts	Current in amps	Resistance in ohms
e.g. 100	1.20	0.16	7.5
e.g. 90	1.18	0.17	6.8
e.g. 10	0.41	0.63	0.7

R=

REQUIRED PRACTICAL 3
RESISTANCE P1 - LENGTH OF WIRE

Safety Tips:
- Avoid touching the resistance wire when connected or hot; run any burns under cold water for 5-10 minutes.
- Keep liquids away from equipment to prevent electrical damage if spilled.

5) **Move crocodile clip B** and record the readings for the different lengths of wire e.g. 20cm, 30cm etc.

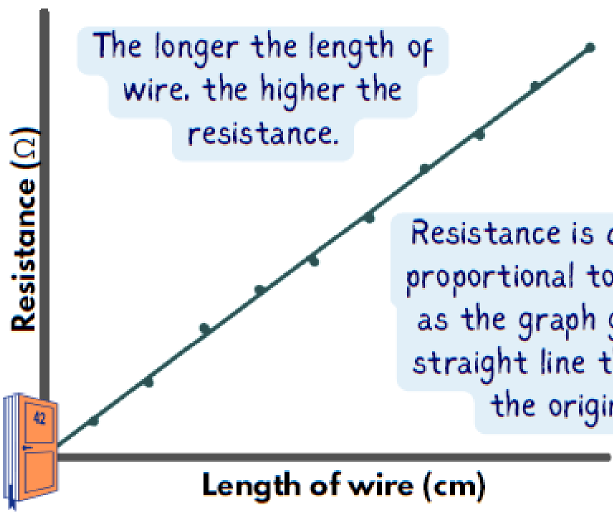
6) **Calculate** the **resistance for each length** of wire using the equation:

$$\text{resistance in } \Omega = \frac{\text{potential difference in V}}{\text{current in A}}$$

7) Plot a graph of **resistance against length of wire** and draw a line of best fit.
Describe the relationship between resistance and length.

Random Errors
- **Limit current flow** to maintain **consistent** wire temperature and resistance.
- **Turn off** current between readings to prevent temperature-related resistance changes.

Systematic Errors
- Ensure the **first crocodile clip is at 0** on the ruler to avoid zero error in length measurements.
- Check that both the ammeter and voltmeter **start from 0.**



The longer the length of wire, the higher the resistance.

Resistance is directly proportional to length as the graph gives a straight line through the origin.

The graph may not pass through the origin due to confounding variables that impact both the independent and dependent variables, such as temperature affecting resistance.
- Increased temperature raises resistance as the wire heats up.
- Longer wire lengths lead to higher resistance and more heating.

To minimize confounding variables, it's best to take readings quickly and allow the wire to cool before measuring again, though time constraints in class often make this difficult.

Exam Style Questions - Resistance P1

1. What is the independent variable in this experiment? (1 mark)

2. State the equation used to calculate resistance. (1 mark)

3. A student tests 50 cm and 100 cm of wire. The current is 0.3 A and the voltages are 0.90 V and 1.80 V respectively. Calculate the resistance for both lengths. (2 marks)

4. Explain why the wire should be left to cool between measurements. (2 marks)

5. What is the relationship between length of wire and resistance? (2 marks)

6. A student plots a graph of resistance against length of wire. The line does not pass through the origin, as expected. Suggest two reasons why. (2 marks)

7. Why should the wire used be the same thickness throughout the experiment? (1 mark)

8. A student finds that resistance is higher at longer lengths.
Explain this using particle theory. (3 marks)

9. Suggest one way to reduce random error when measuring current and voltage. (1 mark)

REQUIRED PRACTICAL 3
RESISTANCE - SERIES AND PARALLEL

Learning Objectives -
- Use circuit diagrams to construct circuits with resistors in series and in parallel
- Measure the potential difference and current in circuits with resistors in series and then in parallel.

Equipment & Apparatus

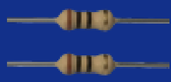
Voltmeter - measure potential difference through the resistors

Ammeter - measure current through the circuit

Connecting leads

Switch

Crocodile clips



2 10Ω resistor

12V power supply (battery) - source of potential difference

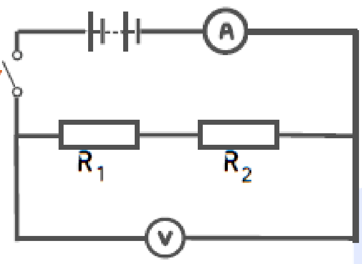
Independent variable - number of resistors

Dependent variable - total resistance (Ω)

Control variables - Temperature of the resistors and potential difference of the power supply

Method:

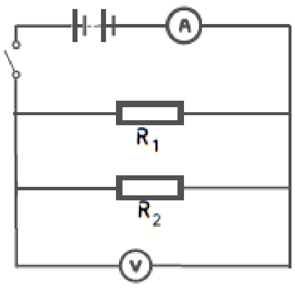
1) Set up a circuit according to this diagram in order to connect the circuit for two resistors in series.



2) Switch on and record the reading of the ammeter and the voltmeter.

3) Calculate the total resistance of the series circuit.

4) Set up a circuit according to this diagram in order to connect the circuit for two resistors in parallel.



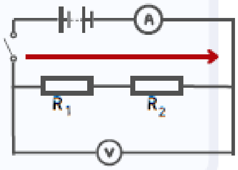
5) Switch on and record the reading of the ammeter and the voltmeter.

6) Calculate the total resistance of the parallel circuit.

7) Write a conclusion about the effect of adding resistors
i) In series
i) In parallel

$$R = \frac{V}{I}$$

i. In series:
- Resistance of combined resistors = sum of two individual resistances
- Electrons, therefore the current, flowthrough one path
- The potential difference is split across the two resistors.

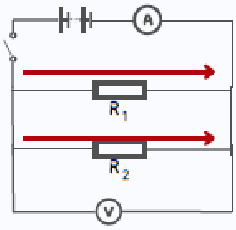


Combined resistance in series (R) = $R_1 + R_2 + R_3$
Therefore, increasing the number of resistors increases the overall resistance.

You can continue this experiment by adding additional resistors in series and parallel to determine the effect.

You can check the value of the resistance of R_1 and R_2 in either circuit by putting each resistor in the circuit on its own and recording the ammeter and voltmeter. The calculation R = V / I should = 10Ω.

ii. In parallel
- Combined resistance of resistors in parallel is less than if they were in series because there is an extra path for the electrons (therefore current) to flow.
- Therefore, current is split and more charge can flow at once, giving a reduced resistance.
- The potential difference across each resistor will be the same as the power supply or battery pd.



$$R = \frac{V}{I}$$

A circuit in parallel is advantageous because it allows components to be individually switched on and off and if one component stops working, they others can continue to work.

Systematic errors
- Check that the ammeter and voltmeter are calibrated to zero before taking any recordings.

Random errors
- Temperature of the wire can increase when current is applied which can affect resistance
  - Minimise current size through wire
  - Switch off circuit between readings of temperature reading

With the current (I) increasing but potential difference (V) staying the same, the denominator in this equation is being split into larger parts, therefore the calculation results in a smaller number.

Resistor	Potential difference in volts	Current in amps	Resistance in ohms
Series	4.45V	0.22A	20.2
Parallel	3.94V	0.79A	4.9

Exam Style Questions - Resistance P2

1. What is the independent variable in this practical? (1 mark)

2. Describe the difference in current between a series and parallel circuit. (2 marks)

3. A student sets up two circuits: one in series, one in parallel. The voltage is the same in both. Explain why the total resistance is lower in the parallel circuit. (3 marks)

4. What is the equation to calculate resistance, and how can it be applied in this practical? (2 marks)

5. A student finds the total resistance in a series circuit is 9.0 Ω and in a parallel circuit is 4.9 Ω. What conclusion can they make about adding resistors in parallel vs series? (2 marks)

6. Why is it important to use identical resistors in this practical? (1 mark)

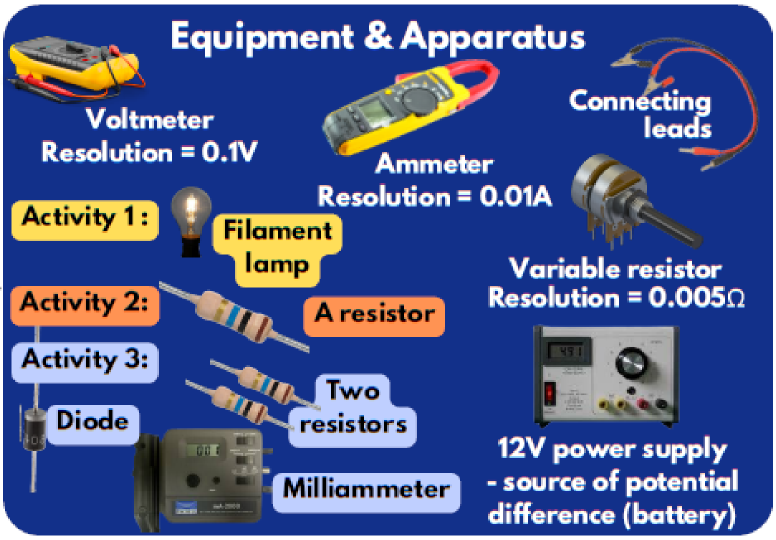
7. In a parallel circuit, the voltage across each resistor is the same. Explain why this means the total current is higher than in a series circuit. (3 marks)

8. A student adds a third identical resistor to a parallel circuit. Predict what happens to the total resistance and explain why. (2 marks)

REQUIRED PRACTICAL 4
I-V CHARACTERISTICS

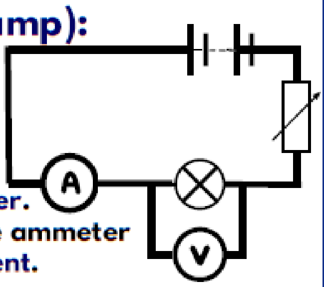
Learning Objectives -

→ Use circuit diagrams to construct appropriate circuits to investigate the I-V characteristics of a variety of circuit elements: 1. a filament lamp, 2. resistor, 3. a diode, at a constant temperature.



Activity 1 (Filament lamp):

1) Set up a circuit according to this diagram:



2) Record the readings on the ammeter and voltmeter. Take three readings from the ammeter to calculate an average current.

3) Adjust the variable resistor and record new readings on the ammeter and voltmeter.

The variable resistor varies the potential difference

4) Repeat this to obtain of readings for 8 voltages.

5) Swap the connections on the battery/power supply so that the ammeter is connected to the negative terminal and the variable resistor to the positive terminal.

6) Repeat steps 2-4 with the battery reversed. Readings on the voltmeter and ammeter should now be negative.

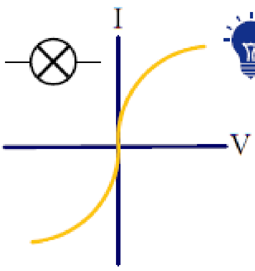
7) Plot a graph of current against potential difference.

8) Draw a line of best fit through the origin - this is the characteristics of a filament lamp.

Voltage (V)	Current I_1 (A)	Current I_2 (A)	Current I_3 (A)	Average Current I (A)
0.5				
...				

Safety Tips:
- Avoid touching the resistance wire when connected or hot, especially under high voltages; run any burns under cold water for 5-10 minutes.
- Keep liquids away from equipment to prevent electrical damage if spilled.
- Switch off the circuit between readings to prevent the circuit heating unnecessarily

Independent variable - Potential difference, V
Dependent variable - Current, I
Control variables - Using the same wires and components

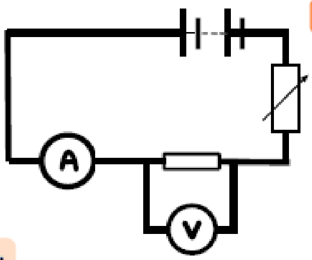


The origin of the graph is in the middle of the paper because there are negative values.

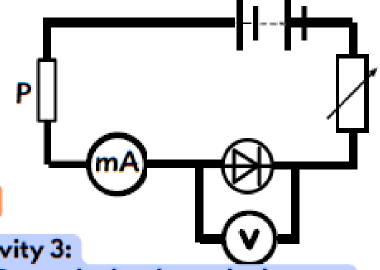
Note: the resistance at any point on the graph is the inverse of the gradient of a line from that point of origin (not the gradient of the graph!)

Activity 2 (Resistor) & Activity 3 (Diode):

The method for taking readings (steps 2 - 8) is the same as activity 1 and should be completed in succession. However, make sure you set up each circuit correctly:



Activity 2:
- Swap the leads on the battery back to their original positions.
- Replace the filament lamp with the resistor.



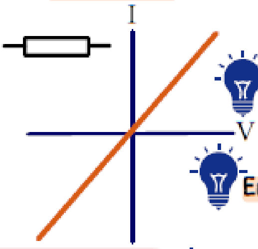
Activity 3:
- Swap the leads on the battery back to their original positions.
- Reduce the battery P.D to <5 V.

  Minimises the current through the diode.
- Swap ammeter for the milliammeter

  Enable us to obtain a low current reading.
- Replace the resistor with a diode
- Connect the extra resistor, P.

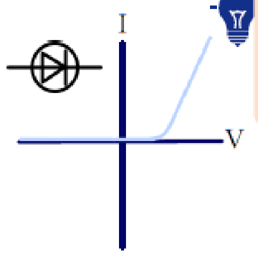
  A 'protective' resistor to protect the diode.

Reduce systematic errors by checking that both the ammeter and voltmeter start from 0.



Random Errors
- Limit current flow to maintain consistent wire temperature and resistance.
- Turn off current between readings to prevent temperature-related resistance changes.
- You cannot completely have zero resistance through the ammeter and voltmeter, therefore readings will have some inaccuracies.
- Take three readings for each voltage to reduce anomalous results

Variable Resistor
- The variable resistor varies the potential difference.
- If using a battery or power pack with a single setting, the variable resistor allows you to change the p.d. from the fixed voltage.
- If you are using a power pack with a dial, you can simply change the p.d. on the dial



The diode behaves different depending on the polarity of the power supply.

Exam Style Questions - I-V Characteristics

1. What is the independent variable in this experiment? (1 mark)

2. What component is used to vary the potential difference across a circuit? (1 mark)

3. Describe the shape of the I-V graph for a filament lamp. (2 marks)

4. Explain why the filament lamp's resistance increases as the current increases. (3 marks)

5. What would a graph of current against potential difference look like for a resistor at constant temperature? (1 mark)

6. Explain why the resistance of the resistor remains constant during the experiment. (2 marks)

7. The student plots a straight-line graph through the origin.
What does this show about the relationship between current and voltage? (2 marks)

8. Why is there no current when the potential difference is negative in a diode circuit? (2 marks)

9. A student says, "The resistance of a filament lamp increases as current increases, but the resistor's resistance stays constant." Use the I-V graphs to explain why the student is correct. (4 marks)

Learning Objectives -

- **Activity 1:** Use a ruler and a balance to determine the density of a regularly shaped object
- **Activity 2:** Use a displacement method to determine the density of an irregularly shaped object
- **Activity 3:** Use measurements of volume and mass to determine the density of a liquid.

Evaluation

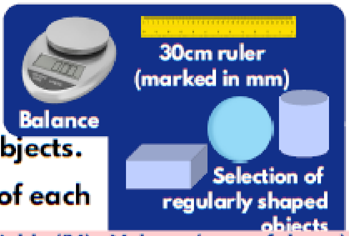
Random errors

- Errors in measurements of length of objects (incorrect volume)
  - Take multiple readings to calculate an average
- Dropping irregular objects from too high a height may cause water to splash out, therefore the volume is incorrectly determined.

Systematic errors

- Zero error - could occur if the digital balance is not initially set to zero.
- Different balances may not be identically calibrated
- Rounding errors
- Resolution of measuring cylinders may be different

Activity 1:

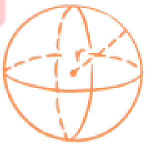


1) Measure and record the length, width and height of your selected objects.

2) Calculate the volume of each object.

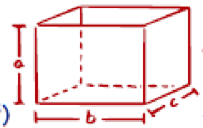
Independent variable (IV) - Volume (type of shape)
Dependent variable (DV) - Mass of object

3) Measure the mass of each object using the digital balance.



$V = \frac{4}{3}\pi r^3$

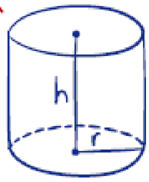
4) Calculate and record the density of each object using the formula:



$V = abc$

$\rho = \frac{m}{v}$ density $(kg/m^3) = \frac{\text{mass (kg)}}{\text{volume } (m^3)}$

5) Convert g/m^3 to kg/m^3.



$V = \pi r^2 h$

Shaped object	Length (cm)	Height (cm)	Width (cm)	Volume (cm^3)	Mass (g)	Density (g/cm^3)
Sphere						
Cylinder						
Cuboid						

1cm = 0.01m
50cm = 0.5m

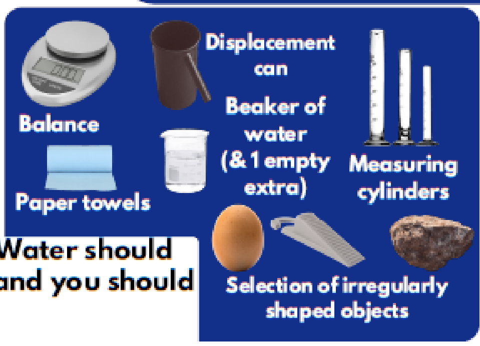
Record results as you go!

Analysis - Explain the differences in density between solids and liquids

E.g.'The density of a substance depends on how closely its particles are packed. In solids, particles are tightly packed in a fixed structure, making them denser. In liquids, particles are still close but can move around, creating small gaps and lowering density. For example, ice is less dense than liquid water because its particles form an open structure.'

REQUIRED PRACTICAL 5 DENSITY

Activity 2:



1) Measure the mass of one of the irregular shaped objects.

2) Record in a table.

3) Put the displacement can on your desk. Put an empty beaker under the spout and fill the can with water. Water should be dripping from the spout and you should wait until you see this stop.

4) Put a measuring cylinder that you think will give the most accurate reading under the spout instead of the beaker.

5) Very carefully lower the object into the displacement can so that it is completely submerged. Collect all of the water that comes out of the spout in the measuring cylinder.

6) Measure the volume of the collected water. This volume is equal to the volume of the object.

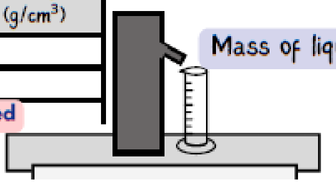
Make sure the can is full before adding the object, otherwise the can will continue to fill, before it can spill out!

7) Calculate and record the density of the object.

8) Repeat the activity for some other objects. Remember to refill the can with water each time.

Shape	Mass (g)	Volume of liquid collected (cm^3)	Density of irregular shape (g/cm^3)
Egg			
Doorstop			
Stone			

IV - Irregular shape / mass
DV - Volume of water displaced



Independent variable (IV) - Volume of water added
Dependent variable (DV)- Mass of cylinder

Activity 3:

1) Measure the mass of the empty measuring cylinder.

2) Record in a table.

3) Pour about $100cm^3$ of the sugar solution into the measuring cylinder. Record the volume accurately

4) Measure and record the mass of the measuring cylinder and liquid. From this calculate and record the mass of just the liquid.

5) Calculate the density of the liquid.

6) Standard units of density are kg/m^3. Use the data above to calculate the density of the liquid in these units.

Mass of empty cylinder (g)	Volume of liquid (cm^3)	Mass of cylinder + liquid (g)	Mass of liquid (g)	Density of liquid (g/cm^3)

Mass of liquid = Mass of cylinder with water − mass of empty cylinder

Exam Style Questions - Density

1. What equipment is needed to measure the volume of a cube or cuboid? (1 mark)

2. A metal block has a mass of 540 g and measures 5.0 cm × 3.0 cm × 2.0 cm. Calculate the density in g/cm^3. (3 marks)

3. Give one reason why it is important to take repeat readings of length when measuring a solid. (1 mark)

4. A student places a stone in a displacement can and collects 120 cm^3 of water. The mass of the stone is 300 g. Calculate the density of the stone. (2 marks)

5. When using a displacement can, explain why it's important to wait until water stops dripping from the spout before taking a reading. (2 marks)

6. A student pours 100 cm^3 of liquid into a measuring cylinder. The mass of the cylinder is 50 g. The total mass of the cylinder and liquid is 130 g. Calculate the density of the liquid in g/cm^3. (3 marks)

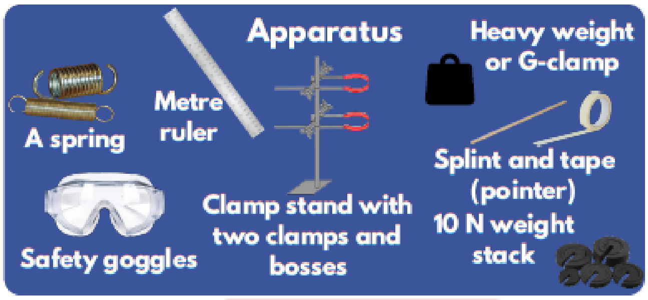
7. Explain why solids usually have a higher density than liquids, using ideas about particle arrangement. (3 marks)

8. A student records the following data:
- Mass of empty measuring cylinder = 60 g
- Mass of cylinder + unknown liquid = 180 g
- Volume of liquid = 150 cm^3

a) Calculate the mass of the liquid
b) Calculate the density in g/cm^3
c) Suggest one source of error in this method and how it could be reduced (4 marks)

Learning Objectives - Investigate the relationship between force and extension of a spring.

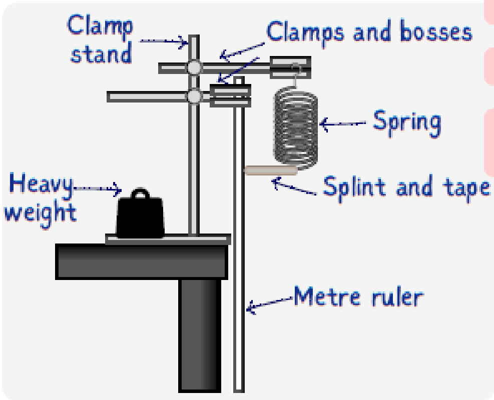
- Hang different masses from a spring and measure the extension of the spring for each mass used.
- Convert mass into weight.
- Use your results to plot a graph of extension against weight.



REQUIRED PRACTICAL 6
FORCE AND EXTENSION

Method:

1) Set up your apparatus as in the diagram making sure that:
- The ruler is vertical.
  - The zero on the scale needs to be at the same height as the top of the spring
- The splint is attached securely to the bottom of the spring.
  - Make sure that the splint is horizontal and that it rests against the scale of the ruler.



Independent Variable:
- Force, F (N)

Dependent Variable:
- Extension of the spring, e (m or cm)

Control Variables:
- Spring used (spring constant, k)
- Ruler alignment
- Initial length of spring
- Environment (e.g. no air movement, stable temperature)

2) Take a reading on the ruler – this is the length of the unstretched spring.
Record this reading in your results table:

Weight in N	Length of spring in cm	Extension of spring in cm
0.0 (No weight stack added)	220	0
1.0 (weight stack added)	250	30
2.0	280	0
...	...	

A force that stretches or compresses a spring does work, storing elastic potential energy. If the spring is not inelastically deformed, the work done equals the stored energy.

Safety precautions for the experiment include:
- Wearing goggles protects eyes if the spring snaps springs.
- Placing some soft material below the apparatus catch falling weights
- Using a G clamp to secure the clamp stand to the desk.
- Avoiding excessive pulling on the spring.

3) Carefully hook the base of a 1.0 newton (1.0N) weight stack onto the bottom of the spring.

4) Take a reading on the ruler.

This is the length of the spring when a force of 1.0 N is applied to it.

5) Add further weights. Measure and record the length of the spring each time.

The force, F added to the spring is the weight of the mass. $F = mg$

6) Calculate the extension for each weight and record it on the table.

Don't forget that the mass added will have to be converted to newtons.

Extension = Stretched length − Original length

Hang an object on the spring to measure its extension, then use the graph to find its weight and verify with a newton meter!

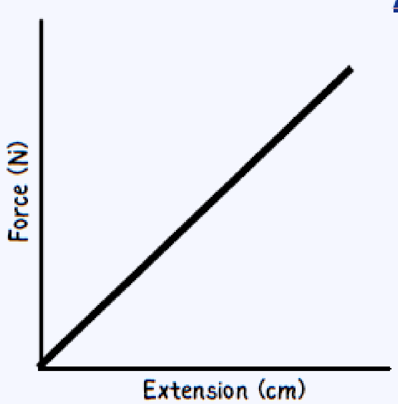
Evaluation

Random Errors
- Use a pointer, such as a fiducial marker to increase the accuracy of the experiment.
- Repeat the measurements for each force three times and calculate an average extension.

Systematic Errors
- Ensure that measurements on the ruler are taken at eye level to prevent parallax error.
- Before starting, check for a zero error on the ruler to ensure it starts at true zero.

A digital displacement sensor or video analysis tool can enhance precision and eliminate human error in measurements compared to using a ruler.

Analysis of Results



a) State the relationship between force and extension of a wire.
The force applied to a spring or wire is directly proportional to its extension.
(- provided the material is not stretched beyond its limit of proportionality.)

b) Calculate the spring constant (force = spring constant x extension).

$$k = \frac{F}{e}$$

Example: If a force of 2.0 N causes a spring to extend by 0.04 m:
$k = 2.0 / 0.04 = 50$ N/m

c) Calculate the work done in stretching your spring using the equation:
Elastic potential energy = 0.5 x spring constant x (extension)^2

Example: Using $k = 50$ N/m and $e = 0.04$ m:

$$E = 0.5 \times 50 \times (0.04)^2 = 0.5 \times 50 \times 0.0016 = 0.04 \text{ J}$$

So, the work done (energy stored) is 0.04 joules.

Go further: Observe the point where the spring doesn't return to its original length to identify the limit of proportionality and determine if inelastic deformation has occurred.

Exam Style Questions - Force and Extension

1. What is the independent variable in this experiment? (1 mark)

2. What is meant by the "extension" of the spring? (1 mark)

3. A student hangs a 2.0 N weight and the spring extends from 200 mm to 250 mm. Calculate the extension in cm. (2 marks)

4. What does it mean if the graph of force vs extension curves upwards? (2 marks)

5. A spring stretches 0.04 m when a force of 2.0 N is applied. Calculate the spring constant. Give units. (2 marks)

7. A student plots a graph of force (N) against extension (cm). The points lie on a straight line until the last two values, which begin to curve.
 a) What does the straight section of the graph show?
 b) What does the curve at the end indicate? (3 marks)

8. A student investigates how the extension of a spring changes when different forces are applied. Describe how they should carry out this experiment and explain how they could ensure their results are valid and reliable.

REQUIRED PRACTICAL 7
FORCE AND ACCELERATION

Learning Objectives -

To determine how the force applied to a trolley affects its acceleration, while keeping the total mass of the system constant.

This links directly to Newton's Second Law of Motion:

F = ma

This law tells us that the acceleration of an object is directly proportional to the force applied to it, provided the mass remains unchanged.

Equipment & Apparatus

Activity 1:

1. **Marking the bench:** Use the ruler to measure 0.2m intervals on the bench and draw straight lines or place tape across the bench at these intervals.

2. **Setting Up the Pulley System:** Attach the bench pulley to the end of the bench.

Make sure it is stable and will not shift during the experiment

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. **Aligning the System:** Make sure the string is taut and runs horizontally and is in line with the toy car or trolley.

Misalignment can cause extra friction or skew the direction of the force, affecting results.

5. **Preparing for Release:** Hold the toy car or trolley at the start point (0cm) and make sure stationary.

6. Attach the full weight stack (1.0 N) to the end of the string.

Recording a video of the sequence will provide more reliable data

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 and for the final time at 100 cm.

8. Record the results in the table.

9. **Repeating with Lower Forces:** Repeat steps 5-8 for decreasing weights on the stack for example, 0.8 N, 0.6 N, 0.4 N, 0.2 N. Make sure you place the masses that you remove from the weight stack onto the top of the car each time you decrease the weight.

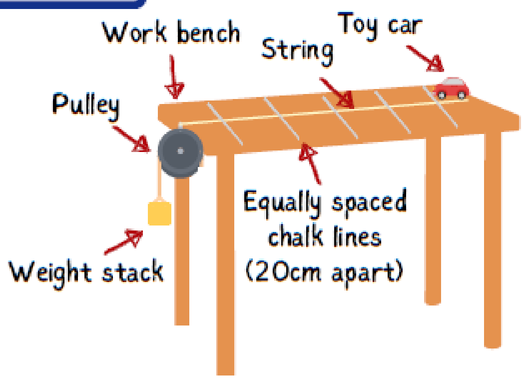
To keep the mass of the system constant, each time you remove a mass from the hanger, attach it to the car using Blu-tac

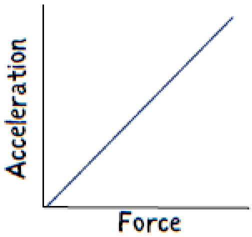
Independent variable
- Force (N), changed by adjusting the mass hanging from the pulley

Dependent variable
- Acceleration of the trolley

Control variables:
- Mass of the system (trolley + weights)
- Surface of the bench
- Starting position
- String length and alignment
- Method of timing

Safety Considerations:
- Secure weights to prevent falls and injuries.
- Stand beside the pulley system, avoiding direct alignment with falling masses.
- Use a soft buffer or sandbag to safely stop the car and prevent damage or injury.





Expected Results

You should observe that:
- When the force increases, the acceleration of the trolley increases.
- A graph of Force (N) on the x-axis and Acceleration (m/s^2) on the y-axis should show a straight line through the origin - a linear relationship.

This is because: Acceleration ∝ Force (when mass is constant), in line with Newton's Second Law, F = m*a

Distance (cm)	Time (s) for 1.0 N	Time (s) for 0.8 N	Time (s) for 0.6 N	Time (s) for 0.4 N	Time (s) for 0.2 N
20					
40					
60					
80					
100					

For each force level, repeat the entire timing process at least 3 times to reduce the effect of random errors.

10. Calculate average velocity and acceleration between intervals using the formulas:
- Velocity (v) = Distance ÷ Time
- Acceleration (a) = (Final velocity - Initial velocity) ÷ Time interval

Exam Style Questions - Force and Acceleration

1. What is the independent variable in this experiment? (1 mark)

2. Describe how you would use the setup to determine the acceleration of the trolley. (3 marks)

3. A student times the trolley over two 20 cm intervals. The first time is 1.20 s and the second time is 0.80 s. Calculate the change in velocity and the acceleration. (3 marks)

4. What relationship should the graph of force against acceleration show? (1 mark)

5. Suggest one way to reduce random errors in the timing of the trolley. (1 mark)

6. A trolley is pulled with different weights while keeping the total mass constant. What type of graph should be plotted with the results and what does the shape show? (2 marks)

7. A student investigates how the force applied to a trolley affects its acceleration.
Describe how the student should carry out the experiment and explain how they would use their data to reach a valid conclusion. (6 marks)

Learning Objectives -

Measuring the effect of mass on acceleration with a constant force

This links directly to Newton's Second Law of Motion:

$m = F/a$

This law tells us that the acceleration of an object is directly proportional to the force applied to it, provided the mass remains unchanged.

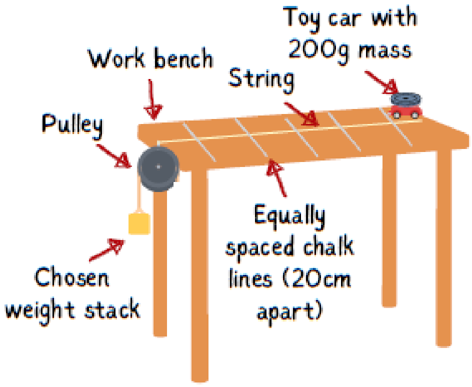
Equipment & Apparatus

Activity 2:

1. **Setup the bench**, pulley, weight stack and car as in steps 1-5 of activity 1.

In Activity 1, we increased the force (F) with weights. This time, we are increasing mass of car (m)

2. Use your **results from activity 1 to select a weight** for the weight stack that will just accelerate the car along the bench.



3. Starting with Minimum Mass: Place the trolley at the starting line with its base mass (e.g. 200 g).

4. Hold the car at the **start** point.

5. Attach your **chosen weight stack** to the end of the string. Attach the hanging weight and make sure the string is straight and taut.

6. Release the car at the same time as you start the stopwatch, press the stopwatch (lap mode) at each measured interval on the bench and for the final time at 100 cm.

7. Record the results in the table outline below.

8. Increasing the Mass: Repeat the test multiple times, each time increasing the trolley mass by 200 g (e.g. 400 g, 600 g, 800 g, 1000 g). Use Blu-tack to securely attach extra masses.

	Change in mass of the toy car				
Distance (cm)					
20					
40					
60					
80					
100					

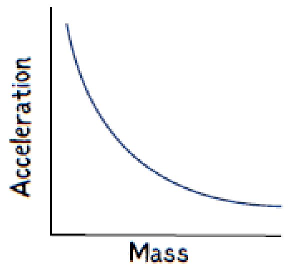
9. Calculate average velocity and acceleration at each interval:
- Velocity (v) = Distance ÷ Time
- Acceleration (a) = (Final velocity - Initial velocity) ÷ Time interval

REQUIRED PRACTICAL 7
FORCE AND ACCELERATION

Expected Results

You should observe that:
- As mass increases, the acceleration decreases.
- A graph of Mass (kg) on the x-axis vs Acceleration (m/s^2) on the y-axis will produce a curve, showing that the relationship is inversely proportional.

This is consistent with the rearranged version of Newton's Second Law:
$a = F \div m$
If F stays the same and m increases, a must decrease



Independent variable
- Mass of the trolley (changed by adding weights)

Dependent variable
- Acceleration of the trolley

Control variables:
- Pulling force (hanging weight stays the same throughout)
- Surface and friction
- Distance travelled
- Surface of the bench
- Starting position
- String length and alignment
- Trolley and pulley system
- Method of Timing

Evaluation and Reducting Errors (Activities 1 and 2)

Systematic Errors:
- Forgetting to transfer removed weights to the car changes the systems mass, invalidating results. (Activity 1)

Random Errors:
- Human reaction time with the stopwatch introduces errors.
- Pulling force may not remain perfectly constant if the string snags or if the pulley sticks.

Human Errors:
- Not securing masses properly – they may shift or fall during movement.
- Inconsistent release technique may affect timing.

Improvements:
- Use light gates and a data logger for more accurate timing.
- Repeat the experiment and use mean values to minimize anomalies.
- Ensure the string is straight and horizontal before each release.

Exam Style Questions - Force and Acceleration

1. What is the independent variable in this experiment? (1 mark)

2. How is the force kept constant during this part of the investigation? (1 mark)

3. A student measures the time for the trolley to travel 1.0 m for five different masses. They notice that the trolley travels more slowly as the mass increases. Explain this result using Newton's Second Law. (3 marks)

4. Describe how to ensure this investigation is a fair test. (2 marks)

5. A student plots a graph of mass against acceleration. What would the shape of the graph be and why? (2 marks)

6. Explain why increasing the mass of the trolley reduces its acceleration. (2 marks)

7. A student wants to investigate how the mass of a trolley affects its acceleration when pulled by a constant force. Describe the steps they should take to collect valid results and explain what conclusion they could draw from their graph. (6 marks)

***PART 2**: Exam Question Practice*

Please complete all six exam questions in this section of the bridging work booklet. These questions have been carefully selected to target topics that students across the year group found most challenging in the end-of-year examinations. You may watch the Cognito videos in the playlist linked below to help you answer these exam questions.

Recommended Video Playlist: https://youtube.com/playlist?list=PLidqqIGKox7UVC-8WC9djoeBzwxPeXph7&si=UFE978Lrldb-V5i0

Question 1 – *Energy Resources (Y9)*

Three energy sources used to generate electricity are given in **List A**. Statements about the energy sources used to generate electricity are given in **List B**.

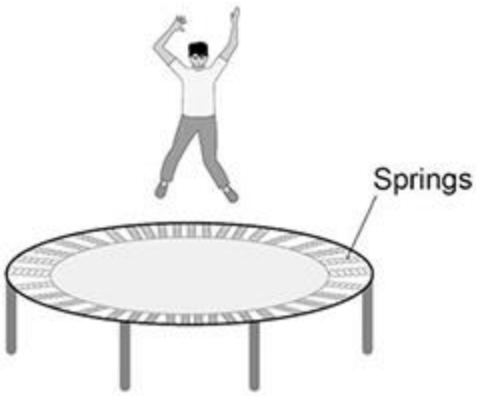
Draw **one** line from each energy source in **List A** to the statement about the energy source in **List B**.

List A **Energy source**	**List B** **Statement about energy source**
	Uses energy from falling water
Geothermal	
	Uses energy from inside the Earth
Hydroelectric	
	Is unpredictable
Nuclear	
	Produces dangerous waste

(Total 3 marks)

Question 2 – *Energy Changes in a System (Y9)*

The figure shows a boy bouncing on a trampoline.



(a) The boy falls from the position in the figure above towards the trampoline.

Complete the sentences.

Choose answers from the box.

chemical	**elastic potential**	**gravitational potential**
kinetic	**nuclear**	

As the boy falls, there is a decrease in his ________________ energy.

As the boy falls, there is an increase in his _______________ energy.

(2)

(b) As the boy lands on the trampoline, each spring stretches 0.015 m.

spring constant of each spring = 120 000 N/m

Calculate the energy stored by each spring.

Use the equation:

$$\text{elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

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Elastic potential energy = ________________ J

(2)

(c) There are 40 springs on the trampoline.

Calculate the total energy stored by the 40 springs when each spring is stretched by 0.015 m.

Use your answer from part (b)

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Total energy stored = ________________ J

(1)

(d) The kinetic energy of the boy as he lands on the trampoline is 600 J.

The maximum kinetic energy of the boy after he bounces is 45% of his kinetic energy as he lands.

Calculate the maximum kinetic energy of the boy after he bounces.

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Maximum kinetic energy = ________________ J

(2)

(e) Why is the kinetic energy of the boy after he bounces less than his kinetic energy as he lands?

Tick (✓) **one** box.

Energy is not conserved.	☐
Energy is transferred to the surroundings.	☐
The springs transfer energy to the boy.	☐

(1)

(Total 8 marks)

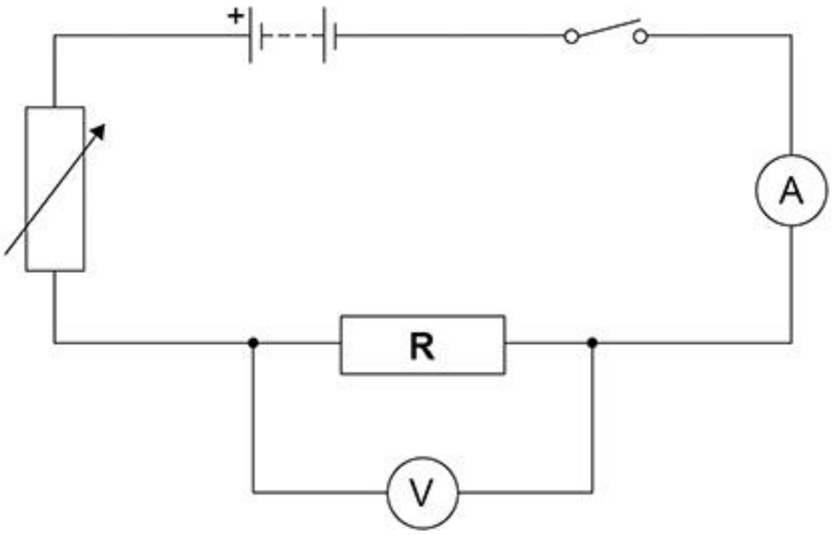
Question 3 – *Electrical Circuits (Y9)*

Student **A** investigated how the current in resistor **R** at constant temperature varied with the potential difference across the resistor.

Student **A** recorded both positive and negative values of current.

Figure 1 shows the circuit Student **A** used.

Figure 1



(a) Describe a method that Student **A** could use for this investigation.

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(6)

(b) Student **B** repeated the investigation. During Student **B**'s investigation the temperature of resistor **R** increased.

Explain how the increased temperature of resistor **R** would have affected Student **B**'s results.

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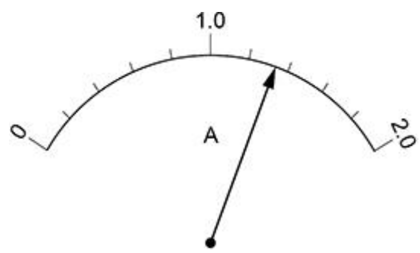
(2)

Figure 2 shows the scale on a moving coil ammeter at one time in the investigation.

Figure 2



(c) What is the resolution of the moving coil ammeter?

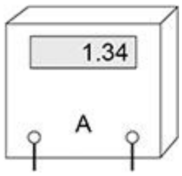
Resolution = ___________ A

(1)

(d) Student **B** replaced the moving coil ammeter with a digital ammeter.

Figure 3 shows the reading on the digital ammeter.

Figure 3



The digital ammeter has a higher resolution than the moving coil ammeter.

Give **one** other reason why it would have been better to use the digital ammeter throughout this investigation.

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(1)

(Total 10 marks)

Question 4 – *Atomic Structure (Y10)*

(a) A radioactive source emits alpha (α), beta (β) and gamma (γ) radiation.

(i) Which **two** types of radiation will pass through a sheet of card?

____ **(1)**

(ii) Which **two** types of radiation would be deflected by an electric field?

____ **(1)**

(iii) Which type of radiation has the greatest range in air?

____ **(1)**

(b) A student suggests that the radioactive source should be stored in a freezer at –20 °C. The student thinks that this would reduce the radiation emitted from the source.

Suggest why the student is wrong.

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____ **(1)**

(c) Phosphorus-32 is a radioactive isotope that emits beta radiation.

(i) How is an atom of phosphorus-32 different from an atom of the stable isotope phosphorus-31?

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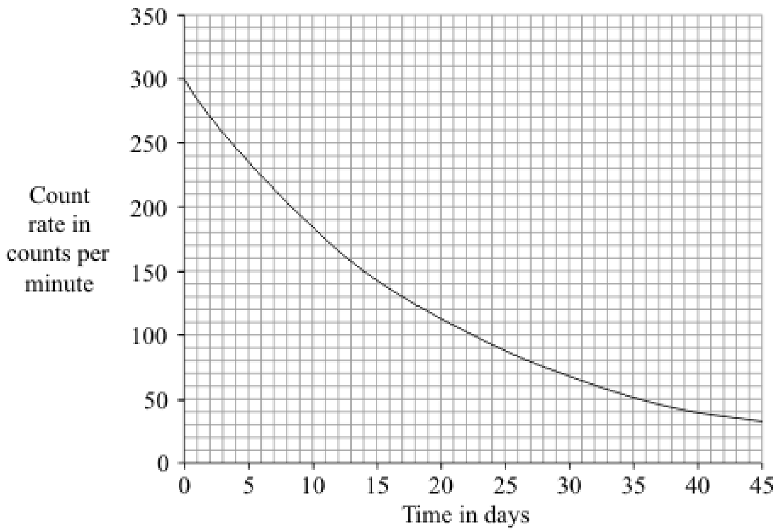
____ **(1)**

(ii) The graph shows how the count rate of a sample of phosphorus-32 changes with time.



Use the graph to calculate the half-life of phosphorus-32.

Show clearly how you used the graph to obtain your answer.

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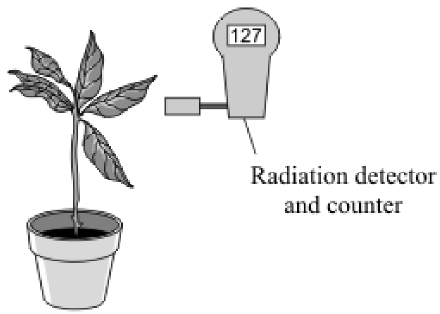
Half-life = ______________________ days

(2)

(iii) Plants use phosphorus compounds to grow. Watering the root system of a plant with a solution containing a phosphorus-32 compound can help scientists to understand the growth process.



Explain why phosphorus-32 is suitable for use as a tracer in this situation.

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(2)

(Total 9 marks)

<u>Question 5</u> – *Motion (Y10)*

(a) An aircraft travels at a constant velocity.

How is the velocity of the aircraft different to the speed of the aircraft?

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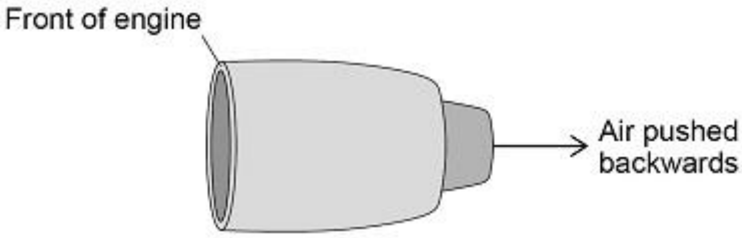
(1)

(b) The diagram below shows one of the engines on the aircraft.



Air is taken into the front of the engine and pushed out of the back of the engine.

Explain the effect this has on the engine.

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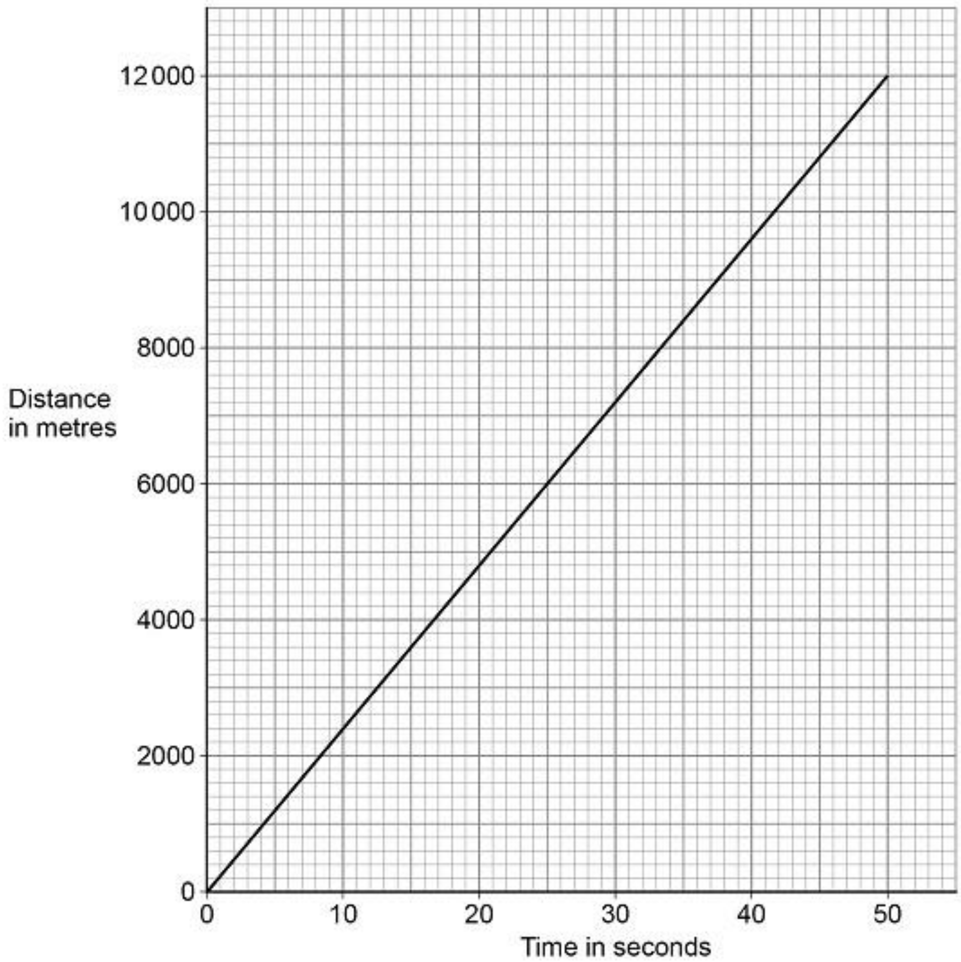
(2)

(c) The graph below shows a distance-time graph for the aircraft.



Determine the speed of the aircraft.

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Speed = ________________ m/s

(3)

(d) Write down the equation that links acceleration (*a*), change in velocity (Δv) and time taken (*t*).

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(1)

(e) At a different stage of the flight, the aircraft was travelling at a velocity of 250 m/s.

The aircraft then decelerated at 0.14 m/s^2.

Calculate the time taken for the aircraft to decelerate from 250 m/s to 68 m/s.

Time = ________________ s

(4)

(f) Write down the equation that links distance (s), force (F) and work done (W).

(1)

(g) When the aircraft landed, it travelled 2000 m before stopping.

The work done to stop the aircraft was 140 000 000 J.

Calculate the mean force used to stop the aircraft.

Mean force = ________________ N

(3)

(Total 15 marks)

Question 6 – *Force and Motion (Y10)*

Speed limits on roads increase safety.

(a) The braking distance of a car increases as the speed of the car increases.

Give two **other** factors that **increase** the braking distance of a car.

1. ____

2. ____

(2)

(b) Explain why the driver's reaction time affects the thinking distance of a car.

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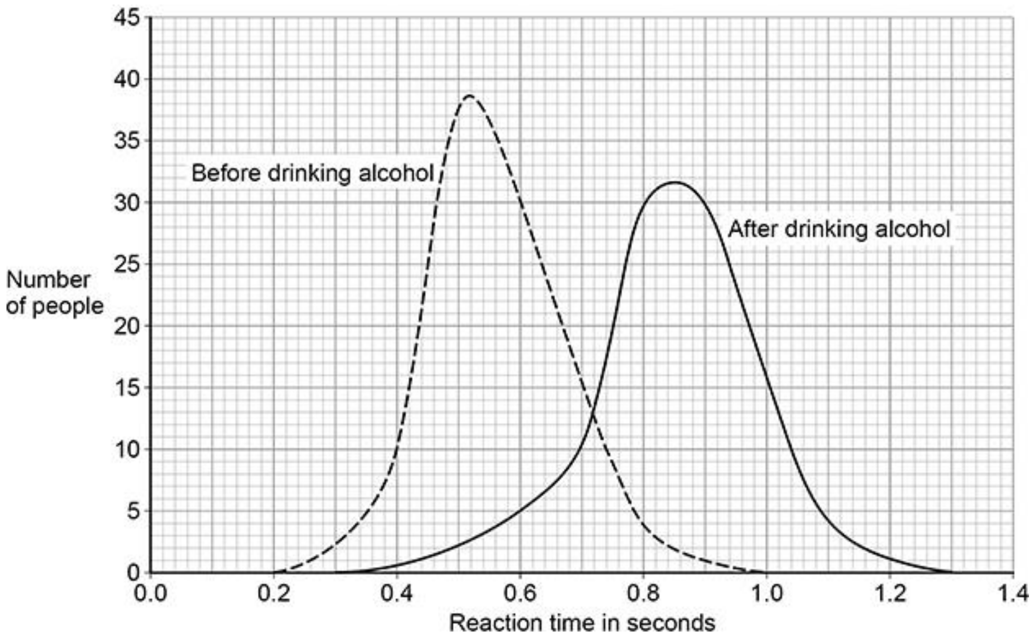
(2)

(c) Scientists have investigated how drinking alcohol affects a person's reaction time.

Figure 1 shows the results of the investigation.

Figure 1



Which of the following conclusions can be made using **Figure 1**?

Tick (✓) **two** boxes.

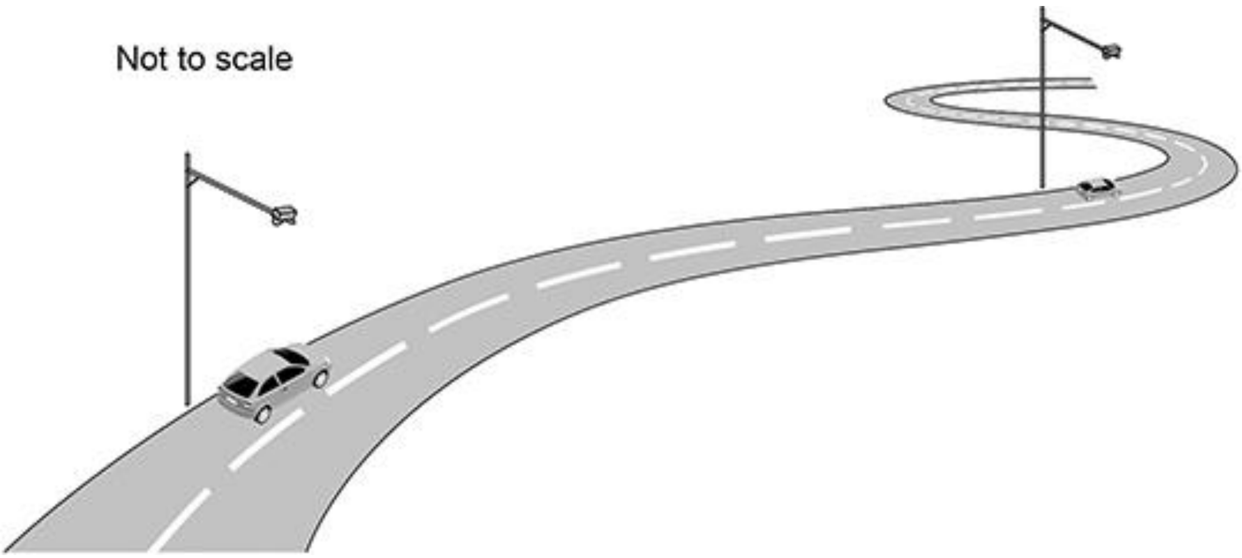
Every person's reaction time increases after drinking alcohol.	☐
Mean reaction time increases after drinking alcohol.	☐
Some people's reaction time is not affected by drinking alcohol.	☐
The change in reaction time is not the same for all people after drinking alcohol.	☐
There is a smaller range of reaction times after drinking alcohol.	☐

(2)

Figure 2 shows some speed cameras on a road.

The speed cameras determine the average speed of cars on the road.

Figure 2



(d) The speed limit on the road in **Figure 2** is 20 m/s.

The cameras in **Figure 2** are 1.5 km apart.

Calculate the minimum time it takes to travel 1.5 km without breaking the speed limit.

Use the Physics Equations Sheet.

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Minimum time = ___________ s

(4)

(e) The average speed of a car between the cameras and the average velocity of the car between the cameras are different.

Explain why.

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(3)

(Total 13 marks)

PART 3: *Educake Quiz on Numeracy and Working Scientifically Skills*

Please complete this Educake quiz to support your numeracy and practical skills. This quiz is visible through your Educake dashboard, but you can also access it by clicking on the link below.

Educake Quiz: https://my.educake.co.uk/assessment/37487429

You must repeat this quiz until you score above 80%.

The deadline for completing this quiz is **Sunday 6th September 2026**.

Good luck!