

GCSE Physics

Worksheet: Specific heat capacity

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Specific heat capacity

NAME	CLASS	DATE
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- 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

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

0 1 . 1

Calculate the energy needed to increase the temperature of 3 kg of water by 17 °C.

Use the equation:

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

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.....

.....

.....

Energy = J

[2 marks]

0 2

0 2 . 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 2 . 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

.....

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.....

Energy = J

[2 marks]

0 3

0 3 . 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 3 . 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 4

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 4 . 1

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

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.....

[1 mark]

0 4 . 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

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Energy = J

[2 marks]

0 4 . 3

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

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[1 mark]

0 5

0 5 . 1

Calculate the energy needed to increase the temperature of a 0.40 kg glass beaker by 25 °C.
specific heat capacity of glass = 840 J/kg °C
Use the equation:
change in thermal energy = mass × specific heat capacity × temperature change

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Energy = J

[2 marks]

0 5 . 2

The beaker is then allowed to cool back down by 25 °C, transferring energy to the surroundings.
State the amount of energy transferred to the surroundings as it cools.

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.....

Energy = J

[1 mark]

0 6

Table 2 shows the specific heat capacity and boiling point of three liquids being considered for use as a car engine coolant. A coolant must absorb a large amount of energy from the engine without a large rise in temperature, and without boiling.

Table 2

Liquid	Specific heat capacity in J/kg °C	Boiling point in °C
Water	4200	100
Ethylene glycol (antifreeze)	2400	197
Mineral oil	1800	300

0 6 . 1

Use Table 2 to identify which liquid needs the least energy to raise the temperature of 1 kg of it by 1 °C.

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.....
[1 mark]

0 6 . 2

A mixture of water and ethylene glycol is used as a coolant in most car engines, rather than pure water, even though the mixture has a lower specific heat capacity than pure water.
Suggest why.

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[2 marks]

0 6 . 3

Explain why a liquid with a high specific heat capacity is generally a good choice for an engine coolant.

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[2 marks]

0 7

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 7 . 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 7 . 2

The actual final temperature of the water was lower than the value you calculated.
Give **one** reason why.

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[1 mark]

0 7 . 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.

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[2 marks]

0 8

Transferring 3420 J of energy to a sample of iron increases its temperature by 19 °C.
specific heat capacity of iron = 450 J/kg °C

0 8 . 1

Calculate the mass of the sample.
Use the Physics Equations Sheet.

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Mass = kg

[3 marks]

0 9

43 200 J of energy is transferred to a 1.2 kg block of a metal. The temperature of the block increases by 40 °C.

0 9 . 1

Calculate the specific heat capacity of the metal.
Use the Physics Equations Sheet.

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Specific heat capacity = J/kg °C

[3 marks]

END OF QUESTIONS

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

Mark scheme

GCSE Physics · Worksheet: Specific heat capacity · 32 marks

Question 1 (2 marks)

01.1 [2 marks]

Answer: 214 200 J

- $\Delta E = 3 \times 4200 \times 17$ (1)
 - 214 200 (J) (1)
-

Question 2 (4 marks)

02.1 [2 marks]

Answer: 1 kg; 1 °C

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

02.2 [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 3 (2 marks)

03.1 [1 mark]

Correct: The temperature change

03.2 [1 mark]

Correct: J/kg °C

Question 4 (4 marks)

04.1 [1 mark]

Answer: Copper

- copper (1)

04.2 [2 marks]

Answer: 7700 J

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

04.3 [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 5 (3 marks)

05.1 [2 marks]

Answer: 8400 J

- $\Delta E = 0.40 \times 840 \times 25$ (1)
- 8400 (J) (1)

05.2 [1 mark]

Answer: 8400 J

- 8400 (J) — the same amount of energy that was transferred to it while heating (1)

Notes: Allow ECF from the previous part.

Question 6 (5 marks)

06.1 [1 mark]

Answer: Mineral oil.

- mineral oil (1)

06.2 [2 marks]

Answer: Ethylene glycol raises the boiling point, so the coolant can run hotter without boiling (and it lowers the freezing point, so it does not freeze in winter); this outweighs the slightly smaller energy absorbed per degree.

- ethylene glycol raises the boiling point of the mixture above 100 °C (1)
- so the coolant can run at a higher temperature without boiling (1)
- ethylene glycol lowers the freezing point, so the coolant does not freeze in cold weather (1)
- these advantages outweigh the mixture absorbing slightly less energy for each degree of temperature rise (1)

Any 2 of the points above.

06.3 [2 marks]

Answer: A high specific heat capacity lets the coolant absorb a lot of energy from the engine for only a small rise in its own temperature.

- a high specific heat capacity means the liquid can absorb a large amount of energy from the engine (1)
 - for a relatively small increase in the temperature of the coolant (1)
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Question 7 (6 marks)

07.1 [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.

07.2 [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)
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07.3 [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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Question 8 (3 marks)

08.1 [3 marks]

Answer: 0.4 kg

- rearranging $\Delta E = mc\Delta\theta$ gives $m = \Delta E \div (c\Delta\theta)$ (1)
 - $m = 3420 \div (450 \times 19)$ (1)
 - 0.4 (kg) (1)
-

Question 9 (3 marks)

09.1 [3 marks]

Answer: 900 J/kg °C

- rearranging $\Delta E = mc\Delta\theta$ gives $c = \Delta E \div (m\Delta\theta)$ (1)
 - $c = 43\,200 \div (1.2 \times 40)$ (1)
 - 900 (J/kg °C) (1)
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