



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

A-level

ENVIRONMENTAL SCIENCE

Paper 1

Monday 19 May 2025

Morning

Time allowed: 3 hours

Materials

For this paper you may use:

- a calculator.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions 1 to 10 and **one** essay from question 11.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 120.
- All questions should be answered in continuous prose.
- You will be assessed on your ability to:
 - use good English
 - organise information clearly
 - use specialist vocabulary where appropriate.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	



J U N 2 5 7 4 4 7 1 0 1

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7447/1

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ANSWER IN THE SPACES PROVIDED**



Answer **all** questions in the spaces provided.

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0 1

Table 1 shows information about methods of exploitation of water sources and methods of water management.

Complete **Table 1**.

The first line has been completed for you.

[5 marks]

Table 1

Exploitation of water source or water management	Name of method	Description of exploitation or water management
Exploitation	Rainwater catchment	Collection and storage of atmospheric water
Exploitation		A structure built across the river, near the sea, used to harness energy
Exploitation		Sharing of water between river catchment areas or reservoirs
Exploitation	Aquifer use	
Management		Recording and calculating domestic water use
Management	Grey water use	

5

Turn over ►



0 2

Figure 1 shows global electricity supply (%) by source from 2000 and predicted supply (%) to 2050.

Figure 1

Graph showing global electricity supply (%) by source from 2000 and predicted supply (%) to 2050.

Electricity supply sources:

Wind / Solar / Other renewables / Nuclear / Oil / Coal and gas with CCS / Gas / Coal

Accessed via:

<https://about.bnef.com/insights/clean-energy/new-energy-outlook/>

Figure 1 not reproduced here due to third-party copyright restrictions.

0 2

1

Describe the trend in the percentage contribution of solar power to global electricity supply from 2000 to 2050.

Use data from **Figure 1** in your answer.

[1 mark]

0 2

2

Calculate the difference in the percentage contribution of renewable energy to global electricity supply from 2020 to 2050 in **Figure 1**.

Show your working.

[1 mark]

_____ %



0	2	.	3
---	---	---	---

Suggest **three** reasons why it is difficult to predict the contribution of different energy sources to global electricity supply.

[3 marks]

1 _____

2 _____

3 _____

5

Turn over for the next question

Turn over ►



0 3

Ionising radiation is used in many industries. Contamination and exposure to ionising radiation may have harmful effects on human health.

0 3 . 1

Define the terms 'contamination' and 'exposure'.

[2 marks]

Contamination _____

Exposure _____

Increasing the distance from a radioactive source decreases the dose of radiation received.

Table 2 shows the fraction of the dose of radiation received at increasing distances from a radioactive source.

Table 2

Distance from source / m	Dose received as a fraction of the dose at 1 m
1	1
2	1/4
3	1/9
4	1/16
5	1/25
	1/64
10	1/100
15	
20	1/400

0 3 . 2

Use the data in **Table 2** to complete the missing values.

[2 marks]

0 3 . 3

The data in **Table 2** demonstrates the inverse square law.

Describe the inverse square law.

[1 mark]

0 3 . 4

Nuclear fusion is currently being researched as a resource for power production.

Describe the advantages and disadvantages of using nuclear fusion for power production in the future.

[5 marks]

10

Turn over for the next question

Turn over ►



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0 4

Monitoring the concentration of greenhouse gases can help assess the relative impacts on climate change.

Table 3 shows atmospheric concentration, residence time and global warming potential for three greenhouse gases.

Global warming potential is an index to show the amount of energy 1 tonne of greenhouse gas will absorb over a 100-year period, compared to 1 tonne of carbon dioxide.

Table 3

Table showing atmospheric concentration in 1750 (pre-industry), atmospheric concentration in 2019, residence time and global warming potential for three greenhouse gases; carbon dioxide, methane and nitrous oxide.

Accessed via:

<https://css.umich.edu/publications/factsheets/climate-change/greenhouse-gases-factsheet>
'The Main Greenhouse Gases'

Table 3 not reproduced here due to third-party copyright restrictions.

0 4**1**

Carbon dioxide is the greatest risk for future climate change.

Give **two** pieces of evidence from **Table 3** to support this statement.

[2 marks]

1 _____

2 _____

Question 4 continues on the next page

Turn over ►



0	4	.	2
---	---	---	---

In 2023, scientists modelled the effect of a future increase and decrease in carbon dioxide and methane emissions and their contribution to tropospheric warming between 2023 and 2073.

Figure 2a shows the modelled **increase** in carbon dioxide and methane emissions.

Figure 2a

Graph showing the modelled increase in carbon dioxide and methane emissions between 2023 and 2073.

Accessed via:

<https://oms->

[www.files.svdcdn.com/production/downloads/academic/Climate_Metrics_%20Under_%20Ambitious%20_Mitigation.pdf](https://oms-www.files.svdcdn.com/production/downloads/academic/Climate_Metrics_%20Under_%20Ambitious%20_Mitigation.pdf)

Page 2

Figure 2a not reproduced here due to third-party copyright restrictions.

Figure 2b shows the individual contributions of carbon dioxide and methane emissions to tropospheric warming for the increase of emissions shown in **Figure 2a**.

Figure 2b

Graph showing the individual contributions of carbon dioxide and methane emissions to tropospheric warming for the increase of emissions shown in **Figure 2a**.

Accessed via:

<https://oms->

[www.files.svdcdn.com/production/downloads/academic/Climate_Metrics_%20Under_%20Ambitious%20_Mitigation.pdf](https://oms-www.files.svdcdn.com/production/downloads/academic/Climate_Metrics_%20Under_%20Ambitious%20_Mitigation.pdf)

Page 2

Figure 2b not reproduced here due to third-party copyright restrictions.



Figure 3a shows the modelled **decrease** in carbon dioxide and methane emissions.

Figure 3a

Graph showing the modelled **decrease** in carbon dioxide and methane emissions.

Accessed via:

<https://oms->

[www.files.svdcn.com/production/downloads/academic/Climate_Metrics_%20Under_%20Ambitious%20_Mitigation.pdf](https://oms-)

Page 2

Figure 3a not reproduced here due to third-party copyright restrictions.

Figure 3b



Complete **Figure 3b** to show the individual contributions of carbon dioxide and methane emissions to tropospheric warming between 2023 and 2073 for the decrease in emissions shown in **Figure 3a**.

Use information from **Table 3 on page 9**, **Figure 2a**, **Figure 2b** and **Figure 3a**.

[3 marks]

Turn over ►



0	4	.	3
---	---	---	---

Describe **three** control methods that reduce methane emissions.

[3 marks]

1 _____

2 _____

3 _____



Figure 4 shows the contribution of different greenhouse gases and aerosols to the mean temperature change in 2010–2019 relative to mean values from 1850–1900.

Figure 4

Graph showing the contribution of different greenhouse gases and aerosols to the mean temperature change in 2010–2019 relative to mean values from 1850–1900.

Green house gases shown in graph:

Carbon dioxide / Methane / Nitrous oxide / Halogenated gases / Nitrogen oxides /
Other gases / Sulfur dioxide / Organic compound / Ammonia / Black carbon

Accessed via:

https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf
Page 7, Figure SPM.2(c)

Figure 4 not reproduced here due to third-party copyright restrictions.

0 4 . 4

Calculate the change in mean temperature in 2010–2019 caused by **only** greenhouse gases.

Use **Figure 4**.

[1 mark]

_____ °C

Turn over ►



0	4	.	5
---	---	---	---

Explain how a change in atmospheric aerosols and greenhouse gases can change the Earth's surface temperature.

[4 marks]

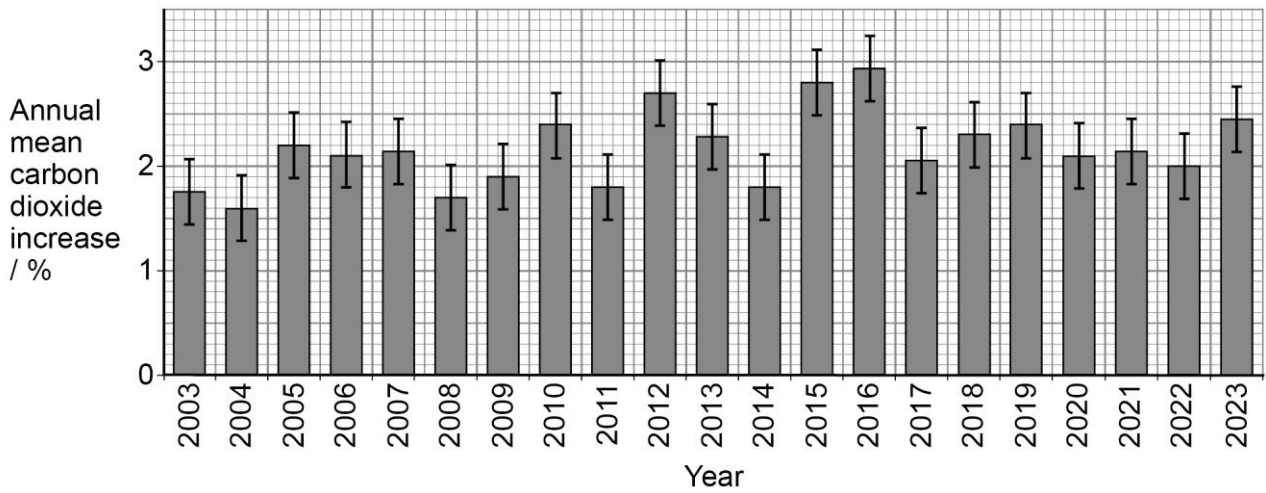
Aerosols _____

Greenhouse gases _____



Figure 5 shows the annual mean percentage increase of carbon dioxide from 2003 to 2023, with standard deviation bars.

Figure 5



Scientists compared the annual mean percentage increases in carbon dioxide to investigate between which pairs of **consecutive years** there was a significant difference.

0 4 . 6

Identify **one** pair of **consecutive** years in **Figure 5** where the scientists could be confident of a significant difference in the annual mean percentage increase in carbon dioxide.

Explain your answer.

[2 marks]

Years _____ and _____

Explanation _____

15

Turn over for the next question

Turn over ►

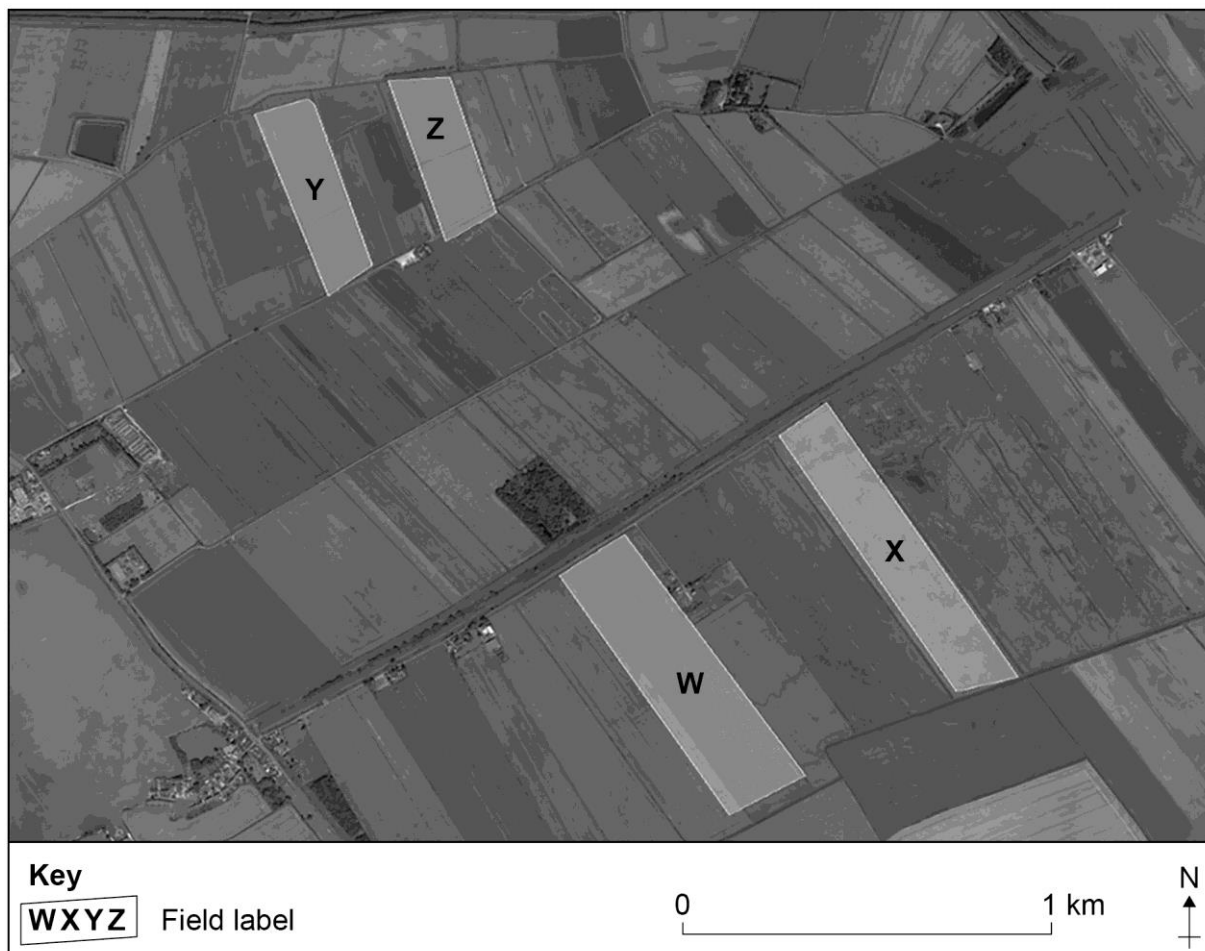


0 5

Students plan to investigate if there is a significant difference in mean erosion rates for agricultural fields with different slope angles in the same area of the UK.

Figure 6 shows the location of the four fields in this study.

Figure 6



Information about the sites

- All fields slope to the south-east.
- Fields **W** and **X** have an angle of 4 degrees.
- Fields **Y** and **Z** have an angle of 7 degrees.

Table 4 shows additional information about the management and soil texture for each field in **Figure 6**.

Table 4

Field	Management	Soil texture
W	Bare soil	Sandy
X	Grass for livestock	Clay loam
Y	Grass for livestock	Sandy
Z	Mulching	Loam



Only **one** answer per question is allowed.

For each question completely fill in the circle alongside the appropriate answer.

CORRECT METHOD



WRONG METHODS



If you want to change your answer you must cross out your original answer as shown.



If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown.



0 5 . 1 Soil erosion rates in **Figure 6** are lowest at field **Z**.

Identify which of the following represents the correct order from **least to greatest** rates of soil erosion.

Use the information in **Table 4 only**.

Shade **one** box only.

[1 mark]

A Z, X, W, Y

☐

B Z, X, Y, W

☐

C Z, Y, W, X

☐

D Z, Y, X, W

☐

0 5 . 2 Explain **two** reasons why soil erosion rates are lowest in field **Z**.

Use evidence from **Table 4 on page 16** in your answer.

[2 marks]

1 _____

2 _____

Question 5 continues on the next page

Turn over ►



0 5 . 3

Describe a method to investigate if there is a significant difference between mean erosion rates for fields with different slope angles.

Use information from **Figure 6 on page 16** and **Table 4 on page 16**.

[5 marks]

0 5 . 4

Desertification is a process that can change soil properties.

Explain how desertification may impact soil texture and organic matter.

[2 marks]

Soil texture _____

Organic matter _____

10



0 6

The Earth is affected by electromagnetic radiation which has an impact on the atmosphere.

0 6 . 1

State the process which converts electromagnetic energy to chemical energy.

[1 mark]

0 6 . 2

Explain the role of UV light in the thermal stratification of the stratosphere.

[2 marks]

0 6 . 3

Cirrus clouds are found in the upper troposphere.

Explain how they may affect the temperature of the troposphere.

[2 marks]

5

Turn over for the next question

Turn over ►

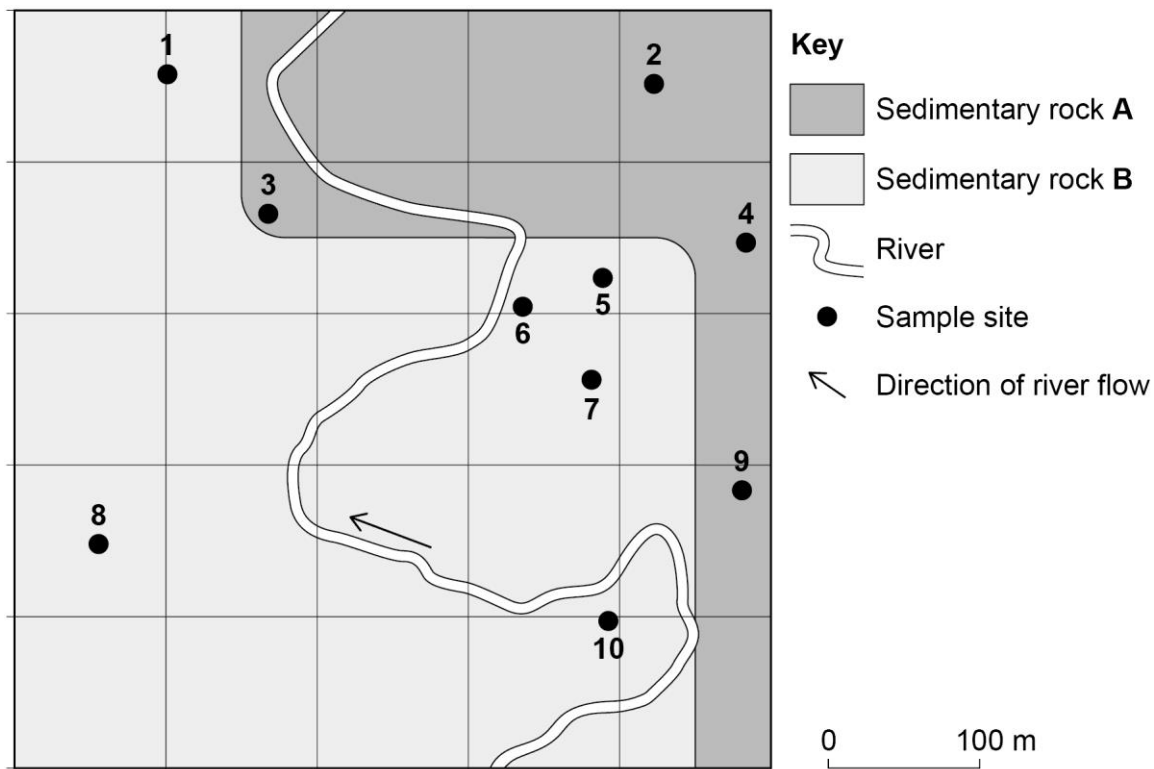


0 7

Students sampled part of a river catchment area with two sedimentary rocks to compare the amount of quartz in each type of rock.

Figure 7 shows a sketch of sample locations close to the river.

Figure 7



0 7 . 1

Calculate the ratio of the area of sedimentary rock **B** to the area of sedimentary rock **A** in **Figure 7**.

Give your answer to **one** decimal place.

Show your working.

[2 marks]

_____ :1



0 7 . 2

The students used random sampling to select the sampling sites.

Suggest **two** reasons why random sampling may **not** have been appropriate for this investigation.

Use **Figure 7**.

[2 marks]

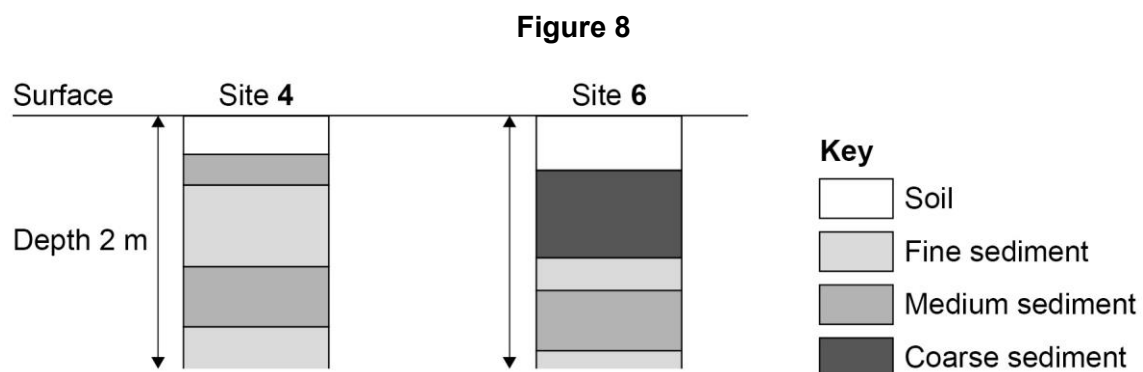
1 _____

2 _____

Quartz can be identified as a medium or coarse sediment in soil and rocks.

A vertical section through the soil and sedimentary rock is used to determine the amount and size of different sediments.

Figure 8 shows data collected from vertical sections at site **4** and site **6** in **Figure 7**.



The section at site **6** has a larger amount of quartz than the section at site **4**.

0 7 . 3

Use evidence from **Figure 8** to support this statement.

[1 mark]

Turn over ►



0 7 . 4

Explain why site **6** has a larger amount of quartz than site **4**.

Use evidence from **Figure 7 on page 20**.

[2 marks]

0 7 . 5

Quartz is one of the main components of sand in a soil sample.

Name and describe **one** method which is used to determine the proportion of sand particles in a soil sample.

[3 marks]

Method _____

Description _____

10


0	8
---	---

Many countries are choosing renewable energy sources to replace fossil fuels.

0	8	.	1
---	---	---	---

Suggest **two** reasons why biofuels may be chosen rather than other renewable energy sources.

[2 marks]

1 _____

2 _____

Question 8 continues on the next page

Turn over ►



Brazil is the world's largest producer of liquid biofuels for transport.
Sugar cane is grown for ethanol production for these liquid biofuels.

Table 5 shows information about ethanol and fossil fuels in Brazil.

$$1 \text{ PJ} = 10^{15} \text{ J}$$

ha = hectares

Table 5

Area used for ethanol production from sugar cane	5 000 000 ha
Productivity of sugar cane	78 000 kg ha ⁻¹
Total production of sugar cane	kg
Total energy supplied by ethanol from sugar cane	800 PJ
Energy density of ethanol	27 MJ kg ⁻¹
Mass of sugar cane converted to ethanol	kg
Total energy supplied per hectare	MJ ha ⁻¹
Energy supplied by diesel and petrol for transport fuels	2500 PJ

0 8 . 2 Use the data in **Table 5** to complete the **three** missing values.

[3 marks]



0 8 . 3

Calculate how much extra land would be needed to produce ethanol from sugar cane to replace **all** diesel and petrol used for transport fuels.

Use information in **Table 5**.

Give your answer in **standard form** and to **two** significant figures.

Show your working.

[3 marks]

_____ ha

0 8 . 4

Suggest **two** reasons why replacing fossil fuels with biofuels for transport may **not** be carbon neutral.

[2 marks]

1 _____

2 _____

10

Turn over for the next question

Turn over ►



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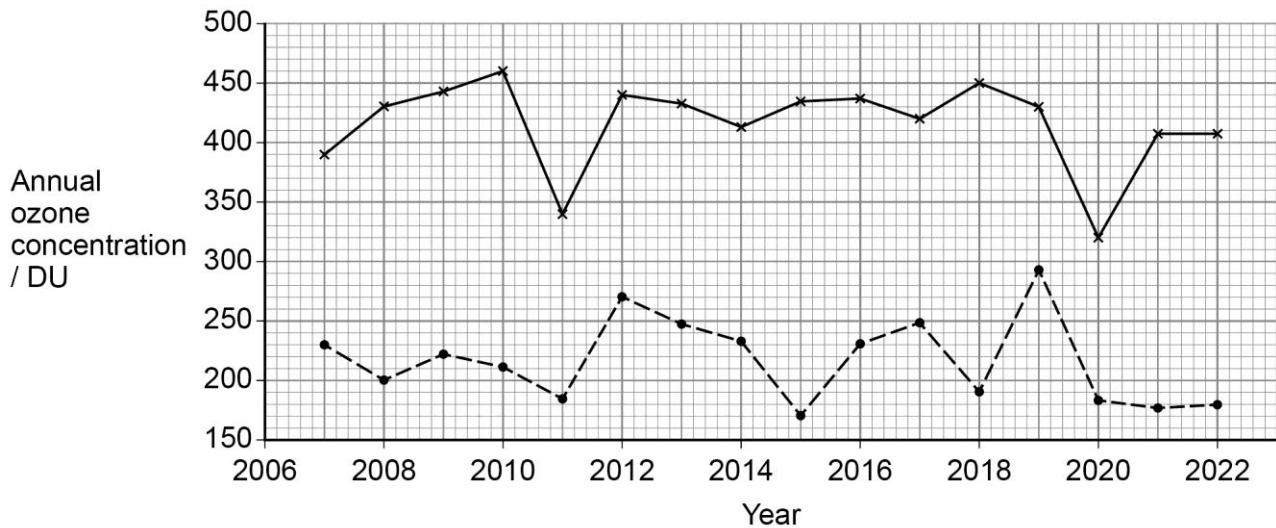
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0 9

Figure 9 shows the annual ozone concentrations from 2007 to 2022 for high latitude locations in the Northern and Southern Hemispheres. Ozone concentration is measured in Dobson units (DU).

Figure 9



Key

- ×—× Northern Hemisphere
- Southern Hemisphere

0 9 . 1

Students analysed the data in **Figure 9** and concluded that changes in the trends of Northern and Southern Hemisphere ozone concentrations are the same.

Give **two** reasons why this conclusion is **not** accurate.

Use data from **Figure 9** in your answer.

[2 marks]

1

2

Turn over ►



0 9 . 2

Explain why ozone concentrations are lower in high latitude locations in the Southern Hemisphere.

[4 marks]

0 9 . 3

Compare the effectiveness of methods used to reduce ozone depletion and methods used to reduce climate change.

[9 marks]



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1 0

The number of homes in the UK using wood-burning stoves has increased.

From 2023, the government made it illegal to burn wet wood in wood-burning stoves. Wet wood has more than 20% moisture content.

Burning wet wood emits more than twice the amount of particulate matter (PM10 and PM2.5) in smoke than burning dry wood.

1 0 . 1

Suggest **one** reason why burning wet wood emits more PM10 and PM2.5 than burning dry wood.

[1 mark]

A study was carried out during 2023 on atmospheric concentrations of PM2.5 at ten rural sites and ten urban sites across England. All the sites in the study were of a similar-sized area.

The urban sites chosen were all in areas where traffic emissions are controlled to minimise the effects of PM2.5 from road traffic.

1 0 . 2

Outline how wind, temperature and precipitation could affect the reliability of the results.

[3 marks]

Wind _____

Temperature _____

Precipitation _____



Monitoring equipment measured PM_{2.5} from wood-burning stoves and PM_{2.5} from other sources.

In the sites studied, there were more households with wood-burning stoves in the urban sites than in the rural sites.

Results from the study showed rural sites have higher mean PM_{2.5} concentrations from wood-burning stoves than urban sites.

1 0 . 3

Suggest **two** reasons why mean PM_{2.5} concentrations from wood-burning stoves in rural sites were greater than those in urban sites.

[2 marks]

1 _____

2 _____

Question 10 continues on the next page

Turn over ►



The study also found that the other sources of PM₁₀ and PM_{2.5} were different in the rural and urban sites.

1 0 . 4

Suggest **two** sources of particulate matter (PM) in the rural sites and **two different** sources of particulate matter (PM) in the urban sites.

Do **not** refer to particulate matter (PM) from wood-burning stoves in your answer.

[4 marks]

Rural sites

1 _____

2 _____

Urban sites

1 _____

2 _____

10



1	1	.	1
---	---	---	---

[25 marks]

1 1 . 2

[25 marks]

Question

1	1	.	1	
---	---	---	---	---

Question

1	1	.	2	
---	---	---	---	----------------------

CORRECT METHOD



WRONG METHODS

[illegible]

Turn over ►



[illegible]

[illegible]

[illegible]

[illegible]

25

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[illegible]

[illegible]

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