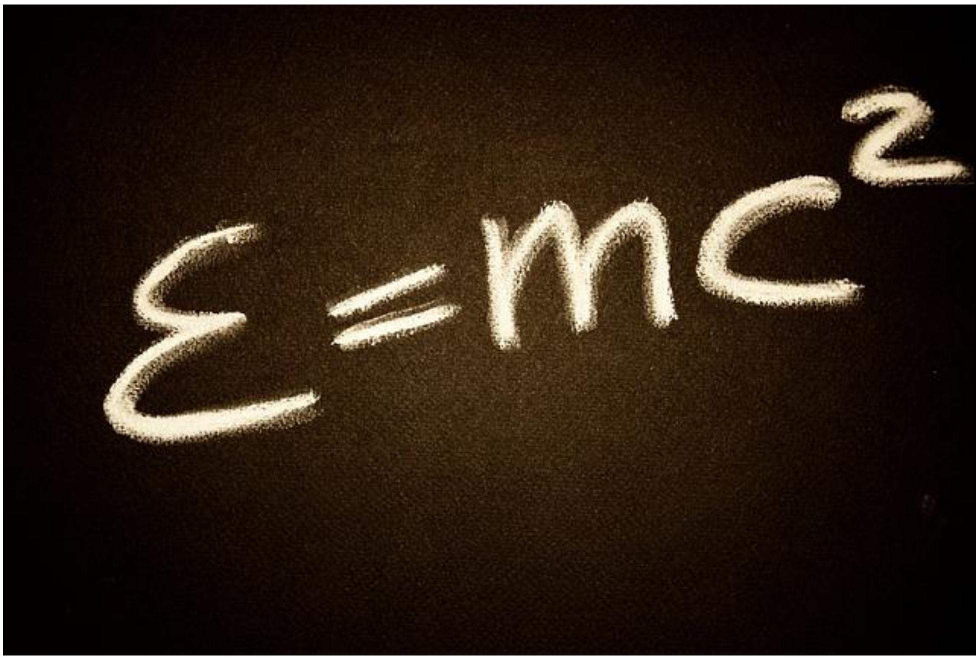
Physics paper one

Stretch and challenge booklet



Exam command words

Command words are the words and phrases used in exams that tell students how they should answer a question.

The following command words are taken from Ofqual's official list of command words and their meanings that are relevant to this subject.

Calculate	Use numbers in the question to work these out.	**Draw**	Produce, or add a diagram.
Choose	Select from a range of alternatives.	**Estimate**	Give an approximate value.
Compare	Describe similarities/differences.	**Use**	The answer must include the information in the question.
Define	Specify the meaning of something.	**Work out**	Students should use numbers in the question.
Describe	Recall facts, events or process in an accurate way.	**Write**	Short answer, no explanation or description.
Design	Set out how something will be done.	**Evaluate**	Students should use the information provided as well as their own knowledge and consider evidence for or against.
Determine	Use the data provided to work out your answer.	**Explain**	Students should make something clear, or state reasons for something happening.
Give	Short answer only.	**Identify**	Name or characterise.
Label	Add words to complete a diagram, picture or graph	**Justify**	Use evidence from the information supplied to support your answer.
Measure	Find an item of data for a given quantity.	**Name**	Single word or phrase.
Plot	Mark on a graph.	**Plan**	Write a method.
Predict	Give a plausible outcome.	**Show**	Provide structured evidence to reach a conclusion.
Suggest	Apply your own knowledge.	**Sketch**	Draw approximately.

Scientific key words

These are keywords often used in questions. You need to be able to recognise and use them in your answers.

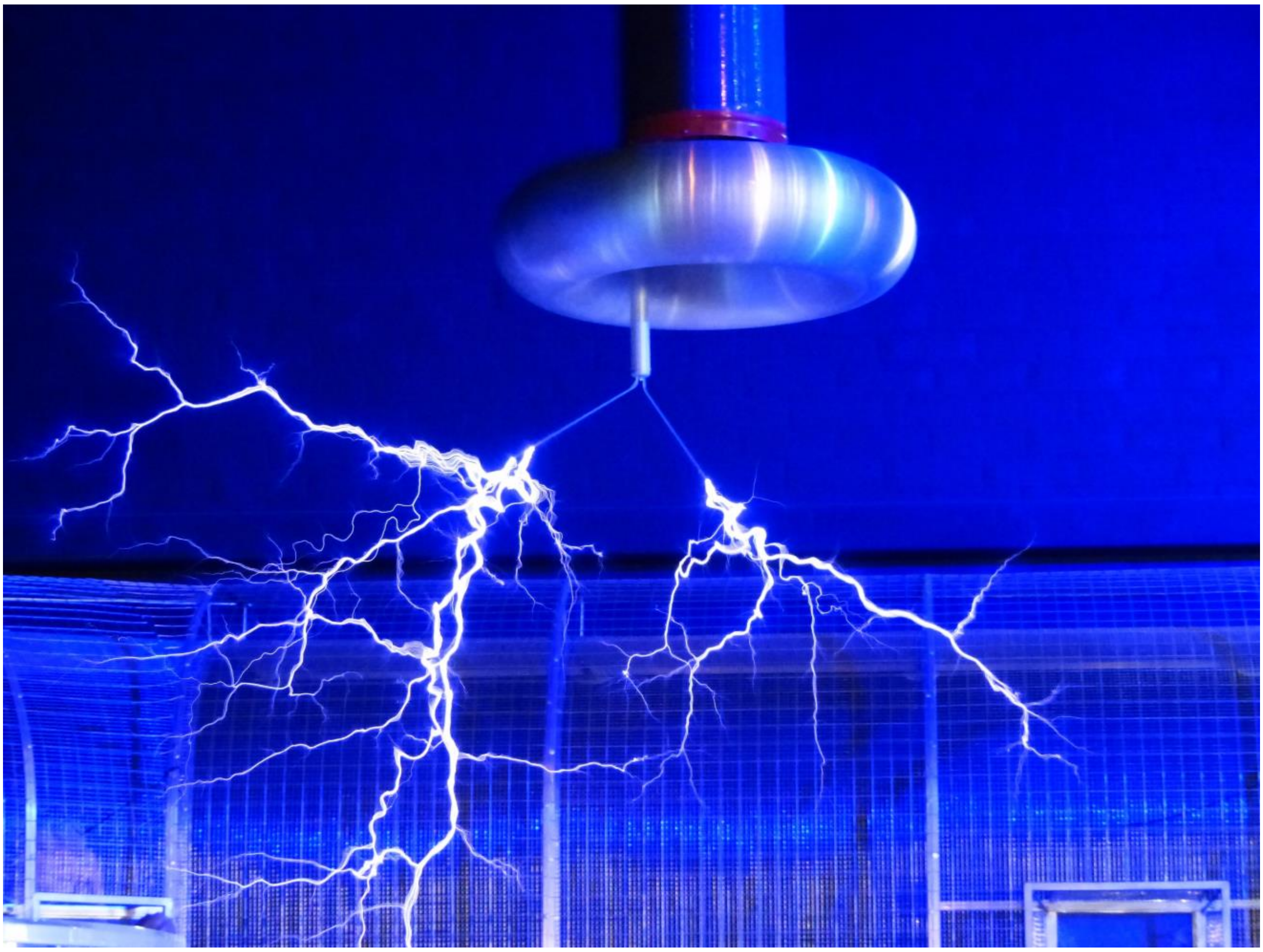
Hypothesis	A scientific statement that explains certain facts or observations	**Anomaly**	A result that does not fit the pattern
Prediction	This describes what you think will happen in an experiment	**Accuracy**	How close the reading is to the true value
Independent variable	This is the variable that is changed during an investigation. There should only be one of these.	**True value**	This is the real value of a measurement in an experiment
Dependent variable	This is the variable that changes as a result of a change in the independent variable	**Precision**	This is determined by the scale on the measuring apparatus e.g. a ruler marked mm is more precise than one in cm
Control variable	Variables that remain constant, to make sure that an investigation is valid	**Resolution**	The smallest change that can be read from a measuring device for example a ruler measured in mm or cm
Fair test	This is where only the independent variable is changed and the others controlled	**Calibration**	When we make sure that the measuring apparatus is making correct readings e.g. the temperature of melting ice is 0 degrees Celsius
Valid	The results and conclusions will be this if the variables are correctly controlled	**Measurement error**	The difference between the real value and the measured value
Categoric variable	A variable that can be described by a label or category such as colour or surface	**Random error**	This error causes measurements to be spread around the true value – can be reduced by taking repeats and calculating a mean
Continuous variable	A variable which can have any numerical value	**Zero error**	When a piece of measuring equipment should be reading zero but it doesn't
Interval	This is the difference between the values of your independent variable	**Systematic error**	This is an error that is always the same for each repeat – usually because of an error in the equipment used
Range	The maximum and minimum values of the independent or dependent variables e.g. 'from 10cm to 50cm'	**Uncertainty**	When the results obtained are not as accurate as they could be due to the procedure carried out
Data	Information or measurements that you collect	**Repeatable**	If the same person can get the same reading using the same equipment and method
Datum	One piece of information	**Reproducible**	If another person can get the same result (trend/specific results) using the same method and equipment or with different method or equipment.

Physics Paper 1 Checklist- Trilogy

Energy		
Name the different types of energy 'store' and describe how energy is transferred between them		
Identify where energy is wasted and describe where this goes		
Calculate the efficiency of devices		
Use Sankey diagrams to represent energy transfers or calculate efficiency		
Define and calculate kinetic energy		
Define and calculate gravitational potential energy		
Use values for GPE to calculate maximum theoretical velocity of a raised object		
Explain why theoretical velocity will not normally be reached		
Calculate the elastic potential energy in a stretched or squashed object		
Use and manipulate the specific heat capacity equation to calculate energy/mass/temperature change/specific heat capacity given the others		
Define specific heat capacity		
Calculate power using P=E/t or P=Work done/t		
Describe the relationship between watts and joules		
Define a 'closed system' and explain what happens to total energy when energy transfers happen in a closed system		
Describe ways to reduce unwanted energy transfers		
Describe factors that affect the thermal conductivity of a building		
Describe the use, reliability and environmental impacts of renewable and non-renewable energy resources		
lectricity		
Describe what is meant by an electric current and calculate it using Q=It		
Describe what is meant by resistance and calculate values for it using Ohm's Law		
Calculate current, voltage and resistance in series and parallel circuits		
Recognise, describe and explain the shape of current-voltage graphs for a filament bulb, ohmic resistor and a diode		
Use and recognise the symbols for all the circuit components covered		

Recognise, describe and explain the shape of resistance- light level graph for a light dependent resistor		
Describe and explain uses of LDRs – e.g switching on lights when it gets dark		
Recognise, describe and explain the shape of resistance- temperature graph for a thermistor		
Label the features and describe the safe operation of a 3 pin plug		
Explain the difference between direct and alternating pd		
Calculate electrical power and energy transferred for given appliances		
Describe the features of the National Grid		
Particle theory		
Describe density in terms of particle arrangement		
Use Density = mass/volume to calculate values and use the correct units		
Explain the term 'internal energy'		
Describe differences in particle arrangement and energy in solids, liquids and gases		
Explain what happens to particles during a change of state		
Use the equation E=mL to calculate mass, specific latent heat or energy		
Distinguish between specific heat capacity and specific latent heat		
Define the terms specific latent heat, latent heat of fusion, latent heat of vaporisation		
Atoms and Nuclear Physics		
Label the parts of an atom and state approximate sizes of the atom and the nucleus		
Explain what might cause changes in distance of electrons from the nucleus		
Describe the changes to the atomic model over time, and why those changes were made		
Describe what is meant by an isotope and describe some of their uses		
Describe the properties and origins of alpha, beta and gamma radiation		
Complete nuclear equations for alpha and beta decay		
Describe what is meant by the half-life of a radioactive isotope and obtain values for this from a decay curve		
Choose an appropriate source for a particular purpose		
Explain the difference between contamination and irradiation and compare the hazards of each		

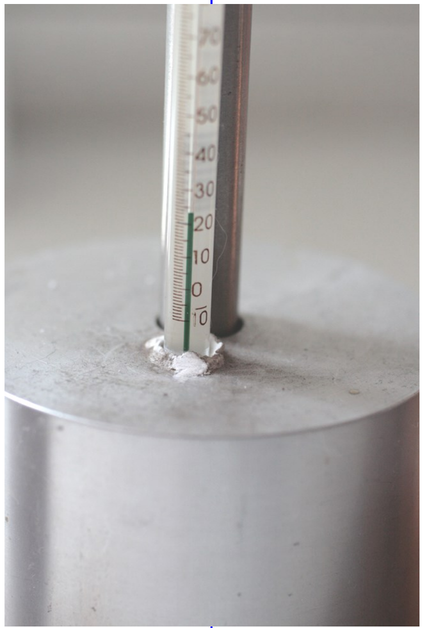
Required practical activities



Specific Heat Capacity

Organise the method used to obtain results to measure Specific Heat Capacity:

- Switch the power pack to 12 V. Switch it on.
- Record the temperature every minute for 10 minutes.
- Place a heater in the larger hole in the block.
- Record the ammeter and voltmeter readings (or Joule Meter Readings)
- Put the thermometer in this hole.
- Measure and record the mass of the copper block in kg.
- Measure the temperature and switch on the



Improvements:

Suggest ways in which you could improve these in the experiment:

Accuracy:

Precision:

Reliability:

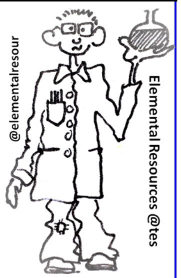
Specific Heat Capacity can be measured using the equation .

Energy = Specific Heat Capacity x Temperature Rise x Mass

Rearrange this formula to find:

Specific Heat Capacity =

What are the units for Specific Heat Capacity?



Calculate the following:

1. What is the specific heat capacity if the temperature rise is 5°C of a 1Kg mass with 2000J of energy?

2. What is the specific heat capacity if the temperature rise from 27°C to 45°C of a 2Kg mass with 1000J of energy?

3. What is the energy needed to increase the temperature from 55°C to 100°C of a 2Kg mass and specific heat capacity?

Risk Assessment

Write a risk assessment for this practical including what you would do to minimise these risks.

Plan

Without turning over (!) write a step by step plan for this experiment.

Calculating the Specific Heat Capacity

Use the information in the table to calculate the specific heat capacities at each temperature

Energy (J)	Temperature (°C)	Specific Heat Capacity (J/Kg/°C)
1760	24	
3580	25	
5320	26	
7100	27	
8900	28	

Calculate the average Specific Heat Capacity from the table.

Average =

Describe what the specific heat capacity tells you about a substance:

I-V Characteristics

Organise the method used to measure the current and Voltage in various components:

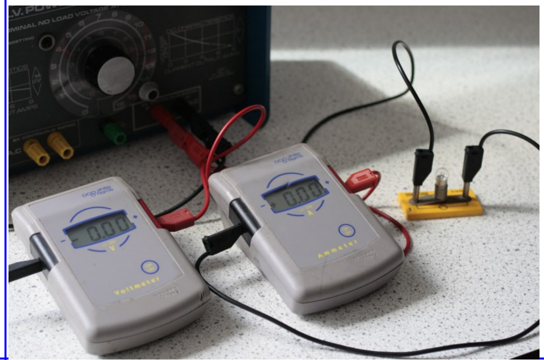
- Swap the connections on the battery. Now the ammeter is connected to the negative terminal and variable resistor to the positive terminal.
- Connect the Voltmeter in parallel across the Power Supply.
- Record the readings on the ammeter and voltmeter in a suitable table.
- Connect the resistor in the circuit as shown in the diagram.
- Continue to record pairs of readings of current and potential difference with the battery reversed.
- Change the component from a resistor to a diode/lamp and repeat.
- Connect the Ammeter in series.
- Adjust the voltage of the Power Supply and record the new ammeter and voltmeter readings. Repeat this to obtain several pairs of readings.
- The readings on the ammeter and voltmeter should now be negative.

Risk Assessment:

Suggest what the risks are in this experiment. Describe what you should do to minimise them:

1.

2.



3.

What are the variables in this experiment:

Independent:

Dependent:

Control (describe how you might keep these from affecting your experiment):

<u>Convert the following units</u>

1. 500 mA = ……………………….. A
2. 25 mA = ……………………….. A
3. 770 mA = ……………………….. A
4. 5.8 mA = ……………………….. A
5. 900 mA = ……………….. A
6. 1 mA = ……………….. A

Help?
1000 mA = 1A

mA→ A ÷1000

Plan

Without turning over (!) write a step by step plan for measuring the resistance of a wire.

Calculating the resistance

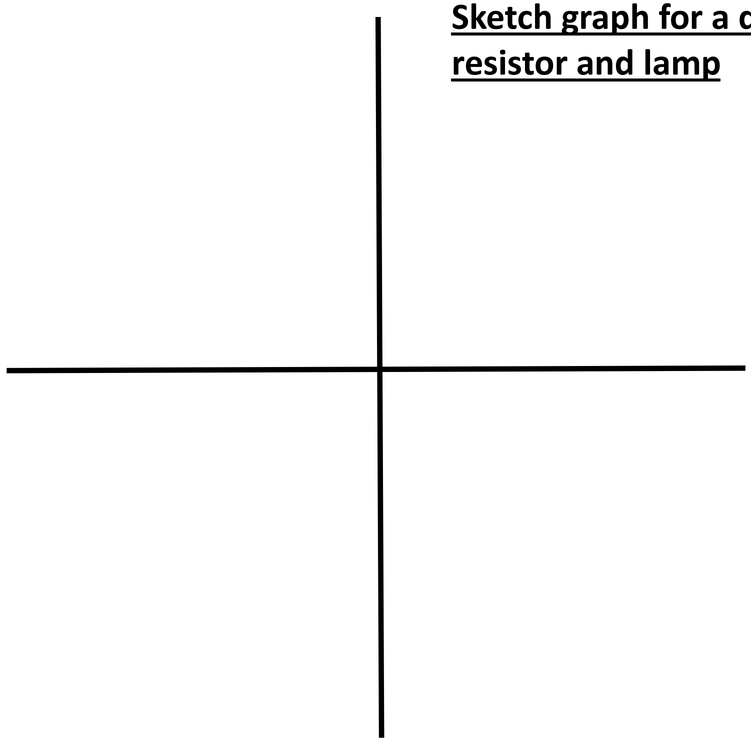
For each component, complete the sentences

As the voltage and current increase in the lamp, the resistance ………………… because …………………………………………………

As the voltage and current are increased in the resistor, the resistance ………………………………..

The resistance in the diode is high when ……………………………………………………..

Sketch graph for a diode, resistor and lamp



Resistance

Organise the method used to obtain results for resistance of a wire:

- Record the length of the wire, the reading on the Ammeter and the Voltmeter.
- Adjust the voltage so that it stays the same.
- Calculate and record the resistance for each length of wire using the equation:
- Change the length of the wire by a fixed amount.
- Set up the apparatus as shown in the circuit diagram.
- Repeat until you have several pairs of meter readings

Risk Assessment:

Suggest what the risks are in this experiment. Describe what you should do to minimise the risks.

1.

2.

3.

Complete the following Calculations in the table, using the rearranged equations in the next box:

Voltage	Current	Resistance
4V	1A	
8V		2Ω
	2A	6Ω
12V	3A	
4V	12A	
4V		8Ω
	20A	10Ω

Calculating the Resistance of the wire at various lengths uses the following equation:

Rearrange the equation to calculate:

Voltage=

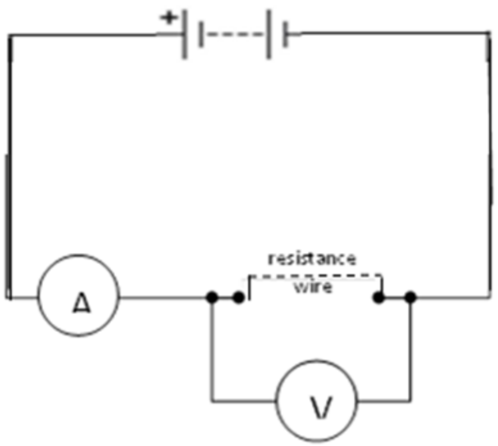
Current =

Resistance= $\frac{\text{Voltage}}{\text{Current}}$

What are the units of the following:
Current:
Voltage:
Resistance:
Length of Wire:

Plan

Without turning over (!) write a step by step plan for measuring the resistance of a wire.



Calculating the resistance at different lengths of wire

By calculating the resistance at different points on the wire, you will be able to see how resistance changes as the length of the wore changes.

Length of wire (m)	Resistance (Ω)
0.1	2
0.2	3
0.3	4
0.4	6
0.5	9

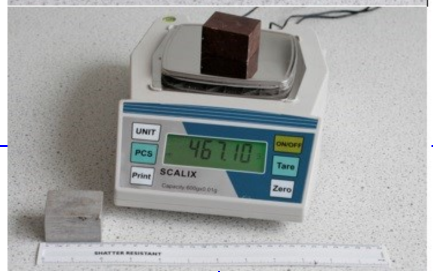
As the length of the wire ____________ the resistance of the wire ____________. This change is not linear because as the current increases the wire gets __________ and this affects the _____________.

<u>Complete this sketch graph</u>

Measuring Density

Organise the method used to measure density

- Calculate and record the volumes (length, width, height).
- Record your results in a table.
- For each object measure the: length, width, height.
- Record the results.
- Calculate and record the densities (mass ÷ volume).
- Include columns for volume, mass, density and substance.
- Measure the mass of each object using the digital balance.



Describe how adding sugar to water affects the density.

Mass of sugar dissolved in 0.1Kg of water (kg)	Density (kg/m^3)
0.005kg	1000 kg/m^3
0.01g	1005 kg/m^3
0.015g	1007 kg/m^3
0.02g	1009 kg/m^3
0.025g	1012 kg/m^3

Why do we not take into account the volume of the sugar?

How should the method be modified for measuring the density of a liquid. Write extra instructions below:

Density

Formula

Density = <u>Mass</u>
Volume

Rearrange this formula to find:

Mass = _________

Volume = _________

What are the units?

Mass is measured in ___________
Volume is measured in ___________
Density is measured in ___________

Plan

Without turning over (!) write a step by step plan for measuring the density of a solid.

Convert the following units

1. 500g = ... Kg
2. 25g = ... Kg
3. 770g = ... Kg
4. 58g = ... Kg
5. 10,000cm^3 = ... m^3
6. 100cm^3 = ... m^3
7. 250,000cm^3 = ... m^3
8. 100,000cm^3 = ... m^3

Help?

1000g = 1kg

g → kg ÷1000
kg → g x1000

1 m^3 = 1,000,000cm^3

m^3 → cm^3 x 1,000,000
cm^3 → m^3 ÷ 1,000,000

Confident?

a. 2g = ... Kg
b. 34.5g = ...kg
c. 0.5 g = ...kg
d. 10 cm^3 = ... m^3
e. 198 cm^3 = ... m^3
f. 2.5 cm^3 = ... m^3

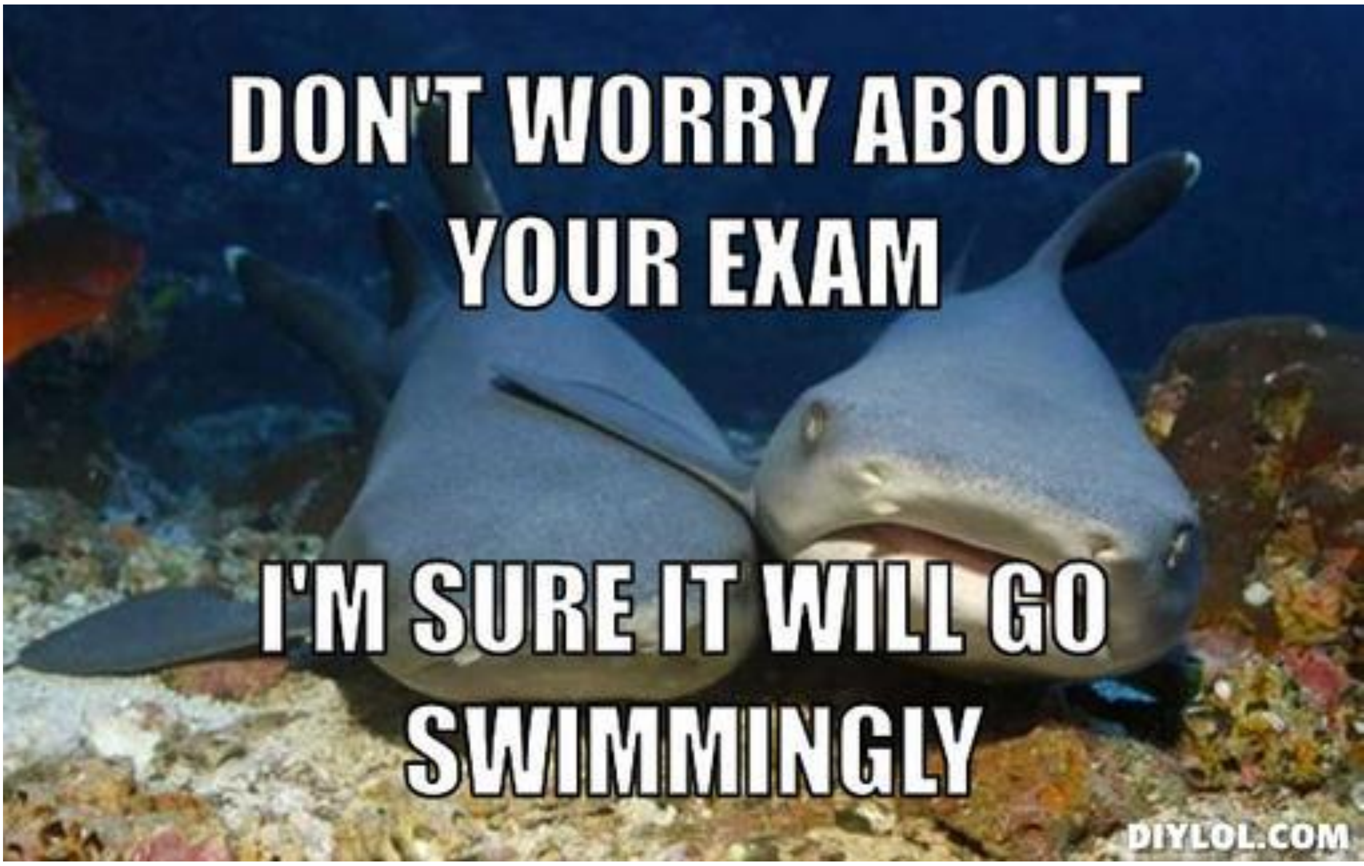
Calculations:

1. A solid block has dimensions of 100 cm x 100cm x 100 cm and a mass of 500g. Calculate it's density.

2. A solid block has dimensions of 12 cm x 8 cm x 5 cm and a mass of 500g. Calculate it's density.

3. A solid block has dimensions of 6 cm x 8 cm x 4.5 cm and a mass of 273g. Calculate it's density.

Exam questions



1. The photograph below shows a sailing boat crossing an ocean.

There is a wind turbine on the boat.

(a) The wind turbine generates electricity to charge a battery on the boat.

Name one **other** renewable energy resource that could be used on the boat to generate electricity.

____

(1)

(b) The boat also has a generator that burns a fossil fuel.

The battery can be charged by either the wind turbine **or** the generator.

Give **two** reasons why this is useful.

1 ____

____

2 ____

____

(2)

(c) Explain **one** environmental impact of using fossil fuels to generate electricity.

____

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(2)

(d) The kinetic energy of the boat is 81 kJ.

mass of boat = 8000 kg

Calculate the speed of the boat.

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Speed = ________________ m/s

(4)

(e) As the boat passes over a wave, the gravitational potential energy of the boat increases by 19 600 J.

mass of boat = 8000 kg

gravitational field strength = 9.8 N/kg

Calculate the change in height of the centre of mass of the boat as it passes over the wave.

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Change in height = ________________ m

(3)

(Total 12 marks)

2. Ice cream is made by cooling a mixture of liquid ingredients until they freeze.

(a) Which statement describes the motion of the particles in solid ice cream?

Tick (✓) **one** box.

They are stationary.	☐
They move freely.	☐
They vibrate about fixed positions.	☐

(1)

(b) How do the kinetic energy and the potential energy of the particles change as a liquid is cooled and frozen?

Tick (✓) **one** box.

Kinetic energy	**Potential energy**	
Decreases	Decreases	☐
Decreases	Does not change	☐
Does not change	Decreases	☐
Does not change	Does not change	☐

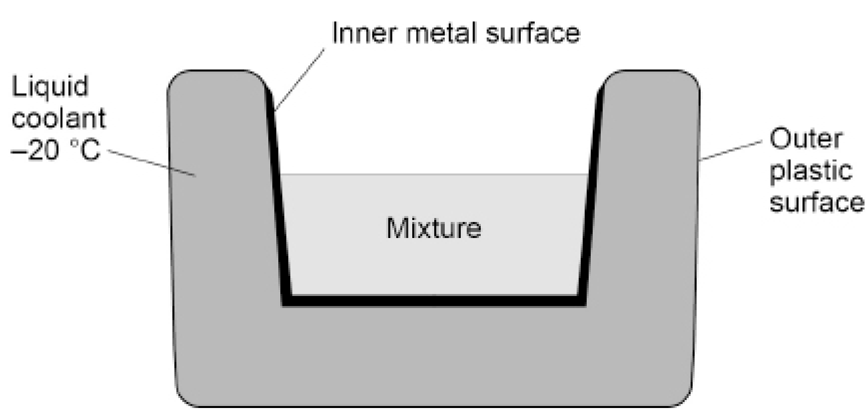
(1)

The diagram below shows a bowl used for making ice cream.

The walls of the bowl contain a liquid coolant.

The bowl is cooled to –20 °C before the mixture is put in the bowl.

The bowl causes the mixture to cool down and freeze.



(c) Explain why the different thermal conductivities of metal and plastic are important in the design of the bowl.

Metal ____

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Plastic ____

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(4)

(d) The liquid coolant has a freezing point below –20 °C

Explain **one** other property that the liquid coolant should have.

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(2)

(e) The initial temperature of the mixture was +20 °C. The mixture froze at –1.5 °C.

A total of 165 kJ of internal energy was transferred from the mixture to cool and freeze it.

specific heat capacity of the mixture = 3500 J/kg °C

specific latent heat of fusion of the mixture = 255 000 J/kg

Calculate the mass of the mixture.

Give your answer to 2 significant figures.

____

Mass (2 significant figures) = _______________ kg

(6)

(Total 14 marks)

3. A hybrid car has an electric motor and a petrol engine.

(a) Petrol is a non-renewable energy resource.

What is meant by a non-renewable energy resource?

____

(1)

(b) The electric motor in the car is powered by a battery.

To charge the battery, the car is plugged into the mains supply at 230 V

The power used to charge the battery is 6.9 kW

Calculate the current used to charge the battery.

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Current = ______________________________ A

(4)

(c) Mains electricity is an ac supply.

Explain the difference between direct and alternating potential difference.

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(2)

(d) The cable used to connect the car to the mains electricity supply has a low resistance.

Explain why it is better to use a cable with a low resistance than to use a cable with a high resistance.

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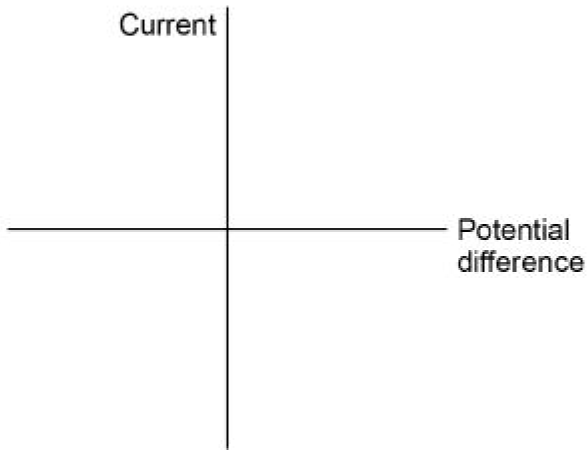
(2)

(Total 9 marks)

4. A student built a circuit using filament lamps.

(a) Sketch a current potential difference graph for a filament lamp on **Figure 1**

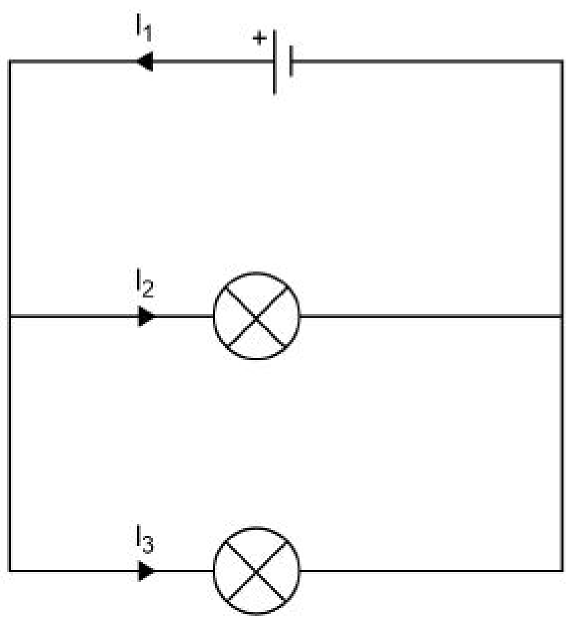
Figure 1



(2)

Figure 2 shows the circuit with two identical filament lamps.

Figure 2



(b) Compare the currents I_1, I_2 and I_3

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(2)

(c) Calculate the charge that flows through the cell in 1 minute.

Each filament lamp has a power of 3 W and a resistance of 12 Ω

Write any equations that you use.

Give the unit.

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Charge = ____________________

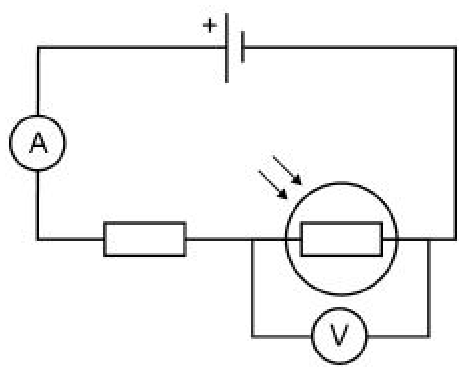
Unit = ____________________

(6)

(d) The student builds a different circuit.

Figure 3 shows the circuit.

Figure 3



Explain how the readings on both meters change when the environmental conditions change.

(6)

(Total 16 marks)

5. **Table 1** shows information about different light bulbs.

The bulbs all have the same brightness.

Table 1

Type of bulb	**Input power in watts**	**Efficiency**
Halogen	40	0.15
Compact fluorescent (CFL)	14	0.42
LED	7	0.85

(a) (i) Calculate the useful power output of the CFL bulb.

____

____

____

Useful power output = ________________ watts

(2)

(ii) Use your answer to part **(i)** to calculate the waste energy produced each second by a CFL bulb.

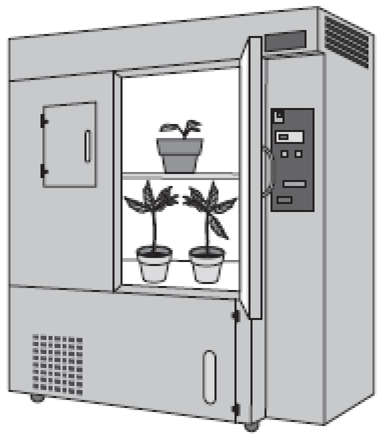
____

Waste energy per second = ________________ joules

(1)

(b) (i) A growth cabinet is used to investigate the effect of light on the rate of growth of plants.

The figure below shows a growth cabinet.



In the cabinet the factors that affect growth can be controlled.

A cooler unit is used to keep the temperature in the cabinet constant. The cooler unit is programmed to operate when the temperature rises above 20 °C.

The growth cabinet is lit using 50 halogen bulbs.

Changing from using halogen bulbs to LED bulbs would reduce the cost of running the growth cabinet.

Explain why.

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(4)

(ii) A scientist measured the rate of growth of plants for different intensities of light.

What type of graph should be drawn to present the results?

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Give a reason for your answer.

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(1)

(c) **Table 2** gives further information about both a halogen bulb and a LED bulb.

Table 2

Type of bulb	**Cost to buy**	**Lifetime in hours**	**Operating cost over the lifetime of one bulb**
Halogen	£1.50	2 000	£16.00
LED	£30.00	48 000	£67.20

A householder needs to replace a broken halogen light bulb.

Compare the cost efficiency of buying and using halogen bulbs rather than a LED bulb over a time span of 48 000 hours of use.

Your comparison must include calculations.

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(4)

(Total 12 marks)

6. The particle model can be used to explain the properties of gases.

(a) Describe the direction of motion of the particles in a gas.

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(1)

(b) Explain why heating a gas increases the average speed of the gas particles.

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(3)

(c) Water can exist as either a liquid or a gas at 100 °C.

Explain why a mass of gaseous water at 100 °C contains more energy than an equal mass of liquid water at 100 °C.

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(2)

(d) Water vapour is a gas. Gases change state when they cool.

The figure below shows condensation on a cold bathroom mirror.

© Dwight Eschliman/Getty Images

A volume of 2.5×10^{-5} m^3 of condensation forms on the mirror.

Density of water = 1000 kg / m^3

Specific latent heat of vaporisation of water = 2.26×10^6 J / kg.

Calculate the energy released when the condensation forms.

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Energy released = ____________________ J

(5)

(e) Central heating boilers burn gas and use the energy released to heat water.

Modern condensing central heating boilers take advantage of the energy that is released when water condenses.

Waste water vapour produced when the water is heated in the boiler is used to preheat the cold water entering the boiler.

Give some of the arguments in favour of condensing boilers compared to older non-condensing boilers.

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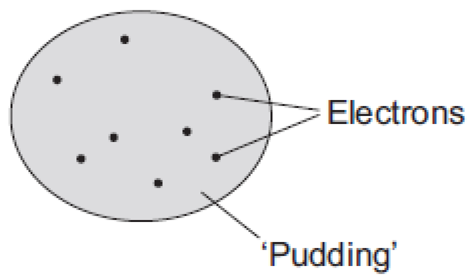
(4)

(Total 15 marks)

7. The ‘plum pudding’ model of the atom was used by scientists in the early part of the 20th century to explain atomic structure.



(a) Those scientists knew that atoms contained electrons and that the electrons had a negative charge. They also knew that an atom was electrically neutral overall.

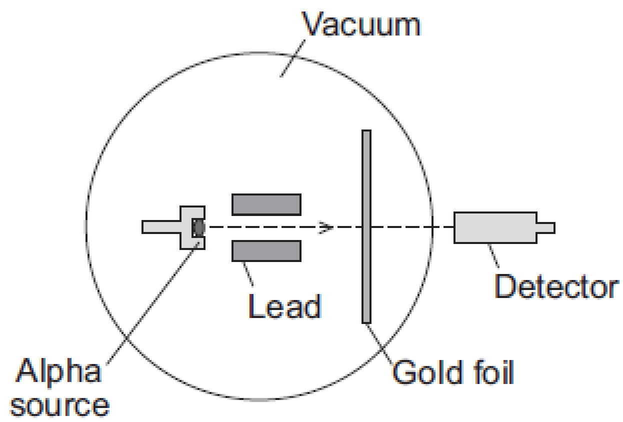
What did this allow the scientists to deduce about the ‘pudding’ part of the atom?

___

___

(1)

(b) An experiment, designed to investigate the ‘plum pudding’ model, involved firing alpha particles at a thin gold foil.



If the ‘plum pudding’ model was correct, then most of the alpha particles would go straight through the gold foil. A few would be deflected, but by less than 4°.

The results of the experiment were unexpected. Although most of the alpha particles did go straight through the gold foil, about 1 in every 8 000 was deflected by more than 90°.

Why did this experiment lead to a new model of the atom, called the nuclear model, replacing the ‘plum pudding’ model?

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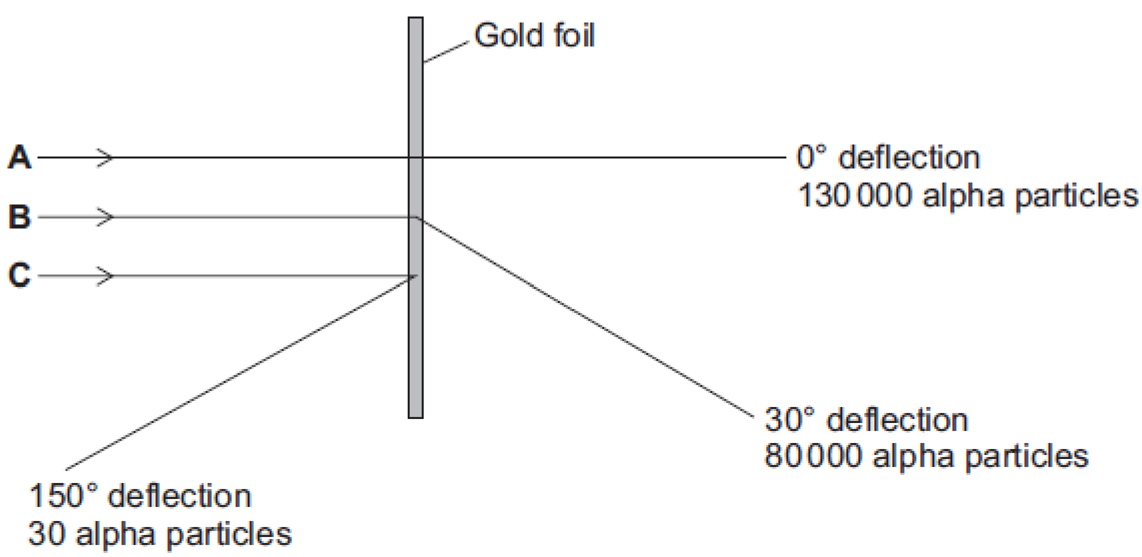
___

(1)

(c) The diagram shows the paths, **A**, **B** and **C**, of three alpha particles. The total number of alpha particles deflected through each angle is also given.



(i) Using the nuclear model of the atom, explain the three paths, **A**, **B** and **C**.

A ____

____

B ____

____

C ____

____

(3)

(ii) Using the nuclear model, the scientist E. Rutherford devised an equation to predict the proportion of alpha particles that would be deflected through various angles.

The results of the experiment were the same as the predictions made by Rutherford.

What was the importance of the experimental results and the predictions being the same?

____

____

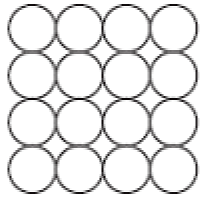
(1)

(Total 6 marks)

8. According to kinetic theory, all matter is made up of small particles. The particles are constantly moving.

Diagram 1 shows how the particles may be arranged in a solid.

Diagram 1



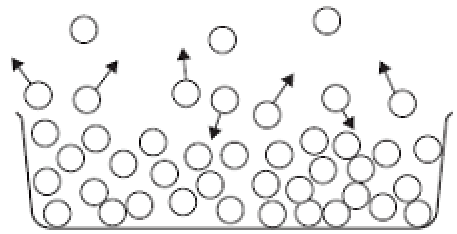
(a) One kilogram of a gas has a much larger volume than one kilogram of a solid.

Use kinetic theory to explain why.

(4)

(b) **Diagram 2** shows the particles in a liquid. The liquid is evaporating.

Diagram 2



(i) How can you tell from **Diagram 2** that the liquid is evaporating?

____

____

(1)

(ii) The temperature of the liquid in the container decreases as the liquid evaporates.

Use kinetic theory to explain why.

____

____

____

____

____

____

____

____

(3)

(Total 8 marks)

Mark schemes

1. (a) solar

allow biofuel / biodiesel allow wave power

1

(b) sometimes there is no wind (but the battery can still be charged using the generator)

allow if the generator breaks then the turbine can still generate electricity

1

when there is wind less fuel is burned

allow a disadvantage of burning fossil fuel

1

(c) carbon dioxide

1

increases global warming

OR

sulfur dioxide or NOx emissions (1)

increases acid rain (1)

OR

particulates or NOx emissions (1)

can harm living organisms (1)

allow increases the greenhouse effect

1

(d) 81 kJ = 81 000 J

1

$81000 = 0.5 \times 8000 \times v^2$

allow a correct substitution using an incorrectly/not converted value of energy

1

$$v = \sqrt{\frac{81\,000}{0.5 \times 8000}}$$

allow a correct re-arrangement using an incorrectly/not converted value of energy

1

v = 4.5 (m/s)

allow a correct calculation using an incorrectly/not converted value of energy

1

(e) 19600 = 8000 × 9.8 × Δh

1

$$\Delta h = \frac{19\,600}{8000 \times 9.8}$$

1

Δh = 0.25 m

1

[12]

2. (a) they vibrate about fixed positions.

1

(b) kinetic energy decreases potential energy decreases

1

(c) metal: has a high thermal conductivity

1

which increases the rate of energy transfer from the mixture

allow ice cream for mixture

1

plastic: has a low thermal conductivity

1

which reduces the rate of energy transfer from the surroundings (to the liquid coolant at –20°C)

ignore references to insulation throughout

1

(d) a high specific heat capacity

1

so it can absorb a large amount of energy with only a small temperature change

1

(e) 165 kJ = 165000 J

1

ΔE = m × 3500 × 21.5
and
ΔE = m × 255000

1

165000 = 75250 m + 255000 m
or
165000 = 330250 m

this mark may be awarded if E is incorrectly/not converted

1

$$m = \frac{165000}{75250 + 255000}$$

or

this mark may be awarded if E is incorrectly/not converted

1

$$m = \frac{165000}{330250}$$

allow an answer consistent with their value of E

m = 0.499621 (kg)

1

m = 0.50 (kg)

this answer only

If no marks awarded other than the first marking point:

either

*165 000 = m × 3500 × 21.5 scores **1** mark*

*m = 2.192… scores **1** mark*

*m = 2.2 (kg) scores **1** mark.*

these marks may be awarded if E is incorrectly/not converted

or

*165 000 = m × 255 000 scores **1** mark*

*m = 0.647 scores **1** mark*

*m = 0.65kg scores **1** mark.*

these marks may be awarded if E is incorrectly/not converted

1

[14]

3. (a) an energy resource that cannot be replenished as it is used

allow an energy resource that will run out

ignore cannot be re-used

1

(b)

*an answer of 30 (A) scores **4** marks*

6.9 k(W) = 6900 (W)

1

6900 = 230 × I

allow correct substitution of an incorrectly/not converted value for power

1

6900 = 230 × I

allow correct substitution of an incorrectly/not converted value for power

1

$I = \frac{6900}{230}$

allow a correct transformation using an incorrectly/not converted value for power

1

I = 30 (A)

allow a correct calculation using an incorrectly/not converted value for power

1

(c) direct potential difference is always in the same direction

allow direct current is always in the same direction

1

alternating potential difference changes direction

allow alternating current changes direction

1

(d) lower potential difference across the cable

allow lower power/energy dissipation

1

it is more efficient

allow it won't get as hot

OR

(lower resistance gives) a greater current (for the same potential difference) (1)

so the car battery can charge faster (1)

[9]

4. (a) a curve in the first and third quadrants only, passing through origin

1

decreasing gradient

1

(b) any **two** from:

- $I_1 = I_2 + I_3$
- $I_2 = I_3$
- $I_1 = 2I_2$
- $I_1 = 2I_3$

*allow **1** mark for each correct description given in words*

2

(c) $3 = I^2 \times 12$

1

$$I = \sqrt{\left(\frac{3}{12}\right)}$$

1

$I = 0.5$ (A)

1

$Q = 0.5 \times 60 = 30$

allow Q =
their calculated I × 60

1

$Q_{total} = 60$

allow an answer that is consistent with their calculated value of I

1

or

$3 = I^2 \times 12$ (1)

$$I = \sqrt{\left(\frac{3}{12}\right)}$$

$I = 0.5$ (A) (1)

$I_{total} = 1.0$ (A) (1)

allow I_{total} = their I × 2

$Q = 1.0 \times 60 = 60$ (1)

allow an answer that is consistent with their calculated value of I

coulombs **or** C

1

*an answer of 60 scores **5** calculation marks*

(d) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

- resistance of LDR changes when light intensity changes
- when light intensity increase resistance of LDR decreases

- overall resistance of circuit decreases
- potential difference across total resistance remains unchanged
- current in ammeter increases

- potential difference across fixed resistor increases
- potential difference across LDR decreases
- reading on the voltmeter decreases

- potential difference is shared between the components in series
- the lower the resistance of the LDR the smaller the share of the potential difference
- reading on the voltmeter decreases

[16]

5. (a) (i) 5.88 (watts)

*an answer of 5.9 scores **2** marks*

*allow **1** mark for correct substitution ie*

$0.42 = \frac{\text{power out}}{14}$

*allow **1** mark for an answer of 0.0588 or 0.059*

2

(ii) 8.12

allow 14 – their (a)(i) correctly calculated

1

(b) (i) input power / energy would be (much) less (reducing cost of running)

accept the converse

electricity is insufficient

1

(also) produce less waste energy / power

accept 'heat' for waste energy

1

(as the waste energy / power) increases temperature of the cabinet

1

so cooler on for less time

1

(ii) line graph

need to get both parts correct

accept scattergram or scatter graph

both variables are continuous

allow the data is continuous

1

(c) number of bulbs used-halogen=24 (LED=1)

1

total cost of LED = £30 + £67.20 = £97.20

accept a comparison of buying costs of halogen £36 and LED £30

1

total cost of halogen= 24 x £1.50 + 24 x £16.00 = £420

or

buying cost of halogen is £36 **and** operating cost is £384

accept a comparison of operating costs of halogen £384 and LED £67.20

allow for ***3*** *marks the difference in total cost is £322.80 if the number 24 has not been credited*

1

statement based on correct calculations that overall LED is cheaper

*must be **both** buying **and** operating costs*

an alternative way of answering is in terms of cost per hour:

buying cost per hour for LED $\left(\frac{£30.00}{48000}\right)$ = 0.0625p/£0.000625

buying cost per hour for halogen = $\left(\frac{£1.50}{2000}\right)$ = 0.075p/£0.00075

*a calculation of both buying costs scores **1** mark*

operating cost per hour for LED = $\left(\frac{£67.20}{48000}\right)$ = 0.14p/£0.0014

operating cost per hour for halogen= $\left(\frac{£16.00}{2000}\right)$ = 0.8p/£0.008

*a calculation of both operating costs scores **1** mark*

all calculations show a correct unit

***all** units correct scores **1** mark*

statement based on correct calculations of **both** buying **and** operating costs, that overall LED is cheaper

*correct statement scores **1** mark*

1

[12]

6. (a) random

accept in all directions

1

description must be of random motion

(b) heating increases the temperature of the gas

1

temperature is proportional to kinetic energy

1

if kinetic energy increases speed increases

1

(c) energy is needed to change the state of the water

1

to break the bonds

1

(d) $1000 = m / 2.5 \times 10^{-5}$

1

$m = 2.5 \times 10^{-5} \times 1000$

1

m = 0.025 (kg)

1

E = 0.025 × 2 260 000

1

E = 56 500 (J)

1

*allow 56 500 (J) without working shown for **5** marks*

***0** marks awarded for E = m × L*

(e) any **four** from:

- because the water is preheated) the change in temperature of the water is less
- so less energy is used to heat the water ($E=mc\Delta\theta$)
- therefore they (condensing boilers) are more efficient
- so less energy is wasted
- less gas is burned to heat the same amount of water
- less waste gas (CO_2) is produced by the boiler **or** (because less gas is used) they are cheaper to run / save money

4

[15]

7. (a) has an equal amount of positive charge

accept pudding/it is positive

1

(b) (experimental) results could not be explained using 'plum pudding' model
or
(experimental) results did not support plum pudding model

accept (experimental) results disproved plum pudding model

1

(c) (i) **A** – most of atom is empty space**or**most of atom concentrated at the centre

1

B – nucleus is positive (so repels alpha particles)

accept nucleus has the same charge as alpha

1

C – nucleus is very small

accept nucleus is positive if not scored for B

or
nucleus is a concentrated mass

accept nucleus has a very concentrated charge

1

(ii) (if predictions correct, this) supports the new model

answers should be in terms of the nuclear model

accept supports his/new/nuclear theory

accept proves for supports

accept shows predictions/ Rutherford was correct

1

[6]

8. (a) there are strong forces (of attraction) between the particles in a solid

accept molecules / atoms for particles throughout
accept bonds for forces

1

(holding) the particles close together

particles in a solid are less spread out is insufficient

1

or

(holding) the particles in a fixed pattern / positions

but in a gas the forces between the particles are negligible

accept very small / zero for negligible
accept bonds for forces

1

so the particles spread out (to fill their container)

accept particles are not close together
gas particles are not in a fixed position is insufficient

1

(b) (i) particles are (shown) leaving (the liquid / container)

accept molecules / atoms for particles throughout

accept particles are escaping
particles are getting further apart is insufficient

1

(ii) *accept molecules / atoms for particles throughout*
accept speed / velocity for energy throughout

particles with most energy leave the (surface of the) liquid

accept fastest particles leave the liquid

1

so the <u>mean / average</u> energy of the remaining particles goes down

1

and the lower the average energy (of the particles) the lower the temperature (of the liquid)

1

[8]