

Please write clearly, in block capitals.

Centre number

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

Candidate number

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

Surname

Forename(s)

Candidate signature

AS ENVIRONMENTAL SCIENCE

Paper 1

Date of Exam

Morning

Time allowed: 3 hours

Materials

For this paper you may have:

- 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. You must answer the questions in the spaces provided. Do **not** write on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

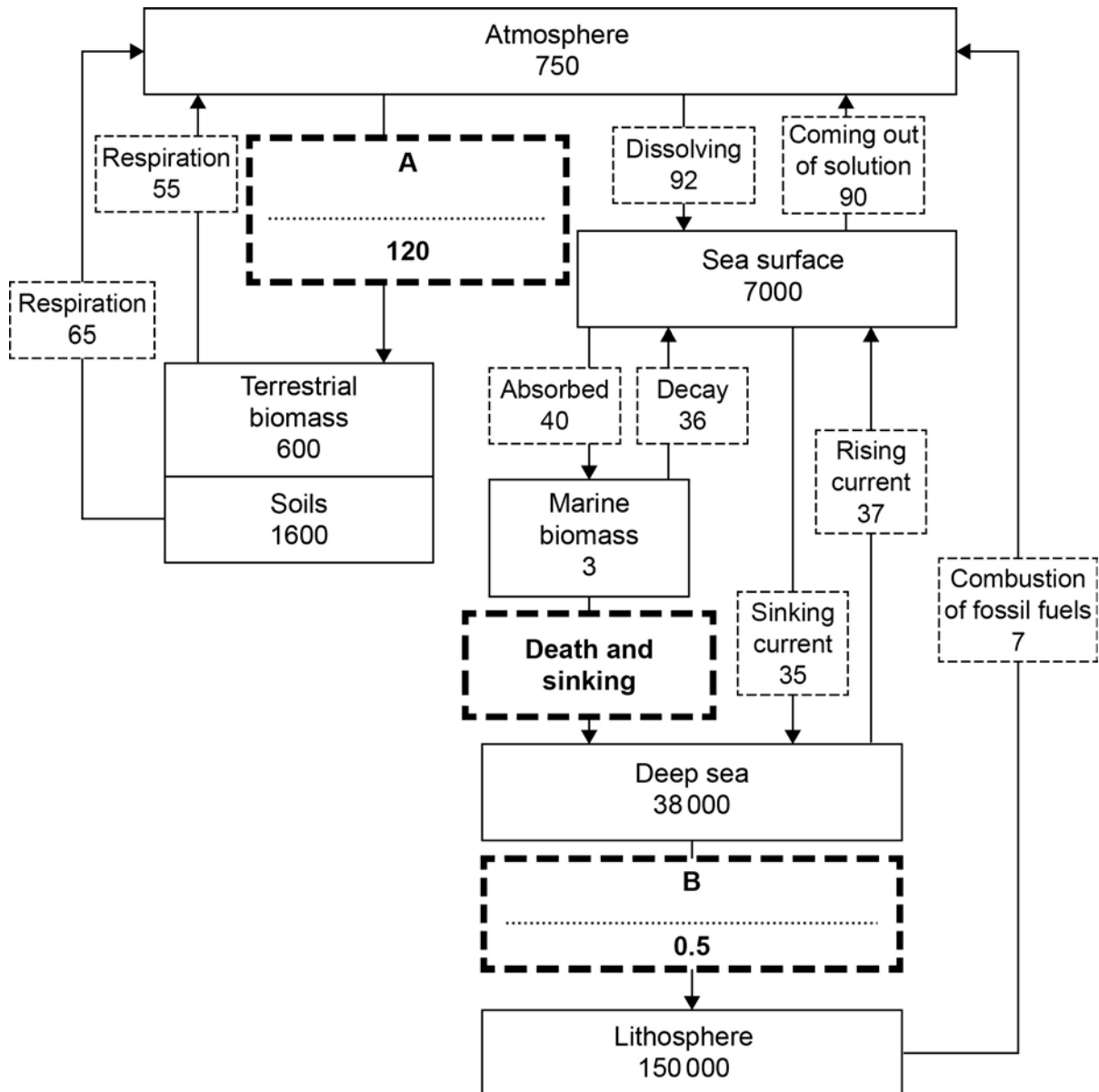
Information

- The marks for questions are shown in brackets.
 - The maximum mark for this paper is 120.
 - 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.
-

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

0 1 . 0 Figure 1 shows some features of the carbon cycle.

Figure 1



Key

Named reservoir with amount of carbon stored / 10^9 t

Named process with annual movement of carbon / 10^9 t

0 1 . **1** Complete **Figure 1** by adding the names of the **two** missing transfer processes **A** and **B**. [2 marks]

0 1 . **2** The amount of carbon in the marine biomass is in a state of dynamic equilibrium.
Calculate the amount of carbon moved annually from the marine biomass by the process of death and sinking. [1 mark]

_____ $\times 10^9$ t

0 1 . **3** Calculate the residence time for carbon dissolved in the sea surface reservoir, using the formula: [1 mark]

residence time = $\frac{\text{amount in the reservoir}}{\text{annual movement in or out of the reservoir}}$

_____ years

0 1 . **4** **Figure 1** shows that the amount of carbon in the atmosphere is **not** in a state of dynamic equilibrium. Growing more trees could help restore the balance of carbon in the atmosphere. [1 mark]

Calculate the mass of extra carbon that would have to be absorbed by trees to restore a state of dynamic equilibrium in the atmosphere.

_____ 10^9 t

Turn over for the next question

0 2 . 0 A student collected soil samples from a field to analyse the water and organic matter content.

Table 1 shows some of the results for two samples, **A** and **B**.

Table 1

| Item | Heating temperature / °C | Time since start of heating at that temperature / hours | Mass / g | |
|--|--------------------------|---|----------|----------|
| | | | Sample A | Sample B |
| Heating period 1 | | | | |
| Weighing dish | - | - | 9.42 | 9.56 |
| Original sample + weighing dish | | 0 | 31.02 | 26.15 |
| Sample + weighing dish | X °C | 12 | 23.68 | 24.29 |
| Sample + weighing dish | | 24 | 19.55 | 20.12 |
| Sample + weighing dish | | 36 | 18.33 | 19.95 |
| Sample + weighing dish | | 48 | 18.33 | 19.95 |
| Storage | | | | |
| Heating period 2 | | | | |
| Dried sample + weighing dish | Y °C | 50 | 18.33 | 19.95 |
| Sample + weighing dish | | 51 | 16.88 | 18.36 |
| Sample + weighing dish | | 52 | 14.43 | 17.42 |
| Sample + weighing dish | | 53 | 14.43 | 17.42 |

0 2 . 1 Suggest suitable heating temperatures for:

X _____ °C

Y _____ °C

[1 mark]

0 2 . **2** Use information from **Table 1** to calculate the percentage water content of **Sample A**.

[2 marks]

Show your working.

_____ %

0 2 . **3** What storage conditions are necessary to ensure the results of the second heating period are valid?

[1 mark]

0 2 . **4** After what time period from the start of heating can the organic matter content of **Sample B** be calculated?

[1 mark]

_____ hours

Turn over for the next question

Turn over ►

0 3 . **1** In the UK, Sand Lizards, *Lacerta agilis*, are protected by the Wildlife and Countryside Act (1981).

Describe how the Wildlife and Countryside Act (1981) protects animal species. **[2 marks]**

0 3 . **2** Give **two** scientific reasons why the conservation of wildlife is important for future agricultural productivity.

[2 marks]

0 3 . **3** Give **one** conservation designation that may be used to protect the habitat of endangered species in the UK.

[1 mark]

0 3 . **4** Explain why biological corridors are important in wildlife conservation.

[3 marks]

0 3 . 5 **Figure 2** shows leg rings used in ecological studies of birds and **Figure 3** shows a Bewick's Swan with an electronic tracking collar.

Figure 2

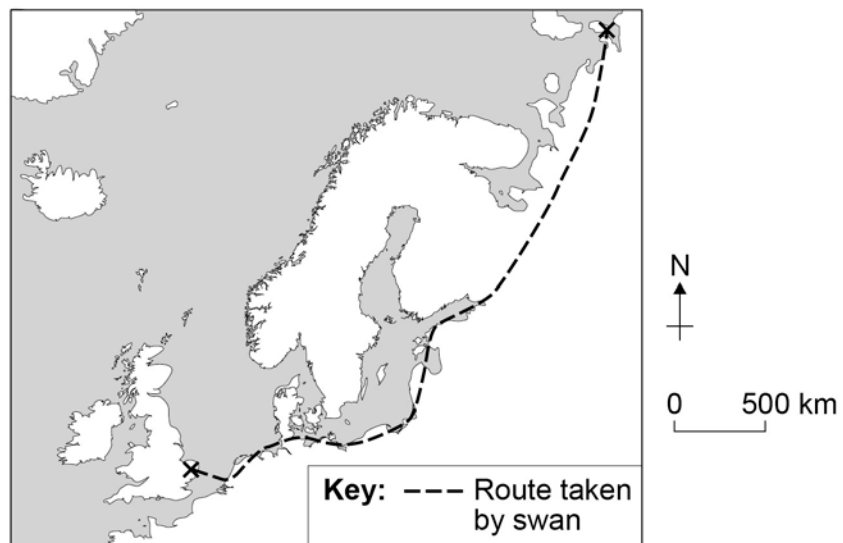


Figure 3



Figure 4 shows the route taken by one Bewick's Swan as it migrated from the UK to Russia.

Figure 4



Explain why the electronic tracking collar provides more useful information about swan migration than the leg rings.

[2 marks]

0 4 . 0 **Table 2** shows the carbon storage in trees and dead organic matter of three areas of forest.

Table 2

| | Mangrove forest | Temperate broadleaf forest | Tropical rainforest |
|--|------------------------|-----------------------------------|----------------------------|
| Total living biomass/ t ha ⁻¹ | 4320 | 2297 | 1558 |
| Water content of living biomass / % mass | 50 | 35 | 45 |
| Carbon in living biomass / % of total carbon | 32 | 45 | 85 |
| Above ground living biomass / % of total living biomass | 48 | 75 | 84 |
| Below ground living biomass / % total living biomass | 52 | 25 | 16 |
| Carbon in dead organic matter / t ha ⁻¹ | 660 | 180 | 120 |
| Carbon content of wood / % of dry biomass | 49.0 | 48.5 | 48.2 |

0 4 . 1 Use information from **Table 2** to calculate the mass of carbon dioxide that would be released if the trees from 25ha of mangrove forest were cut down and then burnt.

Atomic masses: C = 12, O = 16.

[3 marks]

Show your working

Mass of CO₂ _____

0 4 . **2**

Mangroves cover only 0.7% of tropical forest area, yet mangroves are thought to account for around 10% of the total carbon emissions caused by tropical deforestation.

Suggest why the deforestation of mangroves results in higher carbon emissions than the deforestation in other areas of tropical forest.

[2 marks]

0 4 . **3**

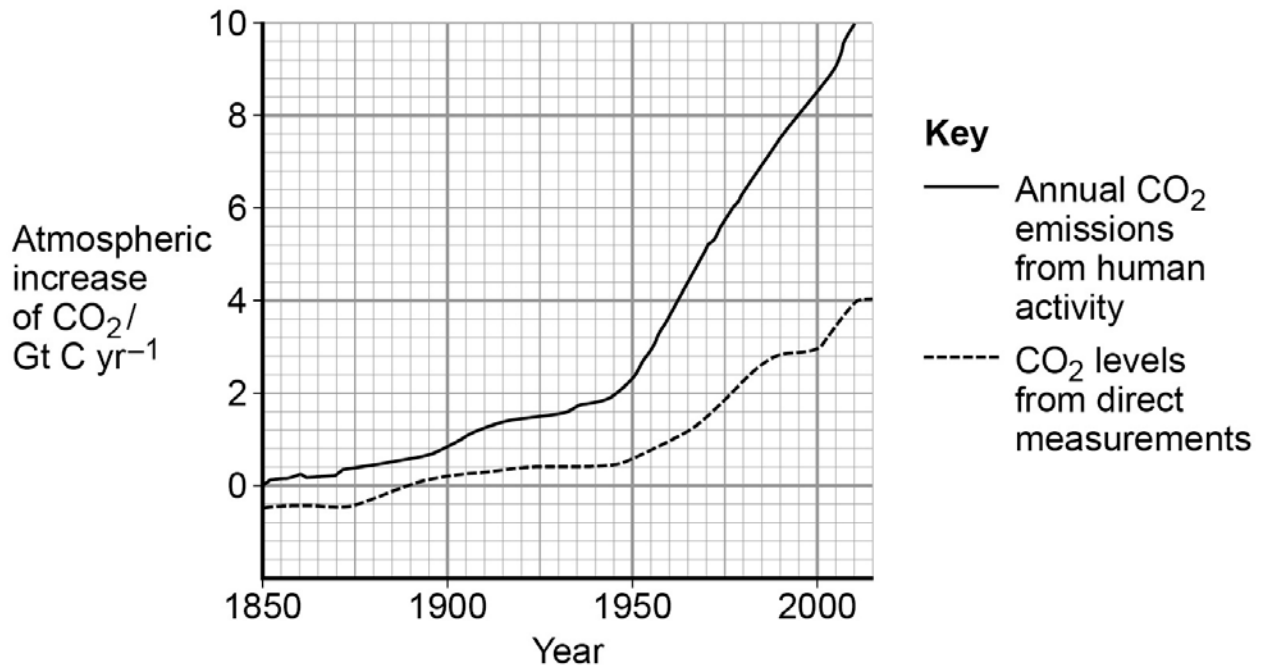
The suitability of mangrove forests as nursery areas for fish is affected by water turbidity.

Describe **one** method that may be used to collect representative data on water turbidity in mangroves.

[5 marks]

0 5 . 0 **Figure 5** shows the trends in atmospheric carbon dioxide concentrations and carbon dioxide emissions as a result of human activity.

Figure 5

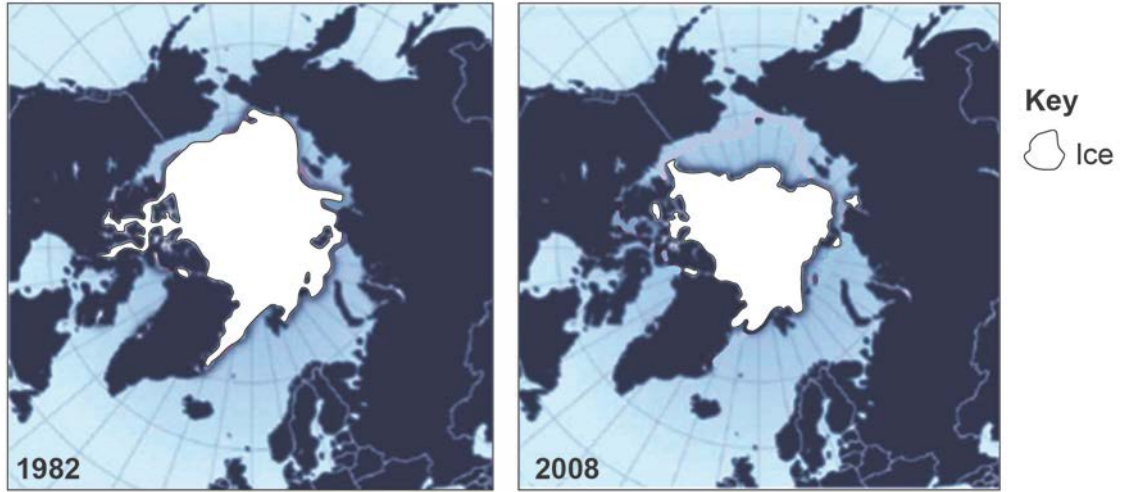


0 5 . 1 Explain why the values for the direct measurements of carbon dioxide levels in the atmosphere are lower than the values for emissions from human activity. **[2 marks]**

0 5 . 2

Figure 6 shows two maps of the sea ice present on the Arctic Ocean in September 1982 and September 2008.

Figure 6



This loss of sea ice area was greater than had been predicted by computer models.

Describe how a positive feedback mechanism may have contributed to the change in the area of sea ice in the Arctic Ocean.

[3 marks]

Question 5 continues on the next page

- 0 5** . **3** Outline **one** named remote sensing method that is used to measure the area of Arctic sea ice.

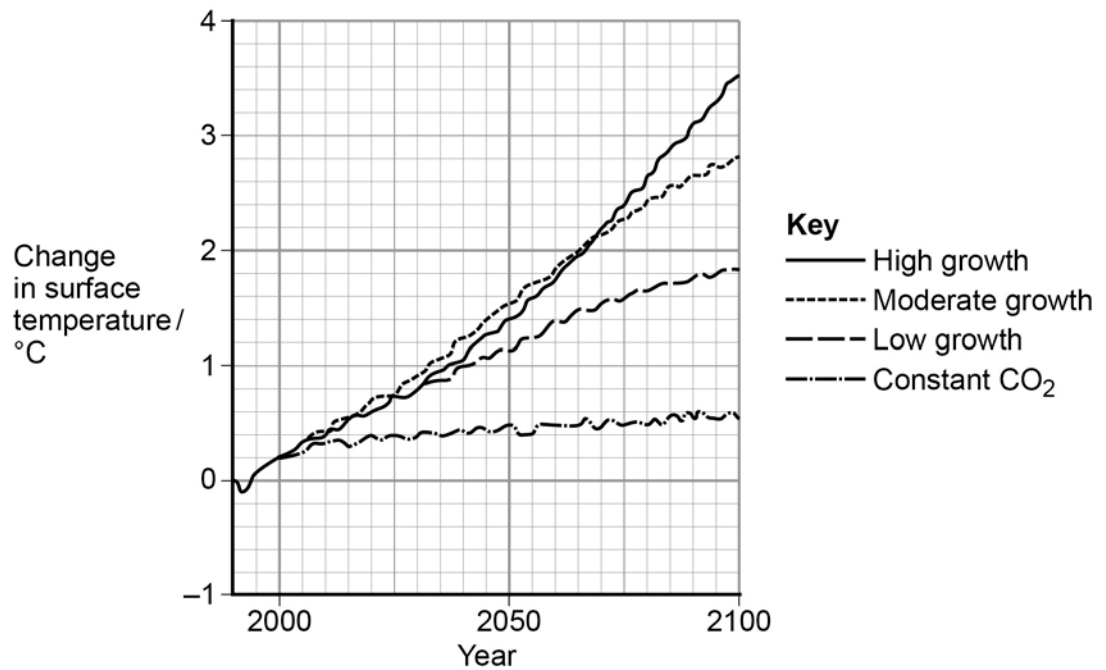
[2 marks]

- 0 5** . **4** Explain what is meant by the term 'tipping point' in climate regulation.

[1 mark]

- 0 5** . **5** **Figure 7** shows graphs of predicted warming produced by four computer models.

Figure 7



Describe how a computer model can be tested to see if it produces accurate results.

[2 marks]

0 6 . **1** Since the Earth formed, the light output of the Sun has increased by approximately 10% each billion years.

Explain how the evolution of photosynthetic organisms has regulated the Earth's temperature, despite the increase in the brightness of the Sun.

[2 marks]

0 6 . **2** Estimates of the historical temperatures on Earth are obtained from many sources.

Assess the accuracy of estimating the historical temperature of the Earth using dendrochronology.

[2 marks]

0 6 . **3** Describe how electronic technology may be used to monitor long term changes in the mean surface temperature of the Earth.

[2 marks]

Question 6 continues on the next page

0 6 . **4** **Table 3** shows data relating to some of the planets in our solar system.

Table 3

| Features | Planets | | |
|--|---------------------|------------|------------------|
| | Mercury | Venus | Earth |
| Distance to Sun / 10^6 km | 58 | 108 | 150 |
| Relative atmospheric pressure Earth = 1 | 1×10^{-14} | 92 | 1 |
| Relative light level Earth = 1 | 6.7 | 1.9 | 1 |
| Mean albedo | 0.12 | 0.75 | 0.30 |
| Mass / 10^{23} kg | 3.3 | 49.0 | 60.0 |
| Time to rotate on axis / hrs | 1416 | 5832 | 24 |
| Mean temperature / $^{\circ}\text{C}$ | 260 | 475 | 15 |
| Temperature range / $^{\circ}\text{C}$ | 100 to 700 | 465 to 480 | -88 to 58 |

Use data from **Table 3** and your own knowledge to explain how the distance from the Sun and the mass of a planet produce the conditions required for life to exist.

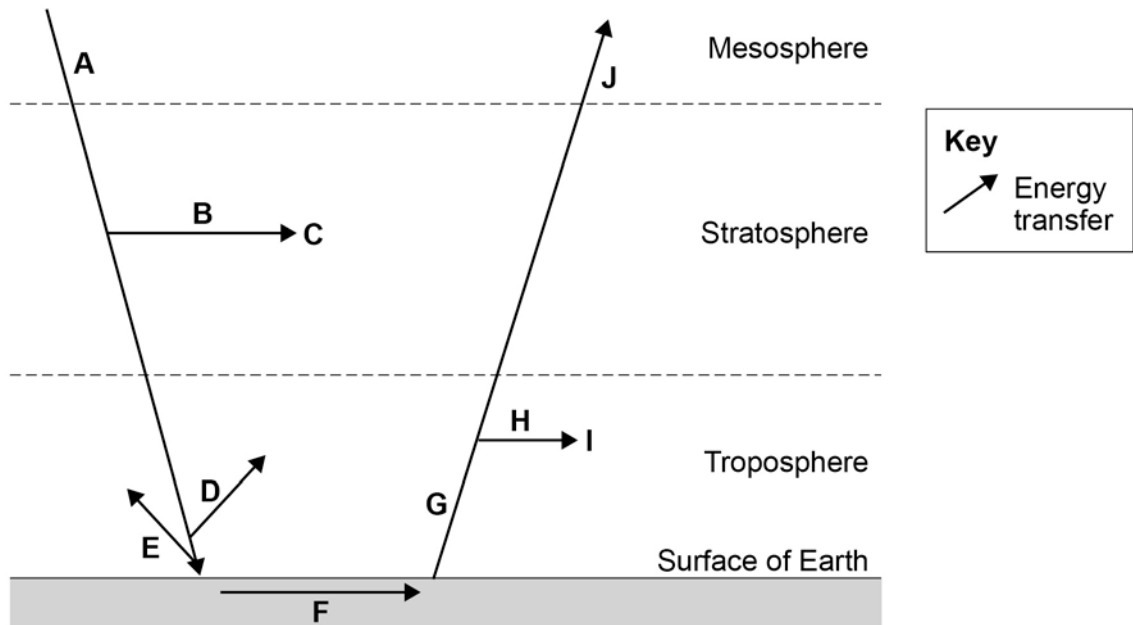
[4 marks]

Turn over for the next question

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

- 0 7 . 0** **Figure 8** shows some of the processes involved in the transfer of energy in the atmosphere.

Figure 8



- 0 7 . 1** Using the information in **Figure 8**, complete **Table 4** by writing the appropriate letter (**A-J**) for the processes identified.

Use any letter only **once**.

[2 marks]

Table 4

| Process | Letter from Figure 8 |
|--|----------------------|
| Ultraviolet light absorbed by ozone layer | |
| Infra red light absorbed by greenhouse gases | |

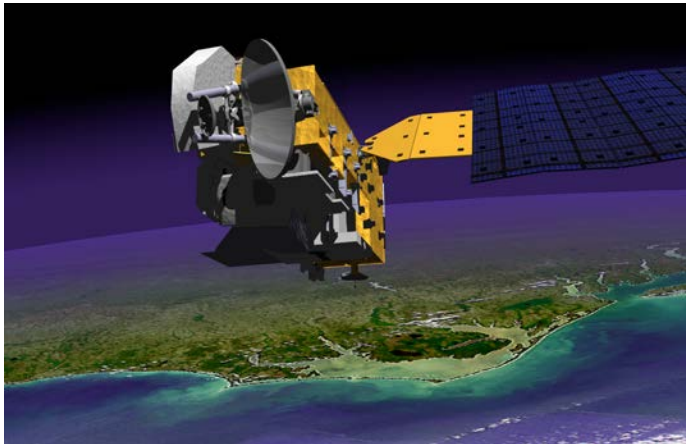
0 7 . 2 **Figure 9** shows two methods that are used to estimate atmospheric ozone concentrations.

Figure 9

A helium balloon that carries an ozone monitor being released over Antarctica.



An ozone monitoring instrument is carried by the Aura satellite.

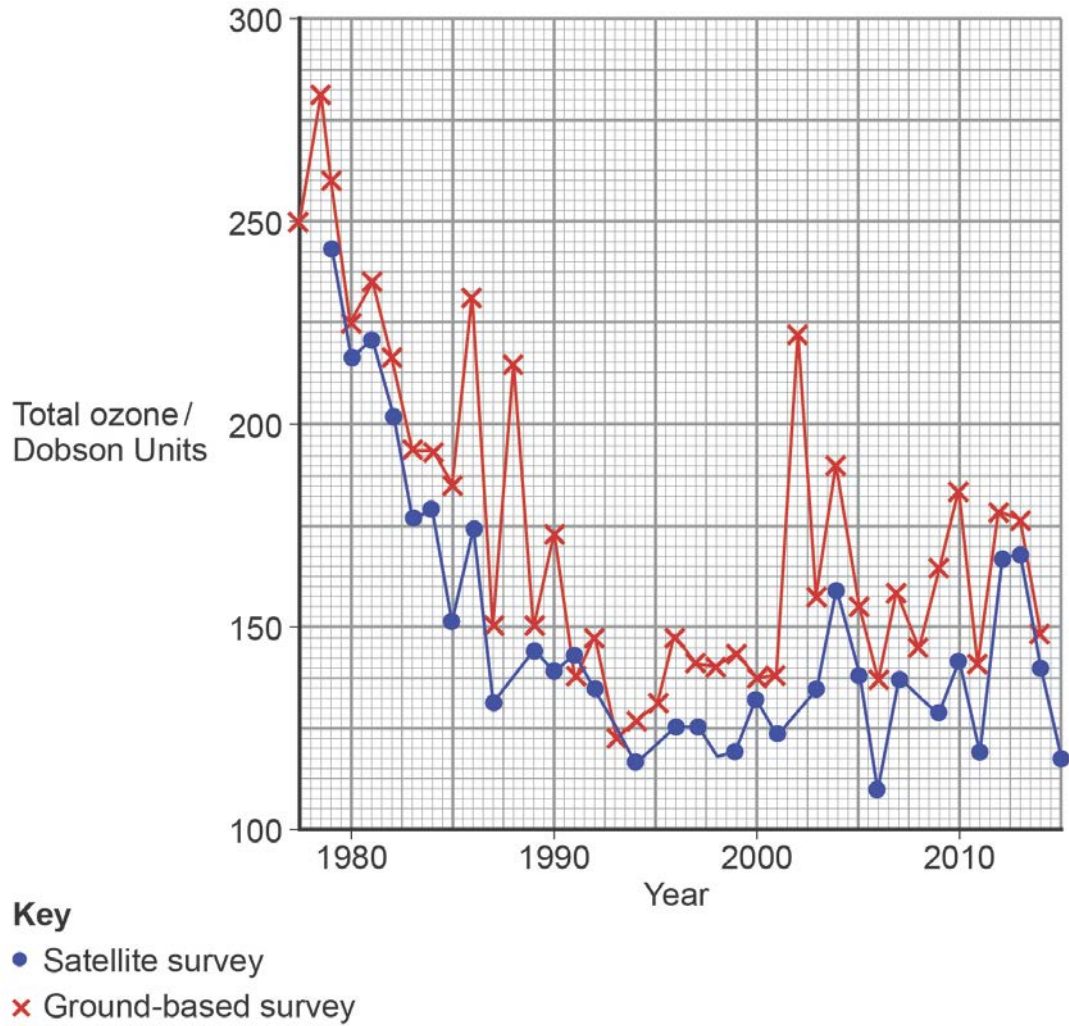


Suggest **one** advantage of using satellites rather than research balloons to carry the monitor that collects data on atmospheric ozone concentrations.

[1 mark]

- 0 7 . 3** **Figure 10** shows the mean ozone concentration in the atmosphere over Antarctica during a 38 year period. Lines may be added to the data points to show the standard deviations of each mean value.

Figure 10



Explain why adding standard deviation lines to the data points shown in **Figure 10** would make it easier to assess whether the differences in the trends are statistically significant.

[2 marks]

0 7 . **4**

Use information from **Figure 10** to calculate the percentage decrease in ozone concentration measured by ground-based surveys between 1980 and 1990.

Show your working.

[1 mark]

_____ %

0 7 . **5**

Explain how the Montreal Protocol (1987) has resulted in the change in the trend in ozone concentration shown in **Figure 10**.

[4 marks]

Turn over for the next question

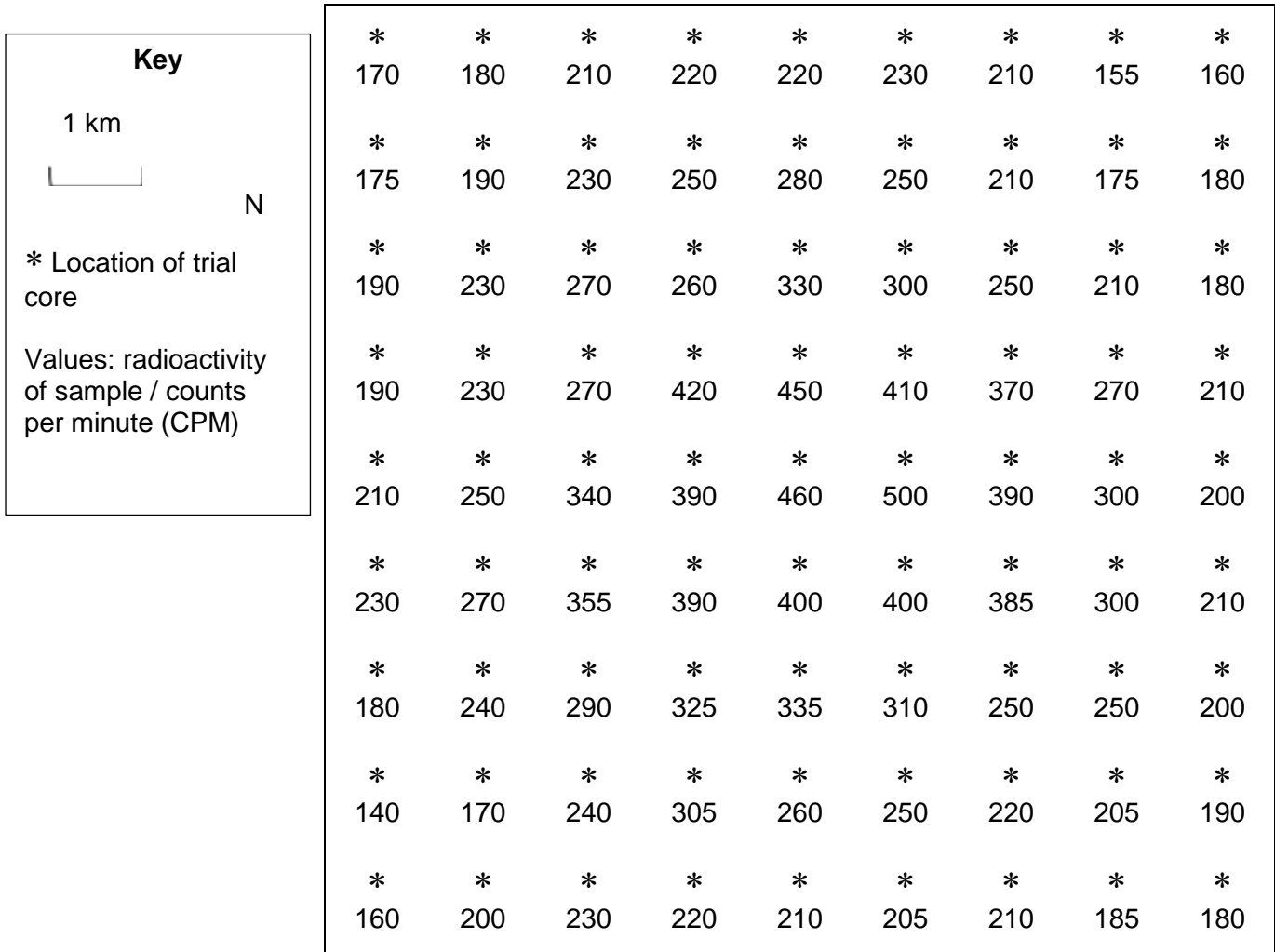
08 . 0

The development of new technologies to locate and extract ores from low-grade sources aims to meet the increasing demand for metal minerals.

Figure 11 shows a map of the locations and results from trial cores in an area where a uranium mine has been proposed.

Samples with radiation levels of 250 CPM and above may produce economically recoverable deposits.

Figure 11



-
- 0 8** . **1** Draw a line on the map in **Figure 11** to show the area that may be mined economically.

[1 mark]

- 0 8** . **2** Use the line you have drawn to estimate the area where uranium may be mined economically.

[1 mark]

Area of mine = _____ km²

- 0 8** . **3** Suggest how further studies could be used to locate the correct position of this line more accurately.

[1 mark]

- 0 8** . **4** Explain how localised concentrations of relatively pure minerals have been produced by geological processes around igneous batholiths.

[3 marks]

Question 8 continues on the next page

08 . **5**

Evaluate the extent to which recycling used materials affects the environmental impact of using mineral resources.

[9 marks]

Extra space

0 9 . **1** Explain how a named human health problem has been treated using a medicine that has been developed following research into a named wildlife taxon.

[3 marks]

0 9 . **2** Use an example to explain how research into the physiology a named wildlife taxon has provided an increased understanding of a named human health problem.


[3 marks]


Question 9 continues on the next page

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

For each answer 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. 

1 0 . **0** Most freshwater for human use is abstracted from rivers and aquifers.

Table 5 shows features of the water samples collected from five different sources:

- a geothermal spring
- seawater
- a river
- rain water
- a limestone aquifer.

Table 5

| | Sample A | Sample B | Sample C | Sample D | Sample E |
|---|-------------|----------|------------|----------|------------|
| Calcium content / mg l ⁻¹ | 24.0 | 0.60 | 104.0 | 7.5 | 400.0 |
| Sodium chloride / mg l ⁻¹ | 25.0 | 0.85 | 80.0 | 55.0 | 35 000.0 |
| Total dissolved solids / mg l ⁻¹ | 135.0 | 3.20 | 670.0 | 220.0 | 40 000.0 |
| pH | 7.4 | 5.70 | 7.6 | 5.5 | 8.2 |
| Temperature range / °C | 4 – 18 | 0 – 24 | 9.8 – 10.1 | 45 | 9.5 – 17.5 |
| Turbidity | Medium/high | Low | Low | Low | Low/medium |
| Dissolved oxygen / % saturation | 65 – 92 | 100 | 45 – 65 | 40 | 75 – 90 |
| Faecal coliform count / number per 100 ml | 0 – 5050 | 0 | 0 | 0 | 0 – 450 |

1 0 . 1

Using the information from **Table 5** and your own knowledge, identify the source at which **Sample A** was collected.

[1 mark]

- A Geothermal spring
- B Seawater
- C River water
- D Rain water
- E Limestone aquifer

1 0 . 2

Using the information from **Table 5** and your own knowledge, identify the source at which **Sample B** was collected.

[1 mark]

- A Geothermal spring
- B Seawater
- C River water
- D Rain water
- E Limestone aquifer

1 0 . 3

Using the information from **Table 5** and your own knowledge, identify the source at which **Sample D** was collected.

[1 mark]

- A Geothermal spring
- B Seawater
- C River water
- D Rain water
- E Limestone aquifer

| | | | |
|---|---|---|---|
| 1 | 0 | . | 4 |
|---|---|---|---|

Use data from **Table 5** and your own knowledge to justify each of your choices of source in questions **10.1**, **10.2** and **10.3**.

[3 marks]

Sample A _____

Sample B _____

Sample D _____

1 1 . **1**

Explain why phosphorus is less readily available than nitrogen for absorption by living organisms, despite having a greater abundance.

[2 marks]

1 1 . **2**

Describe how an increase in the concentration of nitrates in a lake may create problems for the sustainable management and use of water resources.

[4 marks]

There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Copyright Information

For confidentiality purposes, from the November 2015 examination series, acknowledgements of third party copyright material will be published in a separate booklet rather than including them on the examination paper or support materials. This booklet is published after each examination series and is available for free download from www.aqa.org.uk after the live examination series

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team, AQA, Stag Hill House, Guildford, GU2 7XJ.

Copyright © 2016 AQA and its licensors. All rights reserved.

Figure 10: French scientists launching research balloon ©George Steinmetz/Corbis
Satellite ©3DSculptor/iStock.com
