



CANDIDATE
NAME

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CENTRE
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8291/22

May/June 2024

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.

- 1 (a) Fig. 1.1 shows the total fertility rate for 2020. Total fertility rate is the number of children born per woman.

Key

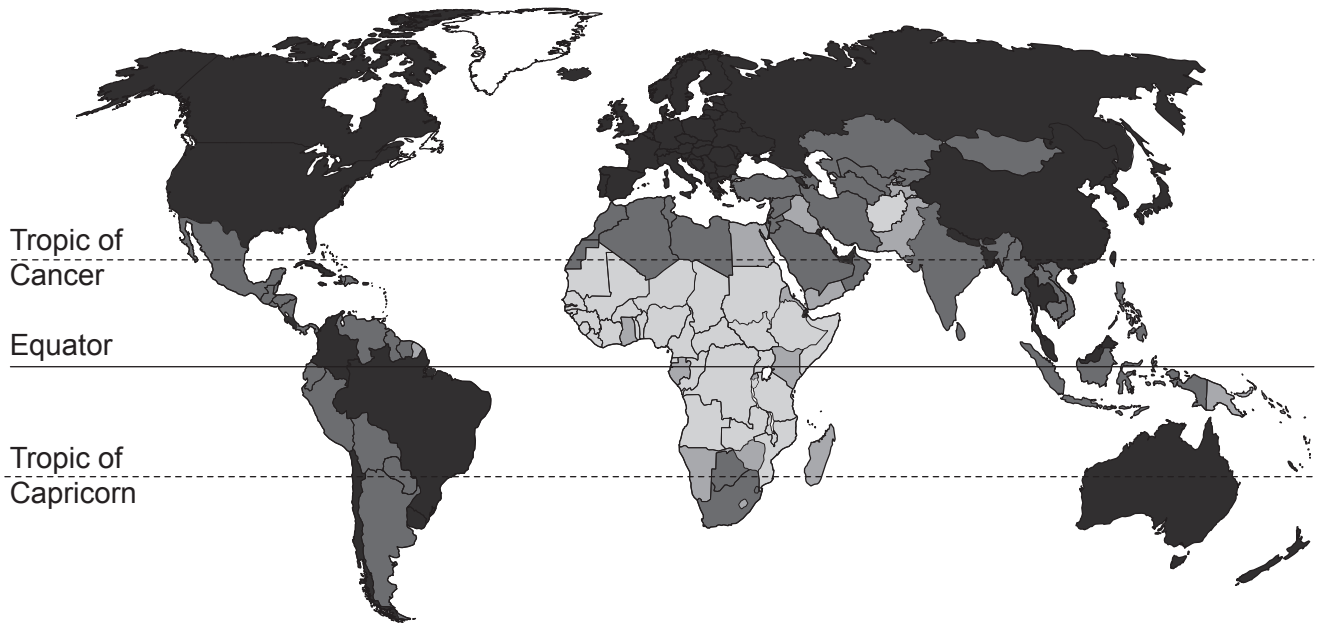
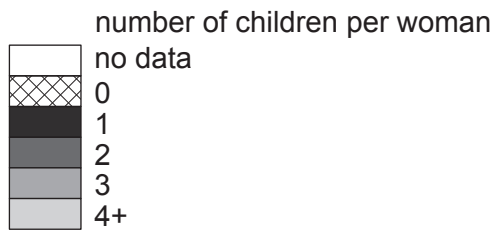


Fig. 1.1

- (i) Describe the distribution shown in Fig. 1.1.

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..... [3]

(ii) Explain why a lower fertility rate reduces the impact of climate change.

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..... [3]

(iii) State **three** factors that affect fertility rate.

1

2

3 [3]

(b) Table 1.1 shows the dependency ratio for Bangladesh in 2001 and 2021.

Table 1.1

year	dependency ratio
2001	75
2021	44

Suggest **two** reasons why the dependency ratio has decreased.

1

.....

2

..... [2]

- (c) A report estimated that adapting to the impacts of climate change will cost countries with low-income economies \$300 billion a year by 2030.

The photograph in Fig. 1.2 shows a road across a shallow river.



Fig. 1.2

Explain why the impacts of climate change will require the road to be adapted.

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..... [2]

- (d) The divided bar chart in Fig. 1.3 shows information about the number of carbon capture and storage (CCS) facilities from 2010 to 2021.

Key

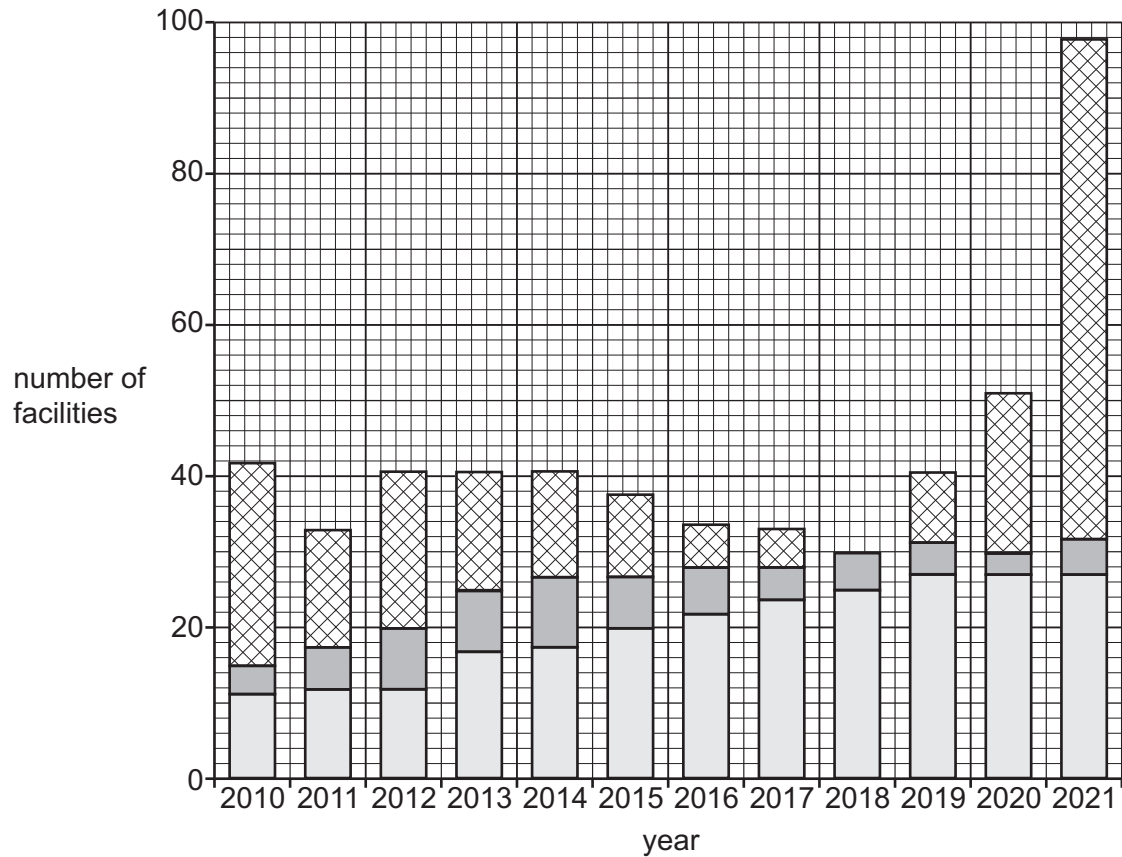
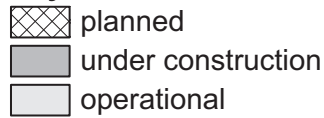


Fig. 1.3

- (i) Complete the bar on Fig. 1.3 for 2018 to show there were 15 planned CCS facilities. [2]
- (ii) State which years had the most operational CCS facilities. [1]
- [1]
- (iii) State the number of CCS facilities that were under construction in 2016. [1]
- [1]
- (iv) Suggest **two** reasons why the number of planned CCS facilities in 2010 was fewer than the number of planned CCS facilities in 2021.

1

.....

2

.....

[2]

- (e) Describe how carbon capture and storage (CCS) reduces the carbon dioxide concentration in the atmosphere.

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..... [3]

- (f) Solar radiation management (SRM) is a strategy which aims to reduce the impact of climate change.

State **two** examples of SRM.

1

2

[2]

[Total: 24]

- 2 (a) Scientists use tree ring data to investigate tree growth in a local area.

Each year a tree grows, a new tree ring forms. Wider tree rings form when trees grow more rapidly.

The scientists make this hypothesis:

‘Emissions from a factory have a negative impact on tree growth in the local area.’

Fig. 2.1 shows tree ring data for one species of tree over an 80-year period in the local area. The factory was opened at the start of the 80-year period.

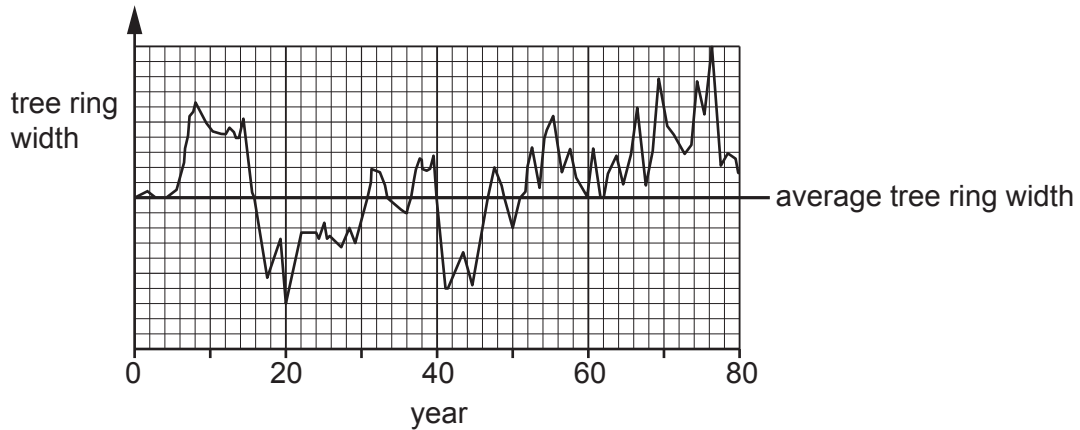


Fig. 2.1

The horizontal line represents the average tree ring width for this species of tree.

Values above the horizontal line indicate higher than average tree ring width.

- (i) Discuss whether the data in Fig. 2.1 supports the scientists' hypothesis.

.....

.....

.....

.....

.....

..... [3]

- (ii) Tree ring data is also used to reconstruct past climate conditions.

State **two** other methods for reconstructing past climate conditions.

1

2

[2]

- (b) A scientist uses a computer model to predict the effect of ground level ozone on plant growth over a 3-year period.

The model:

- uses two concentrations of ozone, 20 and 120 parts per million (ppm)
- predicts the mass of the plant stem every month for 3 years.

Fig. 2.2 shows the results of the model.

Key

ozone concentration
 — 20 ppm
 ---- 120 ppm

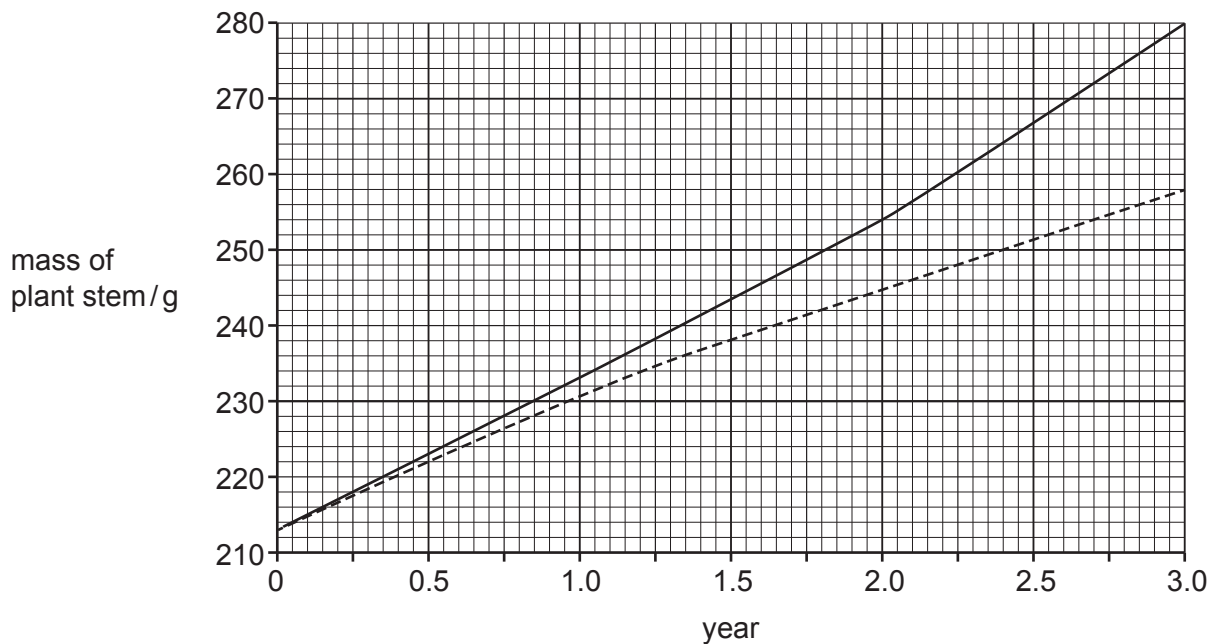


Fig. 2.2

- (i) Describe the results of the model shown in Fig. 2.2.

.....

.....

.....

..... [2]

- (ii) Another scientist wants to repeat the computer model.

Suggest **three** pieces of additional information needed for the model to be repeated.

1

2

3

[3]

(c) Ground level ozone can form photochemical smog.

(i) State the layer of the atmosphere which contains ground level ozone.

..... [1]

(ii) Describe the formation of photochemical smog.

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.....
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.....
.....
..... [3]

(iii) State **two** impacts of photochemical smog on human health.

1
2 [2]

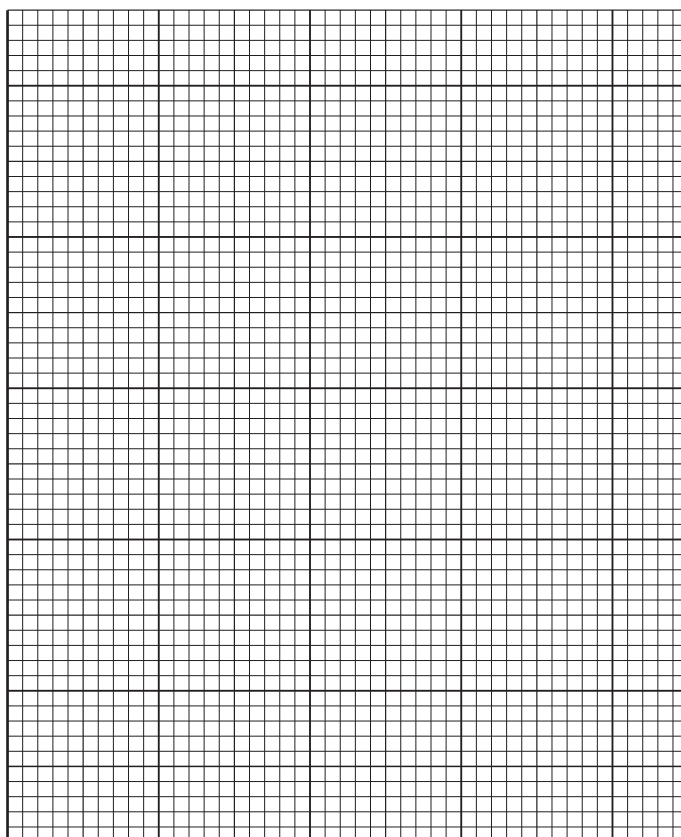
- (d) Table 2.1 shows the concentration of ground level ozone in ppm for a 24-hour period in a USA city.

Table 2.1

time /hour	ozone concentration /ppm
0	0.10
3	0.10
6	0.30
9	0.34
12	0.62
15	0.92
18	0.84
21	0.18
24	0.10

- (i) Plot the data as a line graph on the grid.

Join each point with a straight line.



[5]

- (ii) Calculate the range for ground level ozone concentration in the 24-hour period.

range = ppm [1]

- (iii) A student concludes that the maximum ozone concentration in the 24-hour period is 0.92 ppm.

State whether the student's conclusion is sensible. Justify your answer.

.....
..... [1]

[Total: 23]

- 3 (a) Fig. 3.1 shows the European bee-eater bird.



Fig. 3.1

A scientist investigates whether the number of European bee-eaters can be predicted using sound recordings.

The scientist:

- counts the number of individual birds observed in 30 different populations of European bee-eaters over a 3-day period
- records the songs for each of the 30 populations of European bee-eaters over the 3-day period
- identifies the number of songs per minute for each population.

The results are shown in Fig. 3.2.

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Fig. 3.2

- (i) Suggest why the scientist investigates more than one population of European bee-eater.

.....
 [1]

- (ii) Circle **one** result that is most likely to be anomalous on Fig. 3.2. [1]

- (iii) Write a suitable conclusion for the results.

.....
 [1]

- (iv) The scientist identifies the number of songs per minute for each population of European bee-eaters by listening to the recordings over the 3-day period.

Suggest the limitations of this method.

.....

 [2]

- (v) Suggest the benefit of using sound recordings to investigate populations of endangered birds.

.....
 [1]

- (b) The scientist uses the Lincoln index to estimate the number of European bee-eaters in the local area.

Table 3.1 shows the data the scientist uses.

Table 3.1

number of individuals captured in first sample, n_1	250
total number of individuals captured in second sample, n_2	235
number of marked individuals recaptured in second sample, m_2	124

- (i) Calculate the population size, N , of the European bee-eaters in the local area using the Lincoln index formula.

Give your answer to the nearest whole number.

$$N = \frac{n_1 \times n_2}{m_2}$$

$N =$ [2]

- (ii) The population of European bee-eaters in the local area increases.

Suggest the impact this increase has on the number of marked individuals recaptured in the second sample, m_2 .

Give a reason for your answer.

.....
 [1]

(c) Rewilding is a strategy used to increase biodiversity.

(i) Explain how rewilding increases biodiversity.

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..... [3]

(ii) Suggest **two** reasons why the population of European bee-eaters in the local area increases, other than rewilding.

1

2 [2]

[Total: 14]

4 (a) More than 3 billion people every year are affected by water insecurity.

(i) Define the term water insecurity.

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..... [3]

(ii) State **three** impacts of water insecurity.

1

2

3 [3]

(b) Desalination produces fresh water from salt water.

One method of desalination is reverse osmosis (RO).

(i) 2.5 dm^3 of sea water is needed to produce 1 dm^3 of fresh water.

Calculate the percentage of fresh water produced from sea water.

fresh water = % [1]

(ii) Calculate the volume of sea water needed to produce $200\,000\,000 \text{ dm}^3$ of fresh water.

volume of sea water = dm^3 [1]

(c) Fig. 4.1 shows the process of RO.

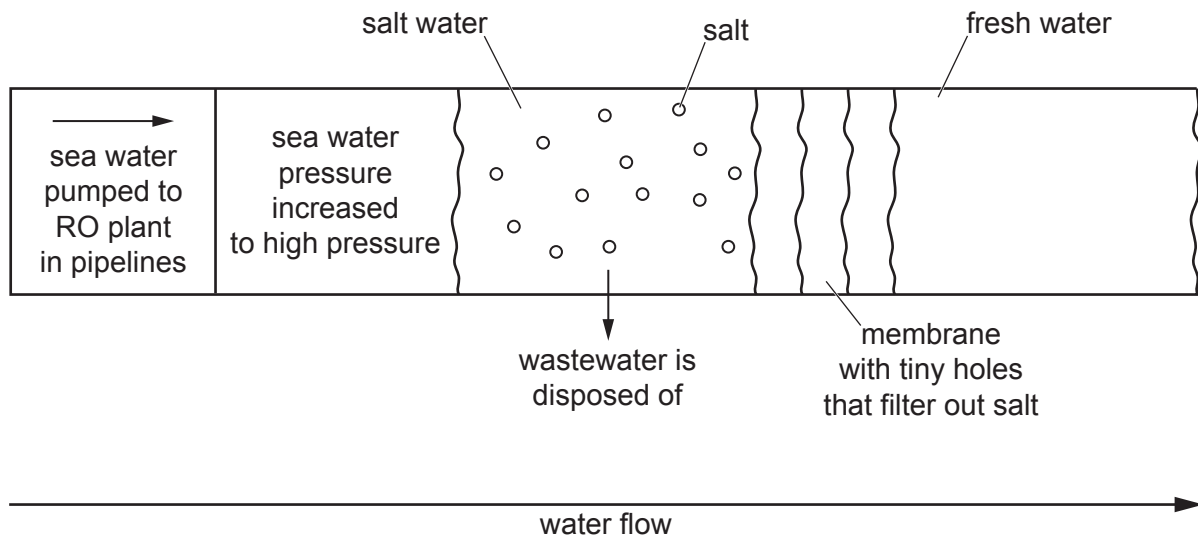


Fig. 4.1

RO desalination plants are located next to the sea and need a minimum of 10 hectares of land.

The membrane has a 3-year lifetime.

(i) Suggest why RO desalination is an expensive process.

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..... [4]

(ii) Wastewater from RO desalination has a very high concentration of salt.

Suggest the impacts of disposing of the wastewater back into the sea.

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..... [2]

(d) Fig. 4.2 shows countries who use desalination to produce fresh water.

Key

 use of desalination



Fig. 4.2

Suggest why desalination is **not** used by more countries.

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.....

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..... [2]

(e) One strategy for managing water insecurity is to relocate populations from areas of high water-usage to areas of low water-usage.

Suggest **one** limitation of this strategy.

.....

..... [1]

- (f) Fig. 4.3 shows a strategy to manage water insecurity.



Fig. 4.3

Name the strategy shown in Fig. 4.3.

..... [1]

- (g) Swamps are one source of surface fresh water.

State **one** other source of surface fresh water.

..... [1]

[Total: 19]

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