AQA GCSE Triple Science Consolidation Pack

Name _____

Instructions:

This consolidation pack will help you to prepare for the consolidation test that takes place on 6th October. You will only be assessed on the topics shown below.

Please use your revision guides, and the knowledge organisers in this document, to help answer the exam questions. In addition, general revision on the topics using your own resources would be of benefit.

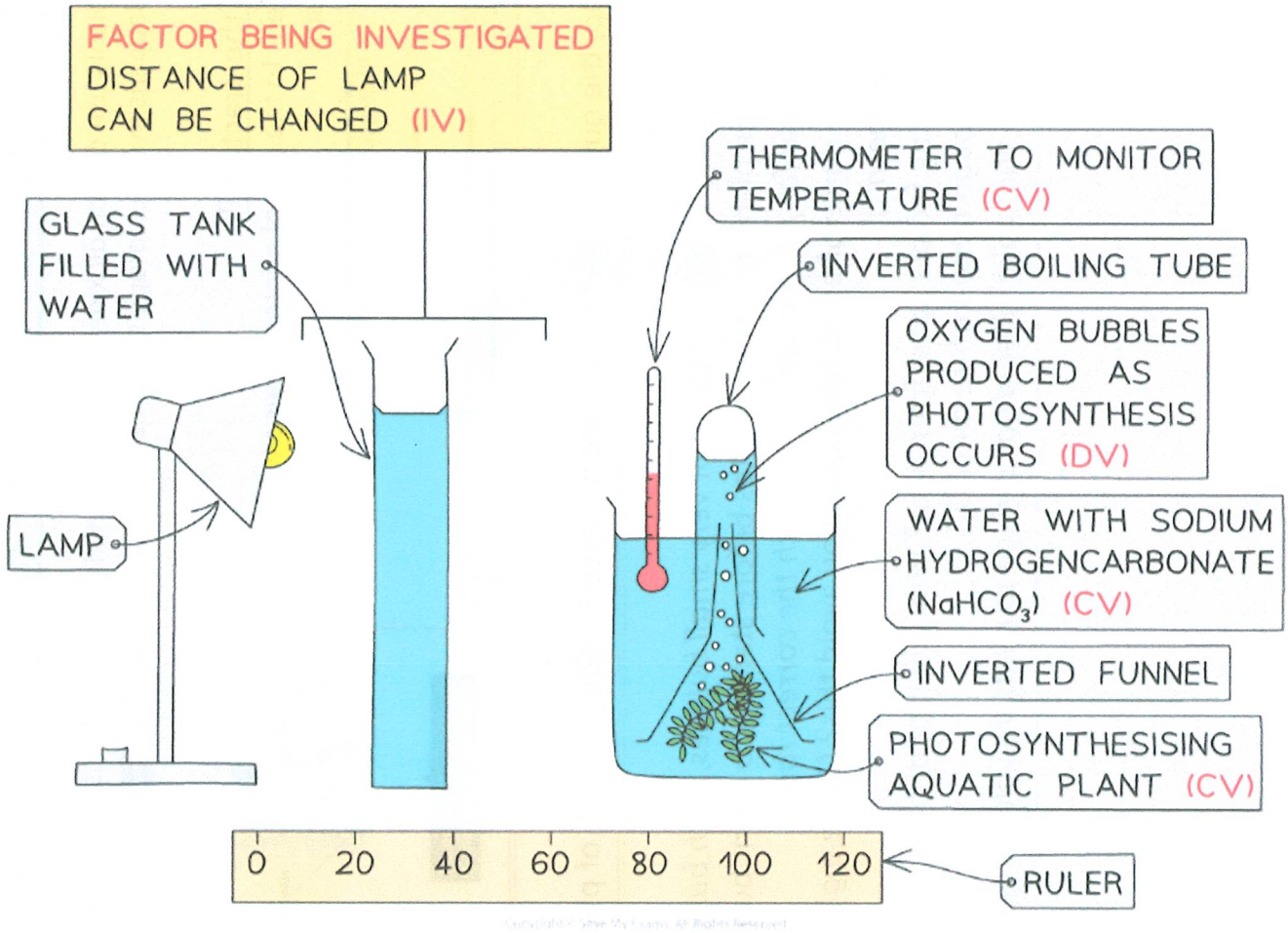
The topics that will be assessed are:

- Bioenergetics (B4) – Photosynthesis required practical
- Chemical changes (C4) – Electrolysis required practical
- Electricity (C2) – Resistance and IV characteristics required practicals

Below are average grade boundaries for each subject:

Grade	Biology %	Chemistry %	Physics %
9	72	77	78
8	65	68	70
7	58	59	65
6	48	47	55
5	40	35	46
4	30	23	37

B4 – Photosynthesis Required Practical
Consolidation Pack



GCSE Required Practical – Biology 1 – Light and Photosynthesis

Photosynthesis: when plants use carbon dioxide and water to make glucose (and oxygen). Happens in the chloroplast and needs light to happen.

What's the point of the practical?

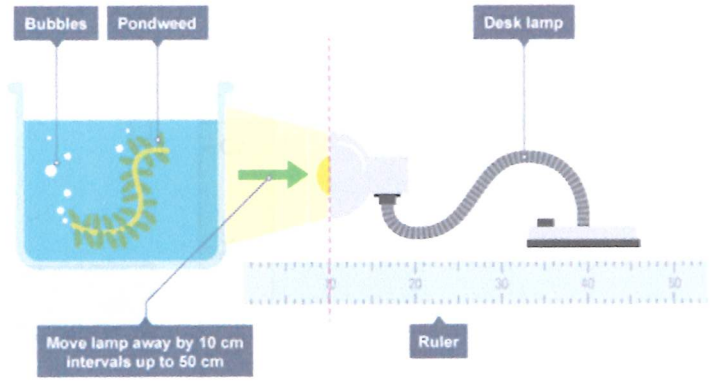
To find out what happens to the rate of photosynthesis when we change the light intensity

Photosynthesis

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

carbon dioxide + water → glucose + oxygen

Example Apparatus



Results

- The closer the lamp, the quicker the bubbles are produced (so higher rate of photosynthesis)

What may they ask us about?

- Why results may be inaccurate (*difficult to count very small bubbles, each bubble counts as '1' no matter how big it is*)
- Why should you leave the plant for a few minutes before starting to count bubbles (*as it takes time for the plant to adjust to the light/temperature and for photosynthesis to reach the correct rate*).
- Heat from the lamp is a source of error, how could you avoid this? (*Place a glass screen in front of the beaker so that light gets through but heat doesn't*)
- What are the other limiting factors apart from light? Why will rate of photosynthesis level off, even with maximum light? (*The plant also needs enough temperature and CO_2*)
- What improvements can you make? *(use a gas syringe to measure volume of O_2, use an LED lamp)*

Q1.

This question is about photosynthesis.

(a) Plants make glucose during photosynthesis. Some of the glucose is changed into insoluble starch.

What happens to this starch?

Tick (✓) **one** box.

The starch is converted into oxygen. ☐

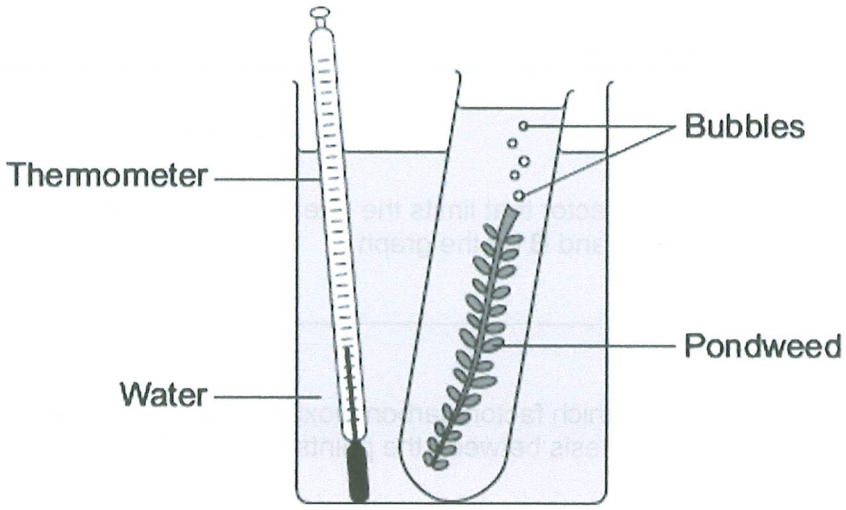
The starch is stored for later use. ☐

The starch is used to make the leaf green. ☐

(1)

(b) A student investigated the effect of temperature on the rate of photosynthesis in pondweed.

The diagram shows the way the experiment was set up.



(i) The student needed to control some variables to make the investigation fair.

State **two** of these variables.

1. _____

2. _____

(2)

(ii) The bubbles of gas are produced only while photosynthesis is taking place.

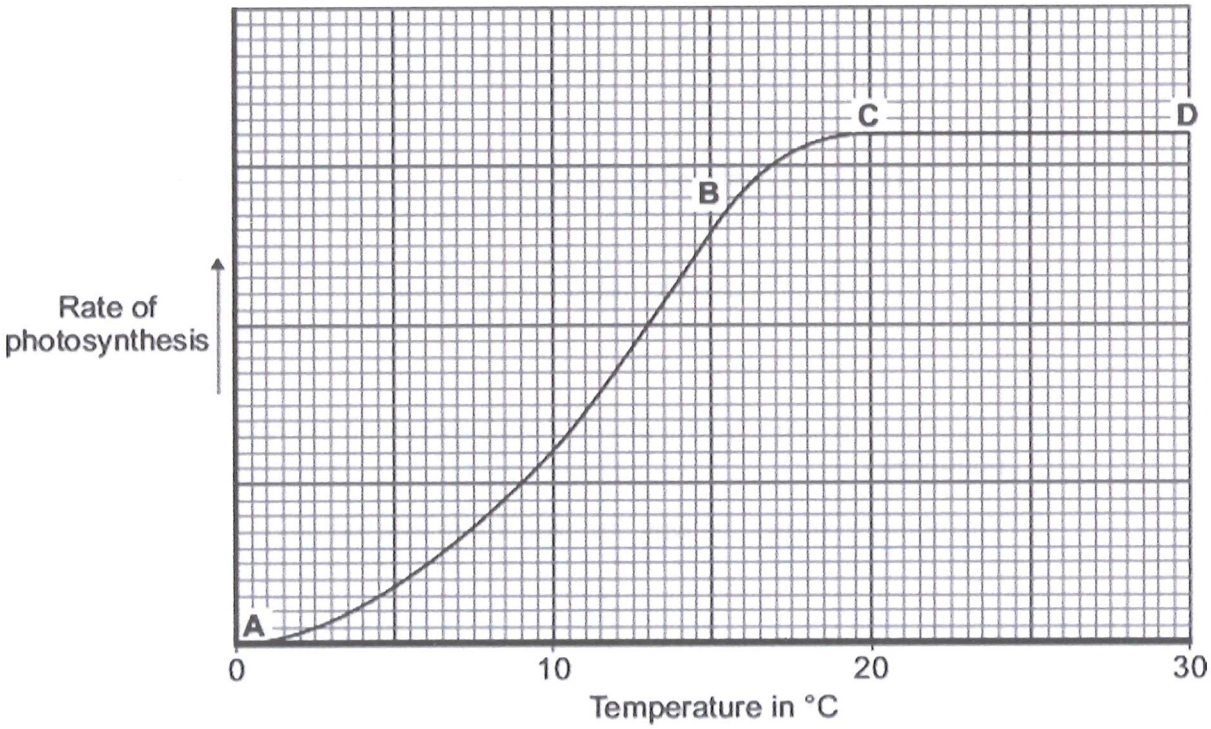
What **two** measurements would the student make to calculate the rate of photosynthesis?

1. _____

2. _____

(2)

(c) The graph shows the effect of temperature on the rate of photosynthesis.



(i) Name the factor that limits the rate of photosynthesis between the points labelled **A** and **B** on the graph.

_____

(1)

(ii) Suggest which factor, carbon dioxide, oxygen or water, might limit the rate of photosynthesis between the points labelled **C** and **D** on the graph.

_____

(1)

(Total 7 marks)

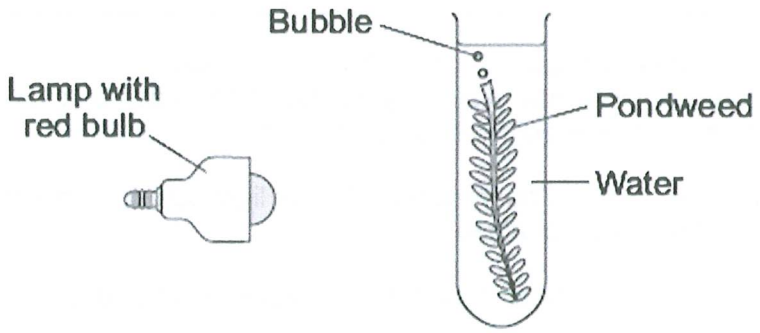
Q2.

A group of pupils investigated the way in which the colour of light affects photosynthesis.

The pupils:

- put a piece of pondweed into a test tube of water
- shone light from a lamp with a red light bulb onto the pondweed
- counted the bubbles of gas produced by the pondweed every minute for three minutes.

The diagram shows the experiment.



The pupils repeated their experiment using a yellow light bulb, a green light bulb and a blue light bulb.

(a) (i) What was the independent variable in the investigation?

_____

(1)

(ii) To make the investigation fair the pupils needed to control some variables.

Suggest **one** variable that the pupils should have controlled during their investigation.

_____

(1)

(iii) It is better to count the bubbles every minute for three minutes than to count all the bubbles in three minutes.

Why?

_____

_____

(1)

(b) The table shows the pupils' results.

Colour of bulb	Number of bubbles produced in one minute			
	1st minute	2nd minute	3rd minute	Mean
Red	24	19	21	21
Yellow	18	14	15	16
Green	6	4	3	4
Blue	32	34	32	33

Algae are tiny organisms that photosynthesise.
In natural light algae grow very quickly on the sides of a fish tank.
The algae make it difficult to see the fish.

(i) What would be the best colour of light bulb to illuminate the fish tank to reduce the growth of algae?

Use the results in the table to help you to decide.

Draw a ring around **one** answer.

red **yellow** **green** **blue**

(1)

(ii) Explain why the colour you have chosen is the best.

_____

_____

_____

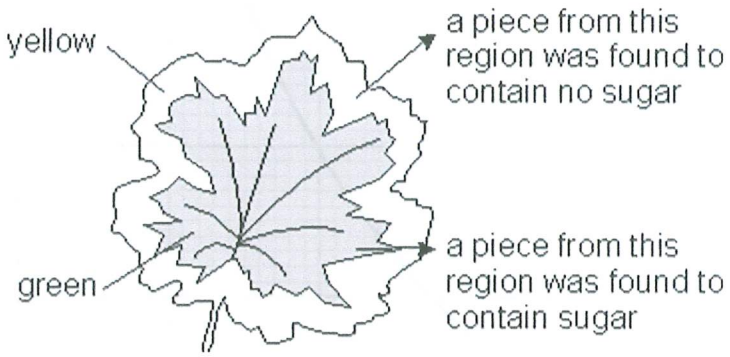
_____

(2)

(Total 6 marks)

Q3.

A plant with variegated (two-coloured) leaves was left in sunlight for several hours. Pieces of one of its leaves were then detached (removed) and tested for sugar. The diagram below shows the results.



Explain, as fully as you can, the results shown by the yellow parts of the leaves.

_____

_____

_____

_____

_____

_____

(Total 3 marks)

Q4.

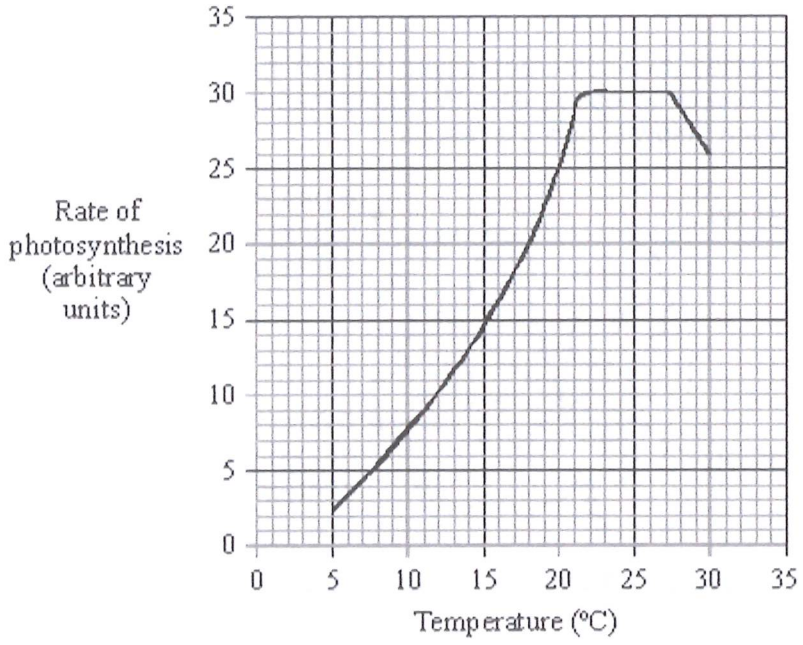
Green plants make food in their leaves.

(a) From where do the leaves get the energy that they need to make food?

_____

(1)

(b) The graph shows the effect of temperature on the rate of photosynthesis.



(i) Between which temperatures is the rate of photosynthesis fastest?

_____ and _____ °C

(1)

(ii) Suggest why the rate of photosynthesis stays the same between these two temperatures.

_____

_____

_____

_____

(2)

(iii) A greenhouse owner wants to grow lettuces as quickly and cheaply as possible in winter.

At what temperature should he keep his greenhouse in order to grow the lettuces as quickly and cheaply as possible?

_____ °C

Explain your answer.

_____

_____

_____

_____

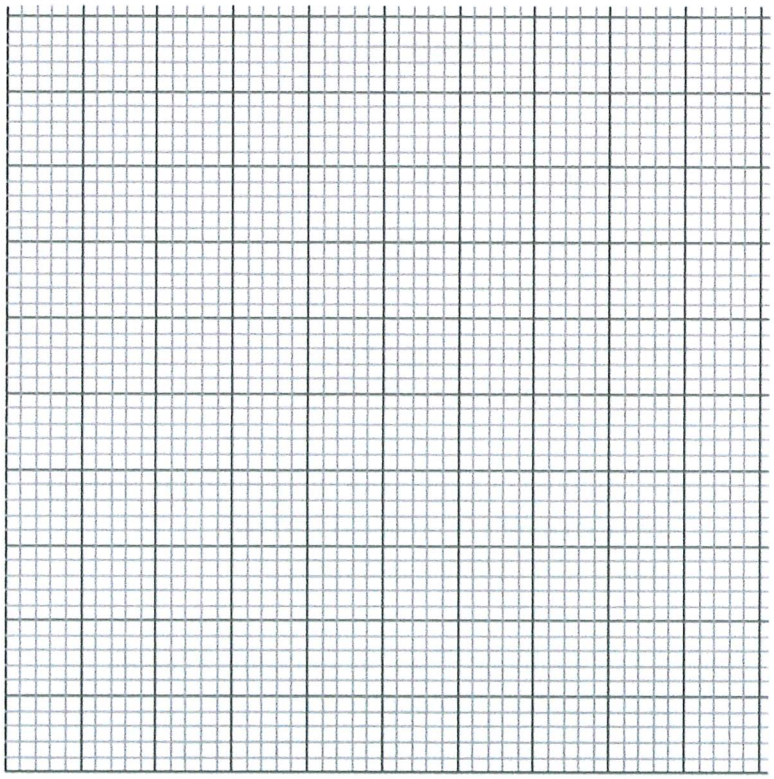
(3)

(Total 7 marks)

Q5. The figures below show how the yield of a wheat crop is affected by adding nitrogen fertiliser.

Nitrogen fertiliser added (kg/hectare)	Yield (tonnes/hectare)
0	26
50	28
75	31
100	34
125	40
150	43
175	44
200	44

(a) Display these results on the graph paper in the most suitable way.



(4)

(b) What conclusions can you draw from the graph?

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q1.

(a) the starch is stored for later use.

1

(b) (i) any **two** from:

*do **not** accept temperature-apply list principle*
ignore reference to time

- carbon dioxide (concentration)
- light intensity
  *allow **one** mark for light if neither intensity or colour are awarded*
- light colour / wavelength
- pH
- size / amount plant
- same / species / type plant
  allow 'the plant'
- amount of water <u>in the tube</u>
  ignore amount of water alone

2

(ii) number / amount of bubbles **or** amount of gas / oxygen

allow volume of bubbles (together)
ignore 'the bubbles' unqualified

1

(relevant reference to) time / named time interval

allow how long it bubbles for
*do **not** accept time bubbles start / stop*
ignore speed / rate bubbles
ignore instruments
*do **not** accept other factors eg temperature*
*accept how many bubbles per minute for **2** marks*

1

(c) (i) temperature

allow heat / °C / cold

1

(ii) carbon dioxide / CO_2

CO2 / CO^2 / Co_2 / Co^2 / co_2 / co^2
*do **not** accept CO / 2CO*

1

[7]

Q2.

(a) (i) colour of light / bulb / lamp

allow wavelength for colour
allow bulb alone
*do **not** accept light / colour unqualified*

1

(ii) any **one** from eg

- temperature
  allow heat
- light intensity **or** distance between lamp and plant / tube
  allow amount / brightness of light
  ignore light unqualified
- carbon dioxide
  allow symbols
- other light in room
  allow use a dark room
- mass / size / amount / age / type of pondweed
  allow same piece of pondweed
  ignore pondweed unqualified
- volume / amount of water
  ignore reference to time

1

(iii) improved reliability

*allow for reliability **or** less likely to lose count*

or

can spot anomalies / changes

allow reference to calculating a mean / average
ignore reference to accuracy / precision / fair

1

(b) (i) green

1

(ii) any **two** from:

ignore references to colour

- least / less bubbles / gas / oxygen / mean
  *reference to least / less needed only once, in context, for **2** marks*
- least / less photosynthesis
- least / less glucose / sugar / carbohydrate / food made

only penalise no once, ie
*no bubbles = **0** mark*
*no bubbles so no photosynthesis = **1** mark*
allow most / more green light reflected (by chloroplasts)

2

[6]

Q3.

Does not contain chlorophyll
which is needed to absorb light **or** energy
so glucose is not produced

each for 1 mark

[3]

Q4.

(a) Sun / sunlight / light

for 1 mark

1

(b) (i) 21.5 – 22 ***and*** 27 – 27.5

for 1 mark

1

(ii) ideas of limiting factor / shortage of
e.g. light / carbon dioxide / water /chlorophyll

each for 1 mark
(allow 1 for 'maximum' rate of enzyme activity if no reference to limiting factors)
(ignore reference to dematuring)

2

(iii) 21.5 – 22° C

(allow first figure from answer to (i) so that no 'double-penalty' <u>but</u> not below 20)

maximum rate of photosynthesis
(can relate to any number on 'flat')

most economical heating (must relate to left end of 'flat'

each for 1 mark

3

[7]

Q5.

(a) both axes labelled
both axes appropriate scale
plotting 7 correct
good attempt at line graph
each for 1 mark

4

(b) more fertiliser added more yield increased
gains 1 mark

but
yield increases with fertiliser up to maximum
gains 2 marks

yield **increase** slows down above 125/150 kg/ha
either for 1 further mark

(do **not** allow yield falls)
maximum yield with 175 kg/ha

3

[7]

Chemistry Knowledge Organiser
C6 - Electrolysis

Extracting Aluminium

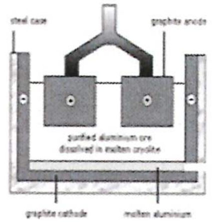
Aluminium oxide is dissolved in molten cryolite .
Cryolite reduces the melting point of aluminium oxide meaning the process requires less energy.
Aluminium ions (Al+) are attracted to the negative electrode.
Aluminium atoms are formed at the negative electrode (gain 1 electron)
Oxide ions are attracted to the positive electrode
Oxygen is formed at the positive electrode (each ion loses 2 electrons)
Oxygen reacts with carbon to make carbon dioxide. This electrode needs to be replaced constantly.

At the negative electrode:

$Al^{3+} + 3e^- \longrightarrow Al$

At the positive electrode

$2O_{2-} \longrightarrow O_2 + 4e^-$



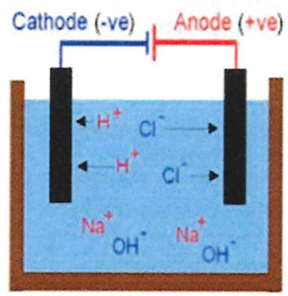
Overall equation:
$2Al_2O_3 \rightarrow 4Al + 3O_2$

Electrolysis of Brine

Which elements form at which electrode depends on the **reactivity** of the elements involved.
For example, the electrolysis of brine, is the electrolysis of a solution of sodium chloride, however there are also H^+ and OH^{-1} ions form the water which is used as the solvent. This means there is more than one possible ion that can go to each electrode.

- **Positive ions:** sodium (Na^+) and hydrogen (H^+)
- **Negative ions:** chlorine (Cl^-) and hydroxide (OH^-)

When there is a mixture of ions, the products formed depend on the reactivity of the elements involved.
Hydrogen is less reactive than sodium, so hydrogen gas (H_2) is produced at the negative electrode.
Chlorine gas (Cl_2) is produced at the positive electrode.
Sodium hydroxide is produced from the ions that remain in solution.

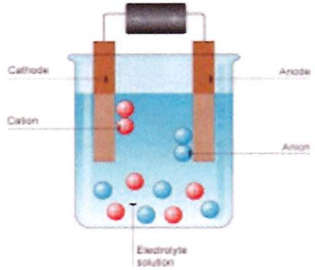


Chemistry Knowledge Organiser
C6 - Electrolysis

Electrolysis

When an ionic compound is melted or dissolved in water, the ions **are free to** move about within the liquid or solution. These liquids and solutions are able to conduct electricity and are called **electrolytes.**

If an electric current is passed through this solution the ions will move to the electrodes.
Remember-opposites attract. The positive ions (cations) will go to the negative electrode (cathode), the negative ions (anions) go to the positive electrode (anode).
For example in the electrolysis of lead bromide, Lead (Pb^{2+}) goes to the negative electrode and bromine (Br^{-1}) goes to the positive electrode.



Electrolysis of Copper Sulphate

Which elements form at which electrode depends on the **reactivity** of the elements involved. For example, in the electrolysis of aqueous copper sulphate is the electrolysis of copper sulphate, however there are also H^+ and OH^- ions form the water which is used as the solvent. This means there is more than one possible ion that can go to each electrode.
· **Positive ions:** sodium (Cu^{2+}) and hydrogen (H^+)
· **Negative ions:** sulphate(SO_4^{2-}) and hydroxide (OH^-)
When there is a mixture of ions, the products formed depend on the reactivity of the ions involved.
Copper is **less reactive** than hydrogen, so copper (Cu) is produced at the negative electrode.
The half equation is:
$Cu^{2+} + 2e^- \rightarrow Cu$
The hydroxide ion is more reactive than the sulphate ion, therefore this **forms water (H_2O) and oxygen** at the positive electrode.
$4OH^- \rightarrow O_2 + 2H_2O + 4\,2e^-$

As a rule if a halide ion is present , this will form at the positive electrode, however if no halide is present then oxygen and water will form at the positive electrode.

Key Terms	Definitions
Electrolysis	The breaking down of a substance using electricity
Electrolyte	The solution which is being broken down during electrolysis
Oxidation	The loss of electrons
Reduction	The gain of electrons
Anode	The positive electrode
Cathode	The negative electrode
Half Equation	An equation that shows the reaction at each electrode

Oxidation and reduction

When a positive ion reaches the negative electrode, it gains electrons. This is a reduction reaction.
When the negative ion reaches the positive electrode, it loses electrons, this is an oxidation reaction.
We can represent these using half equations A half equation can represent the reaction at each electrode. Half equations show how electrons are transferred and an electron is represented in an equation by an e^- symbol
Half equations show electrons (e^-) and how ions become atoms.
For example $Cu^{2+} + 2\,e^- \rightarrow Cu$.
1. Write down the ion and atom: $Cl^- \rightarrow Cl_2$
2. Adjust the number of ions (if needed) and add electrons to balance the charges if required $2Cl^- \rightarrow Cl_2 + 2\,e^-$

Remember that non metal ions will typically form diatomic molecules.

Ionic equations

Half equations can be combined to form an ionic equation, which shows the overall reaction.
For example in the electrolysis of copper chloride the two half equations are:

At the negative electrode (cathode):
$Cu^{2+} + 2\,e^- \rightarrow Cu$
At the positive electrode (anode):
$2Cl^- \rightarrow Cl_2 + 2\,e^-$
Combing these 2 equations gives us:

$Cu^{2+} + 2\,e^- + 2Cl^- \rightarrow Cu + Cl_2 + 2\,e^-$ The electrons either side of the equation cancel out, meaning the final ionic equation is:
$Cu^{2+} + 2Cl^- \rightarrow Cu + Cl_2$
In an ionic equation it is important to check both the atoms and the charges balance

Q1.

A student makes a hypothesis:

'When different salt solutions are electrolysed with inert electrodes, the product at the negative electrode is always a metal'.

(a) Describe how you would test this hypothesis in the laboratory.

You should:

- draw a labelled diagram of the apparatus
- give the independent variable
- describe what you would see at the negative electrode if the hypothesis is true.

Diagram

Independent variable _____

_____

Observation _____

_____

(5)

(b) The student's hypothesis is only partially correct.

Explain why the product at the negative electrode is not always a metal.

_____

_____

_____

_____

(2)

(c) Predict the product at the positive electrode in the electrolysis of:

- sodium chloride solution
- copper sulfate solution.

Sodium chloride solution _____

Copper sulfate solution _____

(2)

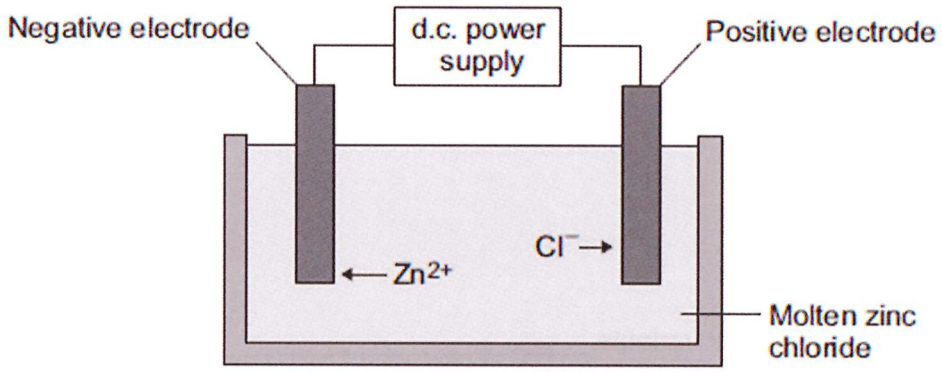
(Total 9 marks)

Q2.

This question is about zinc.

Figure 1 shows the electrolysis of molten zinc chloride.

Figure 1



(a) Zinc chloride is an ionic substance.
Complete the sentence.

When zinc chloride is molten, it will conduct _____ .

(1)

(b) Zinc ions move towards the negative electrode where they gain electrons to produce zinc.

(i) Name the product formed at the positive electrode.

_____

(1)

(ii) Explain why zinc ions move towards the negative electrode.

_____

_____

_____

_____

(2)

(iii) What type of reaction occurs when the zinc ions gain electrons?

Tick (✔) **one** box.

Neutralisation ☐

Oxidation ☐

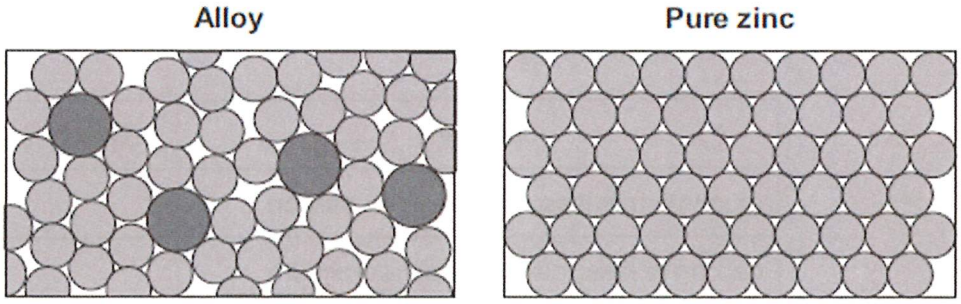
Reduction ☐

(1)

(c) Zinc is mixed with copper to make an alloy.

(i) **Figure 2** shows the particles in the alloy and in pure zinc.

Figure 2



Use **Figure 2** to explain why the alloy is harder than pure zinc.

_____

_____

_____

_____

(2)

(ii) Alloys can be bent. Some alloys return to their original shape when heated.

What name is used for these alloys?

_____

(1)

(Total 8 marks)

Q3.

Cans for food and drinks are made from steel or aluminium.
The main metal in steel is iron.

(a) Reacting iron oxide with carbon produces iron.

Draw a ring around the correct answer to complete the sentence.

The reaction to produce iron from iron oxide is

decomposition.
oxidation.
reduction.

(1)

(b) Aluminium cannot be produced by reacting aluminium oxide with carbon.

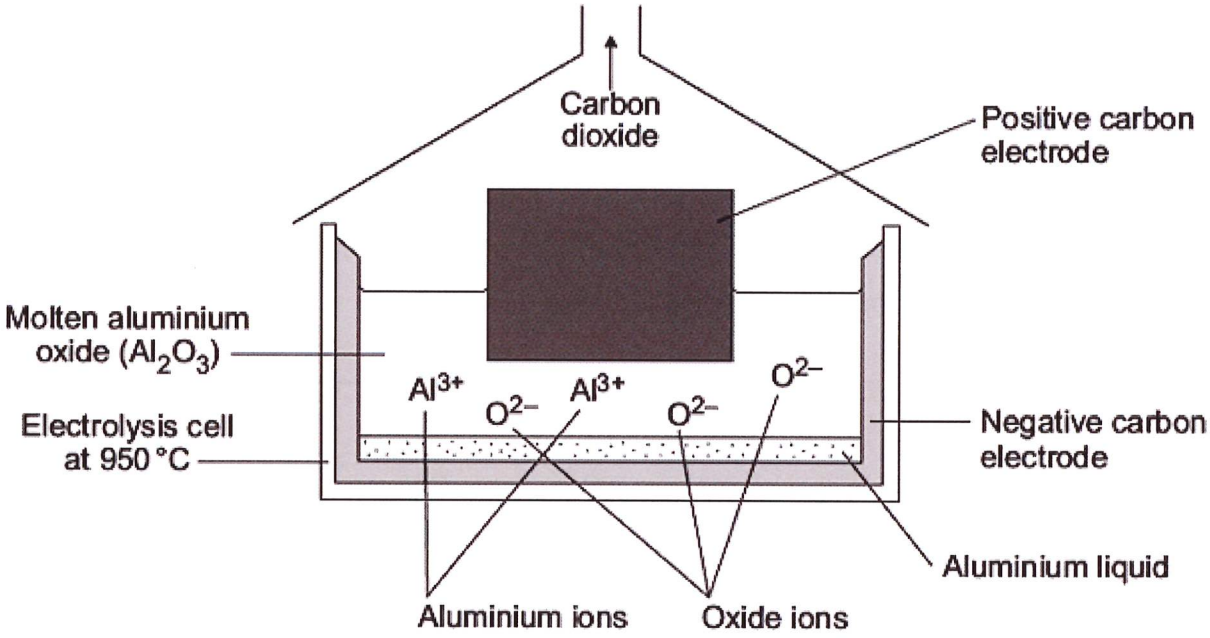
Why does aluminium oxide **not** react with carbon?

Tick (✓) the correct answer.

Answer	Tick (✓)
aluminium is less reactive than carbon	
carbon is less reactive than aluminium	
oxygen is more reactive than carbon	

(1)

(c) Aluminium can be produced by electrolysis.



Why do the aluminium ions collect at the negative electrode?

_____

_____

_____

_____

(2)

(d) Some statements about aluminium are given below.

Tick (✓) **two** statements that are correct reasons why aluminium is used to make cans.

Statement	Tick (✓)
aluminium conducts electricity	
aluminium is not a transition metal	
aluminium has a low density	
aluminium is resistant to corrosion	

(2)

(e) Recycling aluminium cans uses less fossil fuels than producing aluminium from its ore.

Tick (✓) **one** advantage and tick (✓) **one** disadvantage of recycling aluminium to make aluminium cans.

Statement	Advantage Tick (✓)	Disadvantage Tick (✓)
aluminium is the most common metal in the Earth's crust		
less carbon dioxide is produced		
more aluminium ore needs to be mined		
used aluminium cans have to be collected and transported		

(2)

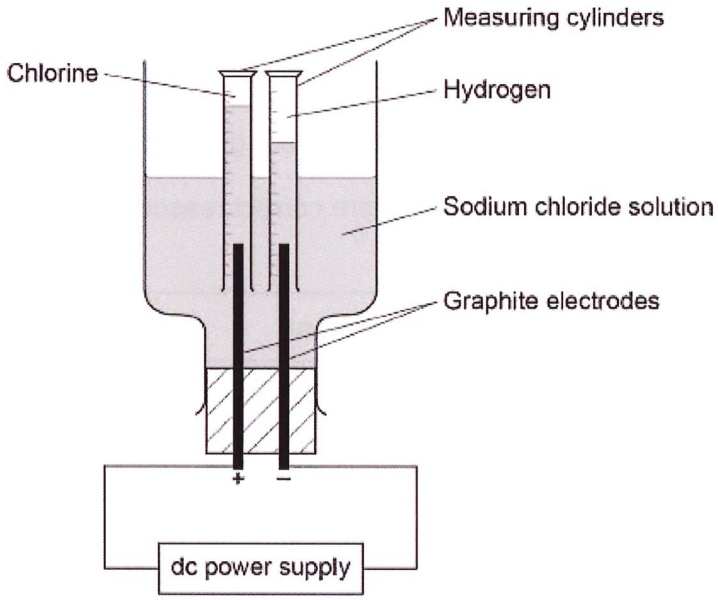
(Total 8 marks)

Q4.

A student investigated the electrolysis of sodium chloride solution.

Figure 1 shows the apparatus.

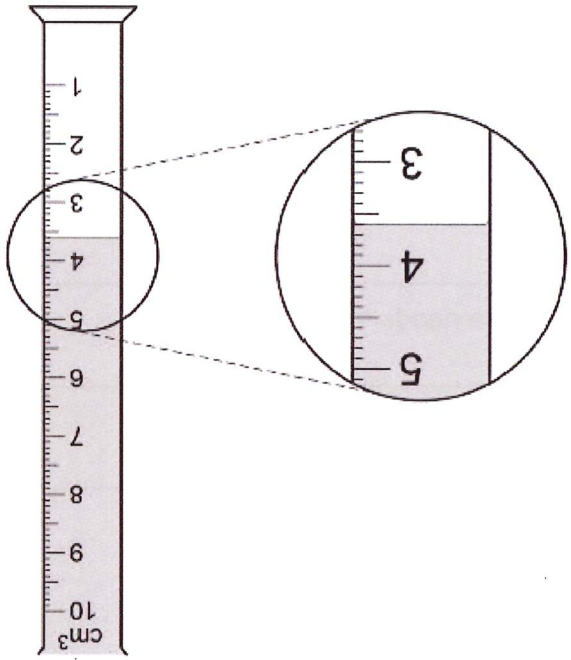
Figure 1



The student measured the volume of gas collected in each measuring cylinder every minute for 20 minutes.

(a) **Figure 2** shows the volume of hydrogen gas collected in the measuring cylinder after 8 minutes.

Figure 2

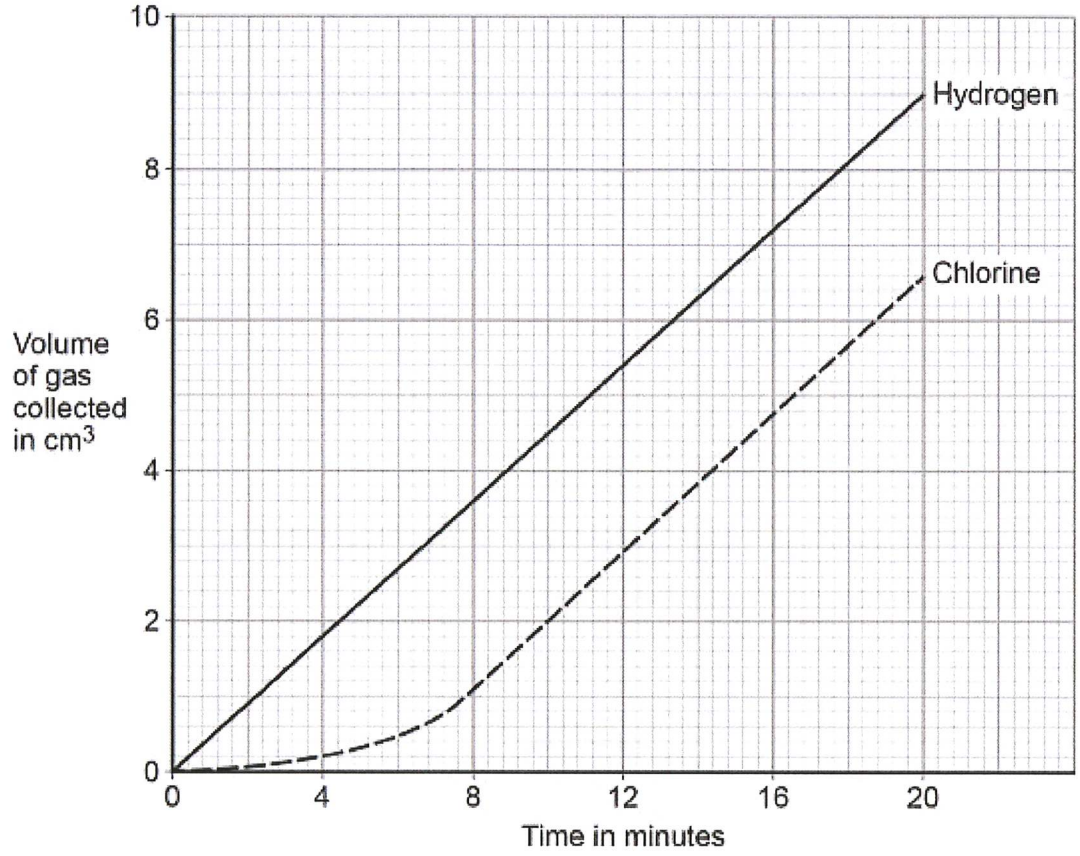


What is the volume of hydrogen gas collected?

Volume = _____ cm^3 **(1)**

Figure 3 shows the results of the investigation.

Figure 3



(b) Which of the lines on **Figure 3** show that the volume of gas collected is directly proportional to the time?

Tick **one** box.

Both lines ☐

Chlorine line only ☐

Hydrogen line only ☐

Neither line ☐

(1)

(c) Which of the lines on **Figure 3** show a positive correlation between the volume of gas collected and time?

Tick **one** box.

Both lines ☐

Chlorine line only ☐

Hydrogen line only ☐

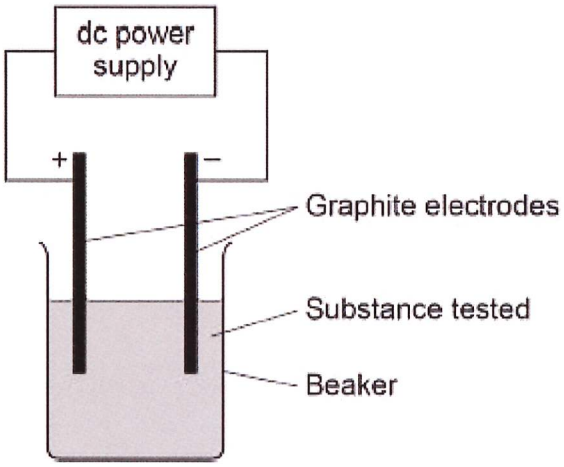
Neither line ☐

(1)

A teacher demonstrates the electrolysis of different substances using graphite electrodes.

Figure 4 shows the apparatus used.

Figure 4



(d) Why can graphite conduct electricity?

Tick **one** box.

Graphite exists in layers of atoms. ☐

Graphite has a giant structure. ☐

Graphite has a high melting point. ☐

Graphite has delocalised electrons. ☐

(1)

(e) The teacher demonstrates the electrolysis of:

- molten zinc chloride
- potassium bromide solution.

Complete the table below to predict the products.

Choose answers from the box.

chlorine	**bromine**	**hydrogen**	**oxygen**	**potassium**	**zinc**

Substance electrolysed	**Product at cathode (negative electrode)**	**Product at anode (positive electrode)**
Molten zinc chloride		
Potassium bromide solution		

(4)

(Total 8 marks)

Q1.

(a) **(diagram)**
complete circuit with power supply

1

test solution in beaker or other appropriate apparatus

1

electrodes

allow carbon, platinum or inert electrodes

1

(independent variable)
salt solutions (with different metal ions)

1

(observation)
solid / metal deposit on the negative electrode

1

(b) (sometimes) hydrogen is produced

1

(because) the metal is more reactive than hydrogen

1

(c) chlorine

1

oxygen

1

[9]

Q2.

(a) electricity

allow an electric current

1

(b) (i) chlorine/Cl_2

*do **not** accept chloride*

1

(ii) (zinc ions are) positive

ignore to gain electrons

1

and (opposite charges) attract

1

(iii) reduction

1

(c) (i) in alloy:

accept converse

different sized atoms/particles

or

no layers/rows
accept layers distorted

1

so cannot slide

1

(ii) shape memory (alloys)
accept smart

1

[8]

Q3.

(a) reduction

1

(b) carbon is less reactive than aluminium

1

(c) aluminium (ions) / they are positively charged
they = aluminium ions
ignore particle names
accept aluminium (ions) / they are cations
allow aluminium (ions they have an opposite charge

1

so they are attracted **or** they move towards the negative electrode

OR

aluminium (ions) / they need to gain electrons (1)

which come from the negative electrode (1)
*if no other marks awarded allow 'opposites attract' for **1** mark*

1

(d) aluminium has a low density

1

aluminium is resistant to corrosion

1

(e) **advantage** less carbon dioxide is produced

1

disadvantage used aluminium cans have to be collected and transported

1

[8]

Q4.

(a) 3.6 (cm^3)

1

(b) hydrogen line only

1

(c) both lines

1

(d) graphite has delocalised electrons

1

(e) **cathode** **anode**

zinc (1) chlorine (1)

*do **not** accept chloride*

*allow **1** mark if chlorine and zinc the wrong way around*

1+1

hydrogen (1) bromine (1)

*do **not** accept bromide*

*allow **1** mark if bromine and hydrogen the wrong way around*

1+1

[8]

Cardinal Pole Catholic School

Year 11 Triple Physics consolidation

P2 Electricity: Required practical's.

Required practical 3: use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include:

- The length of a wire at constant temperature
- Combinations of resistors in series and parallel

Required practical 4: Use circuit diagrams to construct appropriate circuits to investigate the IV characteristics of a variety of circuit elements, including a filament lamp, a diode and a resistor at constant temperature.

Working Scientifically: The steps below will help to ensure your investigation produces valid results.

Aim
State what you are trying to find out. You should set out your aim in the form:
'To find out how _____ affects _____.'

Variables
Determine the independent, dependent and control variables.

Independent
The variable that you change or select the values for.

Dependent
The variable that is measured for each change of the independent variable.

Control
The variables that must be kept constant to ensure a fair test.

Method
Outline, in a logical order, how the investigation will be carried out. The steps should be detailed enough that other people could follow your method to repeat the investigation.

Risk Assessment
Identify the hazards, risks and ways to minimise the risks during your investigation.

Displaying Results
Draw a suitable results table and graph to display your results.

Conclusion
Explain what you found out in your investigation with reference to your results and graph.

Evaluation
Analyse the quality of your method and the data you collected.

Types of Data

Data
(measurements, singular datum)

- **Quantitative or Numeric Data** (numbers)
  - **Continuous Data** — can have any value, e.g. 7.34, -294.6, $2x10^5$
  - **Discrete Data** — only whole numbers, e.g. no. of atoms
- **Qualitative or Categoric Data** (words)
  - **Ordered Data** — can be ranked, e.g. small, medium, large
  - **Categoric Data** — can't be ranked – labels, e.g. blue, red, iron, steel

Types of Variable

Dependent Variable
The variable you *measure*, to see how it is affected by the independent variable.

Independent Variable
The variable you *choose to change*, to see how it affects the dependent variable. You may also measure it when you change it.

Control Variables
The variables you keep constant because they could also affect the dependent variable. If you can't control some variables (such as weather in a field investigation), you should at least monitor them.

Controlled Experiment (Fair Test)
When all relevant variables are controlled, so that observed changes in the dependent variable must be due to changes in the independent variable.

Control Experiment or Group
Used when a fully controlled experiment isn't possible (e.g. in a field investigation or medical study). An experiment or group set up to show that observed changes in the dependent variable must be due to changes in the independent variable e.g. a placebo group in a drugs trial.

Errors

Random Errors
Inaccuracies due to mistakes, poor technique, or random variation. Random errors are very common, but can be improved by taking many replicates.

Systematic Errors
Inaccurate measurements in one direction only, due to poor **calibration** or poor technique. Systematic errors can **not** be improved by taking more replicates.

Zero Error
A particular kind of systematic error, where the instrument does not return to zero.

Bias
When the observer chooses some results and ignores others, to support a particular view.

Measurements

Replicates
Repeats of a measurement.

Range
The highest and lowest replicates, or the interval between them.

Mean or Average
The mid-point of the replicates.
= sum of replicates / N

True Value
The real value of a measurement, if it could be measured with no errors at all.

Quality of Results

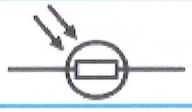
Accurate Data
A measurement that is close to the **true value.**

Precise Data
1. Measurements that give similar values when repeated. The replicates therefore have a small **range**.
2. Data measured on sensitive equipment with a suitably fine scale, e.g. 20 mm is more precise than 2 cm.

Reliable Data
Findings that can be repeated by other people, or by other techniques, or agree with secondary sources.

Valid Data
Data obtained from a controlled experiment that addresses the stated aim.

Evidence
Data that has been checked and is considered sufficiently valid that we can confidently use it to make conclusions.

Component	Symbol	Function
lamp		Lights up when current flows through it
fuse		Breaks a circuit if too much current flows through it by the metal wire melting
open switch		Creates a break in the circuit so that current cannot flow
diode		Allows current to flow through it in one direction only
voltmeter		Measures potential difference across a component in volts
cell		Source of potential difference in a circuit
resistor		Has a designed resistance to electric current passing through it
thermistor		A resistor which reduces in resistance when heated
LED		Diode that emits light when a voltage is applied
closed switch		Completes a circuit so that electric current can flow
battery		Two or more cells electrically connected to provide a source of potential difference
LDR		A resistor whose resistance varies depending on the light intensity
ammeter		Measures electric current through a circuit in amperes
variable resistor		A component which can have its resistance changed to vary the amount of current flowing through a circuit

Required Practical 3: Investigating Resistance

Resistance of the Length of a Wire at a Constant Temperature

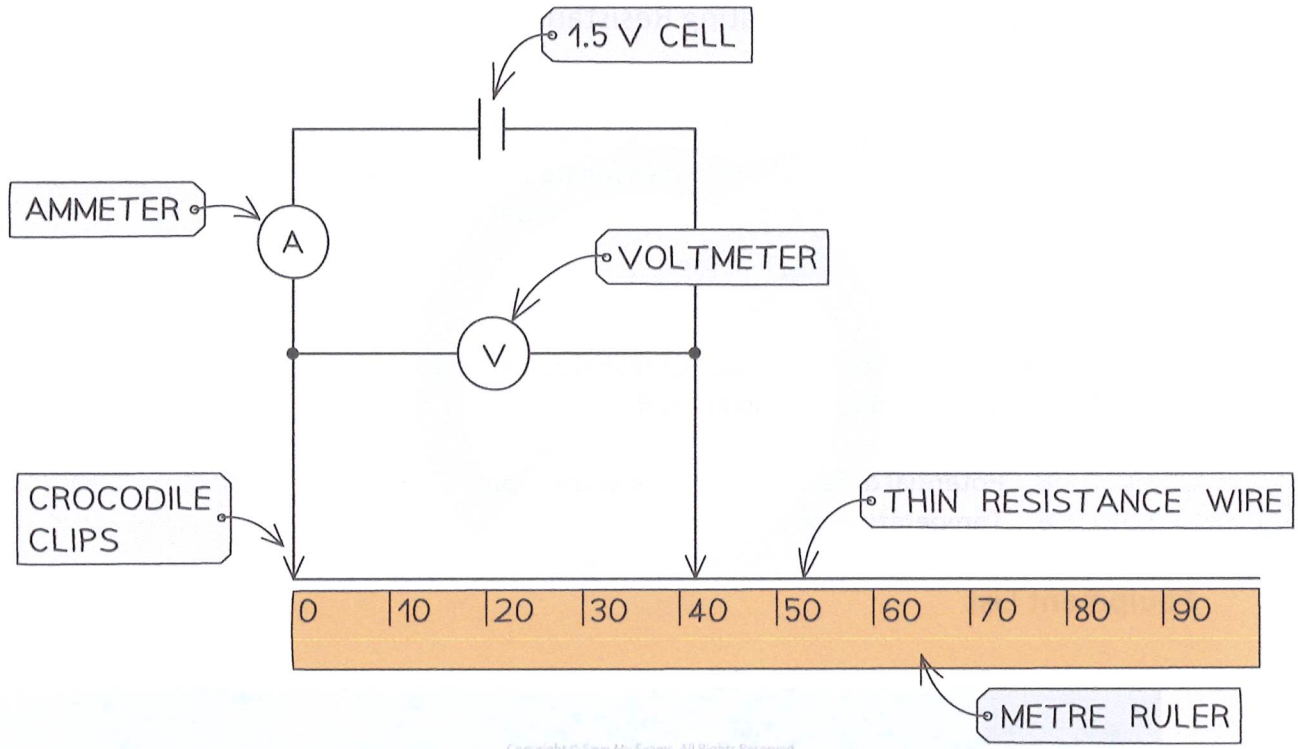
- The aim of this experiment is to investigate how the length of a wire at a constant temperature affects the resistance of electrical circuits

Variables:

- **Independent variable** = Length of resistance wire, *L*
- **Dependent variable** = Resistance, *R*
- Control variables:
  - Potential difference of the power supply
  - Temperature of the wire

Equipment List

Equipment	Purpose
Power supply / cell / battery	Source of potential difference to the circuit
Wires	To connect all components in the circuits
Crocodile clips	To connect different lengths of the resistance wire
Ammeter	To measure the current through the circuit
Voltmeter	To measure the potential difference through the resistors
2 or more resistors	To measure the resistance of
Thin resistance wire	To measure the resistance of
Metre ruler	To measure the length of the resistance wire



Required Practical 4: Investigating I–V Characteristics

Aim of the Experiment

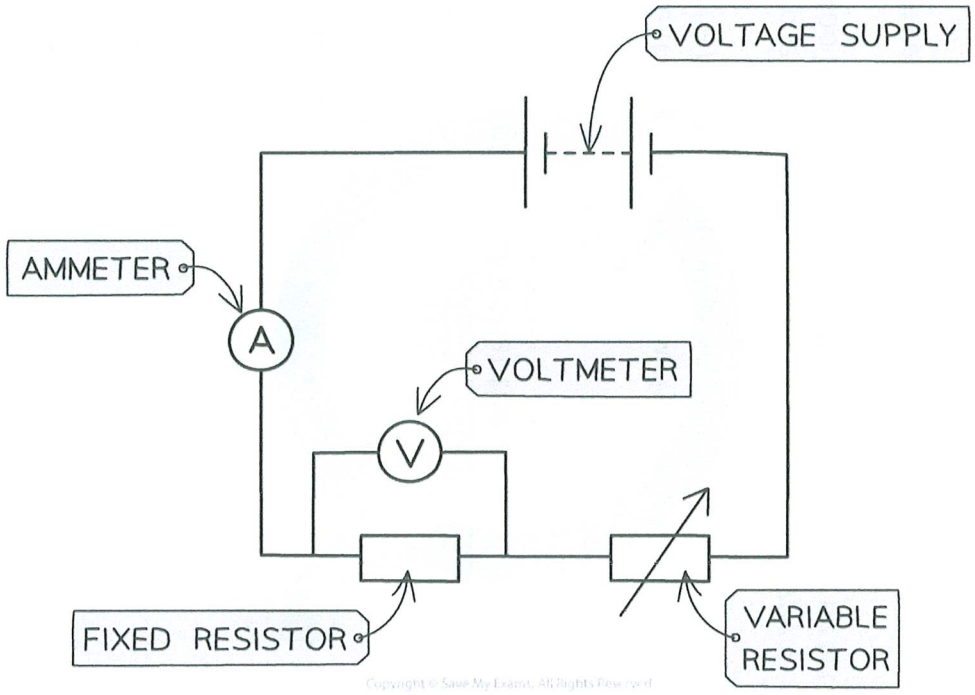
- The aim of the experiment is to use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements
- These include a fixed resistor at a constant temperature, a lamp and diode

Variables:

- **Independent variable** = Potential difference, *V*
- **Dependent variable** = Current, *I*
- Control variables:
  - Potential difference of the power supply
  - Use of the same equipment eg. wires, diodes

Equipment List

- Ammeter
- Voltmeter
- Variable resistor
- Fixed resistor (between 100 Ω and 500 Ω)
- Filament lamp
- Diode
- Voltage Supply
- Wires



Resistance: how difficult it is for current to flow through part of the circuit.

What's the point of the practical?

To find out resistance of a wire.

(You could look at different lengths of wire, different thicknesses, or even different temperatures)

Results:

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

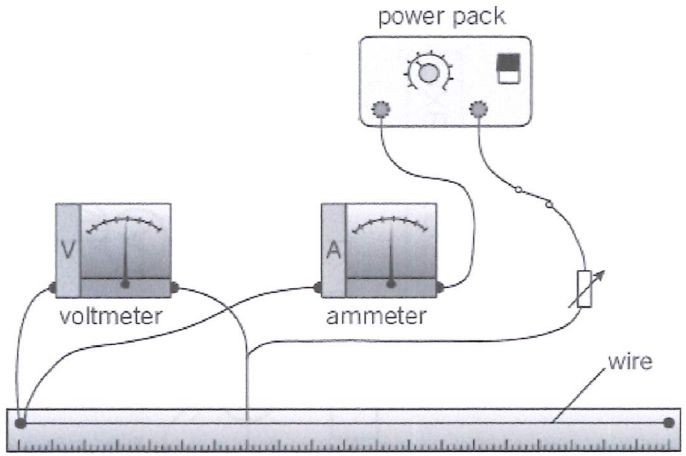
The longer the wire, the more resistance
The thicker the wire, the less resistance
The higher the temperature the more resistance

Example Apparatus

Voltmeter: measures the potential Difference

Ammeter: measures the current

Metre stick: Measures the length of wire that the current is going through



What may they ask us about?

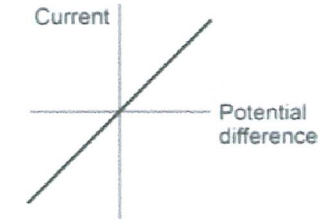
- Why must the power pack be kept on a low potential difference / What are the hazards *(The wire will get very hot, could burn you)*
- Explain how the temperature affects the resistance (*as the wire gets hot, the ions inside the wire vibrate faster so there are more collisions with the electrons cannot flow as easily)*
- Why is it important to switch the electricity off in between each reading (*to let the wire cool down, as temperature affects resistance)*
- What sort of error could cause all the ammeter/voltmeter readings to be too high (*a zero error – the meters need to be set at zero to start with)*
- Resolution of measurements, repeatability, reproducibility, control variables etc etc

Component: part of a circuit Current: the flow of charge diode: only allows current to flow one way
Potential Difference (V): the energy transferred to part of a circuit by each coulomb of charge
Resistor: limits the current in a circuit

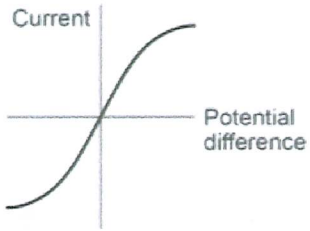
What's the point of the practical?

To find out how current and potential difference change in different components

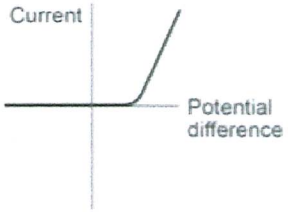
Results:



Resistor



lamp

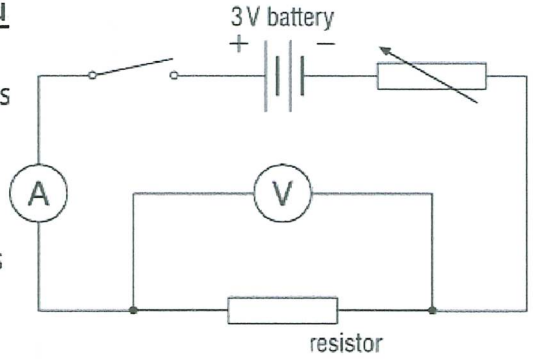


Diode

Example Apparatu

Voltmeter: measures the potential Difference

Ammeter: measures the current



Resistor: what we're testing. (can be replaced with a lamp, then a diode

What may they ask us about?

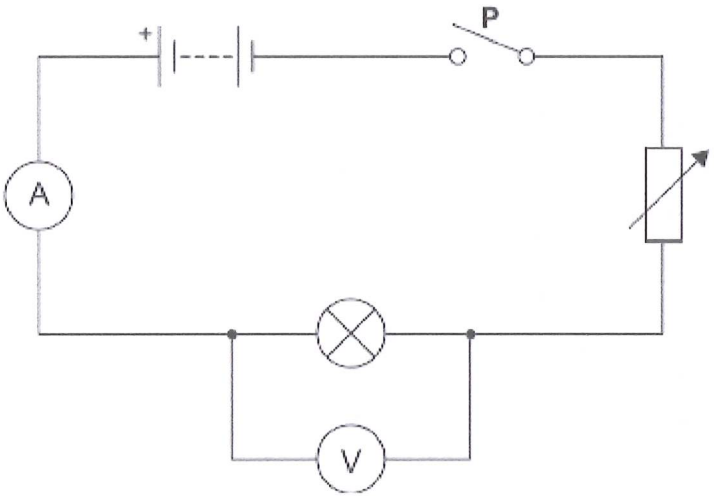
- Explain the pattern for each component (***resistor**: fixed resistance – more PD =more current. **Lamp:** more PD = more current but at high PD, the filament gets hot, ions vibrate so resistance increases and current levels off. **Diode**: current can only flow in one direction)*
- Resolution of measurements, repeatability, reproducibility, control variables etc etc

Q1.

A student investigated how the current in a filament lamp varies with the potential difference across the lamp.

Figure 1 shows the circuit used.

Figure 1



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

_____

(1)

(b) Complete the sentences.

Choose answers from the box.

charge	**current**	**energy**	**potential difference**	**power**

The ammeter in the circuit measures _____.

The voltmeter in the circuit measures _____.

(2)

(c) How will **increasing** the resistance of the variable resistor in **Figure 1** affect each of the following quantities?

Tick (✓) **one** box in **each** row.

Quantity	Decreases	Stays the same	Increases
Current in the circuit			
Potential difference across the lamp			
Total resistance of the circuit			

(3)

(d) A charge flow of 15 coulombs passed through the filament lamp in a time of 60 seconds.

Calculate the current in the lamp.

Use the equation:

$$\text{current} = \frac{\text{charge flow}}{\text{time}}$$

Current = _____ A

(2)

(e) When the current in the filament lamp is 0.12 A, the potential difference across the lamp is 6.0 V.

Calculate the resistance of the filament lamp.

Use the equation:

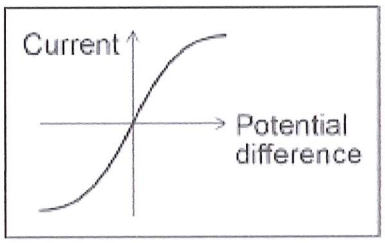
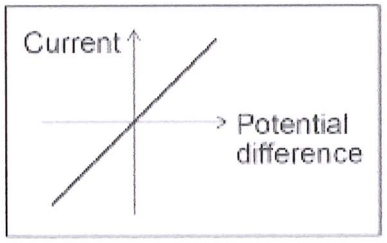
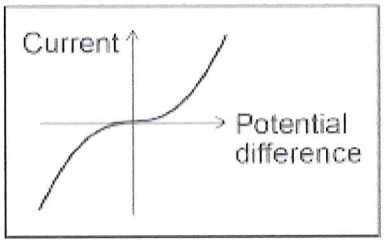
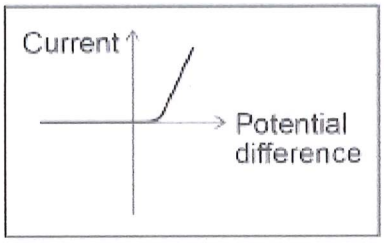
$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

Resistance = _____ Ω **(2)**

(f) The student repeated the investigation after replacing the lamp with a resistor at constant temperature and then a diode.

The student plotted a graph for each component.

Draw **one** line from each component to its graph.

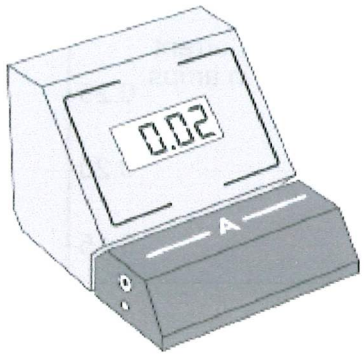
Component	Graph
Diode	
Filament lamp	
Resistor	
	

(2)

(g) **Figure 2** shows an ammeter.

The ammeter is **not** connected to a circuit.

Figure 2



What type of error does the ammeter display?

Tick (✓) **one** box.

A positive error ☐

A random error ☐

A zero error ☐

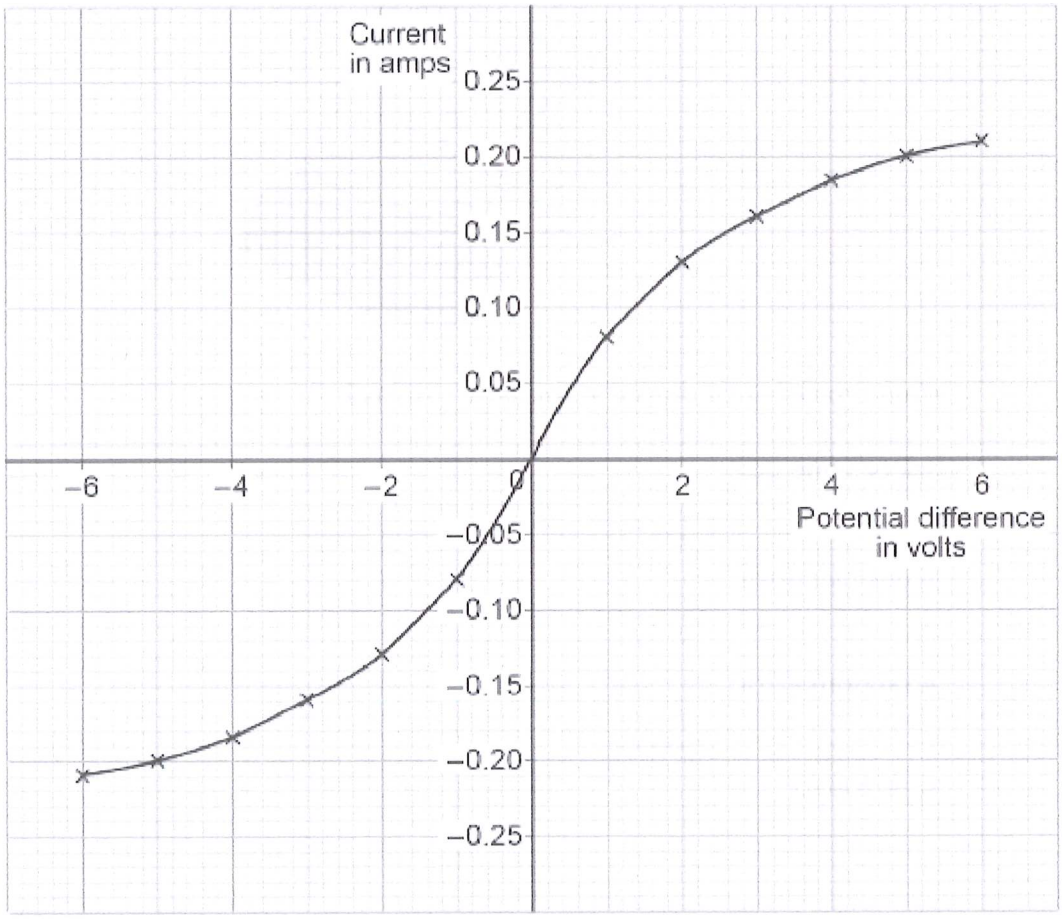
(1)

(Total 13 marks)

Q2.

A student investigated how the current in a filament lamp varies with the potential difference across the filament lamp.

The figure below shows the results.



(a) Describe a method the student could use to obtain these results.

You should include a circuit diagram.

(6)

(b) Determine the resistance of the filament lamp when the potential difference across it is +3.0 V.

Use the Physics Equations Sheet.

Use the figure above.

Resistance = _____ Ω

(3)

(c) The current in the lamp is 0.21 A when the potential difference across the lamp is 6.0 V.

Calculate the energy transferred by the filament lamp in 30 minutes.

Use the Physics Equations Sheet.

Energy transferred = _____ J

(5)

(d) The power output of the lamp is 1.0 W when the potential difference across the lamp is 5.0 V.

A student predicts that the power output would be 4.0 W if the potential difference was doubled.

Explain why the student is **not** correct.

_____

_____

_____

_____

_____

_____

(2)

(Total 16 marks)

Mark schemes

Q1.

(a) switch

1

(b) current

1

potential difference

allow p.d.

allow voltage

1

in this order only

(c)

Quantity	Decrease	Stay the same	Increase
Current in the circuit	✓		
Potential difference across the lamp	✓		
Total resistance of the circuit			✓

any extra tick in a row negates the mark for that row

3

(d) $\text{current} = \frac{15}{60}$

1

current = 0.25 (A)

1

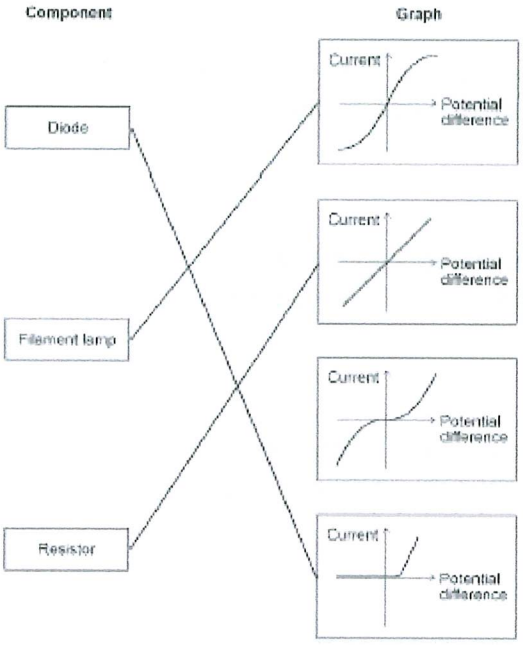
(e) $R = \frac{6.0}{0.12}$

1

$R = 50\ (\Omega)$

1

(f)



2 marks for all 3 correct

1 mark for 1 or 2 correct

additional line from a box on the left negates the mark for that box

2

(g) a zero error

1

[13]

Q2.

(a) **Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

5-6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3-4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1-2

No relevant content

0

Indicative content

- ammeter in series with filament lamp
- current measured with an ammeter
- voltmeter in parallel with filament lamp
- p.d. measured with a voltmeter
- variable resistor (or variable power pack or variable number of cells) used to vary current in and p.d. across filament lamp
- range of p.d. of 0 to 6 V
- interval of p.d. of 1 V
- reverse connections to power supply to obtain negative values
- take repeat readings and calculate a mean
- discard anomalies

Indicative content may be seen in a circuit diagram.

Level 3 answer: needs to include a circuit which would work (if included) and a method to obtain negative values.

(b) $3.0 = 0.16 \times R$

allow a correct substitution of an incorrect value of I in the range 0.15 (A) to 0.17 (A)

1

$$R = \frac{3.0}{0.16}$$

allow a correct rearrangement of an incorrect value of I in the range 0.15 (A) to 0.17 (A)

1

$R = 18.75\ (\Omega)$

allow 19 (Ω)

allow 18.8

1

(c) $t = 1800$ (s)

1

$Q = 0.21 \times 1800$

all subsequent marks can score if an incorrectly / not converted value of t is used

1

$Q = 378$ (C)

1

$E = 378 \times 6.0$

1

$E = 2268$ (J)

allow an answer to 2 or 3 s.f.

OR

$P = 0.21 \times 6.0$ (1)

$P = 1.26$ (W) (1)

$t = 1800$ (s) (1)

all subsequent marks can score if an incorrectly / not converted value of t is used

$E = 1.26 \times 1800$ (1)

$E = 2268$ (J) (1)

allow an answer to 2 or 3 s.f.

1

(d) (for the power to quadruple) the current and the p.d. would both need to double

1

(but the current doesn't double) because the resistance of the filament lamp increases

or

(but the current doesn't double because the graph shows that) current is not proportional to p.d.

allow the graph does not show direct proportionality

ignore the graph is not a straight line

ignore the graph is not linear

1

[16]