AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.1.3

National and global energy resources

Past-paper questions

Tier	**Foundation**
Question groups	**9**
Available paper years	**2018–2025**

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.

6.1.3 National and global energy resources

Question 01

June 2018 | 8464/P/1F | Original Q1

0 1 There are many different energy resources.

0 1 . 1 Which **two** energy resources are renewable?

[2 marks]

Tick **two** boxes.

- Biofuel ☐
- Coal ☐
- Gas ☐
- Geothermal ☐
- Nuclear fuel ☐

0 1 . 2 Some non-renewable energy resources are more reliable than others.

Which statement correctly describes a reliable resource?

[1 mark]

Tick **one** box.

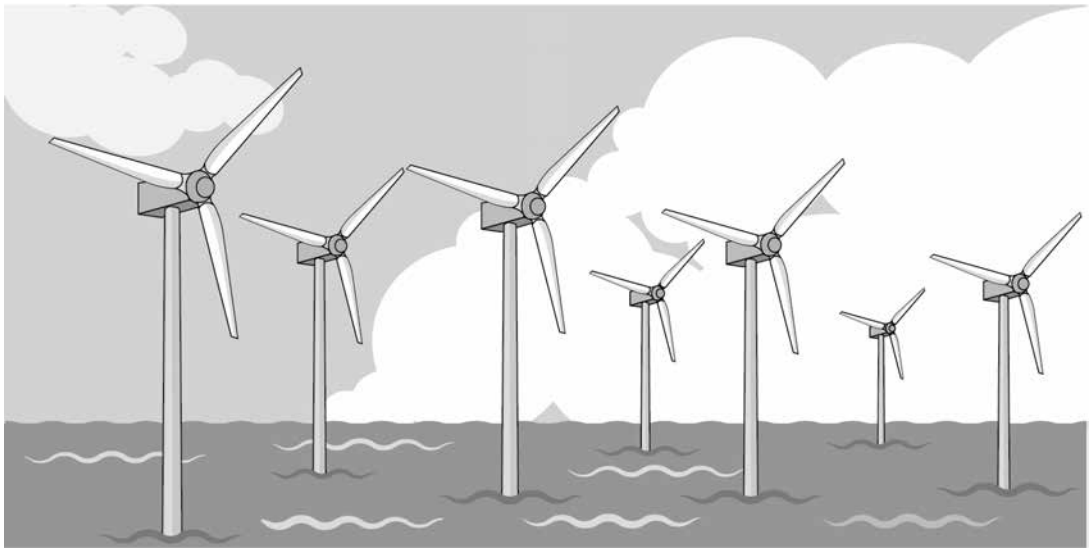
- It does not burn fuel. ☐
- It is predictable. ☐
- It will never run out. ☐
- It is cheap to use. ☐

6.1.3 National and global energy resources

Question 01 · continued

0 1 . 3 **Figure 1** shows a wind farm.

Figure 1



The total power output of the wind farm is 19.6 MW

All of the wind turbines have the same power output.

What is the power output of **one** wind turbine?

[1 mark]

Tick **one** box.

2.7 MW ☐

2.8 MW ☐

2.9 MW ☐

3.2 MW ☐

3.3 MW ☐

0 1 . 4 Give **two** reasons why people might **not** like having wind turbines near their homes.

[2 marks]

1 _____

2 _____

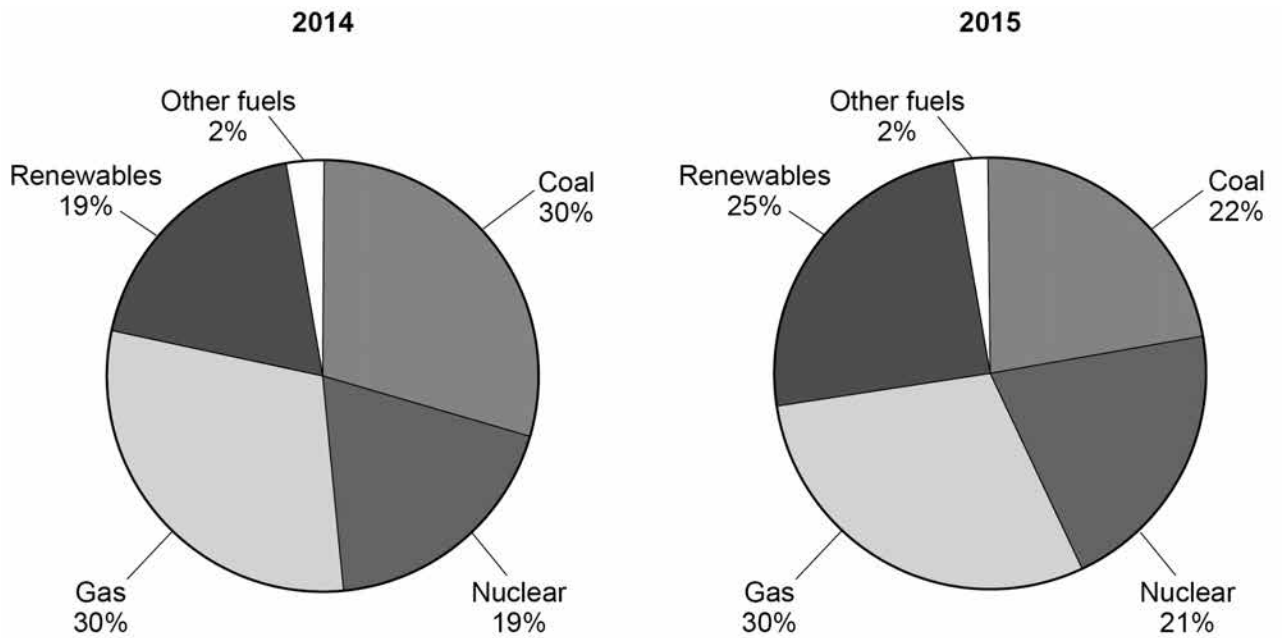
6.1.3 National and global energy resources

Question 01 · continued

0 1 . 5 **Figure 2** shows the electricity generated by different energy resources in the UK.

The total amount of electricity generated was the same in 2014 and in 2015

Figure 2



There are changes in the amounts of different energy resources used between 2014 and 2015

Explain the environmental impacts of the changes.

[4 marks]

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6.1.3 National and global energy resources

Question 02

June 2018 | 8464/P/1F | Original Q5

0 5 Radioactive nuclei can emit alpha, beta or gamma radiation.

0 5 . 1 Which type of radiation is the most penetrating?

[1 mark]

Tick **one** box.

Alpha (α) ☐

Beta (β) ☐

Gamma (γ) ☐

0 5 . 2 Which type of radiation is the most ionising?

[1 mark]

Tick **one** box.

Alpha (α) ☐

Beta (β) ☐

Gamma (γ) ☐

0 5 . 3 Which type of radiation has the longest range in air?

[1 mark]

Tick **one** box.

Alpha (α) ☐

Beta (β) ☐

Gamma (γ) ☐

Question 5 continues on the next page

Question 02 · continued

When radioactive isotopes in the Earth's crust decay they release energy.

The decay causes the heating of rocks in the crust.

0 5 . 4 **Figure 8** shows the decay of uranium–238 (U–238) into thorium–234 (Th–234).

Figure 8

$$^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He$$

Complete **Table 2** to show the number of neutrons and protons in the nuclei.

[2 marks]

Table 2

Isotope	Number of neutrons	Number of protons
uranium–238	146	
thorium–234		90

0 5 . 5 Geothermal power stations pump water through heated rocks.

The temperature of the water increases from 20 °C to its boiling point of 100 °C

Calculate the change in thermal energy when the mass of water heated is 150 kg

Specific heat capacity = 4 200 J/kg °C

Use the Physics Equations Sheet.

[3 marks]

Change in thermal energy = _____ J

8

6.1.3 National and global energy resources

Question 03

June 2019 | 8464/P/1F | Original Q2

0 2 A student investigated how the area of a solar panel affected the output potential difference of the solar panel.

The student placed different sized solar panels under a lamp.

Figure 3 shows a solar panel under a lamp.

Figure 3



0 2 . 1 Which variable should be controlled?

[1 mark]

Tick (✓) **one** box.

- The area of the solar panels ☐
- The brightness of the lamp ☐
- The output potential difference of the solar panels ☐

6.1.3 National and global energy resources

Question 03 · continued

0 2 . 2 The student measured the output potential difference using a voltmeter.

When the voltmeter was **not** connected, the reading on the voltmeter was 0.7 V

What name is given to this type of error?

[1 mark]

Tick (✓) **one** box.

Zero error ☐

Random error ☐

Measurement error ☐

Question 2 continues on the next page

Table 1 shows the results of the investigation.

Table 1

Solar panel	Area of solar panel in cm^2	Output potential difference in volts			
		Test 1	Test 2	Test 3	Mean
A	10	2.5	2.4	2.6	2.5
B	20	5.0	5.0	4.9	5.0
C	30	7.5	11.9	7.5	7.5
D	50	12.4	12.6	12.5	12.5

0 2 . 3 The readings for which solar panel show an anomalous result?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 2 . 4 The student did **not** have a solar panel with an area of 40 cm^2

Determine the most likely value for the mean output potential difference of a 40 cm^2 solar cell.

[1 mark]

Mean output potential difference = _____ V

6.1.3 National and global energy resources

Question 03 · continued

0 2 . 5 The total input energy transfer to one of the solar panels was 8.0 joules.

The useful output energy transfer was 0.96 joules.

Calculate the efficiency of the solar panel.

Use the equation:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

[2 marks]

Efficiency = _____

0 2 . 6 Solar power is a renewable energy resource.

Complete the sentence.

Choose the answer from the box.

[1 mark]

burned	**replenished**	**consumed**

A renewable energy resource is one that is _____ as it is used.

Question 2 continues on the next page

Question 03 · continued

0 2 . 7 Some homes have solar panels which generate electricity.

On a sunny day the potential difference across a solar panel is 31 volts.

A charge of 490 coulombs flows through the solar panel.

Calculate the energy transferred by the solar panel.

Use the equation:

energy transferred = charge flow × potential difference

Give your answer to 2 significant figures.

[3 marks]

Energy transferred = _____ J

0 2 . 8 Why do solar panels on homes help reduce the environmental impact of using electrical devices?

[1 mark]

Tick (✓) **one** box.

Less electricity is used in the home. ☐

Less fossil fuel is burned. ☐

The electricity from the solar panels is cheaper. ☐

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6.1.3 National and global energy resources

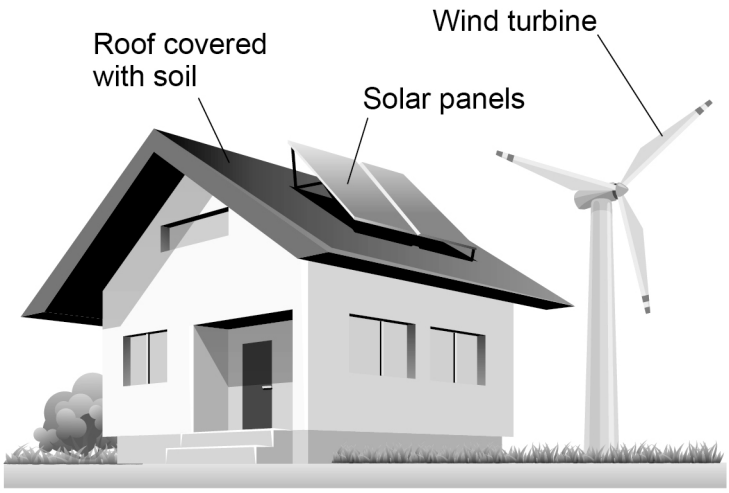
Question 04

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. ☐

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

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

6.1.3 National and global energy resources

Question 04 · 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]

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6.1.3 National and global energy resources

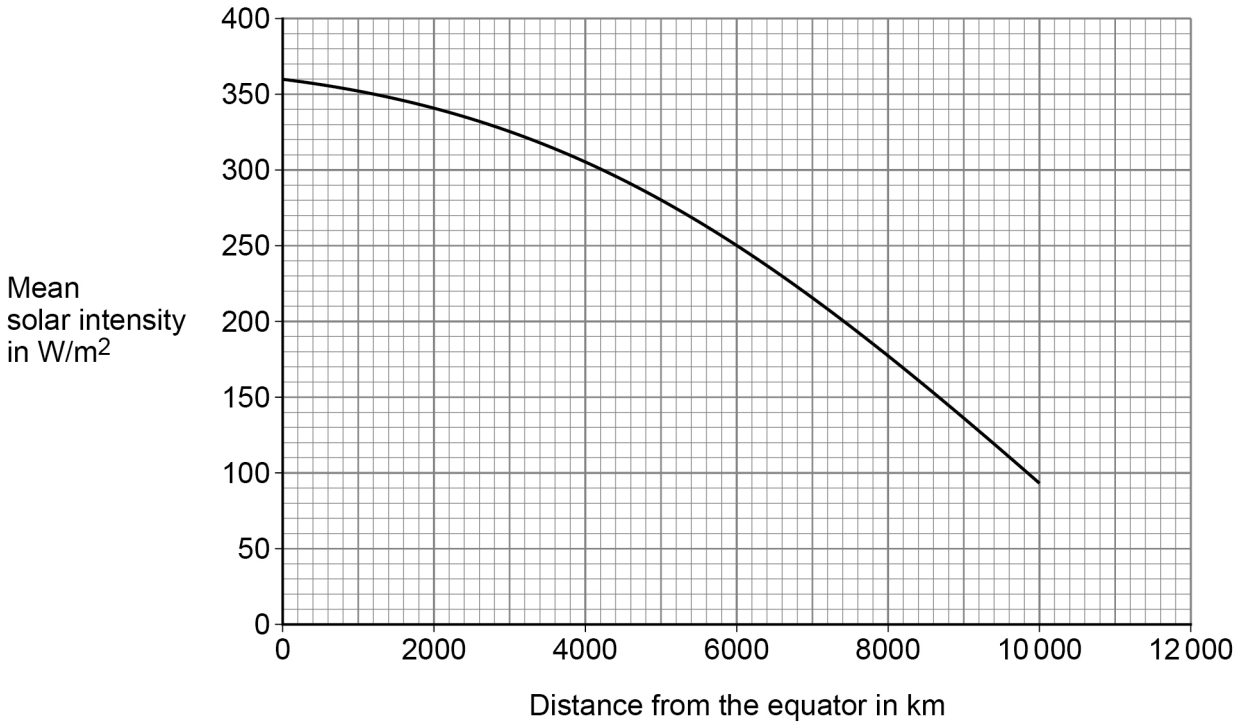
Question 05

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

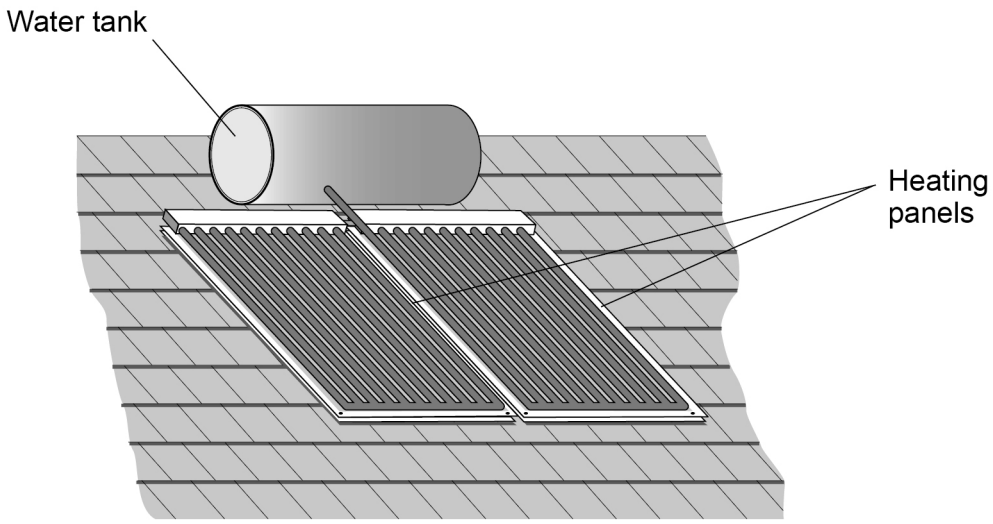
Question 05 · continued

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.

Question 05 · 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. ☐

Question 05 · 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** ☐

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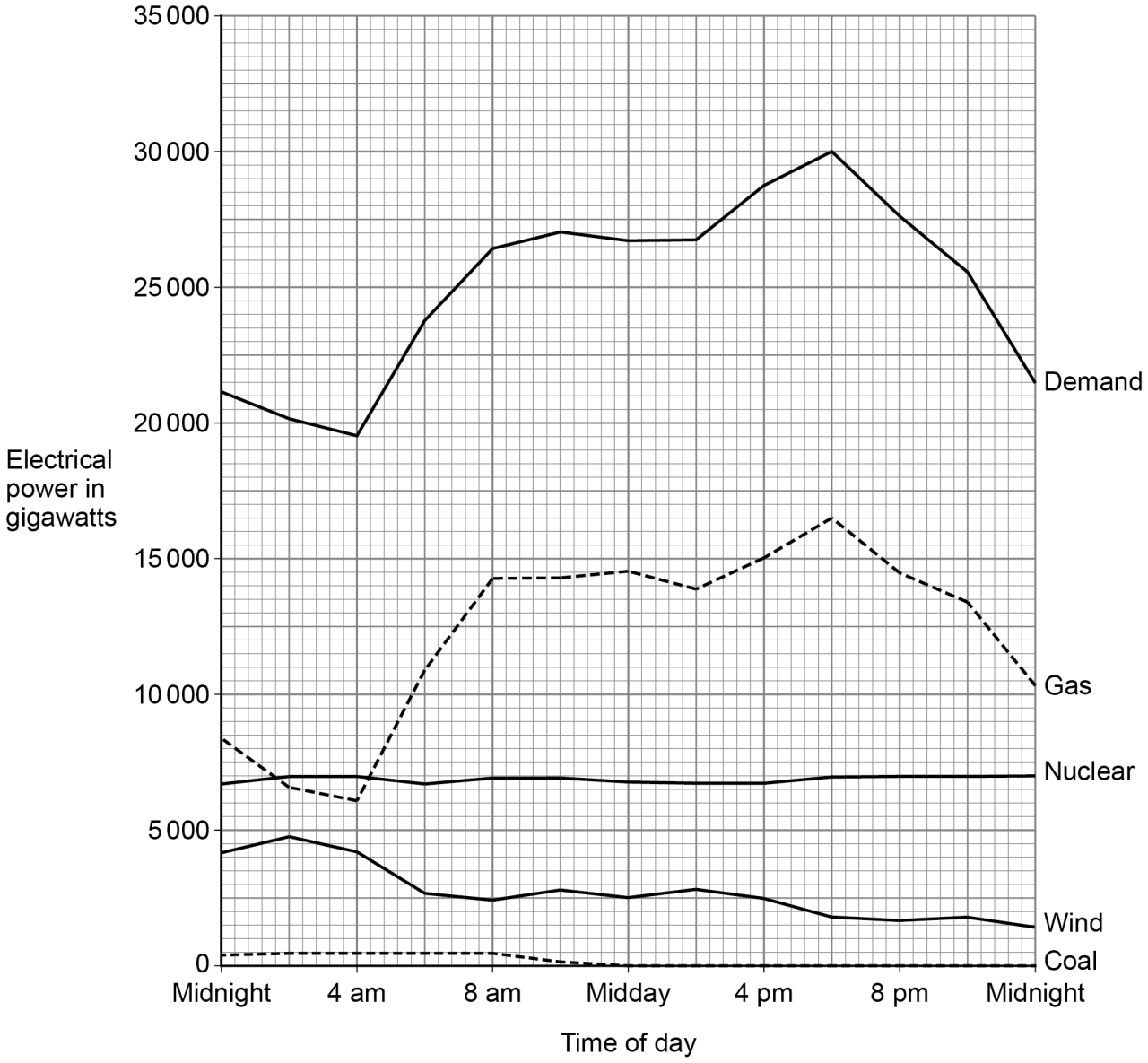
6.1.3 National and global energy resources

Question 06

June 2022 | 8464/P/1F | Original Q5

0 5 **Figure 9** shows some of the energy resources used to meet the demand for electrical power in the UK on one day in 2020.

Figure 9



6.1.3 National and global energy resources

Question 06 · continued

0 5 . 1 The maximum demand for electrical power on that day was at 6 pm.

Determine the percentage of the maximum demand for electrical power that was generated using gas.

[3 marks]

Percentage = _____ %

0 5 . 2 The UK government wants to reduce carbon emissions as much as possible.

Which energy resources need to be used less to achieve this?

[1 mark]

Tick (✓) **one** box.

- Coal and gas ☐
- Gas and nuclear ☐
- Wind and coal ☐
- Wind and nuclear ☐

Question 5 continues on the next page

6.1.3 National and global energy resources

Question 06 · continued

A network of transformers and transmission cables transfers electrical power from power stations to consumers.

0 5 . 3 What is this network called?

[1 mark]

0 5 . 4 Explain how using step-up transformers makes the network efficient.

[3 marks]

8

6.1.3 National and global energy resources

Question 07

June 2023 | 8464/P/1F | Original Q5

0 5 Wind power and solar power are both renewable energy resources used to generate electricity for the National Grid.

0 5 . 1 Which of the following is also a renewable energy resource?

[1 mark]

Tick (✓) **one** box.

- Geothermal ☐
- Natural gas ☐
- Nuclear fuel ☐

0 5 . 2 The energy transferred by the National Grid in one second was 36 gigajoules (GJ).

Which of the following is the same as 36 gigajoules?

[1 mark]

Tick (✓) **one** box.

- 36×10^3 J ☐
- 36×10^6 J ☐
- 36×10^9 J ☐
- 36×10^{12} J ☐

Question 5 continues on the next page

Question 07 · continued

0 5 . 3 **Figure 6** shows how the mean power output from solar and wind energy resources in the UK varied between 2014 and 2019.

Figure 6

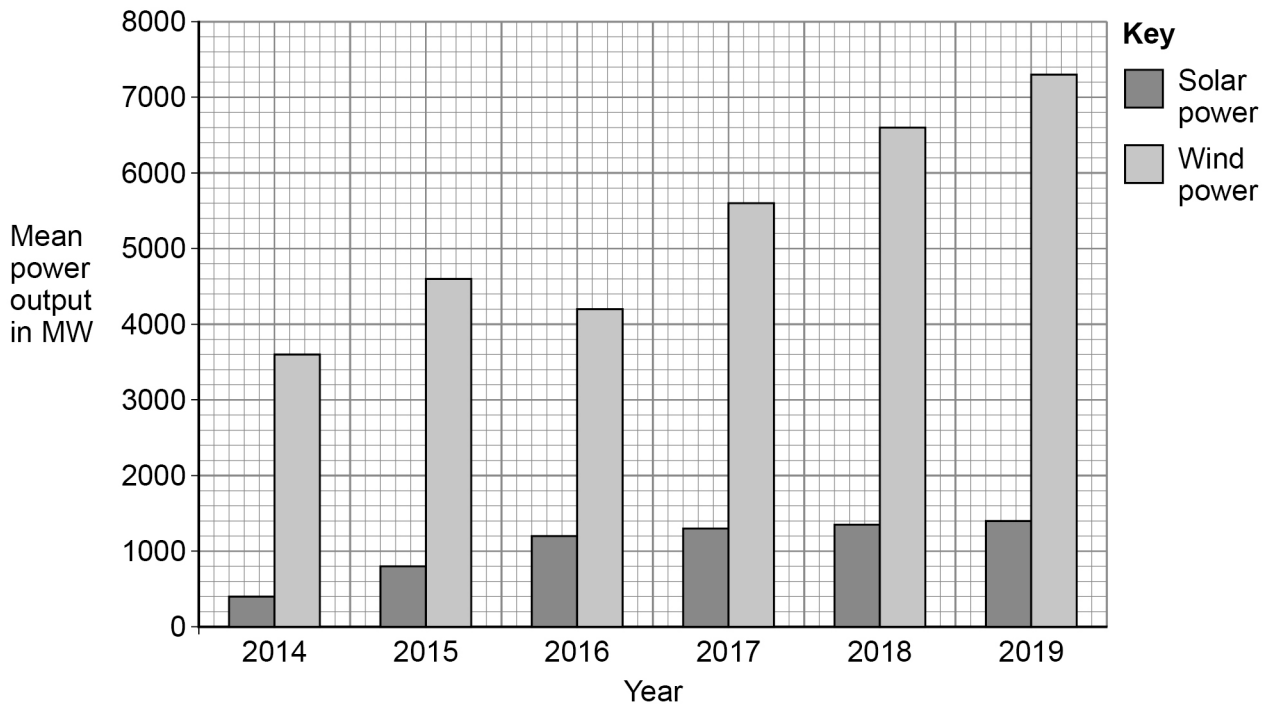
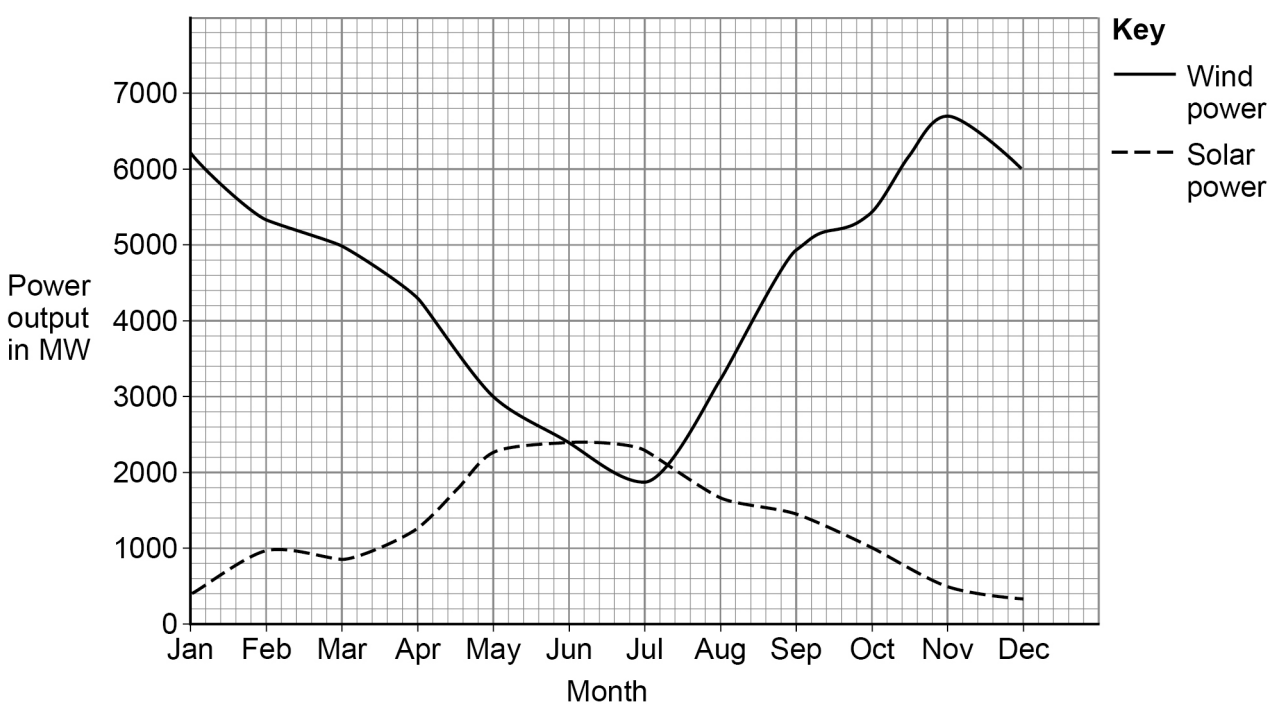


Figure 7 shows how the power output from solar and wind energy resources varies in a typical year.

Figure 7



6.1.3 National and global energy resources

Question 07 · continued

Explain the changes in power output from solar and wind energy resources between 2014 and 2019.

You should include an explanation of the change in power output during a typical year.

[6 marks]

8

6.1.3 National and global energy resources

Question 08

June 2024 | 8464/P/1F | Original Q2

0 2 **Figure 2** shows an outdoor swimming pool.

The water in the swimming pool comes from the sea.

Figure 2



The water in the pool is heated using a geothermal energy resource.

0 2 . 1 Which of the following describes a geothermal energy resource?

[1 mark]

Tick (✓) **one** box.

A non-renewable energy resource with high carbon emissions. ☐

A non-renewable energy resource with low running costs. ☐

A renewable energy resource that uses hot rocks underground. ☐

A renewable energy resource that uses the tides. ☐

0 2 . 2 15 kg of seawater is heated before it is added to the pool.

specific heat capacity of seawater = 3800 J/kg °C

Calculate the change in thermal energy of 15 kg of seawater when its temperature is increased by 9.0 °C.

Use the equation:

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

[2 marks]

Change in thermal energy = _____ J

0 2 . 3 The energy transferred from 1.0 m^2 of the surface of the pool to the air is 80 J each second.

The surface area of the pool is 120 m^2.

Calculate the energy transferred from the whole surface of the pool to the air each second.

[1 mark]

Energy transferred each second = _____ J

Question 2 continues on the next page

Question 08 · continued

0 2 . 4 Which of the following units is the same as 1 J/s?

[1 mark]

Tick (✓) **one** box.

1 N ☐

1 Pa ☐

1 W ☐

0 2 . 5 The pool is above sea level.

5.0 kg of water is pumped from sea level into the pool.

The water gains 196 J of gravitational potential energy.

gravitational field strength = 9.8 N/kg

Calculate the height of the pool above sea level.

Use the equation:

$$\text{height} = \frac{\text{gravitational potential energy}}{\text{mass} \times \text{gravitational field strength}}$$

[2 marks]

Height = _____ m

6.1.3 National and global energy resources

Question 08 · continued

0 2 . 6 The water in some swimming pools is heated by burning fossil fuels.

Explain **one** environmental **disadvantage** of burning fossil fuels.

[2 marks]

9

Turn over for the next question

6.1.3 National and global energy resources

Question 09

June 2025 | 8464/P/1F | Original Q5

0 5 Fossil fuels are burned in car engines and in power stations.

0 5 . 1 Describe how different energy stores change in a car engine when a fossil fuel is burned.

[2 marks]

0 5 . 2 Some car engines burn a fuel that is produced using plants.

Name a fuel produced using plants.

[1 mark]

0 5 . 3 Some cars do **not** contain an engine that burns a fuel.

Suggest how cars that do **not** burn a fuel are powered.

[1 mark]

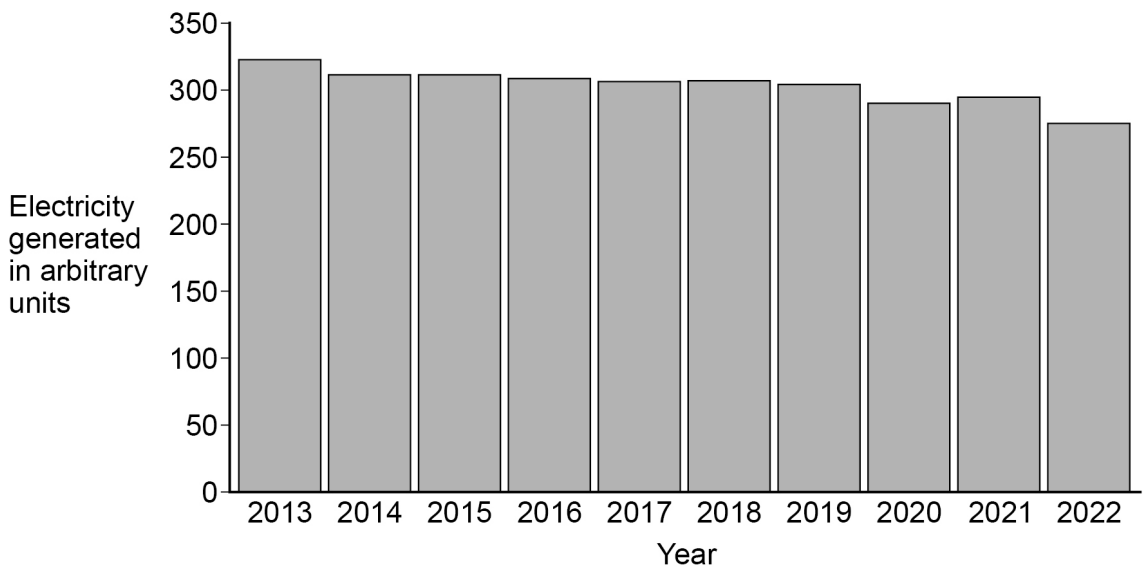
Question 5 continues on the next page

6.1.3 National and global energy resources

Question 09 · continued

Figure 6 shows how the total amount of electricity generated in the UK has changed with time.

Figure 6



0 5 . 4 The proportion of electricity that is generated using renewable energy resources has increased since the year 2013.

Which conclusion is correct?

Use **Figure 6**.

[1 mark]

Tick (✓) **one** box.

The amount of fossil fuel that is burned to generate electricity each year has decreased. ☐

The concentration of carbon dioxide in the atmosphere has decreased. ☐

The rate of increase of the mean temperature of the atmosphere has decreased. ☐

6.1.3 National and global energy resources

Question 09 · continued

0 5 . 5 The UK plans to stop burning fossil fuels to generate electricity.

Explain **one** reason why it will take many years before all electricity is generated using renewable resources.

[2 marks]

0 5 . 6 Renewable energy resources can have a negative impact on the environment.

Give **one** negative environmental impact of hydro-electric power and of wind power.

[2 marks]

Hydro-electric power _____

Wind power _____

9