

GCSE Combined Science: Trilogy

Worksheet: Temperature changes in a system and specific heat capacity

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Temperature changes in a system and specific heat capacity

NAME _____ **CLASS** _____ **DATE** _____

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

0 1 . 1 Which quantity, when multiplied by the mass and the specific heat capacity of a substance, gives the change in its thermal energy?

Tick (✓) **one** box.

The time taken

☐

The temperature change

☐

The final temperature

☐

The power

☐

[1 mark]

0 1 . 2 Which of these is the correct unit for specific heat capacity?

Tick (✓) **one** box.

J

☐

J/kg

☐

J/°C

☐

J/kg °C

☐

[1 mark]

0 2

Table 1 shows the specific heat capacities of some materials.

Table 1

Material	Specific heat capacity in J/kg °C
Aluminium	900
Concrete	880
Copper	385
Water	4200

0 2 . 1

Which material in Table 1 needs the least energy to increase the temperature of 1 kg of the material by 1 °C?

.....

.....

.....

.....
[1 mark]

0 2 . 2

A copper saucepan has a mass of 0.50 kg.
Calculate the energy needed to increase the temperature of the saucepan by 40 °C.
Use the equation:
change in thermal energy = mass × specific heat capacity × temperature change

.....

.....

.....

.....

Energy = J
[2 marks]

0 2 . 3

The radiators in a central heating system are filled with water.
Use Table 1 to give **one** reason why water is used.

.....
.....

[1 mark]

0 3

specific heat capacity of lead = 130 J/kg °C

0 3 . 1

Calculate the energy needed to increase the temperature of 0.2 kg of lead by 42 °C.
Use the equation:
change in thermal energy = mass × specific heat capacity × temperature change

.....
.....
.....
.....

Energy = J

[2 marks]

0 4

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

0 4 . 1

Calculate the energy needed to increase the temperature of 2.5 kg of water by 19 °C.
Use the equation:
change in thermal energy = mass × specific heat capacity × temperature change

.....
.....
.....
.....

Energy = J

[2 marks]

0 5

0 5 . 1

Complete the sentence.

The specific heat capacity of a substance is the amount of energy needed to raise the temperature of of the substance by

[2 marks]

0 5 . 2

Calculate the energy needed to increase the temperature of 2.0 kg of water by 15 °C.

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

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

.....

.....

.....

.....

Energy = J

[2 marks]

0 6

A storage heater contains 120 kg of bricks. Overnight, an electric heater with a power of 2.0 kW heats the bricks for 7.0 hours.

specific heat capacity of the bricks = 840 J/kg °C

0 6 . 1

Calculate the energy transferred by the heater in 7.0 hours.

.....

.....

.....

.....

Energy = J

[3 marks]

0 6 . 2

Calculate the increase in temperature of the bricks. Assume that all of the energy transferred by the heater is stored in the bricks.
Use the Physics Equations Sheet.

.....

.....

.....

.....

Temperature increase = °C

[2 marks]

0 6 . 3

During the day the bricks transfer energy to the room.
Suggest why the bricks are surrounded by a layer of thermal insulation.

.....

.....

[1 mark]

0 7

A 2.5 kW kettle transfers 189 kJ of energy to 0.60 kg of water at 20 °C. Assume that all of the energy transferred by the kettle heats the water.
specific heat capacity of water = 4200 J/kg °C

0 7 . 1

Show that the energy transferred to the water is 189 000 J.

.....

.....

[1 mark]

0 7 . 2

Calculate the final temperature of the water.
Use the Physics Equations Sheet.

.....

.....

.....

.....

Final temperature = °C

[3 marks]

0 7 . 3

Calculate the time the kettle was switched on for.
Give your answer in seconds, to 3 significant figures.

.....

.....

.....

.....

Time = s

[2 marks]

.....

0 8

An electric kettle transfers 151 200 J of energy to 0.60 kg of water. The water starts at a temperature of 18 °C.

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

0 8 . 1

Calculate the final temperature of the water. Assume that all of the energy is transferred to the water.

Use the Physics Equations Sheet.

.....

.....

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.....

.....

Final temperature = °C

[3 marks]

0 8 . 2

The actual final temperature of the water was lower than the value you calculated.

Give **one** reason why.

.....

.....

[1 mark]

0 8 . 3

On a summer day, the temperature of the sea changes much less between day and night than the temperature of the land.

Explain why. Use ideas about specific heat capacity.

.....

.....

.....

.....

[2 marks]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Temperature changes in a system and specific heat capacity · 32 marks

Question 1 (2 marks)

01.1 [1 mark]

Correct: The temperature change

01.2 [1 mark]

Correct: J/kg °C

Question 2 (4 marks)

02.1 [1 mark]

Answer: Copper

- copper (1)
-

02.2 [2 marks]

Answer: 7700 J

- $\Delta E = 0.50 \times 385 \times 40$ (1)
 - 7700 (J) (1)
-

02.3 [1 mark]

Answer: Water has the highest specific heat capacity, so each kilogram transfers a lot of energy to the room for each °C it cools.

- water has a (very) high specific heat capacity, so it transfers / stores a lot of energy for each degree it cools (1)
-
-

Question 3 (2 marks)

03.1 [2 marks]

Answer: 1092 J

- $\Delta E = 0.2 \times 130 \times 42$ (1)
 - 1092 (J) (1)
-

Question 4 (2 marks)

04.1 [2 marks]

Answer: 199 500 J

- $\Delta E = 2.5 \times 4200 \times 19$ (1)
 - 199 500 (J) (1)
-

Question 5 (4 marks)

05.1 [2 marks]

Answer: 1 kg; 1 °C

- one kilogram / 1 kg (1)
 - one degree Celsius / 1 °C (1)
-

05.2 [2 marks]

Answer: 126 000 J

- $\Delta E = 2.0 \times 4200 \times 15$ (1)
- 126 000 (J) (1)

Notes: An answer of 126 000 J scores 2 marks.

Question 6 (6 marks)

06.1 [3 marks]

Answer: 5.04×10^7 J

- $t = 7.0 \times 60 \times 60 = 25\,200$ (s) (1)
- $E = 2000 \times 25\,200$ (1)
- 5.04×10^7 (J) (1)

Notes: An answer of 5.04×10^7 J (50 400 000 J) scores 3 marks. Allow 2 marks for 50 400 (power not converted to W).

06.2 [2 marks]

Answer: 500 °C

- $5.04 \times 10^7 = 120 \times 840 \times \Delta\theta$ (1)
- $\Delta\theta = 500$ (°C) (1)

Notes: Allow ECF from the energy calculated.

06.3 [1 mark]

Answer: To slow the rate of energy transfer so that the stored energy heats the room gradually through the day.

- to reduce the rate of energy transfer (from the bricks) so the room is heated gradually through the day (1)

Question 7 (6 marks)

07.1 [1 mark]

- $189 \times 1000 = 189\,000$ (J) (1)

07.2 [3 marks]

Answer: 95 °C

- $\Delta\theta = 189\,000 \div (0.60 \times 4200) = 75$ (°C) (1)
- final temperature = $20 + 75$ (1)
- 95 (°C) (1)

07.3 [2 marks]

Answer: 75.6 s

- $t = 189\,000 \div 2500$ (1)
 - 75.6 (s) (1)
-

Question 8 (6 marks)

08.1 [3 marks]

Answer: 78 °C

- $151\,200 = 0.60 \times 4200 \times \Delta\theta$ (1)
- $\Delta\theta = 60$ (°C) (1)
- final temperature = $18 + 60 = 78$ (°C) (1)

Notes: An answer of 78 °C scores 3 marks. An answer of 60 °C scores 2 marks.

08.2 [1 mark]

Answer: Some of the energy heated the kettle itself and the surrounding air.

- some of the energy was transferred to the kettle / to the surroundings / to the air (1)

08.3 [2 marks]

Answer: Water has a much higher specific heat capacity than rock or soil, so much more energy must be transferred to change its temperature by each degree.

- water has a higher specific heat capacity than the land / rock / soil (1)
 - so more energy has to be transferred to (or from) each kilogram of water for each 1 °C change in temperature (1)
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