



CANDIDATE
NAME

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CENTRE
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CANDIDATE
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8291/21

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 **24** pages. Any blank pages are indicated.

- 1 (a) Fig. 1.1 shows water usage by sector in the USA and Nigeria.

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Fig. 1.1

Suggest reasons for the differences in water usage for the USA and Nigeria.

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..... [2]

- (b) A recent report stated that 70% of Nigerians have access to basic water sources. However, more than half of these water sources are contaminated.

Explain how contaminated drinking water leads to poverty.

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..... [3]

(c) Fig. 1.2 shows a cross-section of the Earth's surface.

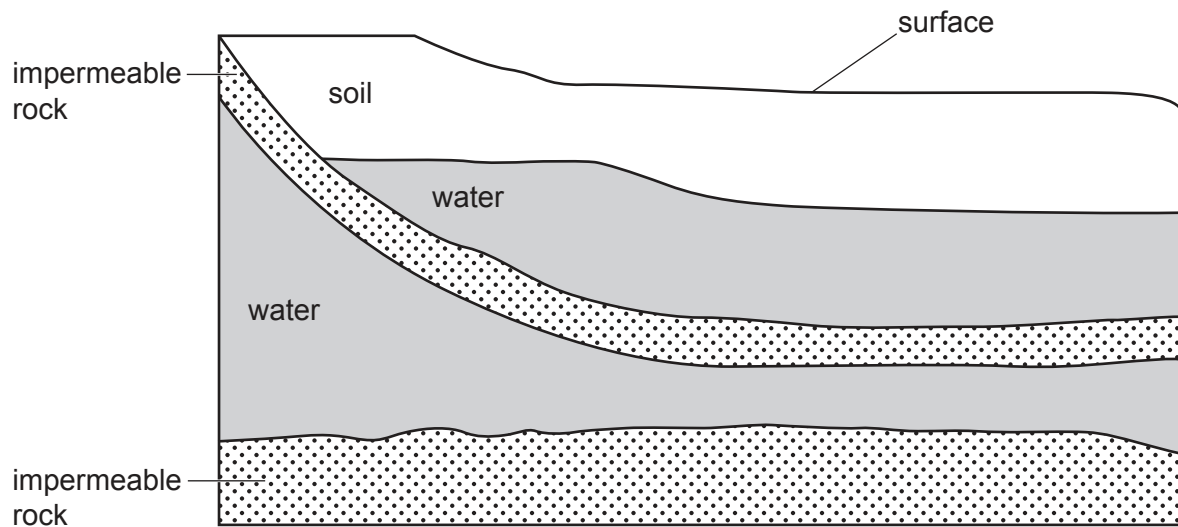


Fig. 1.2

Draw on Fig. 1.2 the location and depth of an artesian well.

[1]

(d) Fig. 1.3 shows a water security management strategy.

water security
management
strategy



Fig. 1.3

Explain how the strategy in Fig. 1.3 improves water security.

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..... [2]

(e) Marshes are one source of surface fresh water.

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

..... [1]

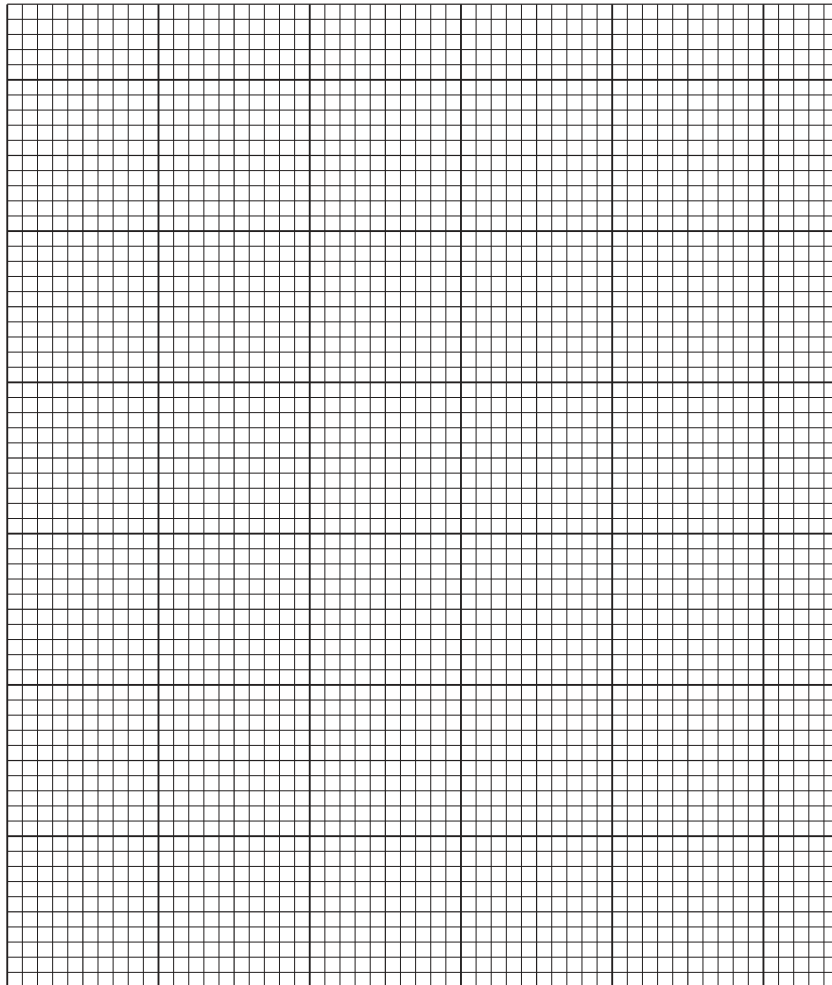
- (f) A water source is contaminated with mercury. Mercury is a toxic metal.

Table 1.1 shows the mean concentration of mercury in the water source for a 10-year period.

Table 1.1

year	1	2	3	4	5	6	7	8	9	10
mean concentration /arbitrary units	0.02	0.06	0.10	0.10	0.09	0.12	0.10	0.05	0.01	0.01

Plot the data as a line graph on the grid.
Join each point with a straight line.



[5]

[Total: 14]

2 (a) In 2022, 80% of the timber used in the UK was imported.

(i) Suggest **one** negative impact for the UK of importing timber.

..... [1]

(ii) Financial incentives were offered to UK farmers to grow trees on agricultural land.

Suggest **two** negative impacts of growing trees on agricultural land.

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2

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[2]

(b) Explain how growing more trees reduces the impact of carbon dioxide in the atmosphere.

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..... [2]

(c) The photograph in Fig. 2.1 shows a forest, a road and a lake.



Fig. 2.1

Describe how the photograph in Fig. 2.1 shows evidence of fragmentation.

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..... [3]

(d) Pollinating insects enable trees to reproduce.

Fig. 2.2 shows the broken-belted bumblebee, which is a pollinating insect.



Fig. 2.2

The map in Fig. 2.3 shows the distribution of broken-belted bumblebees in part of the UK.

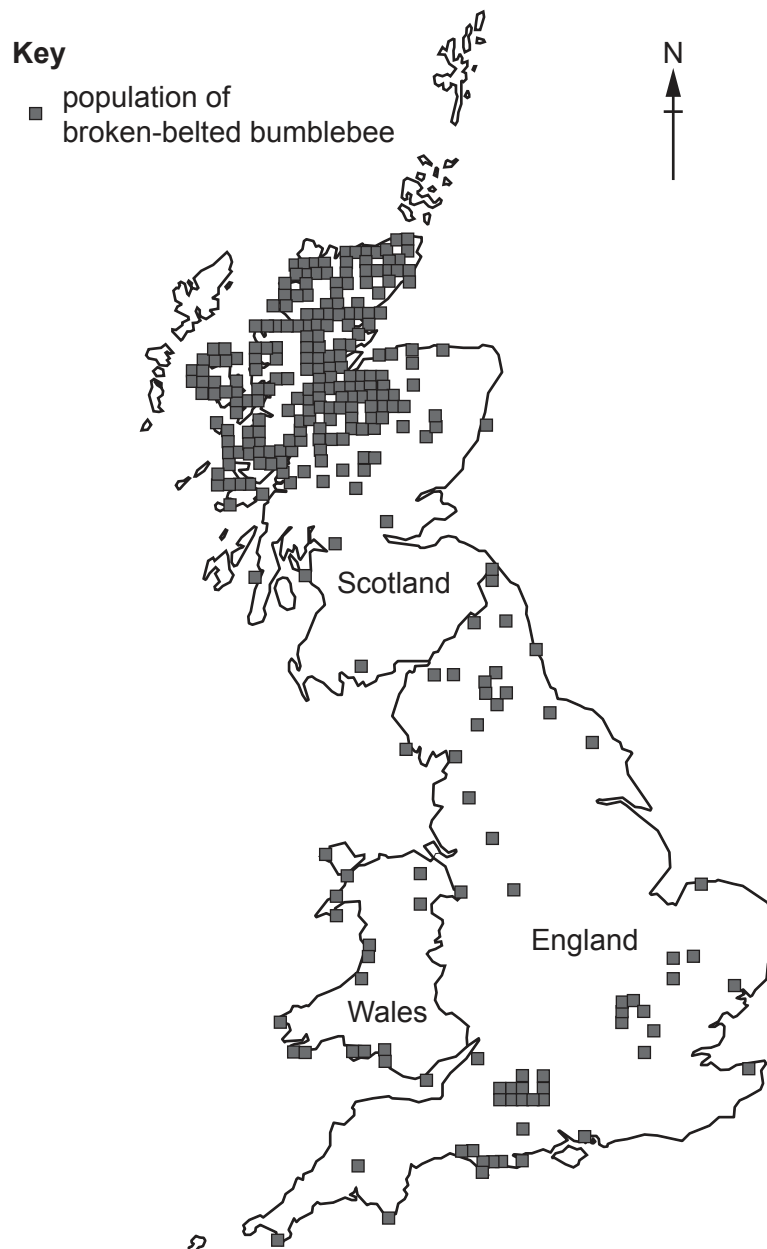


Fig. 2.3

- (i) Describe the distribution of broken-belted bumblebees shown in Fig. 2.3.

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..... [2]

- (ii) The data for the distribution map in Fig. 2.3 was collected using a survey.

People completed an online survey for any species of bumblebee they observed.

Fig. 2.4 shows the form used to collect the data.

species:
when you saw it:
where you saw it:
map grid reference:
contact information:

Fig. 2.4

Suggest the limitations of this type of bee population distribution survey.

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..... [3]

- (e) A scientist investigates the population of broken-belted bumblebees using a transect method.

The transect is a measured straight line where the population of broken-belted bumblebees are located.

The length of this transect line is 10 m.

Describe how the scientist can use this transect line to estimate the population of broken-belted bumblebees.

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..... [4]

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(f) The diagram in Fig. 2.5 shows a natural bee nest in a tree.

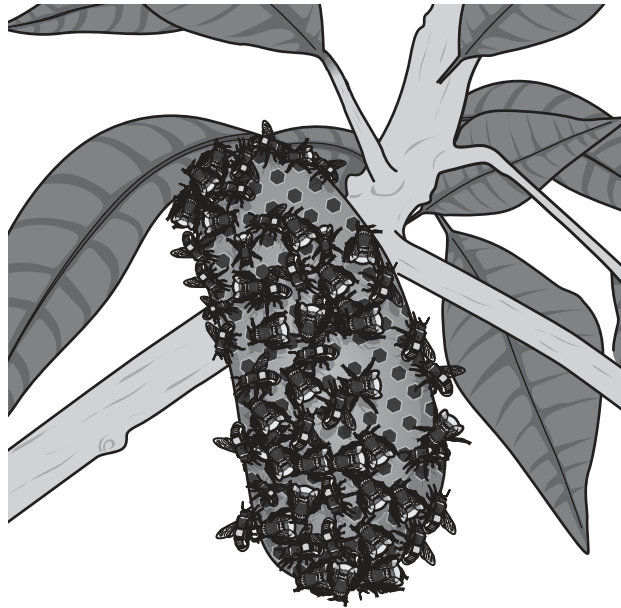
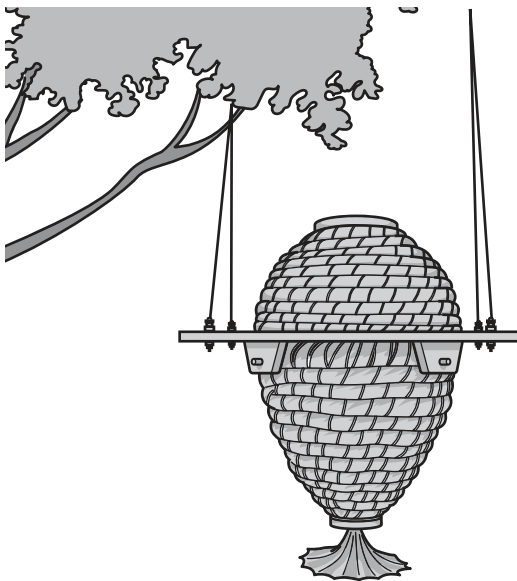


Fig. 2.5

Fig. 2.6 shows two types of artificial bee nest: a sun hive and a wooden hive.



sun hive



wooden hive

Fig. 2.6

Suggest the benefits and limitations of the two artificial bee nests.

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..... [5]

(g) The Asian hornet is an invasive species to the UK.

Explain how the Asian hornet can endanger bumblebee populations in the UK.

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..... [3]

[Total: 25]

3 Methane is an atmospheric pollutant.

(a) Fig. 3.1 shows the concentration of methane gas in the atmosphere from 1983 to 2022.

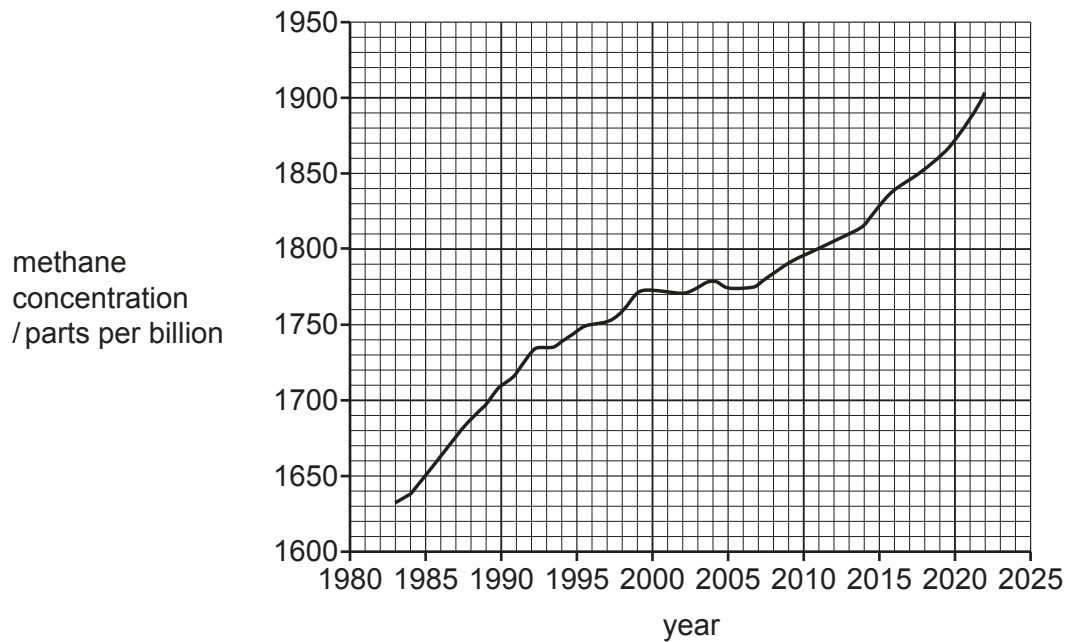


Fig. 3.1

(i) Describe the atmospheric impacts of the trend shown in Fig. 3.1.

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..... [2]

(ii) State **two** sources of methane.

1

2

[2]

(b) Sulfur dioxide is an atmospheric pollutant.

In 1990, the USA introduced strategies for managing sulfur dioxide emissions.

Fig. 3.2 and Fig. 3.3 show data for annual sulfur dioxide emissions for 1990 and 2020 in the USA.

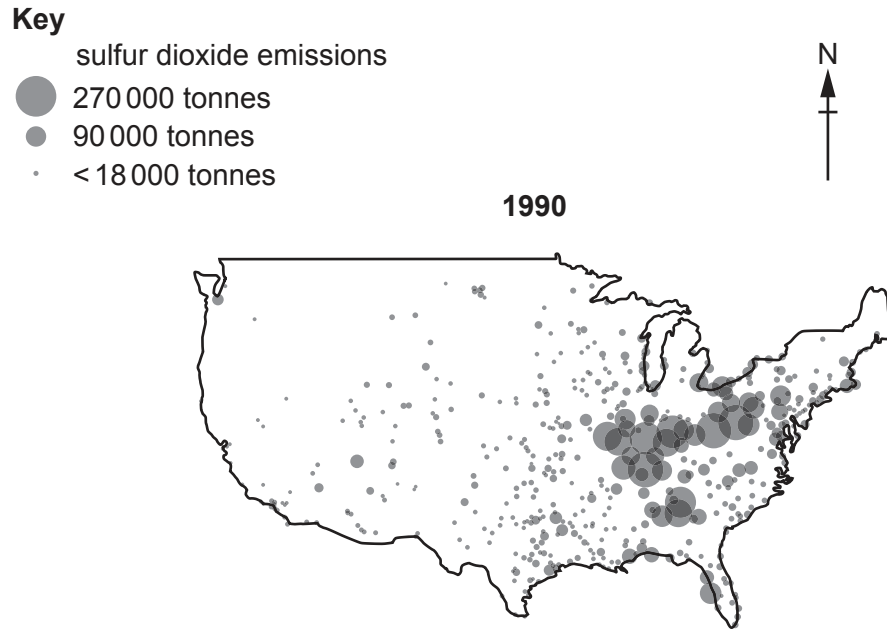


Fig. 3.2

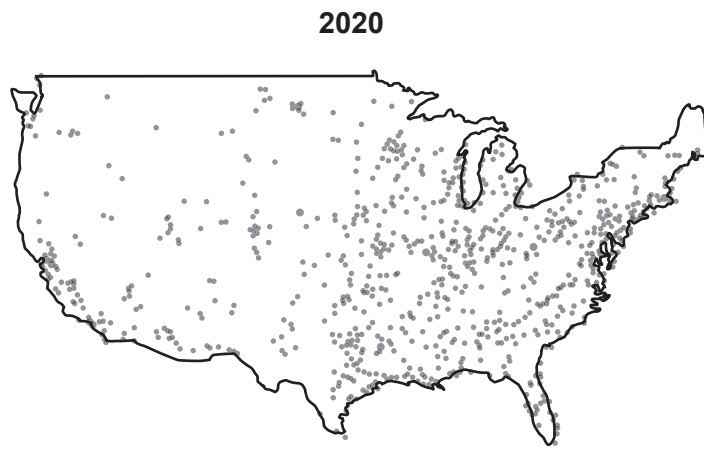


Fig. 3.3

- (i) Evaluate the success of the strategies introduced to manage sulfur dioxide emissions.

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..... [3]

- (ii) Explain how sulfur dioxide forms acid deposition.

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..... [2]

- (iii) State **one** type of wet acid deposition and **one** type of dry acid deposition.

wet acid deposition

dry acid deposition [2]

- (iv) Combustion of fossil fuels contributes to acid deposition.

Describe strategies to reduce the impact of acid deposition from the combustion of fossil fuels.

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..... [3]

(c) Fig. 3.4 shows mustard greens, which are a food crop.

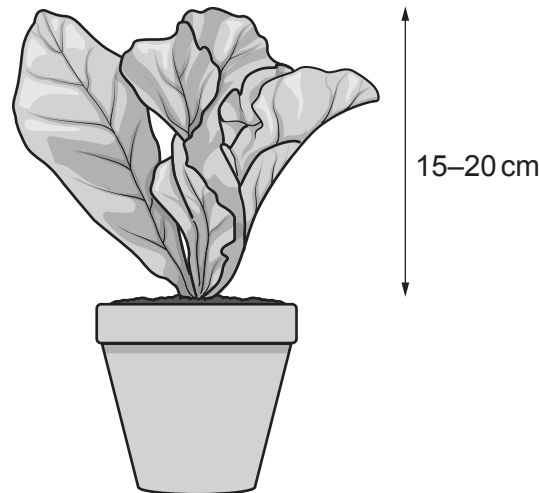


Fig. 3.4

A scientist uses four different pH values of water to investigate the effect of acid deposition on the yield of mustard greens. The pH values are pH 6.0, 4.0, 3.5 and 3.0.

The scientist uses this method.

- Thoroughly mix 15 kg of soil.
- Fill 10 pots, each with 1.5 kg of soil.
- Put 1 mustard green plant in each pot.
- Spray each of the 10 plants with pH 6.0 water continuously for 1.5 hours a day.
- After 3 months, harvest and dry all the leaves.
- Measure the mass of the leaves.
- Repeat the method for each pH value.

(i) Suggest why the 15 kg of soil must be thoroughly mixed.

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 [1]

(ii) Suggest why a pH value of 6.0 is used.

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 [1]

(iii) Identify the independent variable in this investigation.

..... [1]

(iv) Suggest why 10 plants are used for each pH value.

.....
 [1]

- (v) Suggest why the leaves are dried before their mass is measured.

.....
 [1]

- (vi) Table 3.1 shows the mean dry mass of the leaves from the 10 plants at each pH value.

Table 3.1

pH	6.0	4.0	3.5	3.0
mean dry mass /g	59.28	58.05	58.00	48.36

Write a suitable conclusion for the results.

.....
 [1]

- (vii) Calculate the range for the mean dry mass of the leaves.

Give your answer to **two** decimal places.

range = g [1]

- (viii) The scientist investigates the impact of acid deposition on leaf damage.

Table 3.2 shows the results.

Table 3.2

pH	6.0	4.0	3.5	3.0
percentage of leaf damage	0.0	0.0	4.3	10.4

Write a suitable conclusion for the results.

.....
 [1]

[Total: 22]

- 4 A megacity is an urban centre with more than 10 million people.

(a) The bar chart in Fig. 4.1 shows countries with large megacities in 2021.

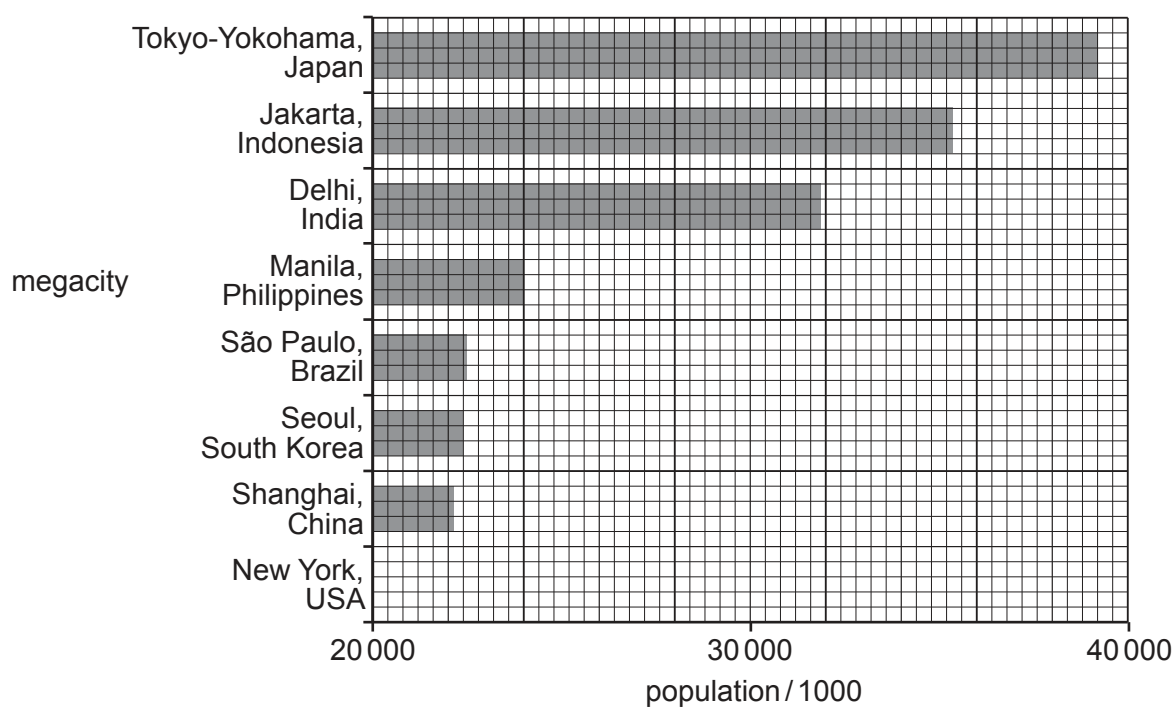


Fig. 4.1

- (i) Complete the bar chart in Fig. 4.1 to show a population of New York of 21 000 000. [2]

- (ii) Tokyo-Yokohama has an area of 2194 km².

Calculate the population density of Tokyo-Yokohama.

Give your answer to the nearest whole number.

population density = people/km² [3]

(iii) The World Bank classifies countries by their economy.

The classifications are:

- high-income economies (HICs)
- middle-income economies (MICs)
- low-income economies (LICs)

Each classification can be further split into lower and upper economies.

Table 4.1 shows the classifications for the countries in Fig. 4.1.

Table 4.1

country	World Bank classification
Japan	HIC
Indonesia	HIC
India	lower MIC
Philippines	lower MIC
Brazil	upper MIC
South Korea	HIC
China	upper MIC
USA	HIC

Calculate the percentage of the megacities in Fig. 4.1 that are from countries classified as HICs.

percentage = % [1]

(iv) State **two** economic factors that influence population density.

- 1
-
- 2
-

[2]

(b) Table 4.2 shows the age structure for Japan.

Table 4.2

age range	population
0–14	15 670 950
15–24	11 889 729
25–54	46 184 525
55–64	15 134 799
65+	36 627 469

The formula for calculating dependency ratio is shown.

$$\frac{[\text{young population (0 to 14)} + \text{old population (65+)}] \times 100}{\text{population aged 15 to 64}}$$

(i) Use Table 4.2 to calculate the dependency ratio for Japan.

dependency ratio = % [2]

(ii) Dependency ratios show the ratio of the non-working age population to the working age population.

Suggest the limitations of classifying the working age population as between 15 to 64.

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..... [3]

(iii) Fig. 4.2 shows the life expectancy for the population of Japan from 2002 to 2022.

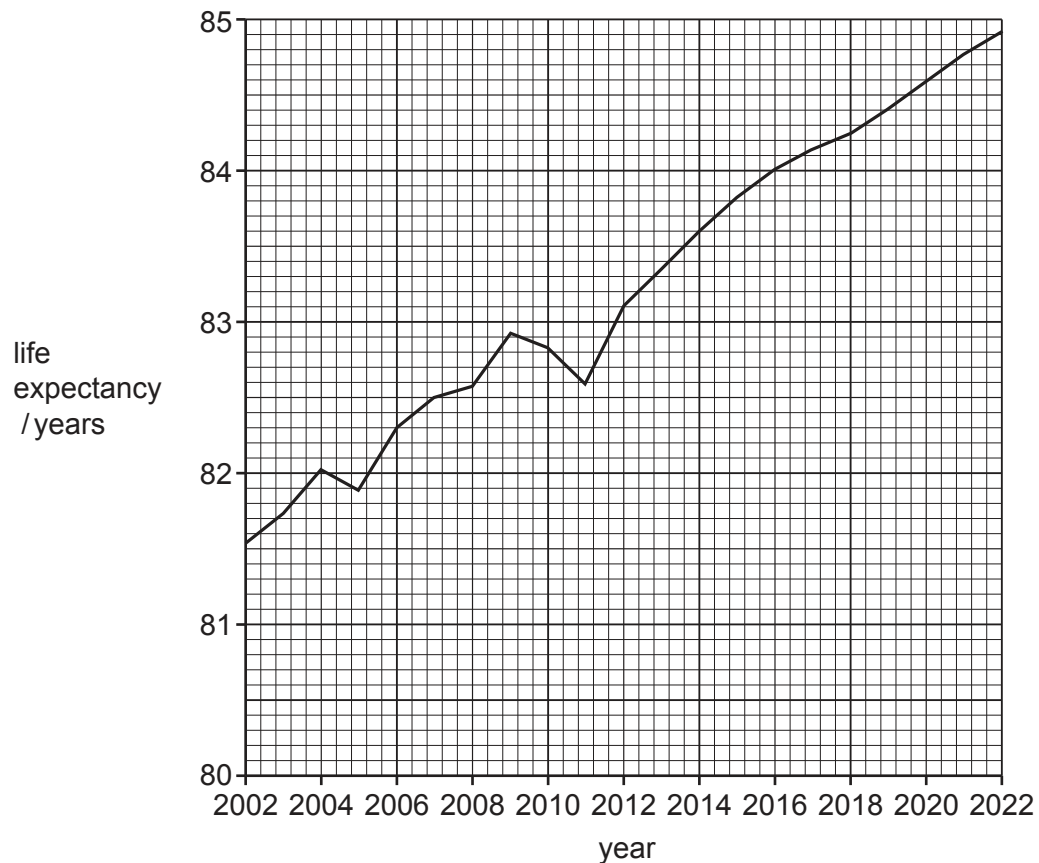


Fig. 4.2

Suggest the impacts of the trend shown by the data in Fig. 4.2 on Japan.

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..... [3]

(c) Local, national and global policies are strategies for managing human population.

State **three** local strategies for managing human population.

1

2

3

[3]

[Total: 19]

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