Energy Changes in Systems

Question Paper

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.1 Energy
Sub-Topic	Energy Changes in Systems
Difficulty Level	Silver Level
Booklet	Question Paper

Time Allowed: **60 minutes**

Score: **/58**

Percentage: **/100**

Grade Boundaries:

Q1.Figure 1 shows a battery operated remote control car.

Figure 1

(a) The car's battery contains a store of energy.

As the car moves, energy from one store is transferred to another store.

Describe how different stores of energy change as the car moves.

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(2)

(b) The car has a top speed of 12 m / s and a mass of 800 g.

Write down the equation that links kinetic energy, mass and speed.

Equation .....

(1)

(c) Calculate the maximum kinetic energy of the car.

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Maximum kinetic energy = ... J

(2)

(d) Explain why having a more efficient motor increases the top speed of the car.

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(2)

(e) **Figure 2** shows an electric car being charged.

Figure 2

By Alan Trotter Electric Car Charging [CC-BY-2.0]via Flickr

A driver wishes to buy a new car.

The table below gives some data about an electric car and one with a petrol engine.

	Electric car	**Petrol engine car**
Cost (£)	27 000	15 000
Running cost per year (£)	250	2 000
Average lifetime (years)	12	12

Which car would be the most economic over its 12 year lifetime?

Use data from the table above to support your answer.

You should include the difference in cost in your answer.

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(4)
(Total 11 marks)

Q2.A student investigated the specific heat capacity of metals.

(a) Describe an experiment the student could do to measure the specific heat capacity of a metal.

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(6)

(b) The student calculated the specific heat capacity of four metals.

The table below shows the student's results.

Metal	Mass of material in kg	Time in minutes	Temperature change in °C	Change in thermal energy in J	Calculated specific heat capacity of material in J / kg °C
Aluminium	1	10	2	4 780	2 390
Brass	1	10	4	4 660	1 165
Copper	1	10		4 600	657
Steel	1	10	5	4 690	938

Use data from the table above to calculate the temperature change for copper.

Use the correct equation from the Physics Equation Sheet.

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Temperature change = ... °C

(3)

(c) What is the independent variable in the student's investigation?

Tick **one** box.

- Mass of material ☐
- Power used ☐
- Time in minutes ☐
- Type of material ☐

(1)

(d) The student calculated the specific heat capacity of aluminium to be 2390 J / kg °C.

The 'true' specific heat capacity of aluminium is 900 J / kg °C.

Suggest why the student's result for aluminium is different from the 'true' value.

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(2)

(e) The teacher suggested that putting bubble wrap round the metal block would change the results.

How would using bubble wrap change the results?

Give a reason for your answer.

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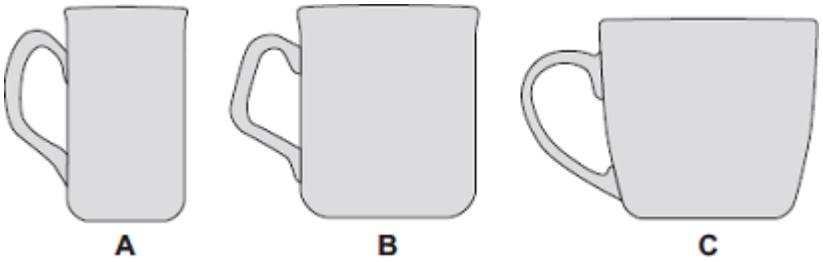
(2)

(Total 14 marks)

Q3. The diagram shows three cups **A**, **B** and **C**.



Energy is transferred from hot water in the cups to the surroundings.

(a) Use the correct answer from the box to complete each sentence.

condensation	**conduction**	**convection**

Energy is transferred through the walls of the cup by ..... .

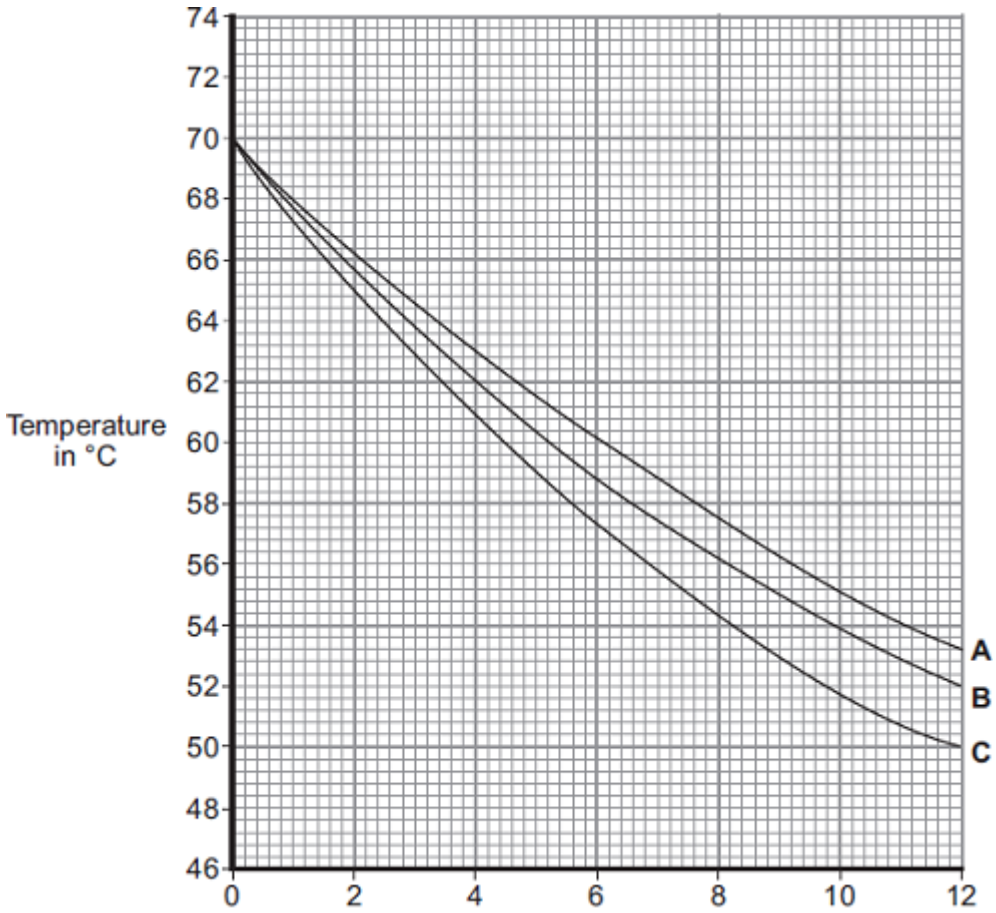
In the air around the cup, energy is transferred by ..... .

(2)

(b) Some students investigated how the rate of cooling of water in a cup depends on the surface area of the water in contact with the air.

They used cups **A**, **B** and **C**. They poured the same volume of hot water into each cup and recorded the temperature of the water at regular time intervals.

The results are shown on the graph.



Time in minutes

(i) What was the starting temperature of the water for each cup?

Starting temperature = ... °C

(1)

(ii) Calculate the temperature fall of the water in cup **B** in the first 9 minutes.

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Temperature fall = ... °C

(2)

(iii) Which cup, **A**, **B** or **C**, has the greatest rate of cooling? ☐

Using the graph, give a reason for your answer.

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(2)

(iv) The investigation was repeated using the bowl shown in the diagram.

The same starting temperature and volume of water were used.

Draw on the graph in part **(b)** another line to show the expected result.

(1)

(v) After 4 hours, the temperature of the water in each of the cups and the bowl was 20°C.

Suggest why the temperature does **not** fall below 20°C.

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(1)

(c) (i) The mass of water in each cup is 200 g.

Calculate the energy, in joules, transferred from the water in a cup when the temperature of the water falls by 8°C.

Specific heat capacity of water = 4200 J / kg°C.

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Energy transferred = ... J

(3)

(ii) Explain, in terms of particles, how evaporation causes the cooling of water.

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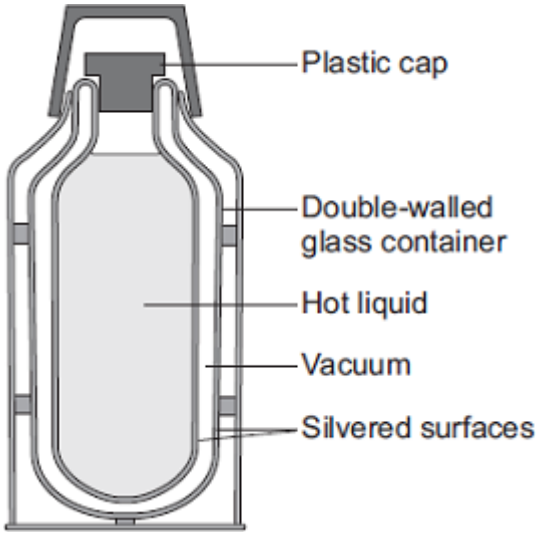
(4)
(Total 16 marks)

Q4.(a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The diagram shows the structure of a vacuum flask.



A vacuum flask is designed to reduce the rate of energy transfer by heating

processes.

Describe how the design of a vacuum flask keeps the liquid inside hot.

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(6)

(b) Arctic foxes live in a very cold environment.

© Purestock/Thinkstock

Arctic foxes have small ears.

How does the size of the ears help to keep the fox warm in a cold environment?

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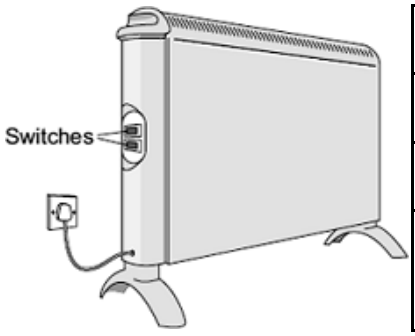
(2)
(Total 8 marks)

Q5. (a) The diagram shows two switches on a room heater. The heater has three power settings. The power produced by two of the settings is given in the table.



Setting	Power in watts
Low	700
Medium	1400
High	

(i) When both switches are on, the heater works at the high power setting.

What is the power of the heater, in kilowatts, when it is switched to the **high** power setting?

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Power = ... kilowatts

(1)

(ii) The heater is used on the **high** power setting. It is switched on for 1½ hours.

Calculate the energy transferred from the mains to the heater in 1½ hours.

Show clearly how you work out your answer and give the unit.

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Energy transferred = ...

(3)

(iii) This type of heater is a very efficient device.

What is meant by a device being very efficient?

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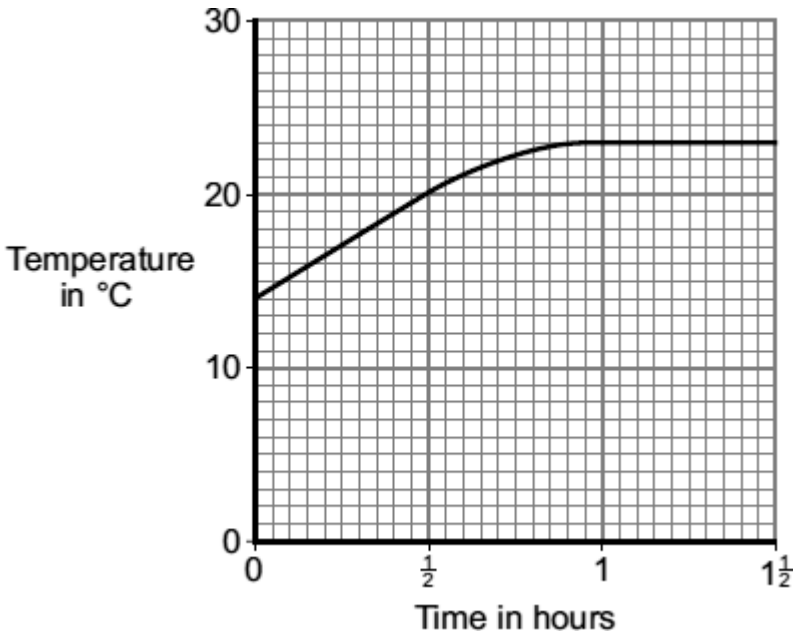
(1)

(b) The graph shows how the temperature of a room changes during the 1½ hours that the heater is used.



After 1 hour, the temperature of the room has become constant, even though the heater is still switched on.

Explain why.

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(2)

(Total 7 marks)

Q6. When you transfer *energy* to a shopping trolley, the amount of *work done* depends on the *force* used and the *distance moved*.

Complete the table by using the correct units from the box.

joule (J)	metre (m)	newton (N)

The first one has been done for you.

Quantity	Unit
energy (transferred)	joule
force	
distance (moved)	
work done	

(Total 2 marks)