Year 10 Summer Science: Paper 1 Required Practicals

Name: Total marks: /70

For each of the required practical here, there is information to help you attempt exam questions on that required practical. Read each section and then complete the exam question.

Biology Paper 1

1. Microscopy

This practical helps you learn how to prepare a slide, use a light microscope and calculate magnification. During the practical you carefully peel a thin layer of onion epidermis and place it onto a microscope slide. You add a drop of iodine solution to stain the cells and make structures easier to see, then place a coverslip on top. You begin viewing the specimen under the lowest-power objective lens before increasing magnification. You should be able to identify the cell wall, cell membrane, cytoplasm, nucleus and vacuole.

A key skill is calculating magnification:

Magnification = Image size ÷ Actual size

- **Image size** is the size of the image, drawing or photograph.
- **Actual size** is the real size of the cell.

For example:

If a cell measures **40 mm** on a drawing and its actual size is **0.08 mm**:

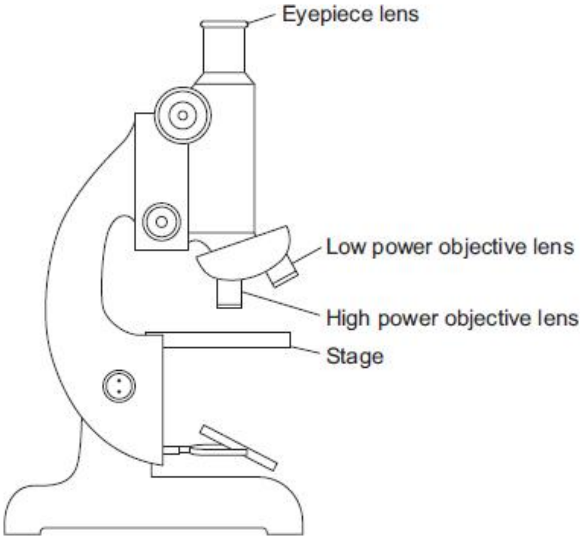
Magnification = 40 ÷ 0.08 = ×500

When drawing cells:

- Use a sharp pencil.
- Draw clear, single lines.
- Make the drawing large enough to show detail.
- Keep structures in proportion.
- Use ruled label lines.
- Do not shade or sketch.

Q1. Microscopy PPQ: **Figure 1** shows a light microscope.

Figure 1



(a) The eyepiece lens has a magnification of ×10 The high power objective lens has a magnification of ×40 Which calculation shows the total magnification?

Tick (✓) **one** box.

10 × 40 ☐ $\frac{40}{10}$ ☐ 10 + 40 ☐

(1)

(b) Write down the equation which links magnification, size of image and size of real object.

____

____

(1)

(c) A student used a different microscope to view a cell. The cell was viewed with a magnification of ×250 The size of the image of the cell was 1.5 cm.

Calculate the real size of the cell. Give your answer in mm.

Real size of cell = ____________________ mm

(4)

(Total 6 marks)

2. Osmosis

This practical investigates how concentration affects the movement of water into and out of potato cells. During the practical you cut potato cylinders of identical size and measure their starting mass. You place them into solutions containing different sucrose concentrations and leave them for a fixed time. After removing and drying the cylinders (excess solution will affect the mass), you measure their final mass and calculate the percentage change in mass.

Independent variable: Solute (e.g. salt or sucrose) concentration

Dependent variable: Change in mass of potato cylinders

Control variables:

- Size of potato cylinders
- Volume of solution
- Temperature
- Time left in solution

If the potatoes gain mass, water has entered the cells by osmosis. If they lose mass, water has left the cells. The concentration where there is no change in mass is called the **isotonic point**.

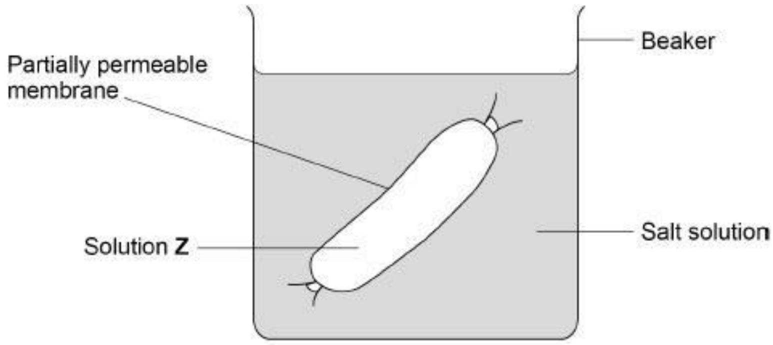
Q2. Osmosis: A student investigated the concentration of salt in solution **Z**. The student used a method involving osmosis. The student used tubing made of partially permeable membrane.

This is the method used.

1. Cut six pieces of tubing to the same length.
2. Tie one end of each piece of tubing.
3. Put the same volume of solution **Z** into each piece of tubing.
4. Tie the other end of each piece of tubing to form a sealed tube.
5. Record the mass of each tube.
6. Place each tube into a different concentration of salt solution.
7. After 2 hours, remove each tube from the salt solutions.
8. Record the mass of each tube.

Figure 1 shows one of the sealed tubes in a salt solution.

Figure 1



(a) What was the independent variable for the investigation? Tick (✓) **one** box.

Change in mass of tube ☐

Concentration of salt solution ☐

Time in salt solution ☐

Volume of solution **Z** ☐

(1)

(b) The student dried the outside of each tube with a paper towel before recording the mass. Why was it important to dry the tubes?

____

____

(1)

The table below shows the results.

Concentration of salt solution in mol/dm^3	**Mass of tube in grams**			**Percentage (%) change in mass**
	At start	**After 2 hours**	**Change**	
0.0	15.54	16.50	0.96	**X**
0.2	15.16	15.78	0.62	4.1
0.4	15.00	15.35	0.35	2.3
0.6	15.29	15.37	0.08	0.5
0.8	14.95	14.75	–0.20	–1.3
1.0	14.77	14.40	–0.37	–2.5

(c) Calculate value **X** in the table above. Give your answer to 1 decimal place.

____

____

____

Value **X** (1 decimal place) = ____________________ %

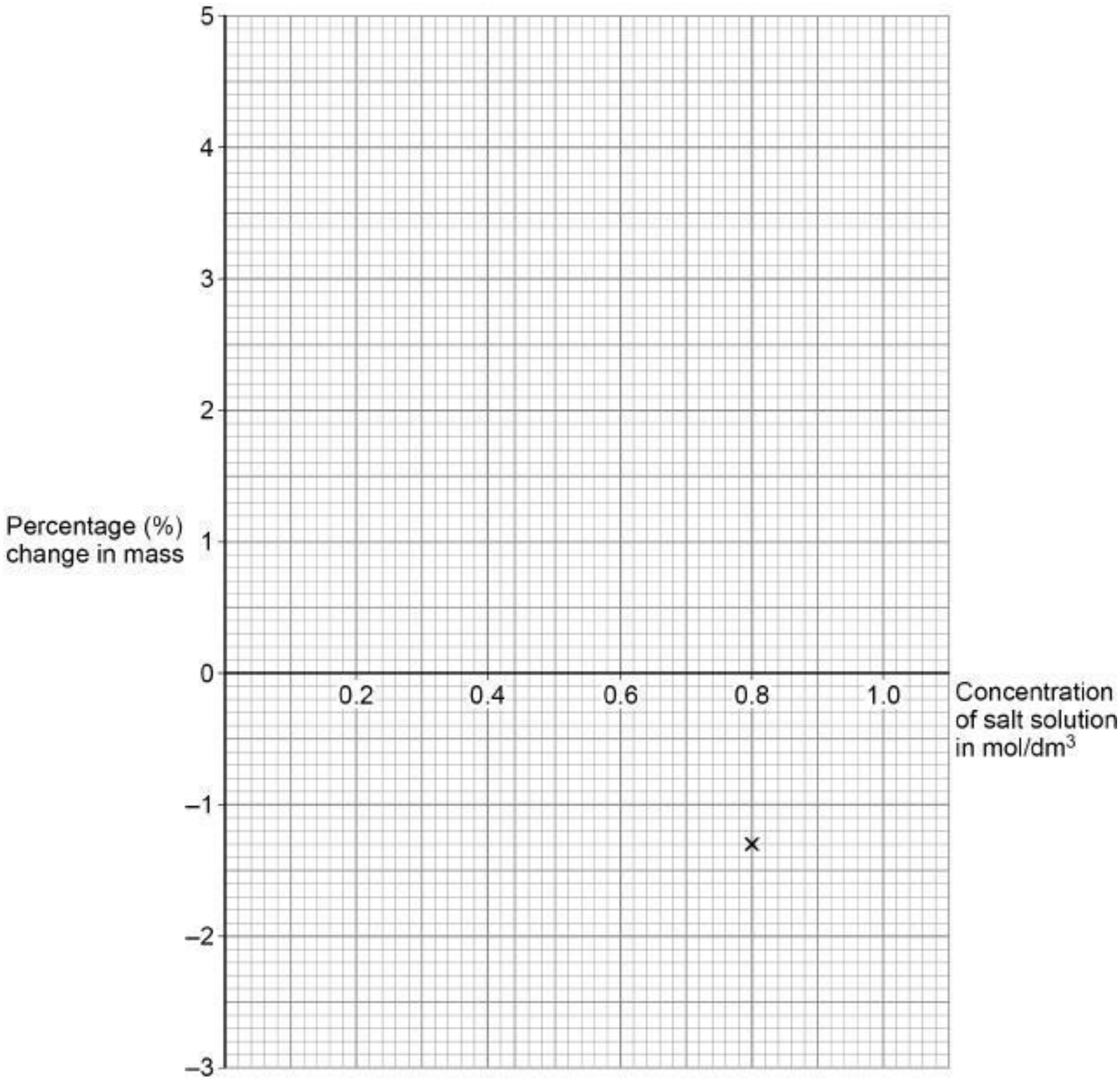
(3)

(d) Complete **Figure 2**. You should:

- plot the percentage change in mass from the table above for salt concentrations of **only** 0.2 mol/dm^3 to 1.0 mol/dm^3
- draw a line of best fit.

One of the results has been plotted for you.

(3)



(e) Determine the concentration of salt in solution **Z**.

Use **Figure 2**.

Concentration = ____________________ mol/dm^3

(1)

(Total 9 marks)

3. Food Tests

This practical helps you identify biological molecules in food samples. During the practical you prepare a food solution by crushing the food and mixing it with distilled water. Separate tests are then carried out for reducing sugars, starch, proteins and lipids. You need to know both the method and the positive result for each test.

Nutrient Tested	**Reagent/Method**	**Positive Result**
Reducing Sugar	Add Benedict's solution and heat in a water bath	Solution changes from blue → green, yellow, orange or brick-red precipitate
Starch	Add iodine solution	Solution changes from orange-brown → blue-black
Protein	Add Biuret solution	Solution changes from blue → Lilac/Purple
Lipid	Add ethanol, shake, then add water	Cloudy white emulsion forms

Q4. Food tests: Describe how to test a sample of food for protein, starch and sugar.

Give the colours that would be seen if the food sample contained protein, starch and sugar.

____

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____

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(Total 6 marks)

4. Enzymes

This practical investigates how pH affects the activity of amylase. During the practical you mix amylase, starch and a buffer solution. Samples are removed at regular intervals and added to iodine solution on a spotting tile. If starch is present, the iodine turns blue-black. When the iodine remains orange-brown, all the starch has been digested.

Independent variable: pH

Dependent variable: Time taken for starch to disappear (or reaction rate)

Control variables:

- Temperature
- Starch concentration
- Amylase concentration
- Total volume of solutions

The shortest time (or fastest rate) shows the optimum pH for amylase. Questions often ask you to explain how pH affects enzyme activity and why enzymes become denatured at extreme pH values.

Q3. Enzymes

A student investigated the effect of pH on the rate of starch digestion.

This is the method used.

1. Add 2 cm^3 of amylase solution at pH 5.0 to a test tube.
2. Add 2 cm^3 of starch solution to the same test tube.
3. Start the timer.
4. Remove one drop of the amylase-starch mixture after 30 seconds.
5. Test the drop for starch.
6. Remove a drop of the amylase-starch mixture every 30 seconds until no starch is detected.
7. Record the total time taken for no starch to be detected.
8. Repeat steps **1** to **7** using amylase solution at different pHs.

The student kept all the solutions in a water bath at 37 °C

(a) What is the independent variable in the investigation? Tick (✓) **one** box.

pH of amylase solution	
Temperature of water bath	
Volume of starch solution	

(1)

(b) Describe the test for starch. Give the result of the test if starch is present.

Test ____

____

Result ____

____

(2)

The table below shows the results.

pH	**Time for no starch to be detected in seconds**
5.0	420
5.5	330
6.0	270
6.5	240
7.0	120
7.5	90
8.0	120
8.5	180
9.0	270

(c) What is the pH range the student used? Use the table above.

pH range from _____ to _____

(1)

(d) At the optimum pH the enzyme works fastest. What is the optimum pH for amylase enzyme? Use the table above.

Optimum pH = _______________

(1)

(e) How could the investigation be improved to get a more accurate value for the optimum pH?

Tick (✓) **one** box.

Remove one drop of the amylase-starch mixture every minute.	
Use a less concentrated amylase solution.	
Use smaller pH intervals.	

(1)

(e) How could the investigation be improved to get a more accurate value for the optimum pH? Tick (✓) **one** box.

Remove one drop of the amylase-starch mixture every minute. ☐

Use a less concentrated amylase solution. ☐

Use smaller pH intervals. ☐

(1)

(f) What is the best way for the student to display the results? Tick (✓) **one** box.

Bar chart ☐

Frequency table ☐

Line graph ☐

Pie chart ☐

(1)

(Total 8 marks)

5. Photosynthesis

This practical investigates how light intensity affects the rate of photosynthesis. During the practical you place pondweed into sodium hydrogencarbonate solution to provide carbon dioxide. A lamp is positioned at different distances from the pondweed. You measure the rate of photosynthesis by counting oxygen bubbles produced in a set time or by collecting oxygen gas.

Independent variable: Light intensity (distance from the lamp)

Dependent variable: Rate of photosynthesis

Control variables:

- Species and size of pondweed
- Temperature
- Carbon dioxide concentration
- Time used for each measurement

As light intensity increases, the rate of photosynthesis usually increases until another factor becomes limiting. Questions often ask you to explain this relationship and interpret graphs showing photosynthesis rate.

Q7. Photosynthesis: Plants absorb light to photosynthesise.

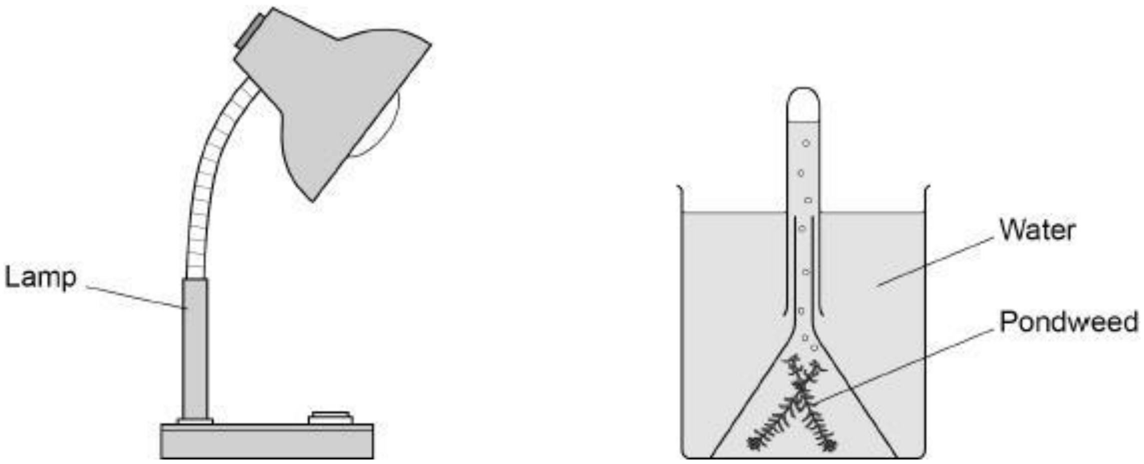
(a) Complete the word equation for photosynthesis.

____________________ + water ⟶ ____________________ + glucose

(1)

Light intensity affects the rate of photosynthesis.

The diagram below shows some of the equipment used to measure the rate of photosynthesis.



(b) Describe a method to investigate the effect of light intensity on the **rate** of photosynthesis.

Use the equipment in the diagram above and other laboratory equipment.

____

(6)

Algal cells photosynthesise. Scientists investigated the effect of light intensity on algal cells.

The algal cells were placed in different light intensities. The table below shows the number of **extra** algal cells after two days.

Light intensity in lux	**Number of EXTRA algal cells after two days**
0	no extra cells
250	1.00×10^6
500	1.65×10^6
750	2.15×10^6
1000	2.40×10^6
1250	2.50×10^6
1500	2.50×10^6

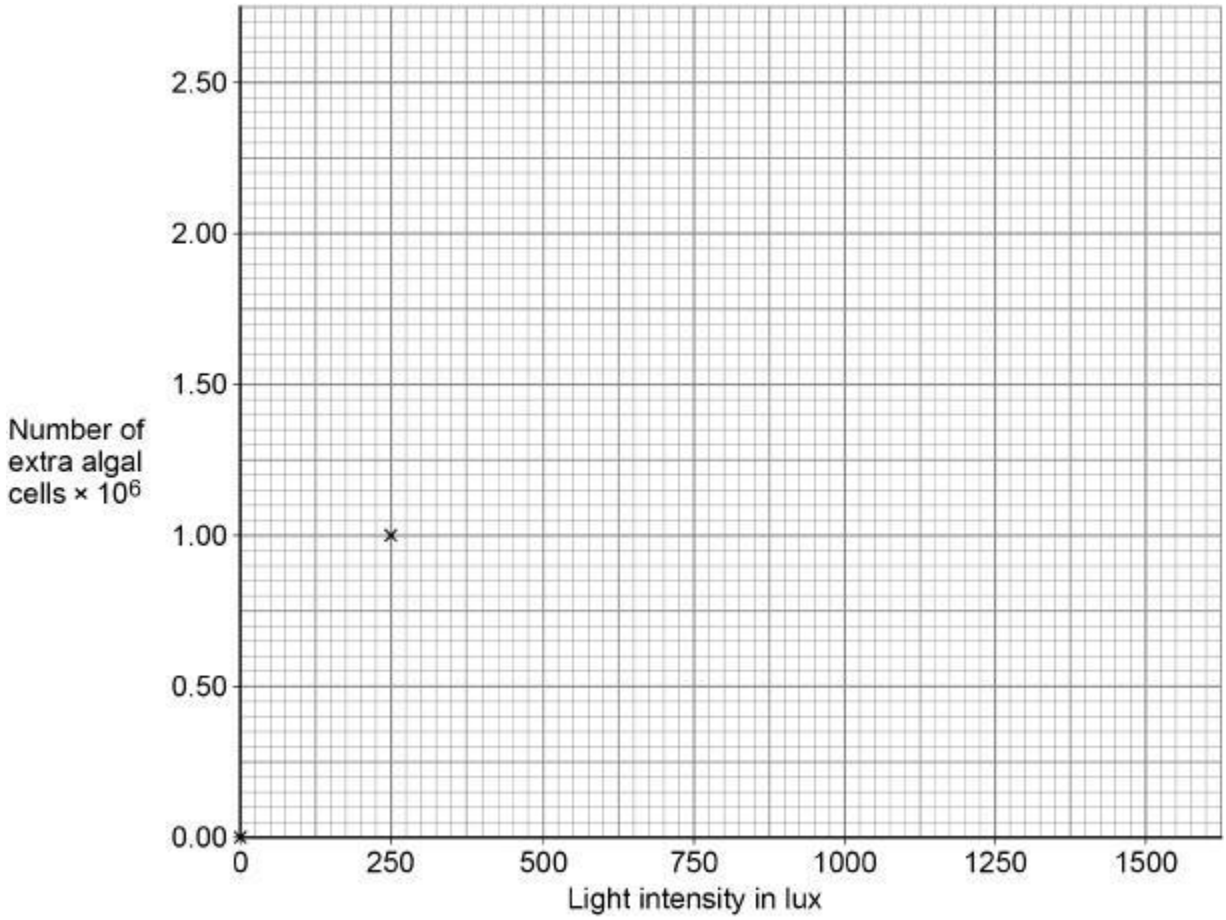
(c) The initial number of algal cells was 200 000

Calculate the total number of algal cells after two days when the light intensity was 500 lux

Total number of algal cells = ____________________

(2)

(d) Plot the data from the table above on the graph below. The first two points have been plotted. Draw a line of best fit.



(e) Give **two** conclusions from the results.

Use information from the table above.

1. ____________________

____

2. ____________________

____

(2)

(Total 11 marks)

Chemistry Paper 1

6. Making Salts

This practical produces a pure, dry sample of a soluble salt. During the practical you warm a dilute acid and add an insoluble base, such as copper oxide. Excess base is used to ensure all of the acid reacts. The unreacted solid is removed by filtration. The filtrate is then heated to evaporate some water and left to cool so that crystals form. These crystals are filtered and dried. Key techniques used:

- Neutralisation
- Filtration
- Evaporation
- Crystallisation

Q6: Making Salts: A student plans a method to prepare pure crystals of copper sulfate. The student's method is:

1. Add one spatula of calcium carbonate to dilute hydrochloric acid in a beaker.
2. When the fizzing stops, heat the solution with a Bunsen burner until all the liquid is gone.

The method contains several errors and does not produce copper sulfate crystals.

Explain the improvements the student should make to the method so that pure crystals of copper sulfate are produced.

(Total 6 marks)

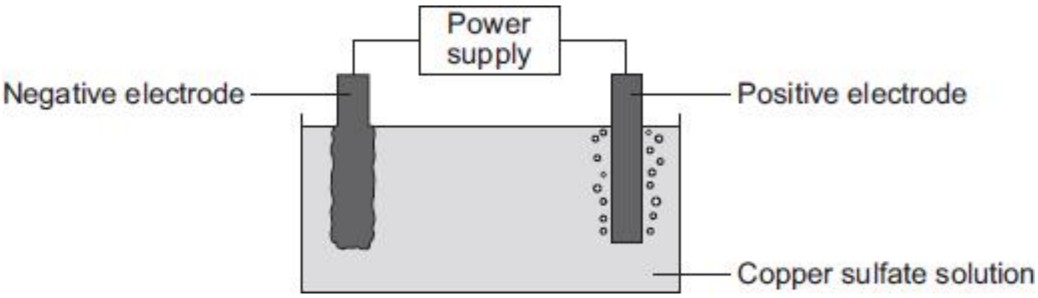
7. Electrolysis

This practical investigates the decomposition of ionic compounds using electricity. During the practical you place two inert electrodes into aqueous copper sulfate solution and connect them to a d.c. power supply. Copper ions gain electrons at the negative electrode (cathode), producing copper metal, while oxygen is produced at the positive electrode (anode).

You should know that:

- Positive ions move to the cathode.
- Negative ions move to the anode.
- Reduction occurs at the cathode.
- Oxidation occurs at the anode.

Q7 Electrolysis: A student electrolysed copper sulfate solution using inert electrodes. The figure below shows the apparatus used.



Copper was produced at the negative electrode. Oxygen was produced at the positive electrode.

(a) Describe the observations seen at each electrode.

Negative electrode

Positive electrode ____

____

(2)

(b) Copper sulfate solution contains copper ions and hydrogen ions.

Why is copper produced instead of hydrogen during the electrolysis of copper sulfate solution? Tick (✓) **one** box.

Copper is less reactive than hydrogen. ☐

Copper has the same reactivity as hydrogen. ☐

Copper is more reactive than hydrogen. ☐

(1)

The student measured how the mass of copper produced varied with time. The table shows the results.

Time in seconds	**Mass of copper produced in grams**
120	0.08
240	0.16
360	0.24
480	0.32
600	0.40

(c) What conclusion can be made about how the mass of copper produced varied with time?

Use the table above.

____

____

(1)

(d) Predict the time taken to produce 0.20 g of copper.

Use the table above.

____

Time = ________________ s

(1)

(Total 5 marks)

8. Temperature Change

This practical investigates energy changes in chemical reactions. During the practical you measure the starting temperature of reactants and then mix them in an insulated polystyrene cup (which prevents heat loss or gain from the surroundings). You record the highest or lowest temperature reached and calculate the temperature change.

- A temperature increase indicates an **exothermic reaction** because energy is released to the surroundings.
- A temperature decrease indicates an **endothermic reaction** because energy is absorbed from the surroundings.

Q8. Temperature Changes: A teacher demonstrated the temperature change when hydrochloric acid is added to sodium hydroxide. This is the method used.

1. Add 25.0 cm^3 of sodium hydroxide solution to a polystyrene cup.
2. Measure the temperature of the sodium hydroxide solution.
3. Add 25.0 cm^3 of hydrochloric acid to the sodium hydroxide solution.
4. Stir the solution.
5. Measure the maximum temperature of the solution.

(a) Draw **one** line from each measurement to the most suitable piece of equipment to use to make the measurement.

Measurement	**Equipment**
	balance
Temperature of solution	beaker
	measuring cylinder
Volume of hydrochloric acid	metre rule
	thermometer

(2)

(b) The teacher did the experiment four times.

The table below shows the teacher's results.

Experiment	Maximum temperature rise in °C
1	6.1
2	7.8
3	6.1
4	6.4

Calculate the mean maximum temperature rise. Do **not** use the anomalous result in your calculation.

____

____

(2)

(c) How could the accuracy of the experiment be improved?

Tick **one** box.

Add 20.0 cm^3 of hydrochloric acid	☐
Use a lid on the polystyrene cup	☐
Use a metal beaker	☐
Use a thermometer with a resolution of 1 °C	☐

(1)

(Total 5 marks)

Physics Paper 1

9. Specific Heat Capacity

This practical investigates the energy required to increase the temperature of a substance. During the practical you measure the mass of a metal block and insert an immersion heater and thermometer.

The block is insulated to reduce heat loss. You record the current, voltage and heating time so that the energy supplied can be calculated. You then measure the temperature rise of the block.

Independent variable: Energy supplied (or heating time)

Dependent variable: Temperature increase

Control variables:

- Mass of the block
- Type of block
- Insulation
- Heater used

Key equations:

Energy transferred = Current × Potential Difference × Time

Energy transferred = Mass × Specific Heat Capacity × Temperature Change

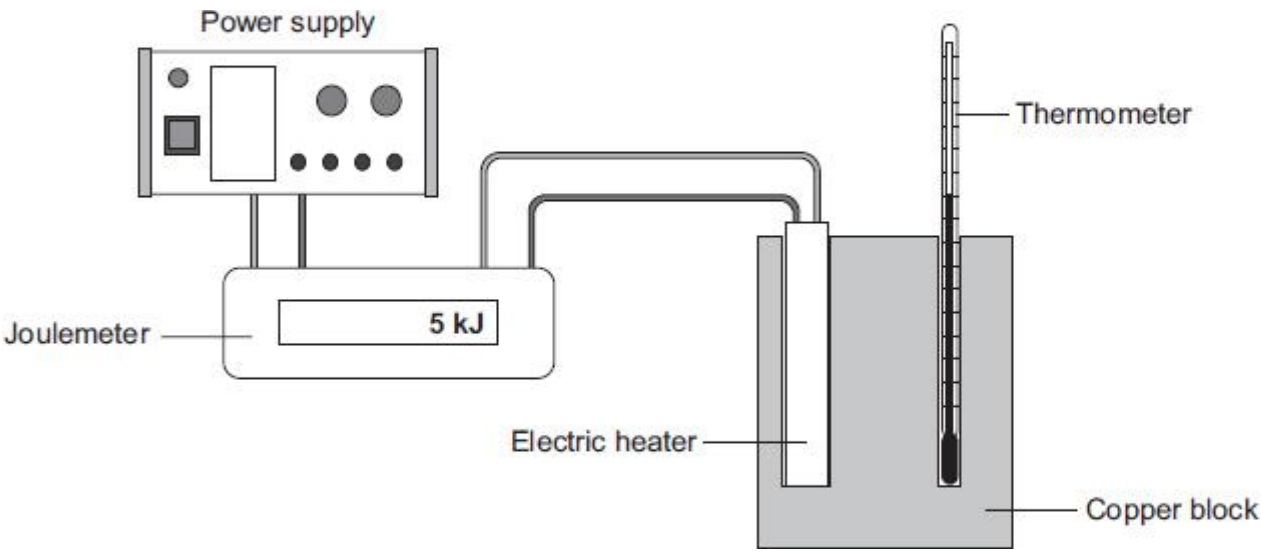
Questions often test energy calculations and explain why different materials heat up at different rates.

Q9. Specific Heat Capacity: A student investigated the heating of a copper block.

An electric heater and a thermometer were inserted into holes in the copper block.

Figure 1 shows the apparatus used.

Figure 1



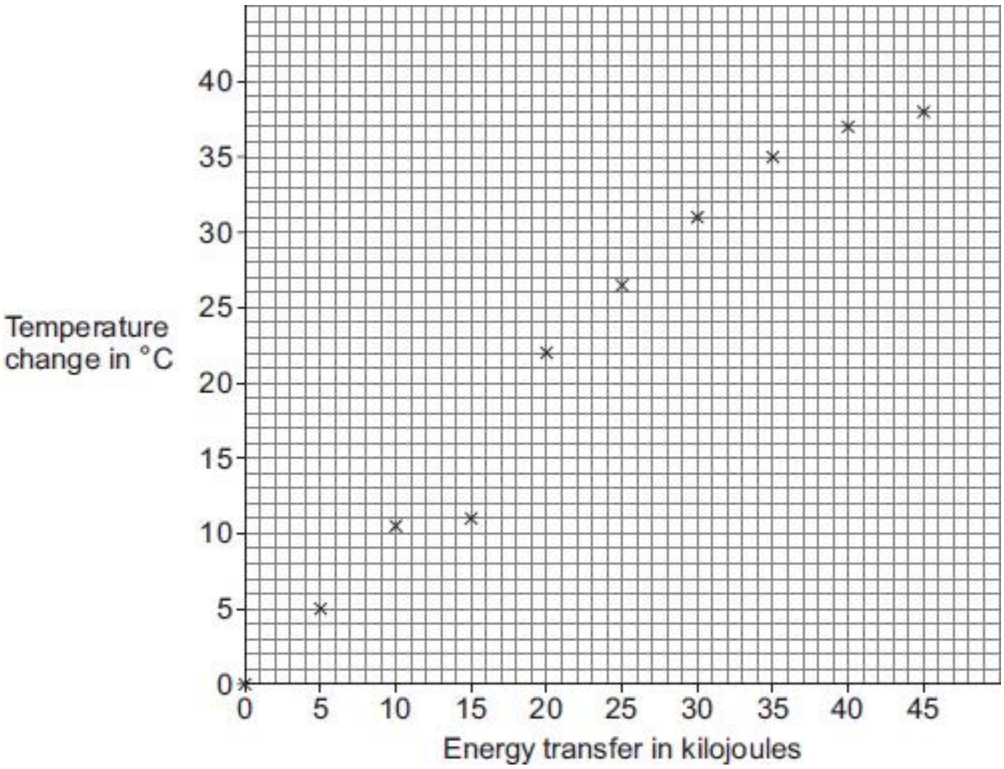
The joulemeter measured the energy transferred to the electric heater.

Every minute, the student recorded:
- the temperature of the copper block

• the energy transferred to the electric heater.

Figure 2 shows the results.

Figure 2



(a) Draw a line of best fit on **Figure 2**.

(1)

(b) What conclusion can be made from **Figure 2**?

____

____

(1)

(c) The student calculated the specific heat capacity of copper using the final temperature of the copper block. The copper block was **not** insulated.

Explain why the student's calculated value of specific heat capacity was higher than expected.

____

____

____

____

(2)

(Total 4 marks)

10. Resistance of a Wire

This practical investigates how the length of a wire affects its resistance. During the practical you set up a circuit containing a power supply, voltmeter and ammeter. You change the length of resistance wire and measure the current and potential difference for each length. Resistance is calculated using:

Resistance = Potential Difference ÷ Current (R = V/I)

Independent variable: Length of wire

Dependent variable: Resistance

Control variables:

- Wire material
- Wire diameter (thickness)
- Temperature
- Supply voltage

Your results should show that resistance increases as wire length increases because electrons experience more collisions with metal ions as they travel through the conductor.

11. Resistors in Series and Parallel

This practical investigates how the arrangement of resistors affects total resistance. During the practical you build a series circuit and measure current and potential difference. You then repeat the measurements using the same resistors connected in parallel. Resistance is calculated using:

Resistance = Potential Difference ÷ Current (R = V/I)

You should know that:

- In a series circuit, resistances add together.
- In a parallel circuit, total resistance decreases because current has multiple pathways.

12. I–V Characteristics

This practical investigates the relationship between current and potential difference for electrical components. During the practical you build a circuit containing a resistor, filament lamp or diode. A variable resistor is used to change the potential difference across the component, and the corresponding current is measured. Results are plotted on a current–voltage graph for the three different components.

Independent variable: Potential difference (voltage)

Dependent variable: Current

Control variables:

- Component being tested
- Temperature (where possible)

You should recognise the characteristic graphs for:

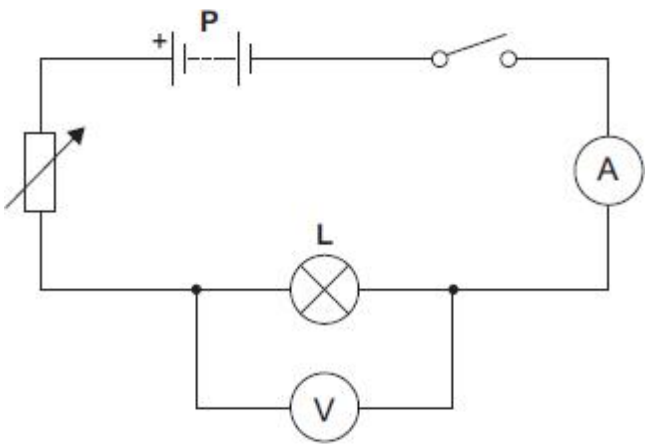
- **Ohmic resistor** – straight line through the origin.
- **Filament lamp** – curved graph because resistance increases as temperature rises.
- **Diode** – current flows in one direction only.

Q10: Resistance of a wire, Resistors in Series and Parallel and IV Characteristics

Two students investigated how the current in filament lamp **L** varied with the potential difference across the lamp.

Figure 1 shows the circuit used.

Figure 1



(a) What is component **P**?

Tick (✓) **one** box.

Battery	☐
Cell	☐
Fuse	☐

(1)

(b) The resistance of the variable resistor is increased.

How does increasing the resistance of the variable resistor affect the reading on the ammeter? Tick (✓) **one** box.

The ammeter reading decreases.	☐
The ammeter reading stays the same.	☐
The ammeter reading increases.	☐

(1)

Figure 2 shows the results.

Figure 2

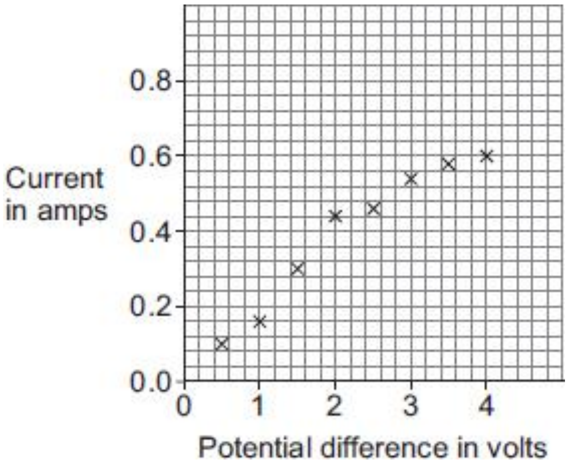
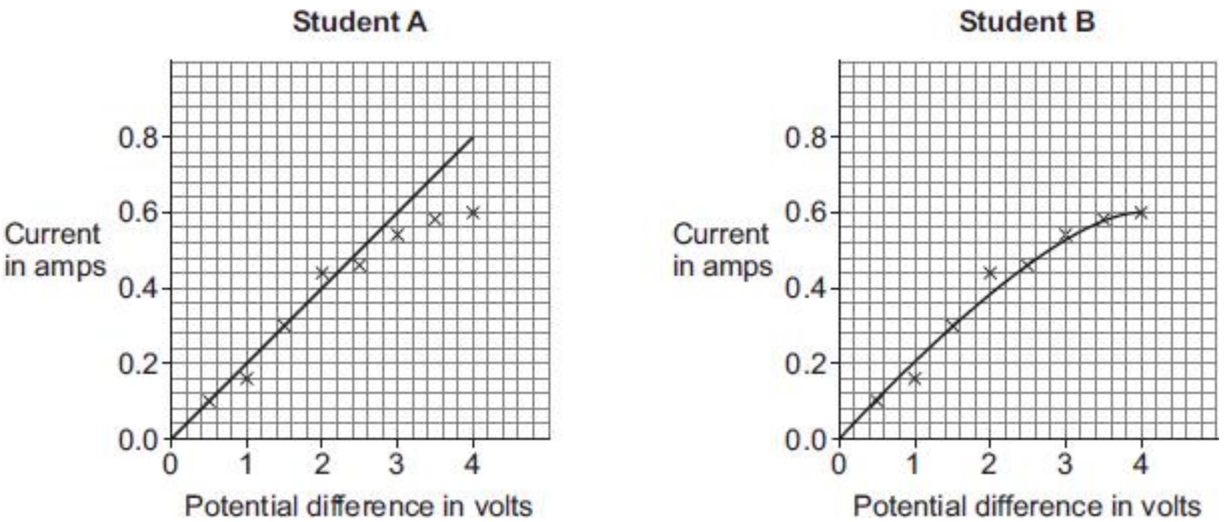


Figure 3 shows the line of best fit drawn by each student.

Figure 3



(c) Explain why student **B**'s line of best fit is correct.

____

____

____

____

(2)

(d) What type of error will have caused the point at 2 V to be above the line of best fit?

Tick (✓) **one** box.

A random error ☐

A systematic error ☐

A zero error ☐

(1)

(e) When the potential difference across the filament lamp is 1.5 V, the current in the lamp is 0.3 A.

Calculate the resistance of the filament lamp.

Use the equation:

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

____

____

____

Resistance = ____________________ Ω

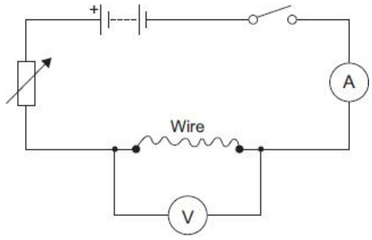
(2)

(f) The students investigated how the length of a wire affects the resistance of the wire.

Figure 4 shows the circuit used.

The temperature of the wire was kept constant.

Figure 4



Identify the variables in the investigation.

Tick (✓) **one** box in **each** row.

Variable	**Control variable**	**Dependent variable**	**Independent variable**
Length of the wire			
Resistance of the wire			
Temperature of the wire			

(3)

(Total 10 marks)