Past Exam Questions Core Practicals Physics Paper 1

Name: _____

Class: _____

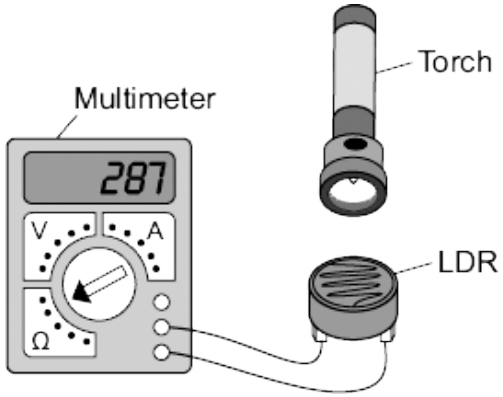
Date: _____

Time: **148 minutes**

Marks: **148 marks**

Comments:

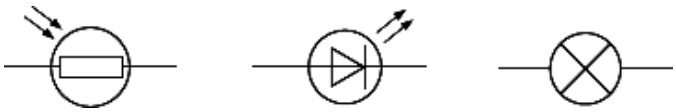
1 A student used the apparatus below to find out how the resistance of a light-dependent resistor (LDR) depends on light intensity.



The resistance of the LDR was measured directly using a multimeter.

(a) (i) Which **one** of the following is the correct circuit symbol for a LDR?

Draw a ring around your answer.



(1)

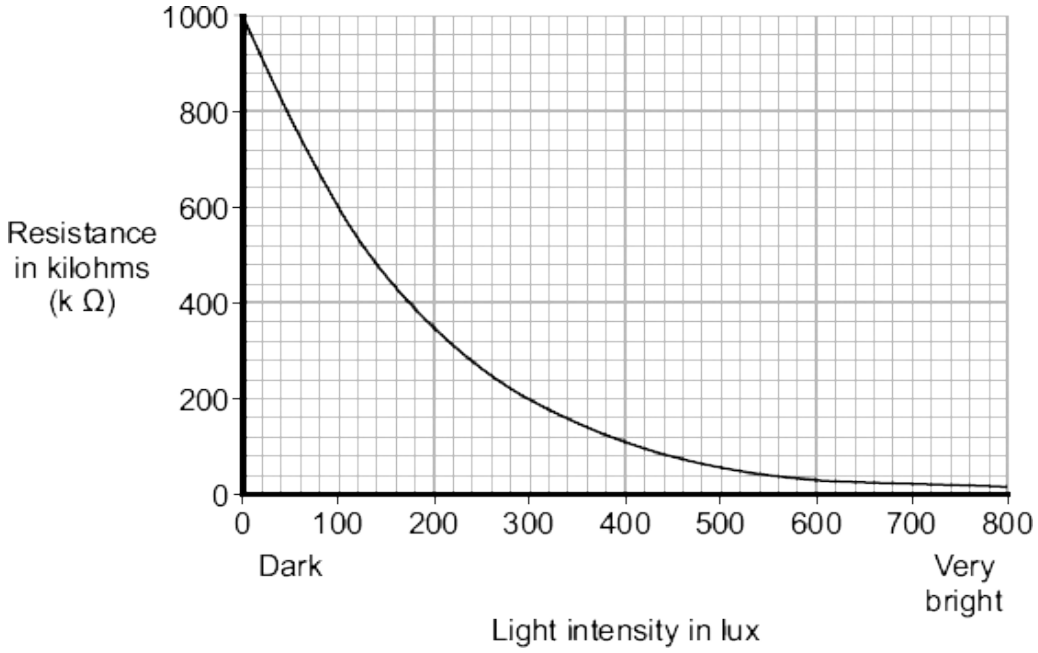
(ii) Name **one** factor that will affect the intensity of the light hitting the LDR.

.....

.....

(1)

(b) The manufacturer of the LDR provides data for the LDR in the form of a graph.



Describe how the resistance of the LDR changes when the light intensity increases from 100 lux to 300 lux.

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.....

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(2)

(c) The student only obtained three results. These are given in the table.

Light intensity	Resistance in kilohms
Dark	750
Bright	100
Very bright	1

(i) The student could **not** use the results to draw a line graph.
Why not?

.....

.....

(1)

(ii) Do the student's results agree with the data the manufacturer provided?

Draw a ring around your answer. YES NO

Give a reason for your answer.

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(1)

(d) Which **one** of the following circuits probably includes a LDR?

Tick (✓) **one** box.

A circuit that automatically switches outside lights on when it gets dark. ☐

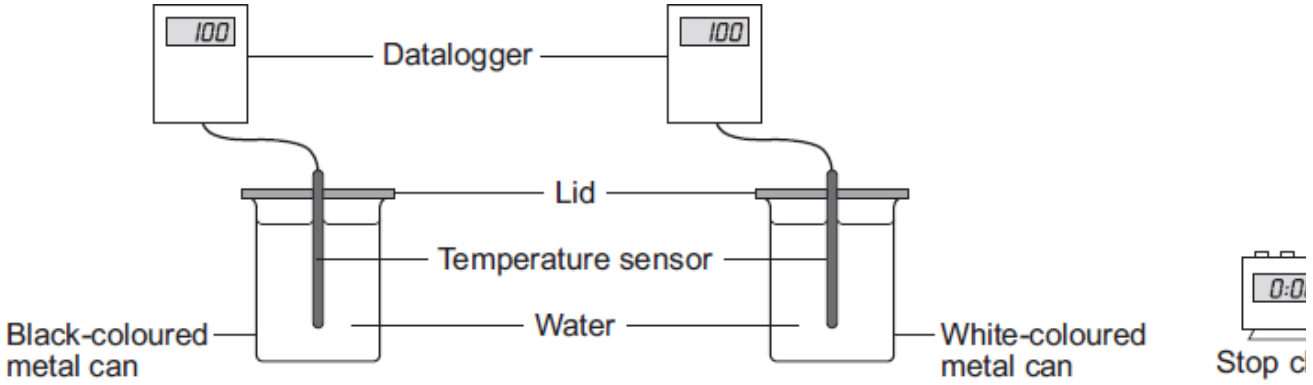
A circuit that automatically switches central heating on and off. ☐

A circuit that automatically turns lights off when no one is in the room. ☐

(1)

(Total 7 marks)

2 The diagram shows the equipment a student used to investigate how the colour of a surface affects how fast it emits (gives out) heat.



An equal volume of boiling water was poured into each metal can. The student then recorded the temperature of the water in each can every minute for ten minutes.

(a) (i) Which of the following was a control variable in this investigation?

Put a tick (✓) in the box next to your answer.

The volume of boiling water. ☐

The decrease in temperature of the water. ☐

The outside colour of the metal can. ☐

(1)

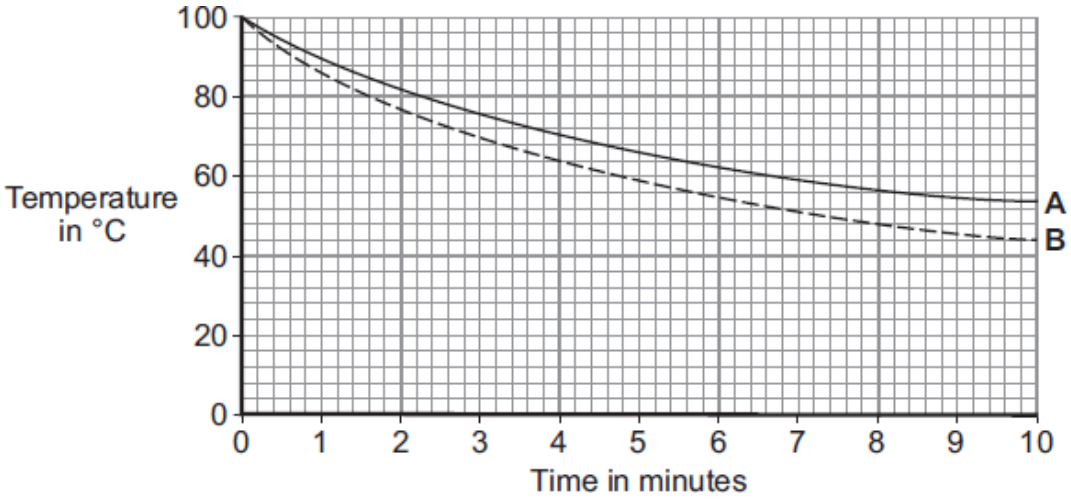
(ii) Give **one** advantage of using a temperature sensor and datalogger rather than a thermometer to measure the temperature of the water.

.....

.....

(1)

(b) The student's results for both cans are plotted on the graph.



Which line, **A** or **B**, shows how the temperature of the water inside the black-coloured metal can changed?

Draw a ring around your answer. **A** **B**

Explain the reason for your answer.

.....

.....

.....

.....

(2)

(c) Some gardeners make soil darker by digging black soot into the soil. Other gardeners use straw to protect plants from the cold.

(i) Complete the following sentence by drawing a ring around the correct line in the box.

On a warm day, the temperature of darker coloured soil will increase

slower than
as fast as
faster than

the temperature of lighter coloured soil.

(1)

(ii) Give a reason for your answer to part (c)(i).

.....

.....

(1)

(iii) The statement in the box is **false**.

Straw keeps plants warm by trapping air. | This is because air is a good conductor.

Change **one** word in the statement to make the statement **true**.

Write down your **new** statement. The answer has been started for you.

This is because air is a .....

(1)

(Total 7 marks)

3 (a) Electrical circuits often contain resistors.

The diagram shows **two** resistors joined in series.

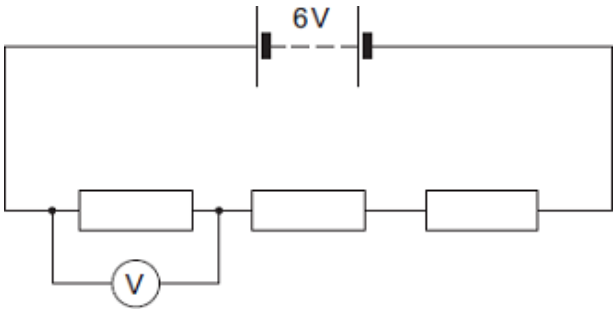
Calculate the total resistance of the **two** resistors.

.....

Total resistance = ... Ω

(1)

(b) A circuit was set up as shown in the diagram. The three resistors are identical.



(i) Calculate the reading on the voltmeter.

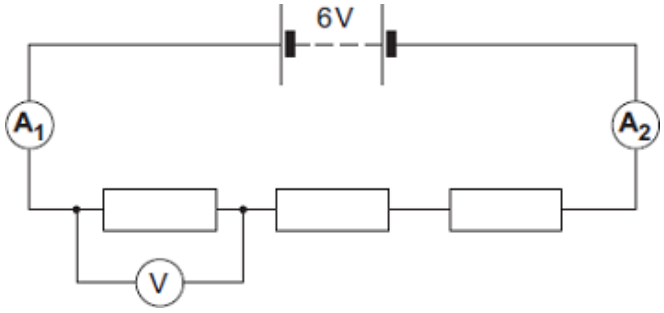
.....

.....

Reading on voltmeter = ... V

(2)

(ii) The same circuit has now been set up with two ammeters.



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

The reading on ammeter **A_2** will be

smaller than
equal to
greater than

the reading on ammeter **A_1**.

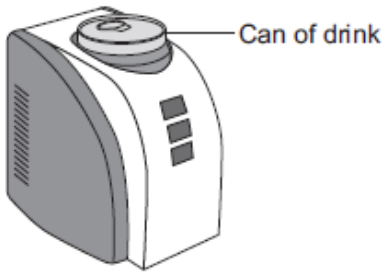
(1)

(Total 4 marks)

4 A 'can-chiller' is used to make a can of drink colder.

Figure 1 shows a can-chiller.

Figure 1



(a) The can-chiller decreases the temperature of the liquid in the can by 15 °C.
The mass of liquid is 0.33 kg.
The specific heat capacity of the liquid is 4200 J / kg °C.

Calculate the energy transferred from the liquid as it cools.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Energy = ... J

(2)

(b) Complete the following sentence.

The specific heat capacity of a substance is the amount of energy required to

change the ..... of one kilogram of the

substance by one degree Celsius.

(1)

(c) To calculate the specific heat capacity of a material, the mass of the material needs to be measured.

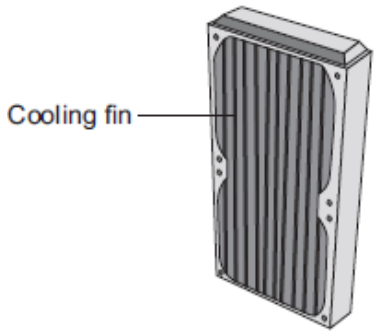
State the name of a measuring instrument used to measure mass.

.....

(1)

(d) The back of the can-chiller has cooling fins, as shown in **Figure 2**.

Figure 2



The cooling fins increase the rate of energy transfer from the can-chiller to the surroundings.

Complete the following sentences.

The cooling fins are a ..... colour because that makes them

good emitters of infrared radiation.

The large surface area of the cooling fins allows the air around the can-chiller

to gain energy quickly and rise, transferring energy by ..... .

(2)

(e) (i) The energy input to the can-chiller is the same as the energy output. This shows that energy is conserved.

Complete the following sentence.

Energy can be transferred usefully, stored or dissipated, but cannot be

..... or destroyed.

(1)

(ii) The temperature of the can of drink decreases while it is in the can-chiller.

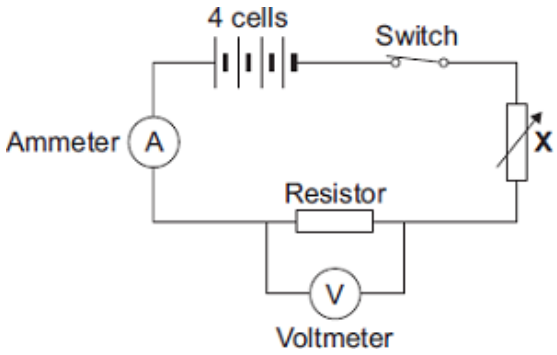
What happens to the temperature of the air around the cooling fins?

.....

(1)

(Total 8 marks)

5 (a) The diagram shows the circuit that a student used to investigate how the current through a resistor depends on the potential difference across the resistor.



(i) Each cell provides a potential difference of 1.5 volts.

What is the total potential difference provided by the four cells in the circuit?

.....

Total potential difference = ... volts

(1)

(ii) The student uses the component labelled **X** to change the potential difference across the resistor.

What is component **X**?

Draw a ring around your answer.

light-dependent resistor **thermistor** **variable resistor**

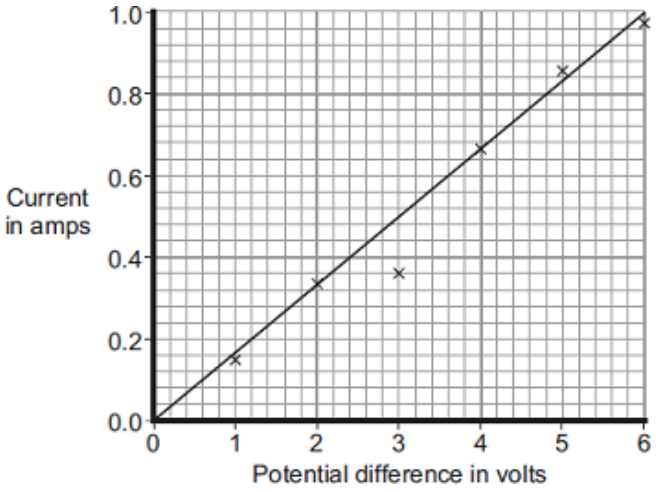
(1)

(iii) Name a component connected in parallel with the resistor.

.....

(1)

(b) The results obtained by the student have been plotted on a graph.



(i) One of the results is anomalous.

Draw a ring around the anomalous result.

(1)

(ii) Which **one** of the following is the most likely cause of the anomalous result?

Put a tick (✓) in the box next to your answer.

The student misread the ammeter. ☐

The resistance of the resistor changed. ☐

The voltmeter had a zero error. ☐

(1)

(iii) What was the interval between the potential difference values obtained by the student?

.....

.....

(1)

(c) Describe the relationship between the potential difference across the resistor and the current through the resistor.

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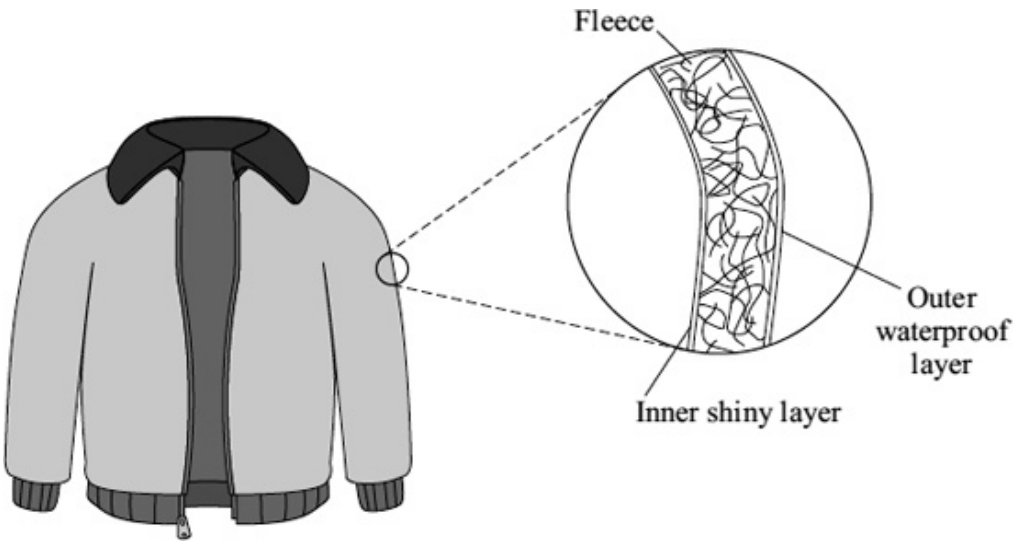
(1)

(Total 7 marks)

6 (a) The diagram shows a ski jacket that has been designed to keep a skier warm.
The jacket is made from layers of different materials.



(i) The inner layer is shiny to reduce heat transfer.

Which process of heat transfer will it reduce?

.....

(1)

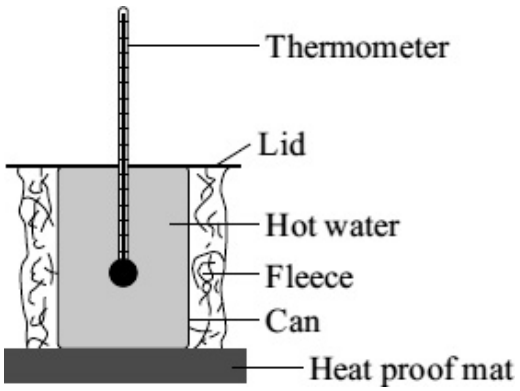
(ii) Why is the layer of fleece good at reducing the transfer of heat from a skier's body?

.....

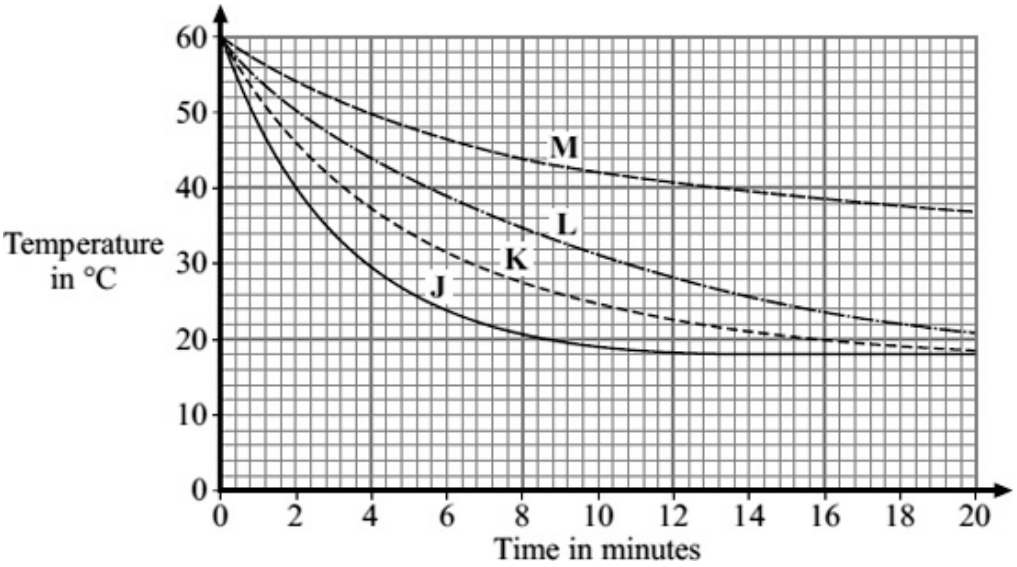
.....

(1)

(b) A student tested four different types of fleece, **J**, **K**, **L** and **M**, to find which would make the warmest jacket. Each type of fleece was wrapped around a can which was then filled with hot water.
The temperature of the water was taken every two minutes for 20 minutes.



The graph shows the student's results.



(i) In each test, the water cooled faster during the first five minutes than during the last five minutes. Why?

.....

.....

(1)

(ii) To be able to compare the results, it was important to use the same volume of water in each test.

Give **one** other quantity that was the same in each test.

.....

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(1)

(iii) Look at the graph line for fleece **K**.

Estimate what the temperature of the water in the can wrapped in fleece **K** would be after 40 minutes.

.....

(1)

(iv) Which type of fleece, **J**, **K**, **L** or **M**, should the student recommend to be used in the ski jacket?

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Give a reason for your answer.

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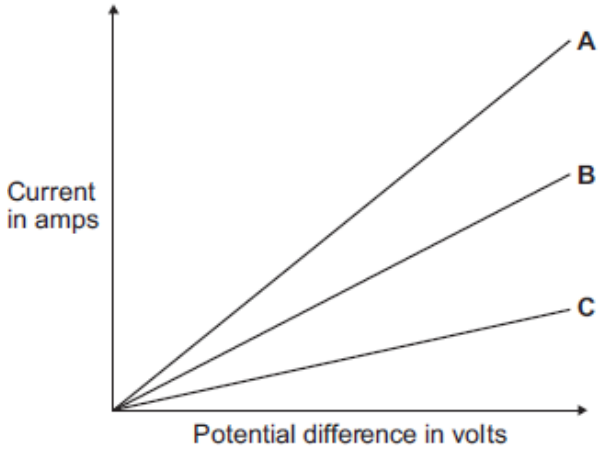
(2)

(Total 7 marks)

7 (a) **Figure 1** shows the current−potential difference graph for three wires, **A**, **B** and **C**.

Figure 1



(i) Using **Figure 1**, how can you tell that the temperature of each wire is constant?

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(1)

(ii) Which **one** of the wires, **A**, **B** or **C**, has the greatest resistance?

Write the correct answer in the box. ☐

Give a reason for your answer.

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(2)

(b) A student measured the resistance of four wires.

The table below shows the resistance of, and other data about, each of the four wires, **J**, **K**, **L** and **M**.

Wire	**Type of metal**	**Length in cm**	**Diameter in mm**	**Resistance in … …**
J	copper	50	0.17	0.36
K	copper	50	0.30	0.12
L	copper	100	0.30	0.24
M	constantan	100	0.30	7.00

(i) The last column of the table should include the unit of resistance.

What is the unit of resistance?

.....

(1)

(ii) The resistance of a wire depends on many factors.

Look at the table. Which **two** wires from **J**, **K**, **L** and **M** show that the resistance of a wire depends on the **length** of the wire?

Wire ☐ and wire ☐

Give a reason for your answer.

.....

.....

.....

(2)

(iii) A student looked at the data in the table and wrote this conclusion:

'The resistance of a wire depends on the type of metal from which the wire is made.'

The student could **not** be certain that her conclusion is true for **all** types of metal.

Suggest what extra data is needed for the student to be more certain that the conclusion is correct

.....

.....

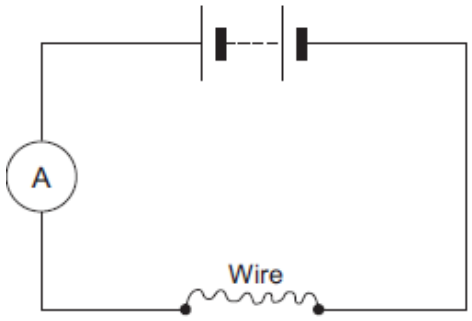
.....

(1)

(c) The resistance of a wire can be calculated using the readings from an ammeter and a voltmeter.

(i) Complete **Figure 2** by drawing a voltmeter in the correct position in the circuit. Use the correct circuit symbol for a voltmeter.

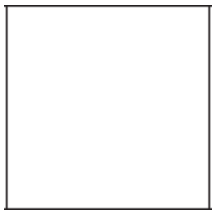
Figure 2



(1)

(ii) In a circuit diagram, a wire can be represented by the symbol for a resistor.

In the box below, draw the circuit symbol for a resistor.

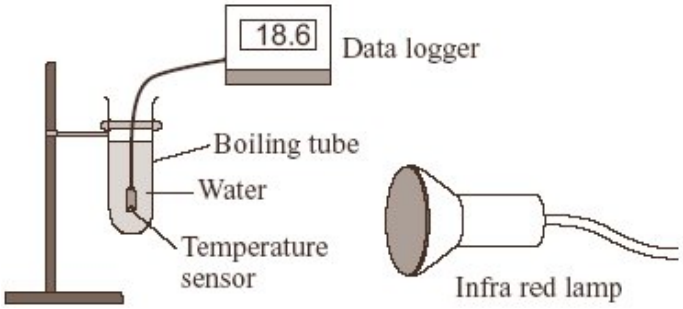


(1)

(Total 9 marks)

8 A student had read about a glacier that had been covered in insulating material. The idea was to slow down the rate at which the glacier melts in the summer.

She investigated this idea using the apparatus shown in the diagram.



(a) These are the steps taken by the student.

- Measure 30 cm^3 of cold water into a boiling tube.
- Place the boiling tube 25 cm from an infra red lamp.
- Record the temperature of the water.
- Switch on the infra red lamp.
- Record the temperature of the water every minute for 5 minutes.
- Repeat with boiling tubes covered in different insulating materials.

(i) Why did she use an infra red lamp?

.....

(1)

(ii) Name **one** control variable in this investigation.

.....

(1)

(iii) Give **one** advantage of using a temperature sensor and data logger instead of a glass thermometer to measure temperature.

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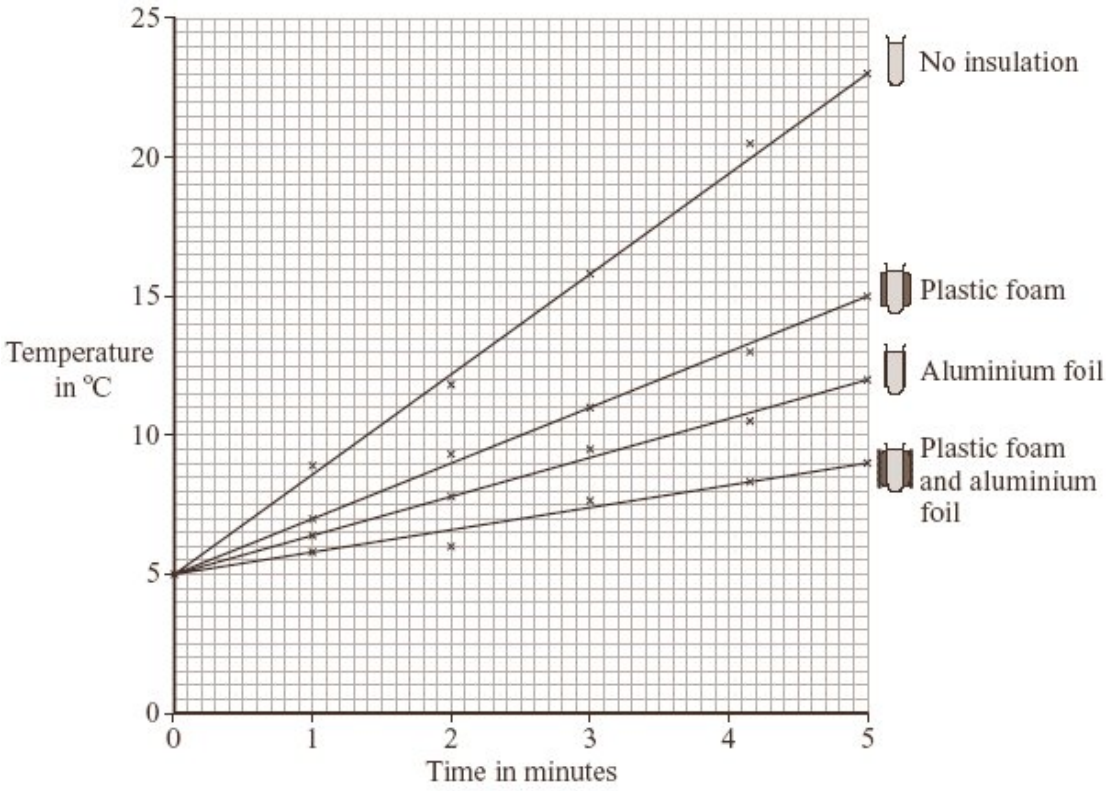
(1)

(b) The results of the investigation are shown in the graph.



(i) Why did the student use a boiling tube with no insulation?

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(1)

(ii) From her results, what should she recommend is used to insulate the glacier?

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(1)

(iii) Explain why the insulation recommended by the student will reduce the heat transfer from the Sun to the glacier.

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(2)

(c) Explain, in terms of particles, how heat is transferred through the glass wall of a boiling tube.

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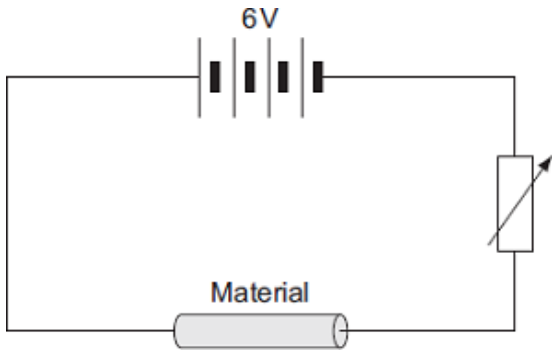
(2)

(Total 9 marks)

9 (a) The diagram shows the circuit used to investigate the resistance of a sample of a material. The diagram is not complete; the ammeter and voltmeter are missing.



(i) Draw the symbols for the ammeter and voltmeter on the diagram in the correct places.

(2)

(ii) How can the current through the material be changed?

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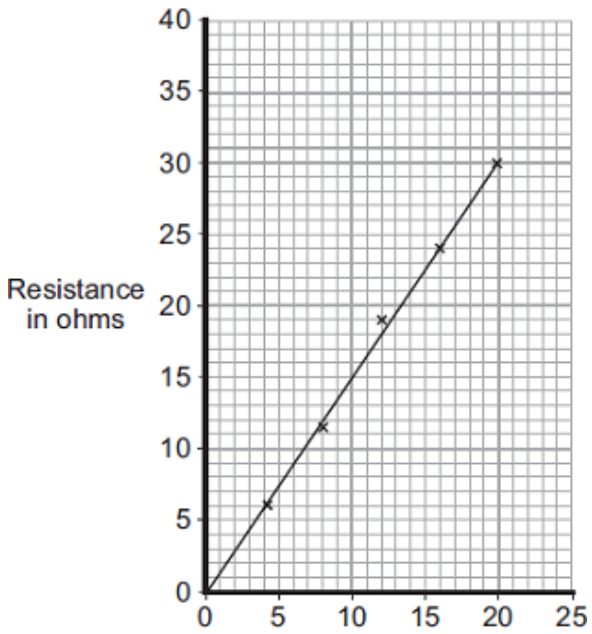
(1)

(b) The material, called conducting putty, is rolled into cylinders of different lengths but with equal thickness.

Graph 1 shows how the resistance changes with length.

Graph 1



(i) The current through a 25 cm length of conducting putty was 0.15 A.

Use **Graph 1** to find the resistance of a 25 cm length of conducting putty.

Resistance = ... ohms

(1)

(ii) Use your answer to **(b) (i)** and the equation in the box to calculate the potential difference across a 25 cm length of conducting putty.

potential difference = current x resistance

Show clearly how you work out your answer.

.....

.....

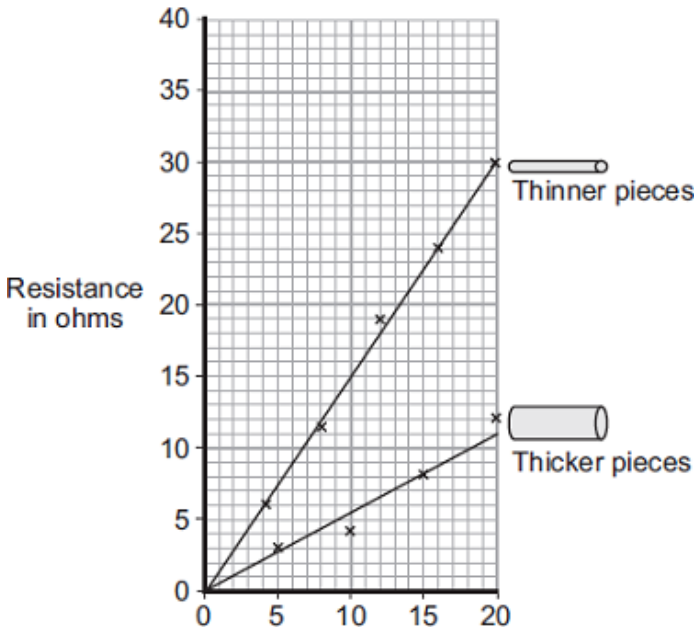
.....

Potential difference = ... volts

(2)

(c) A second set of data was obtained using thicker pieces of conducting putty. Both sets of results are shown in **Graph 2**.

Graph 2



(i) What is the relationship between the resistance and the thickness of the conducting putty?

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.....

(1)

(ii) Name **one** error that may have reduced the accuracy of the results.

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(1)

(iii) How could the reliability of the data have been improved?

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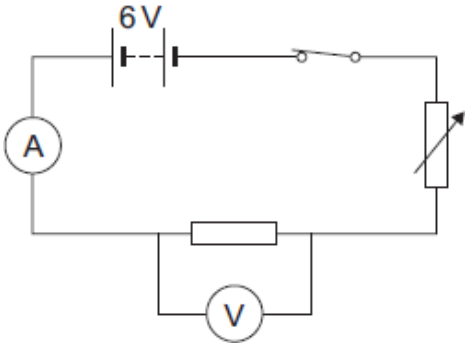
(1)

(Total 9 marks)

10 The diagram shows the circuit set up by a student.



(a) The student uses the circuit to test the following hypothesis:

'The current through a resistor is directly proportional to the potential difference across the resistor.'

(i) If the hypothesis is correct, what should the student predict will happen to the current through the resistor when the potential difference across the resistor is doubled?

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.....

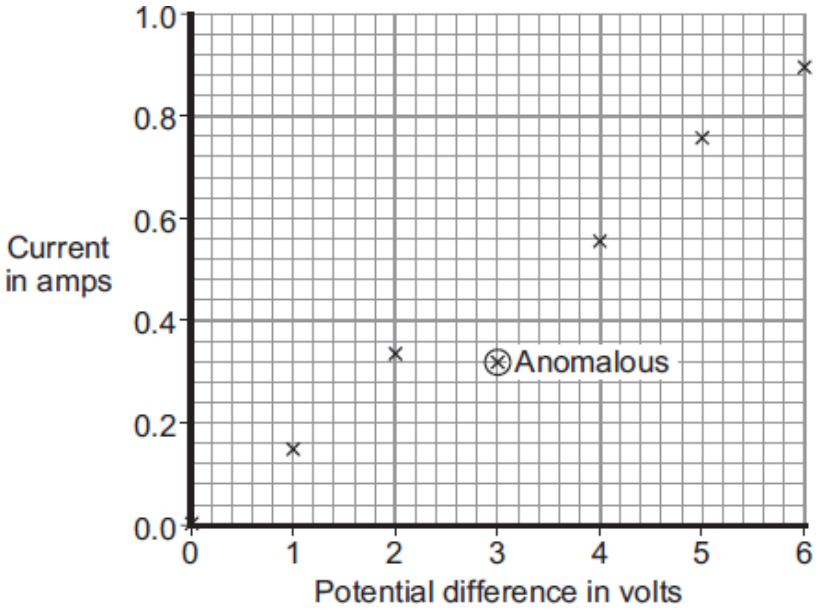
(1)

(ii) Name the component in the circuit used to change the potential difference across the resistor.

.....

(1)

(b) The student used the data obtained to plot the points for a graph of current against potential difference.



(i) Why has the student plotted the points for a line graph and not drawn a bar chart?

.....

.....

(1)

(ii) One of the points has been identified by the student as being anomalous.

What is the most likely cause for this anomalous point?

.....

.....

(1)

(iii) Draw a line of best fit for these points.

(1)

(iv) Does the data the student obtained support the hypothesis?

Give a reason for your answer.

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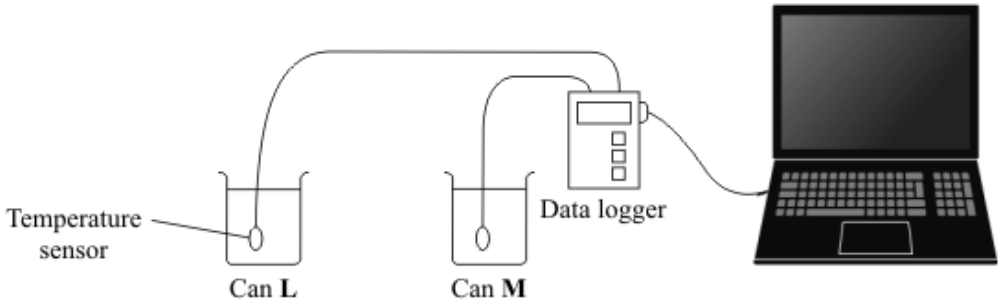
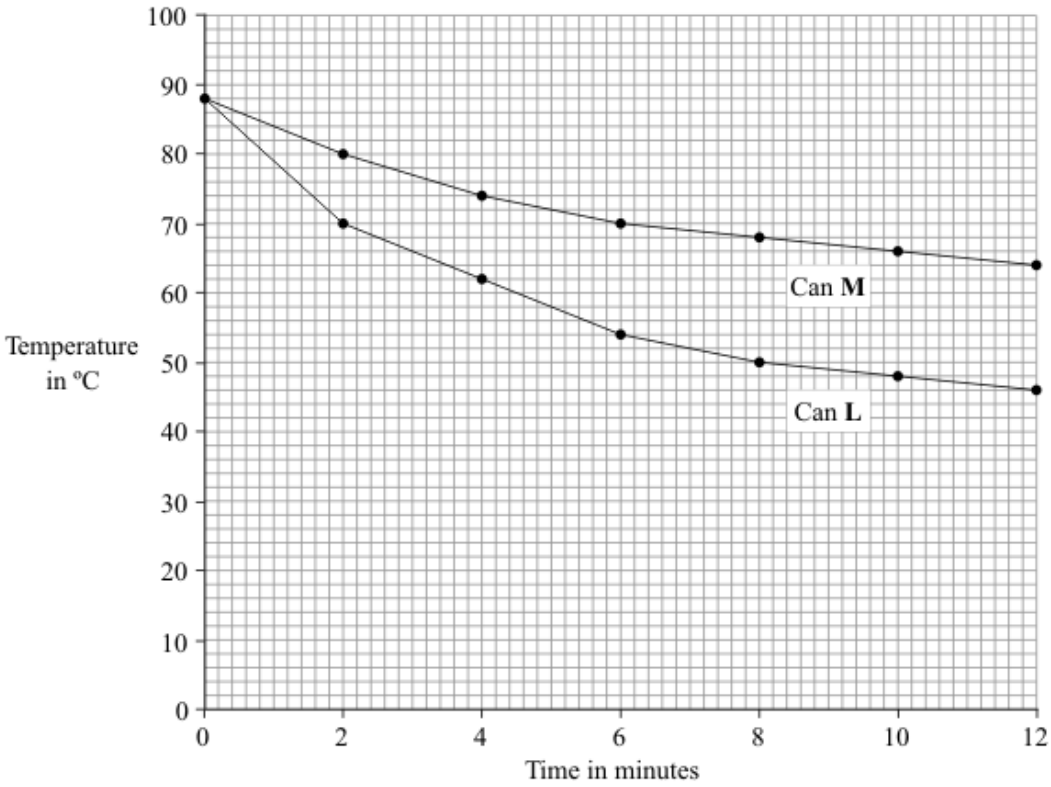
(1)

(Total 6 marks)

11 A student was asked to investigate the heat loss from two metal cans, L and M. The cans were identical except for the outside colour.



The student filled the two cans with equal volumes of hot water. He then placed the temperature sensors in the water and started the data logger. The computer used the data to draw the graph below.



(a) Which **one** of the following is a categoric variable?

Put a tick (✓) in the box next to your answer.

the outside colour of the cans ☐

the starting temperature of the hot water ☐

the time ☐

the volume of hot water ☐

(1)

(b) For can **L**, state the temperature drop of the water:

(i) in the **first** two-minute interval

.....

(1)

(ii) in the **second** two-minute interval.

.....

(1)

(c) In both cans the water cooled faster at the start of the investigation than at the end of the investigation. Why?

.....

.....

(1)

(d) One can was black on the outside and the other can was white on the outside.

What colour was can **L**? .....

Explain the reason for your answer.

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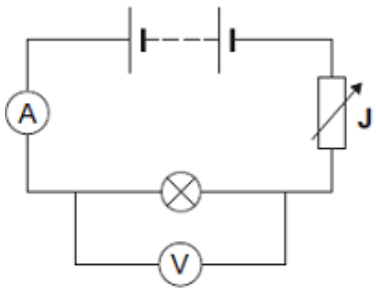
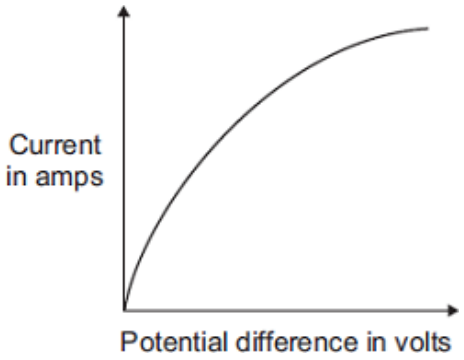
(3)

(Total 7 marks)

12 (a) The diagram shows the circuit used to obtain the data needed to plot the current–potential difference graph for a filament bulb.





(i) Why is the component labelled '**J** included in the circuit?

.....

.....

(1)

(ii) The resistance of the bulb increases as the potential difference across the bulb increases. Why?

.....

.....

(1)

(iii) The bulb is at full brightness when the potential difference across the bulb is 12 V. The current through the bulb is then 3 A.

Calculate the power of the bulb when it is at full brightness and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Power = ...

(3)

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The table gives data about two types of light bulb people may use in their homes.

Type of light bulb	Energy efficiency	Cost of one light bulb	Average lifetime in hours
Halogen	10%	£1.95	2 000
Light Emitting Diode (LED)	32%	£11.70	36 000

Both types of light bulb produce the same amount of light.

Evaluate, in terms of cost and energy efficiency, the use of the two types of light bulb.

To gain full marks you must compare both types of light bulb and conclude which light bulb would be the best to use.

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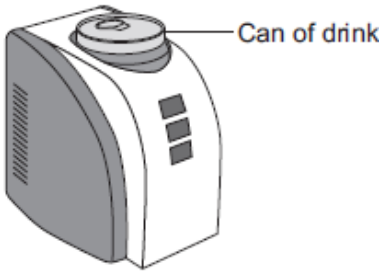
(6)

(Total 11 marks)

13 A 'can-chiller' is used to make a can of drink colder.

The image below shows a can-chiller.



(a) The initial temperature of the liquid in the can was 25.0 °C.
The can-chiller decreased the temperature of the liquid to 20.0 °C.
The amount of energy transferred from the liquid was 6930 J.
The mass of liquid in the can was 0.330 kg.

Calculate the specific heat capacity of the liquid.

Give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

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.....

Specific heat capacity = ... unit .....

(4)

(b) Energy is transferred through the metal walls of the can of drink by conduction.
Explain how.

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(4)

(c) The energy from the can of drink is transferred to the air around the can-chiller. A convection current is set up around the can-chiller. Explain how.

.....

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(3)

(d) The can-chiller has metal cooling fins that are designed to transfer energy quickly to the surroundings.

Give **two** features that would help the metal cooling fins to transfer energy quickly to the surroundings.

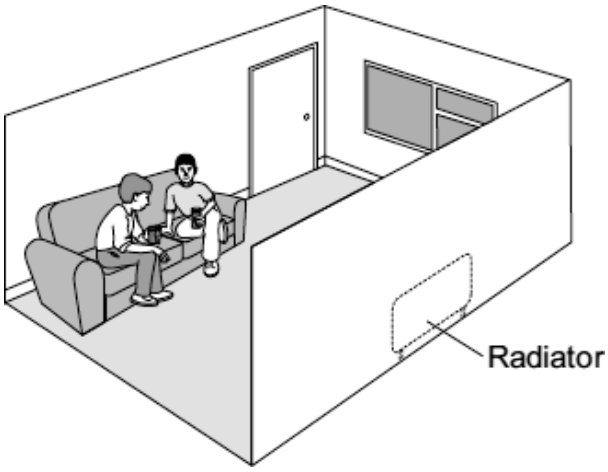
1.....

2.....

(2)

(Total 13 marks)

14 (a) The diagram shows the position of a radiator inside a room. The radiator is made from metal and is painted white.



(i) Heat is transferred from the hot water inside the metal radiator to the air touching the outside surface of the radiator.

What name is given to this method of heat transfer?

.....

(1)

(ii) Explain, in terms of the particles in the metal, how heat is transferred through the radiator.

.....

.....

.....

.....

(2)

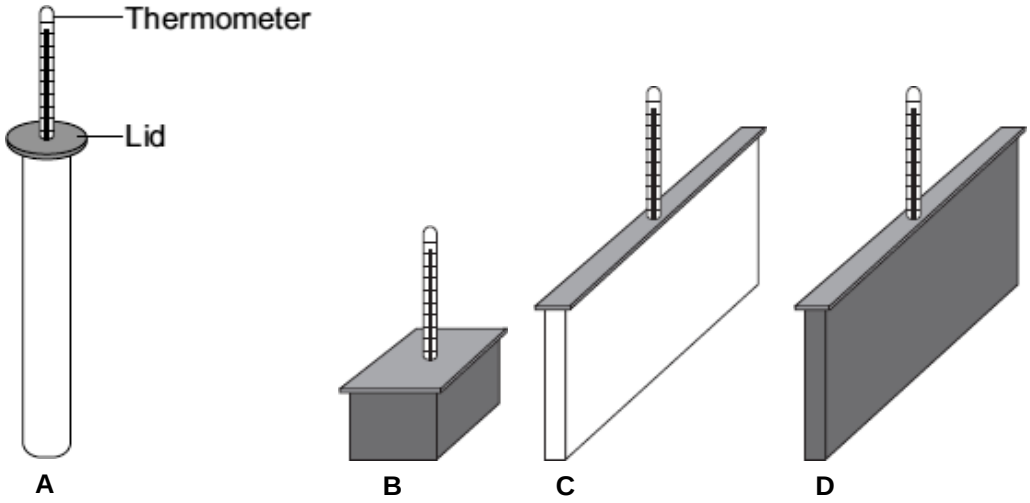
(iii) What name is given to the main method by which heat is transferred from the radiator to the people on the other side of the room?

.....

(1)

(b) A student investigated the effect of shape and colour on heat transfer.

The student used metal containers with the same volume but with different shapes and outside colour. The containers were each filled with water at 100 °C.
After 20 minutes the temperature of the water inside each container was measured.



The results from the investigation are given in the table.

Container	Colour	Temperature after 20 minutes in °C	Temperature fall in °C
A	White	86	14
B	Black	86	14
C	White	73	27
D	Black	60	40

(i) The student uses the results in the table to see if shape has affected heat transfer.

Which containers should the student compare to do this?

.....

Give a reason for your answer.

.....

.....

(1)

(ii) Explain why the temperature of the water in both containers **A** and **B** fell by the same amount.

.....

.....

.....

.....

(2)

(iii) A central heating system has several radiators joined together. The hot water goes from the boiler, through each radiator in turn and then back to the boiler for reheating.

Give **one** reason, other than appearance, why it might **not** be a good idea to paint radiators black.

.....

.....

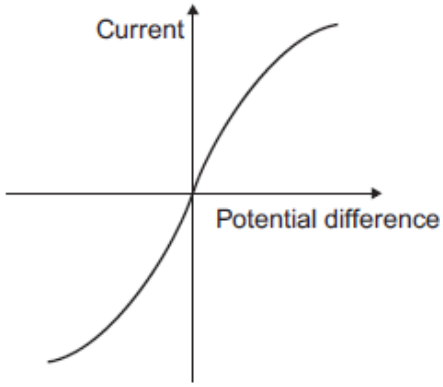
(1)

(Total 8 marks)

15 The current in a circuit depends on the potential difference provided by the cells and the total resistance of the circuit.

(a) **Figure 1** shows the graph of current against potential difference for a component.

Figure 1



What is the name of the component?

Draw a ring around the correct answer.

diode **filament bulb** **thermistor**

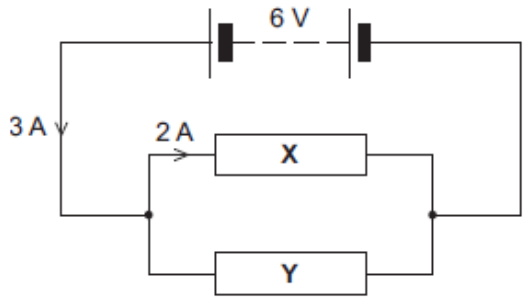
(1)

(b) **Figure 2** shows a circuit containing a 6 V battery.

Two resistors, **X** and **Y**, are connected in parallel.

The current in some parts of the circuit is shown.

Figure 2



(i) What is the potential difference across **X**?

Potential difference across **X** = ... V

(1)

(ii) Calculate the resistance of **X**.

Use the correct equation from **Section C** of the Physics Equations Sheet.

.....

.....

Resistance of **X** = ... Ω

(2)

(iii) What is the current in **Y**?

Current in **Y** = ... A

(1)

(iv) Calculate the resistance of **Y**.

.....

Resistance of **Y** = ... Ω

(1)

(v) When the temperature of resistor **X** increases, its resistance increases.

What would happen to the:

- potential difference across **X**
- current in **X**
- total current in the circuit?

Tick (✓) **three** boxes.

	Decrease	**Stay the same**	**Increase**
Potential difference across **X**			
Current in **X**			
Total current in the circuit			

(3)

(Total 9 marks)

16 Under the same conditions, different materials heat up and cool down at different rates.

(a) What is meant by specific heat capacity?

.....

.....

.....

.....

(2)

(b) Quenching' is a process used to change the properties of steel by cooling it rapidly.

The steel is heated to a very high temperature and then placed in a container of cold water.

(i) A metalworker quenches a steel rod by heating it to a temperature of 900 °C before placing it in cold water. The mass of the steel rod is 20 kg.

The final temperature of the rod and water is 50 °C.

Calculate the energy transferred from the steel rod to the water.

Specific heat capacity of steel = 420 J / kg °C.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Energy transferred = ... J

(3)

(ii) The temperature of the steel rod eventually returns to room temperature.

Compare the movement and energies of the particles in the steel rod and in the air at room temperature.

.....

.....

.....

.....

.....

.....

(3)

(iii) When the steel rod is being quenched, the temperature of the water rises to 50 °C. After a few hours the water cools down to room temperature.

Some of the cooling of the water is due to evaporation.

Explain in terms of particles how evaporation causes the cooling of water.

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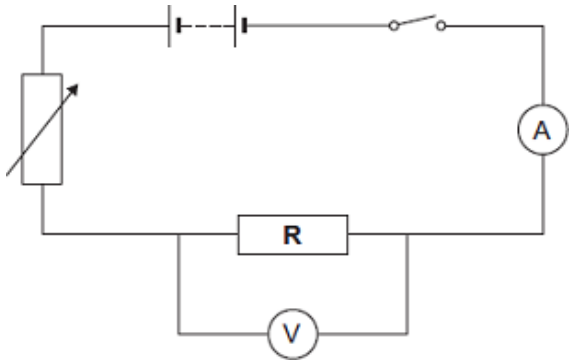
(4)

(Total 12 marks)

17 (a) A resistor is a component that is used in an electric circuit.



(i) Describe how a student would use the circuit to take the readings necessary to determine the resistance of resistor **R**.

.....

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(6)

(ii) Explain why the student should open the switch after each reading.

.....

.....

.....

.....

(2)

(iii) In an experiment using this circuit, an ammeter reading was 0.75 A.
The calculated value of the resistance of resistor **R** was 16 Ω.

What is the voltmeter reading?

Use the correct equation from **Section C** of the Physics Equations Sheet.

.....

.....

Voltmeter reading = ... V

(2)

(iv) The student told his teacher that the resistance of resistor **R** was 16 Ω.

The teacher explained that the resistors used could only have one of the following values of resistance.

10 Ω **12 Ω** **15 Ω** **18 Ω** **22 Ω**

Suggest which of these resistors the student had used in his experiment.

Give a reason for your answer.

.....

.....

.....

.....

(2)

(b) The diagram shows a fuse.

Describe the action of the fuse in a circuit.

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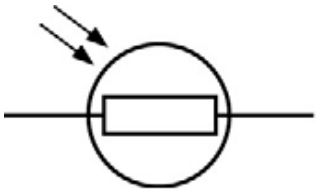
(3)

(Total 15 marks)

1

(a) (i) correct symbol ringed



1

(ii) accept any suggestion that would change light intensity, eg:

- torch on or off
  accept power of torch
  *do **not** accept watts / wattage of torch*
- distance between torch and LDR
- lights in room on or off
- shadow over the LDR

1

(b) resistance decreases

1

from 600 kΩ to 200 kΩ
accept by 400 kΩ

1

(c) (i) no numbers for light intensity
or
light intensity is categoric / a description / not continuous
not enough results is insufficient

1

(ii) YES
mark is for the reason

both show that resistance increases with decreasing (light) intensity / brightness
accept they both get the same results / pattern

1

(d) A circuit that automatically switches outside lights on when it gets dark.

1

[7]

2

(a) (i) The volume of boiling water.

1

(ii) any **one** from:

- (more) precise
  *do **not** accept better (reading)*
- accurate
- reliable
  *do **not** accept thermometer is unreliable*
- removes human / reading error
  accept easier to read
  accept take temperature more frequently

1

(b) **B**

marks are for the explanation

temperature falls faster

*this mark point cannot score if **A** chosen*

1

because black is a better / good emitter

ignore reference to better absorber
*accept for both marks an answer in terms of why **A** is the white can*

1

(c) (i) faster than

1

(ii) darker / black surfaces absorb heat faster

accept black is a better / good absorber
dark surfaces attract heat negates this mark

1

(iii) air is a <u>bad / poor</u> conductor
or
air is a good <u>insulator</u>

accept air is an insulator

1

[7]

3 (a) 25(Ω)

1

(b) (i) 2(V)

*allow **1** mark for showing a correct method, ie 6 / 3*

2

(ii) equal to

1

[4]

4 (a) 20 790 (J)

*an answer of 21 000 (J) (2 s.f.) gains **2** marks*

*allow **1** mark for correct substitution:*
ie E = 0.33 × 4200 × 15 provided no subsequent step shown

2

(b) temperature

1

(c) (top pan) balance

accept scales

*do **not** accept a scale*
*do **not** accept weighing scales*
*do **not** accept newtonmeter*
*do **not** accept spring balance*

1

(d) dark / black / (dark) grey

1

convection

correct order only

1

(e) (i) created

accept made

1

(ii) increases

1

[8]

5 (a) (i) 6

1

(ii) variable resistor

1

(iii) voltmeter

1

(b) (i) point at 3 V ringed

1

(ii) The student misread the ammeter.

1

(iii) 1 (volt)

accept every volt

1

(c) as one increases so does the other
or
directly proportional
or
positive correlation

accept a numerical description, eg when one doubles the other also doubles

1

[7]

6 (a) (i) radiation

1

(ii) traps (small pockets of) air

*do **not** accept it's an insulator*

*do **not** accept reduces conduction and / or convection*

*do **not** allow it doesn't allow heat to escape*

1

(b) (i) bigger temperature difference (between the water and surroundings) at the start (than at the end)

*do **not** accept water is hotter*

1

(ii) starting temperature (of the water)

accept thickness of fleece

*do **not** accept same amount of fleece*

*do **not** accept thermometer / can*

*do **not** accept time is the same*

1

(iii) 18 (°C)

correct answer only

1

(iv) **M**

1

smallest temperature drop (after 20 mins)

*cannot score if **M** is not chosen*

accept it's the best insulator

accept smallest loss in heat

accept keeps heat / warmth in for longer

1

[7]

7 (a) (i) p.d. is (directly) proportional to current
or
gradient / slope is constant
or
the lines show constant resistance
accept lines are straight / diagonal

1

(ii) C
reason only scores if C is chosen

1

for the same p.d. the current is the smallest
*accept lowest gradient **and** the gradient = 1 / R*

1

(b) (i) ohm
accept correct symbol Ω
accept an answer written in the table if not given in answer space

1

(ii) K and L
reason only scores if both K and L are chosen

1

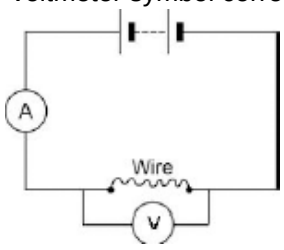
only length varies
accept type of metal and the diameter are the same

1

(iii) measure the resistance of more wires made from different metals
accept test more (types of) metals
measure the resistance of more wires is insufficient
they only use two metals is insufficient

1

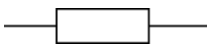
(c) (i) voltmeter symbol correct and drawn in parallel with the wire



accept voltmeter symbol correct and drawn in parallel with the battery

1

(ii) correct symbol drawn



symbol must be rectangular

1

[9]

8

(a) (i) as a source of thermal <u>radiation</u>

accept heat for thermal radiation

accept to act as the Sun

*do **not** accept sunlight alone*

1

(ii) any **one** from:

- volume of water

  accept amount for volume

- distance between lamp and boiling tube
- initial / starting temperature of water
- same room temperature

  *do **not** accept time or same insulation material*

1

(iii) any **one** from:

- greater sensitivity / precision

  *do **not** accept more reliable (negates mark)*

- could link to a computer for (automatic) data analysis
- could take more frequent readings
- reduces instrument reading error

  accept more accurate

  *do **not** accept easier to use on its own*

1

(b) (i) acts as a control

accept to be able to make a comparison

accept to see the difference

*do **not** accept 'to make it a fair test' OWTTE on its own*

1

(ii) (plastic) <u>foam</u> and aluminium foil

1

(iii) (aluminium) <u>foil</u> is a <u>poor</u> absorber of thermal radiation

accept heat / infra red for thermal radiation

1

or (aluminium) <u>foil</u> is a (good) reflector of thermal radiation

*do **not** accept 'reflects sunlight' on its own*

(plastic) <u>foam</u> traps air which is a (good) insulator

accept (plastic) foam is a poor conductor / (good) insulator

*do **not** accept 'the material' is a good insulator / poor conductor*

1

(c) particles vibrate with a bigger / stronger amplitude / faster / with more (kinetic) energy

accept particles vibrate more

*do **not** accept start to vibrate only*

1

energy transferred by collisions with other particles

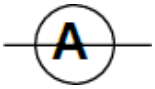
*do **not** accept answers in terms of free/mobile electrons*

1

[9]

9

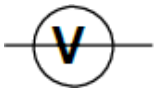
(a) (i) ammeter symbol correct and drawn in series

accept 

*do **not** accept lower case a*

1

voltmeter symbol correct and drawn in parallel with the material

*do **not** accept* 

1

(ii) adjust / use the variable resistor

accept change the resistance

or

change the number of cells

accept battery for cell

accept change the pd / accept change the voltage

accept increase / decrease for change

1

(b) (i) 37.5 (Ω)

accept answer between 36 and 39 inclusive

1

(ii) 5.6(25) **or** their (b)(i) × 0.15

*allow **1** mark for correct substitution ie 37.5 **or** their (b)(i) × 0.15 provided no subsequent step shown*

2

(c) (i) the thicker the putty the lower the resistance

answer must be comparative

accept the converse

1

(ii) any **one** from:

- measuring length incorrectly
  accept may be different length
- measuring current incorrectly
  *do **not** accept different currents*
- measuring voltage incorrectly
  *do **not** accept different voltage*
- ammeter / voltmeter incorrectly calibrated
- thickness of putty not uniform
  *do **not** accept pieces of putty not the same unless qualified*
- meter has a zero error
  *do **not** accept systematic / random error*
  accept any sensible source of error eg putty at different temperatures
  *do **not** accept human error without an explanation*
  *do **not** accept amount of putty not same*

1

(iii) repeat readings and take a mean
accept check results again
accept do experiment again
accept do it again and take mean(s)
accept compare own results with other groups
*do **not** accept take more readings*

1

[9]

10 (a) (i) also double
increases is insufficient

1

(ii) variable resistor
accept rheostat / potentiometer

1

(b) (i) the data / results / variables are continuous
accept data / results / variables are not categoric / discrete

1

(ii) misreading the ammeter
*do **not** accept misreading the meter / results*
*do **not** accept misreading the ammeter and / or voltmeter*
reading / human error is insufficient

1

(iii) straight line from the origin drawn passing close / through points at 1 V, 5 V, 6 V and ignoring anomalous point
*do **not** accept line drawn 'dot-to-dot'*

1

(iv) yes

mark is for the reason

supports prediction
or
(straight) line passes through the origin

accept a mathematical argument, eg when p.d. went from 2 to 4 the current went from 0.3 to 0.6

it's directly proportional is insufficient

1

[6]

11 (a) the outside colour of the cans

1

(b) (i) 18 (°C) **or** 88 to 70

ignore negative sign

1

(ii) 8 (°C) **or** 70 to 62

ignore negative sign

1

(c) greater temperature difference between water and surroundings (at start)

must mention temperature difference

ignore just water hotter

accept energy used to heat cans initially

1

(d) black

1

temperature falls the fastest (in L)

accept (can L) loses more heat / cools quicker

accept heat for temperature

1

black is a good / the best / better emitter (of heat / radiation)

accept converse

ignore black is best absorber

1

[7]

12 (a) (i) to obtain a range of p.d. values

accept increase / decrease current / p.d. / voltage / resistance

accept to change / control the current / p.d. / voltage / resistance

to provide resistance is insufficient

a variable resistor is insufficient

*do **not** accept electricity for current*

1

(ii) temperature of the bulb increases

accept bulb gets hot(ter)

accept answers correctly

expressed in terms of collisions between (free) electrons and ions / atoms

bulb gets brighter is insufficient

1

(iii) 36

*allow **1** mark for correct substitution, ie 12 × 3 provided no subsequent step shown*

2

watt(s) / W

accept joules per second / J/s

*do **not** accept w*

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a basic comparison of either a cost aspect or an energy efficiency aspect.

Level 2 (3-4 marks)
There is a clear comparison of either the cost aspect or energy efficiency aspect
OR
a basic comparison of both cost and energy efficiency aspects.

Level 3 (5-6 marks)
There is a detailed comparison of both the cost aspect and the energy efficiency aspect.

For full marks the comparisons made should support a conclusion as to which type of bulb is preferable.

Examples of the points made in the response:

cost

- halogen are cheaper to buy

  simply giving cost figures is insufficient
- 6 halogen lamps cost the same as one LED
- LEDs last longer
- need to buy 18 / more halogen lamps to last the same time as one LED
- 18 halogens cost £35.10
- costs more to run a halogen than LED
- LED has lower maintenance cost (where many used, eg large departmental store lighting)

energy efficiency

- LED works using a smaller current
- LED wastes less energy
- LEDs are more efficient
- LED is 22% more energy efficient
- LED produces less heat
- LED requires smaller input (power) for same output (power)

6

[11]

13 (a) 4200

*allow **2** marks for correct substitution*
ie 6930 = 0.330 × c × 5.0

*answers of 1050 **or** 840*

or

correctly calculated answer from correct substitution of incorrect temperature change

or

identification of temperature change ie 5 °C
*gain **1** mark*

3

J / kg°C

accept J / kg K

1

(b) (in a metal) free electrons

to gain full credit the answer must be in terms of free electrons

1

gain kinetic energy

accept move faster

1

(free electrons) transfer energy to other electrons / ions / atoms

*do **not** accept particles*

1

by collision

*allow a maximum of **2** marks for answers in terms of atoms / ions / particles*

- *gaining kinetic energy or vibrating faster / more*
- *transferring energy by collisions*

1

(c) (air) particles spread out

1

(which causes the) air to become less dense / expand

*do **not** accept particles become less dense*

1

(so the) warm air rises

*do **not** accept heat rises*
particles rise is insufficient

1

(d) large surface area

ignore references to type of metal or external conditions

1

black / dark (colour)

1

[13]

14 (a) (i) conduction

1

(ii) free / mobile electrons gain (kinetic) energy

accept free / mobile electrons move faster

1

free electrons collide with other (free) electrons / ions / atoms / particles

*an answer in terms of atoms / particles gaining (kinetic) energy (and) colliding with / vibrating and passing energy to other atoms / particles gains **1** mark only*

answers in terms of heat particles negate

1

(iii) convection

1

(b) (i) *this mark only scores if a correct pair is chosen **and** a correct reason given*

A and **C**

<u>both</u> required and none other

or

B and **D**

<u>both</u> required and none other

only one (independent) variable

or

different shapes but the same colour

accept only the shape changes

1

(ii) **B** <u>radiates</u> heat faster

*converse answer in terms of **A** gains full marks*

1

or

B is a better <u>emitter</u> (of heat)

but B has a smaller (surface) <u>area</u>

or

B has a smaller (surface) <u>area</u>: volume ratio

*allow **2** marks for both lose the same quantity / amount of heat in the same time*

***or** both have same rate of heat loss*

*allow **1** mark for both lose the same quantity / amount of heat*

1

(iii) any **one** from:

- transfer a lot of heat (too rapidly)
- water temperature drops too rapidly

  accept (significantly) more heat will be lost from the first radiator
- water too cold for the next radiator

  mention of absorption of heat negates mark

1

[8]

15 (a) filament bulb

1

(b) (i) 6 V

1

(ii) 3 Ω or their $\frac{\text{(i)}}{2}$ correctly calculated

allow 1 mark for correct substitution ie

6 = 2 × R

or their (i) = 2 × R

2

(iii) 1 A

1

(iv) 6 Ω or their (i) / their (iii) correctly calculated

1

(v)

Decrease	Stay the same	Increase
	✓	
✓		
✓		

1
1
1

[9]

16 (a) energy required to raise the temperature of a substance by 1 °C

accept heat for energy

1

unit mass / 1 kg

1

(b) (i) 7 140 000 (J)

allow 2 marks for a correct substitution, ie

E = 20 × 420 × 850

provided no subsequent step

*850 gains **1** mark if no other mark awarded*

3

(ii) particles in the air have more (kinetic) energy than the particles in the steel

allow particles in the air have a greater speed.

1

steel
particles vibrate (about fixed positions)

1

air
particles move freely

1

(ii) the most energetic particles

accept molecules for particles throughout

accept the fastest particles

1

have enough energy to escape from (the surface of) the water

1

therefore the mean energy of the remaining particles decreases

accept speed for energy

1

as energy decreased, temperature has decreased

1

[12]

17 (a) (i) any **six** from:

- switch on
- read both ammeter and voltmeter

  allow read the meters
- adjust variable resistor to change the current
- take further readings
- draw graph
- (of) V against I

  allow take mean
- R = V / I

  allow take the gradient of the graph

6

(ii) resistor would get hot if current left on

1

so its resistance would increase

1

(iii) 12 (V)

*0.75 × 16 gains **1** mark*

2

(iv) 15 (Ω)

1

16 is nearer to that value than any other

1

(b) if current is above 5 A / value of fuse

1

fuse melts

allow blows / breaks

*do **not** accept exploded*

1

breaks circuit

1

[15]