AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.1.2.1

Energy transfers in a system

Past-paper questions

Tier	**Foundation**
Question groups	**4**
Available paper years	**2020–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

6.1.2.1 Energy transfers in a system

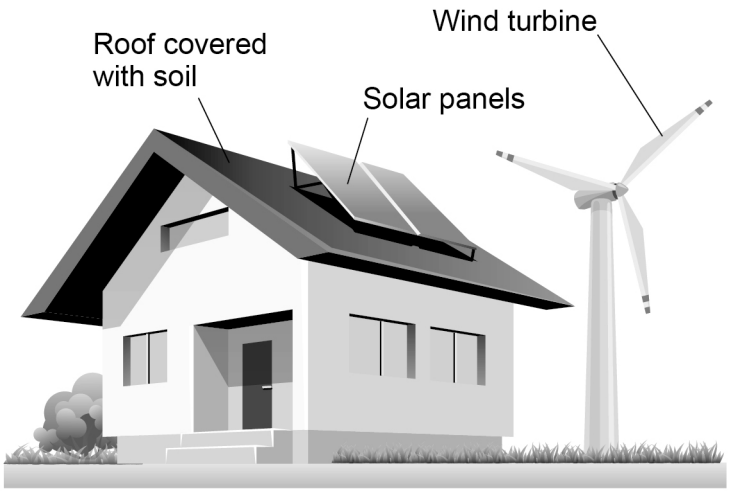
Question 01

November 2020 | 8464/P/1F | Original Q3

0 3 An eco-house is designed to be environmentally friendly.

Figure 4 shows a picture of an eco-house.

Figure 4



0 3 . 1 The solar panels and a wind turbine are used to generate electricity for the eco-house.

Solar and wind are both renewable energy resources.

What does renewable energy resource mean?

[1 mark]

Tick (✓) **one** box.

- It can be replenished as it is used. ☐
- It is unreliable. ☐
- It has no fuel costs. ☐
- It produces no greenhouse gases. ☐

6.1.2.1 Energy transfers in a system

Question 01 · continued

0 3 . 2 Biomass, nuclear and natural gas are three other energy resources.

Complete the table to show whether each energy resource is renewable or non-renewable.

[2 marks]

Tick (✓) **one** box for **each** energy resource.

Energy resource	Renewable	Non-renewable
Biomass		
Nuclear		
Natural gas		

0 3 . 3 Moving air makes the wind turbine spin.

The wind turbine generates electricity which is used to charge a battery.

Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	electrical	gravitational	kinetic

When the wind turbine spins faster there is an increase in its _____ energy.

Charging the battery increases the _____ store of energy of the battery.

Question 3 continues on the next page

6.1.2.1 Energy transfers in a system

Question 01 · continued

0 3 . 4 The roof of the eco-house is covered with soil.

Covering the roof with soil decreases the thermal conductivity of the roof.

What are the advantages of having a roof with a lower thermal conductivity?

[2 marks]

Tick (✓) **two** boxes.

- Less energy is needed to heat the house. ☐
- The rate of energy transfer by conduction is greater. ☐
- The roof is a better insulator. ☐
- The roof is less likely to leak. ☐
- Weather will have a greater effect on the temperature of the house. ☐

0 3 . 5 The average power transferred to the solar panels by sunlight is 26 000 W

Calculate the average energy transferred to the solar panels in 30 seconds.

Use the equation:

energy transferred = power × time

[2 marks]

Average energy transferred to solar panels = _____ J

6.1.2.1 Energy transfers in a system

Question 01 · continued

0 3 . 6 Write down the equation that links efficiency, total power input and useful power output.

[1 mark]

0 3 . 7 The solar panels on the roof of the eco-house have an efficiency of 0.15

The average power input to the solar panels is 26 000 W

Calculate the average useful power output from the solar panels.

[3 marks]

Average useful power output = _____ W

0 3 . 8 Explain why it is a good idea for the eco-house to have both a wind turbine and solar panels.

[2 marks]

15

6.1.2.1 Energy transfers in a system

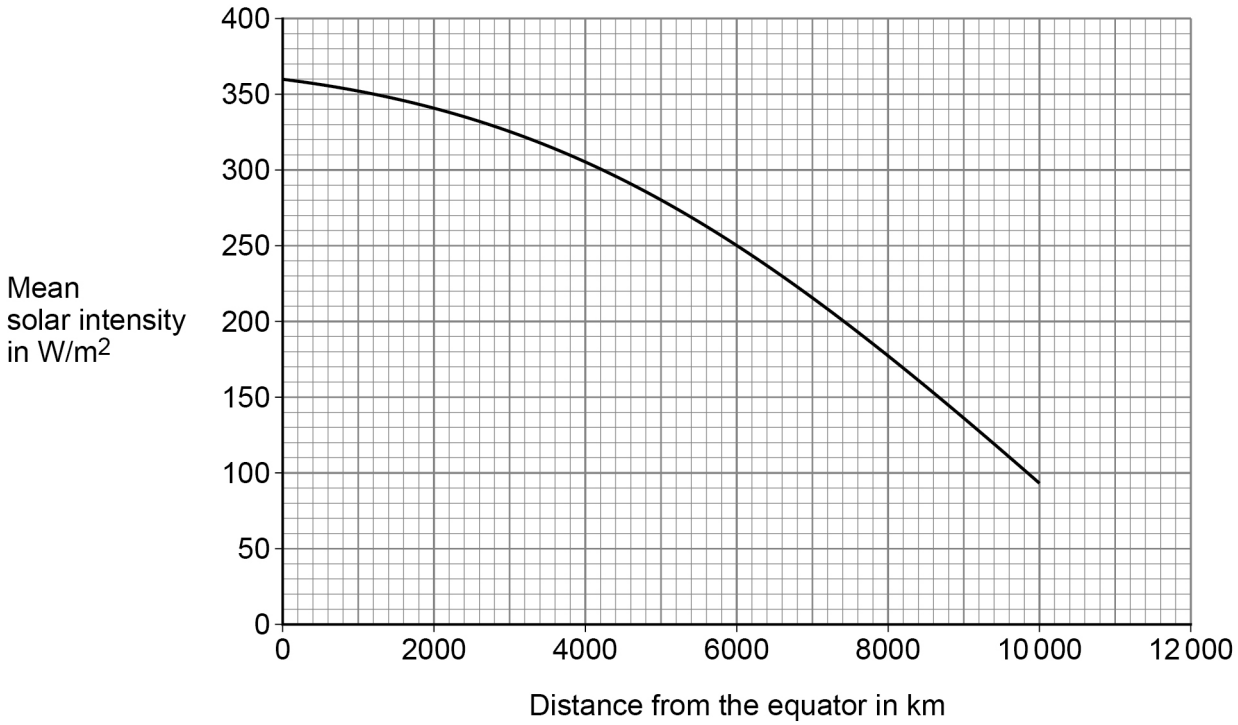
Question 02

November 2021 | 8464/P/1F | Original Q4

0 4 Solar intensity is a measure of the radiation received from the Sun at the surface of the Earth.

Figure 7 shows how the mean solar intensity changes with the distance from the equator.

Figure 7



0 4 . 1 The city of Athens is 4200 km from the equator.

What is the mean solar intensity in Athens?

[1 mark]

Mean solar intensity = _____ W/m^2

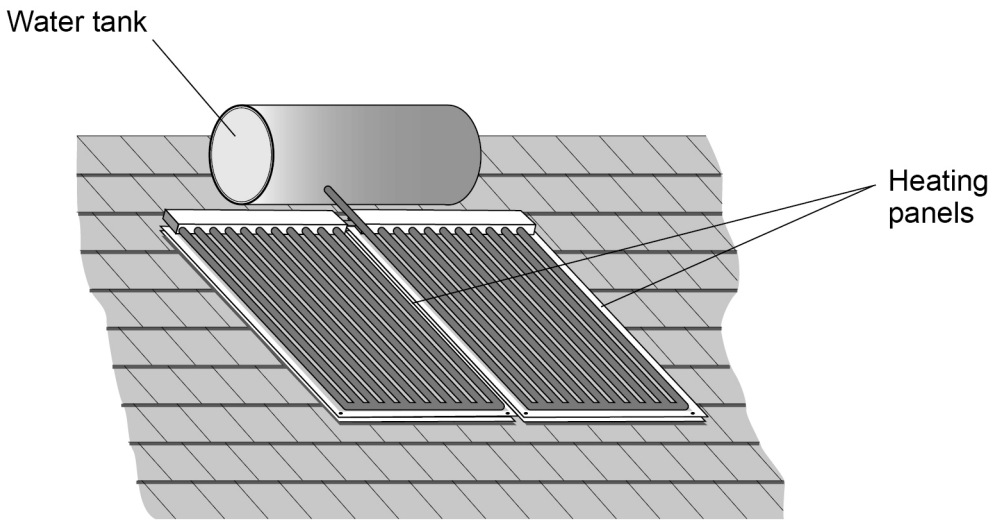
Question 02 · continued

Solar water heaters use radiation from the Sun to heat water.

The heated water is stored in a water tank.

Figure 8 shows a solar water heater on the roof of a building.

Figure 8



0 4 . 2 Cities closer to the equator have many more buildings with solar water heaters than cities further away from the equator.

Suggest why.

[1 mark]

0 4 . 3 The use of solar water heaters may reduce the need to burn fossil fuels.

Complete the sentence.

Choose the answer from the box.

[1 mark]

carbon dioxide	**nitrogen**	**oxygen**

Burning fossil fuels contributes to global warming because there is an increase in the amount of _____ in the atmosphere.

6.1.2.1 Energy transfers in a system

Question 02 · continued

0 4 . 4 The efficiency of the solar water heater is 0.61

Calculate the useful power output when the total power input to the solar water heater is 1100 W.

Use the equation:

useful power output = efficiency × total power input

[2 marks]

Useful power output = _____ W

0 4 . 5 Different solar water heaters have different sized heating panels.

Suggest how the size of the heating panels affects the input power to a solar water heater.

[1 mark]

0 4 . 6 Water has a high specific heat capacity.

What is meant by the specific heat capacity of water?

[1 mark]

Tick (✓) **one** box.

- The energy required to change the state of 1 kg of water from liquid to gas. ☐
- The energy required to increase the temperature of 1 kg of water by 1 °C. ☐
- The power required to change the state of 1 kg of water from liquid to gas. ☐
- The power required to increase the temperature of 1 kg of water by 1 °C. ☐

6.1.2.1 Energy transfers in a system

Question 02 · continued

0 4 . 7 The water tank contained 80 kg of water.

The change in thermal energy of the water was 8 400 000 J.

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

Calculate the temperature change of the water.

Use the Physics Equations Sheet.

[3 marks]

Temperature change = _____ °C

0 4 . 8 The water tank is thermally insulated.

How does thermal insulation affect the rate of energy transfer from the water in the tank?

[1 mark]

Tick (✓) **one** box.

- Thermal insulation decreases the rate of energy transfer. ☐
- Thermal insulation does not change the rate of energy transfer. ☐
- Thermal insulation increases the rate of energy transfer. ☐

Question 4 continues on the next page

0 4 . 9 **Table 1** shows information about different materials.

Table 1

Material	Thermal conductivity in arbitrary units
A	3
B	2
C	8
D	4

Which material in **Table 1** is the best thermal insulator?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

12

6.1.2.1 Energy transfers in a system

Question 03

June 2022 | 8464/P/1F | Original Q4

0 4 **Figure 6** shows a swimmer wearing a wetsuit.

The wetsuit helps to keep the swimmer warm.

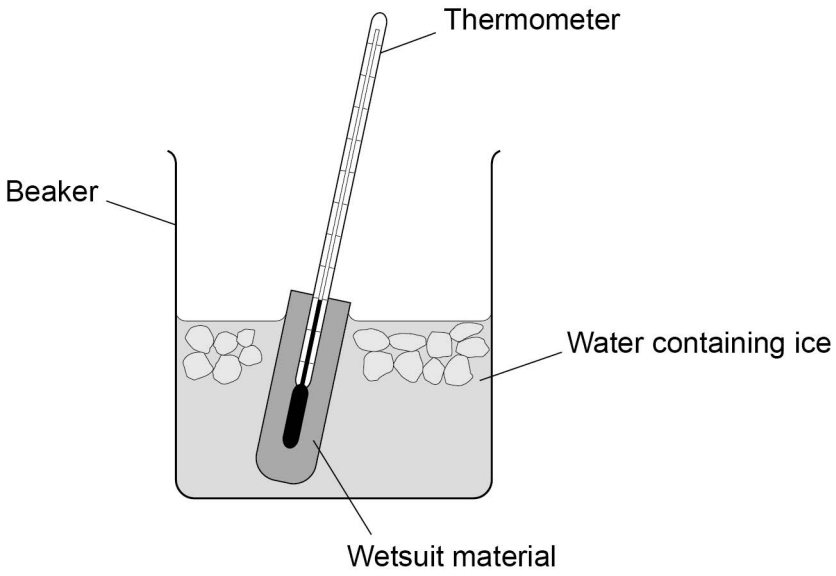
Figure 6



A student wrapped a thermometer in a piece of wetsuit material and placed the thermometer in water containing ice.

Figure 7 shows the apparatus.

Figure 7



6.1.2.1 Energy transfers in a system

Question 03 · continued

0 4 . 1 After 30 seconds in the water the temperature of the thermometer had decreased by 7.5 °C

Calculate the average decrease in temperature each second.

[2 marks]

Average decrease in temperature each second = _____ °C

Question 4 continues on the next page

Question 03 · continued

The student recorded the temperature of the thermometer after 30 seconds for four materials. Each piece of material was the same size and thickness.

In each test the starting temperature of the thermometer was 21.0 °C

Table 2 shows the results.

Table 2

Material	W	X	Y	Z
Temperature in °C	13.5	8.0	16.0	12.0

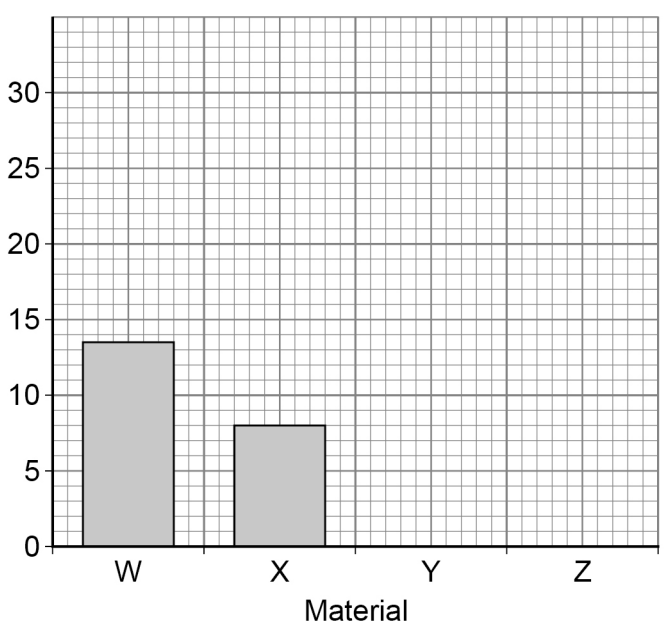
0 4 . 2 Complete **Figure 8** using the data in **Table 2**.

You should:

- label the *y*-axis
- draw the bars for materials Y and Z.

[2 marks]

Figure 8



6.1.2.1 Energy transfers in a system

Question 03 · continued

0 4 . 3 Which material is the best thermal insulator?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

W ☐ **X** ☐ **Y** ☐ **Z** ☐

Reason _____

_____

0 4 . 4 The student tested a new material with a greater thermal conductivity than material Z.

The piece of new material was the same size and thickness as the piece of material Z.

What was the temperature of the thermometer after 30 seconds?

[1 mark]

Tick (✓) **one** box.

Less than 12.0 °C ☐

Exactly 12.0 °C ☐

Greater than 12.0 °C ☐

Question 4 continues on the next page

Question 03 · continued

0 4 . 5 During the investigation 0.0150 kg of the ice melted. The temperature of the water and ice did not change.

specific latent heat of fusion of ice = 334 000 J/kg

Calculate the energy needed to melt the ice.

Use the equation:

energy to melt the ice = mass × specific latent heat

[2 marks]

Energy needed to melt the ice = _____ J

The student wanted to determine the density of a wetsuit material.

The student measured the length of one side of a cube of wetsuit material with:

- a micrometer
- a ruler.

Table 3 shows the results.

Table 3

Equipment	Length in cm		
	Measurement 1	**Measurement 2**	**Measurement 3**
Micrometer	0.581	0.557	0.576
Ruler	0.6	0.6	0.6

6.1.2.1 Energy transfers in a system

Question 03 · continued

0 4 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

calibration	**precision**	**reproducibility**	**resolution**

The results show that compared to the ruler the micrometer has a higher

_____ .

Use the Physics Equations Sheet to answer questions **04.7** and **04.8**.

0 4 . 7 Write down the equation that links density (ρ), mass (m) and volume (V).

[1 mark]

_____

_____

0 4 . 8 The student calculated the volume of the cube of wetsuit material to be 0.186 cm^3

The density of the cube was 0.300 g/cm^3

Calculate the mass of the cube.

Give your answer in grams.

[3 marks]

_____

_____

_____

_____

_____

_____

Mass = _____ g

14

6.1.2.1 Energy transfers in a system

Question 04

June 2025 | 8464/P/1F | Original Q6

0 6 A student investigated the specific heat capacity of aluminium.

The student used an electric heater to increase the temperature of an aluminium block.

The student measured the:

- mass of the block
- energy transferred to the block
- temperature change of the block.

Table 2 shows the results.

Table 2

Mass in kilograms	0.75
Energy transferred in joules	13 800
Temperature change in °C	20

0 6 . 1 Calculate the specific heat capacity of aluminium.

Use the Physics Equations Sheet.

[3 marks]

Specific heat capacity = _____ J/kg °C

6.1.2.1 Energy transfers in a system

Question 04 · continued

0 6 . 2 Describe a method the student could have used to obtain the results in **Table 2**.

[6 marks]

Extra space

Question 6 continues on the next page

6.1.2.1 Energy transfers in a system

Question 04 · continued

0 6 . 3 Wrapping the aluminium block in insulation makes the value for the specific heat capacity of aluminium more accurate.

Which are **two** reasons why?

[2 marks]

Tick (✓) **two** boxes.

- The amount of wasted energy is less. ☐
- The energy transferred to the aluminium block is greater. ☐
- The insulation heats the aluminium block. ☐
- The power of the electric heater increases. ☐
- The temperature increase of the aluminium block is greater. ☐

11