

# 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	Gold Level
Booklet	Question Paper

**Time Allowed:** 39 minutes

**Score:** /37

**Percentage:** /100

**Grade Boundaries:**

**Q1.**Figure 1 shows a kettle a student used to determine the specific heat capacity of water.

**Figure 1**



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The student placed different masses of water into the kettle and timed how long it took for the water to reach boiling point.

The student carried out the experiment three times.

The student's results are shown in the table below.

Mass of water in kg	Time for water to boil in seconds				Mass × change in temperature in kg°C	Energy supplied in kJ
	1	2	3	Mean		
0.25	55	60	63	59	20	131
0.50	105	110	116	110	40	243
0.75	140	148	141	143	60	314
1.00	184	190	183	182	80	401
1.25	216	215	211	214	100	471
1.50	272	263	266	267	120	587
1.75	298	300	302		140	

- (a) Suggest how the student was able to ensure that the change in temperature was the same for each mass of water.

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(2)

- (b) Calculate the uncertainty in the student's measurements of time to boil when the mass of water was 1.75 kg.

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Uncertainty = ..... s

(2)

- (c) The power rating of the kettle is 2.20 kW.

Calculate the average electrical energy used by the kettle, in kJ, for 1.75 kg of water to reach boiling point.

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Average energy = ..... kJ

(2)

- (d) Use information from the table above to calculate the change in temperature of the water during the investigation.

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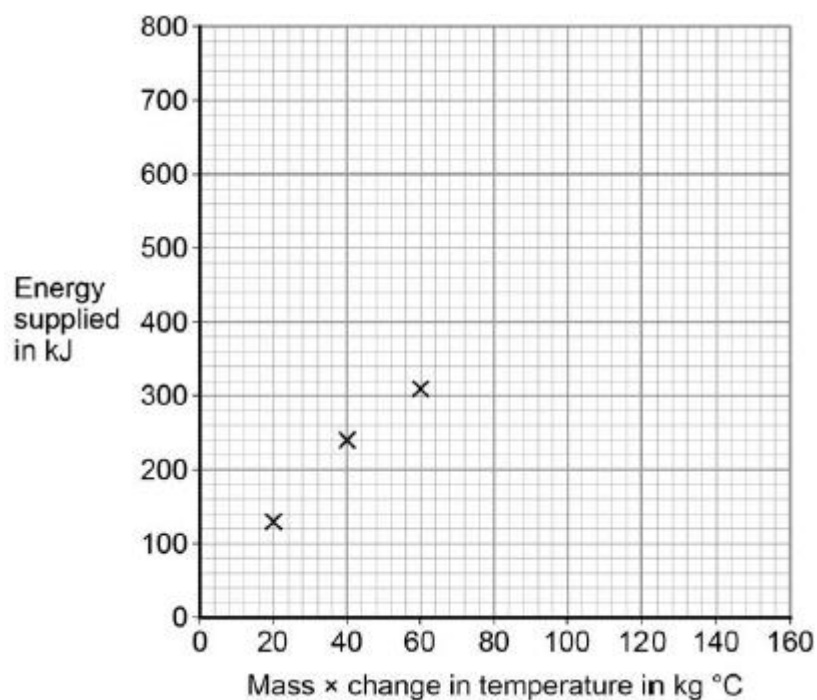
Change in temperature = ..... °C

(2)

- (e) The student plotted a graph of energy supplied in kJ against mass  $\times$  change in temperature in kg °C.

**Figure 2** shows the graph the student plotted.

**Figure 2**



Use data from the table above to plot the four missing points.

Draw a line of best fit on the graph.

(3)

- (f) Use the graph to determine the mean value of the specific heat capacity of water, for the student's investigation.

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

(4)

- (g) The student's value for the specific heat capacity of water was greater than the accepted value.

Suggest why.

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(1)

- (h) The kettle used in the experiment had a label stating that the power rating of the kettle was 2.2 kW.

The student did not measure the power of the kettle.

Suggest why measuring the power of the kettle may improve the student's investigation.

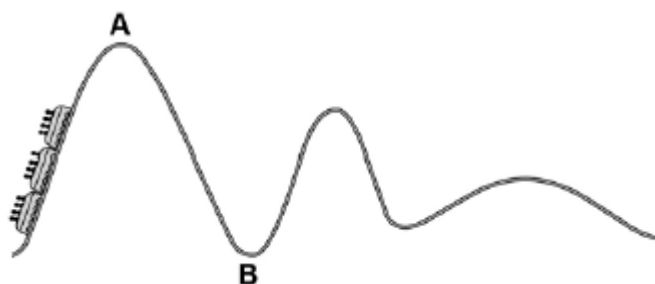
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(1)

(Total 17 marks)

**Q2.** The figure below shows a rollercoaster.



The rollercoaster car is raised a vertical distance of 35 m to point **A** by a motor in 45 seconds.

The mass of the rollercoaster is 600 kg.

The motor has a power rating of 8 000 W.

- (a) Calculate the percentage efficiency of the motor.

Gravitational field strength = 9.8 N / kg.

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Efficiency = ..... %

(5)

- (b) The rollercoaster rolls from point **A** to point **B**, a drop of 35 m.

Calculate the speed of the roller coaster at point **B**.

Assume that the decrease in potential energy store is equal to the increase in kinetic energy store.

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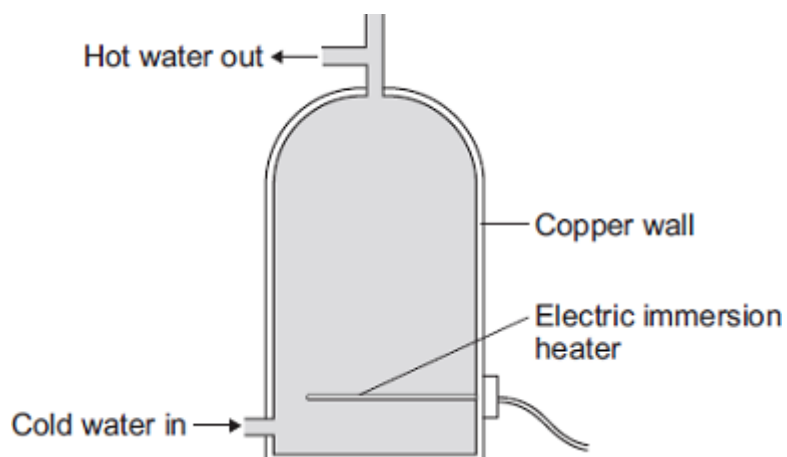
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Speed at point **B** = ..... m / s

(6)

(Total 11 marks)

- Q3.** An electric immersion heater is used to heat the water in a domestic hot water tank.  
When the immersion heater is switched on the water at the bottom of the tank gets hot.



- (a) Complete the following sentence.

The main way the energy is transferred through the copper wall of the water tank is by

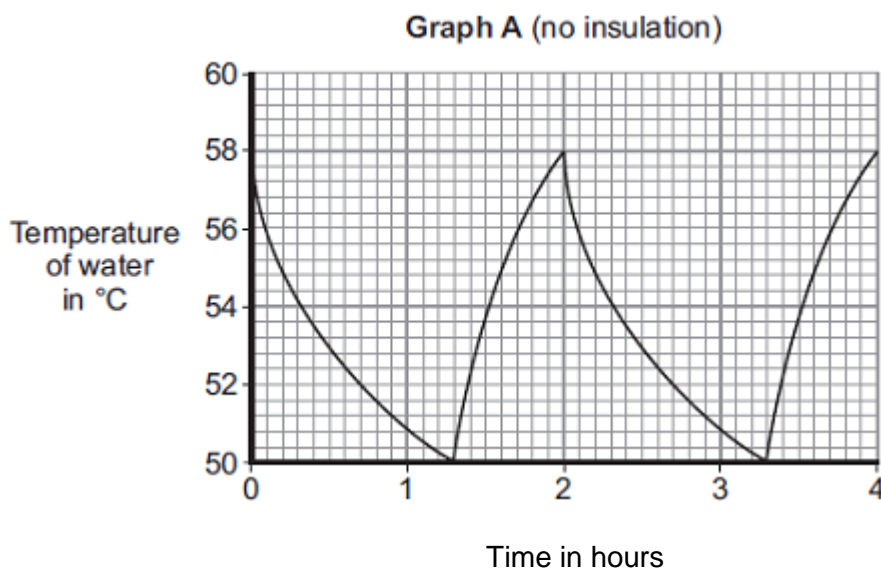
the process of .....

(1)

- (b) The immersion heater has a thermostat to control the water temperature.

When the temperature of the water inside the tank reaches  $58^{\circ}\text{C}$  the thermostat switches the heater off. The thermostat switches the heater back on when the temperature of the water falls to  $50^{\circ}\text{C}$ .

**Graph A** shows how the temperature of the water inside a hot water tank changes with time. The tank is **not** insulated.



- (i) The temperature of the water falls at the fastest rate just after the heater switches off.

Explain why.

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(2)

- (ii) To heat the water in the tank from 50°C to 58°C the immersion heater transfers 4032 kJ of energy to the water.

Calculate the mass of water in the tank.

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

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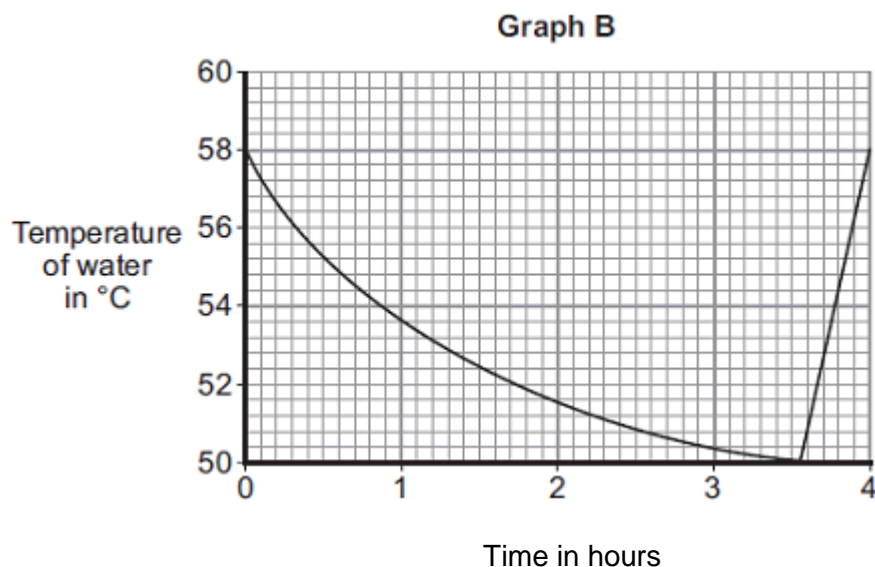
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Mass = ..... kg

(3)

- (iii) An insulating jacket is fitted to the hot water tank.

**Graph B** shows how the temperature of the water inside the insulated hot water tank changes with time.





An insulating jacket only costs £12.

By comparing **Graph A** with **Graph B**, explain why fitting an insulating jacket to a hot water tank saves money.

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(3)  
(Total 9 marks)