LUI ☐☐☐☐☐☐☐☐☐☐   School code ☐☐☐☐

School name ☐

Given name/s ☐

Family name ☐

Attach your
barcode ID label here

Book ☐ of ☐ books used

External assessment 2022

Question and response book

General Mathematics SEE

SEE 1

Time allowed

- Planning time — 15 minutes
- Working time — 180 minutes

General instructions

- Answer all questions in this question and response book.
- Write using black or blue pen.
- QCAA-approved scientific calculator permitted.
- Ruler required.
- QCAA formula book provided.
- Planning paper will not be marked.

**Section 1 (50 marks)**

- 7 short response questions

Section 1

Instructions

- Questions worth more than one mark require mathematical reasoning and/or working to be shown to support answers.
- If you need more space for a response, use the additional pages at the back of this book.
    - On the additional pages, write the question number you are responding to.
    - Cancel any incorrect response by ruling a single diagonal line through your work.
    - Write the page number of your alternative/additional response, i.e. See page …
    - If you do not do this, your original response will be marked.

QUESTION 1 (6 marks)

Use Stimulus 1 in the stimulus book to identify two characteristics of the time series plots in graphs 1, 2 and 3.

QUESTION 2 (8 marks)

The scatterplot uses data from Stimulus 1 Graph 2 to show the association between atmospheric carbon dioxide concentration (ppm) and year.

a) Plot the least-squares regression line of $y = 1.738x - 3106.077$ on the scatterplot. *[3 marks]*
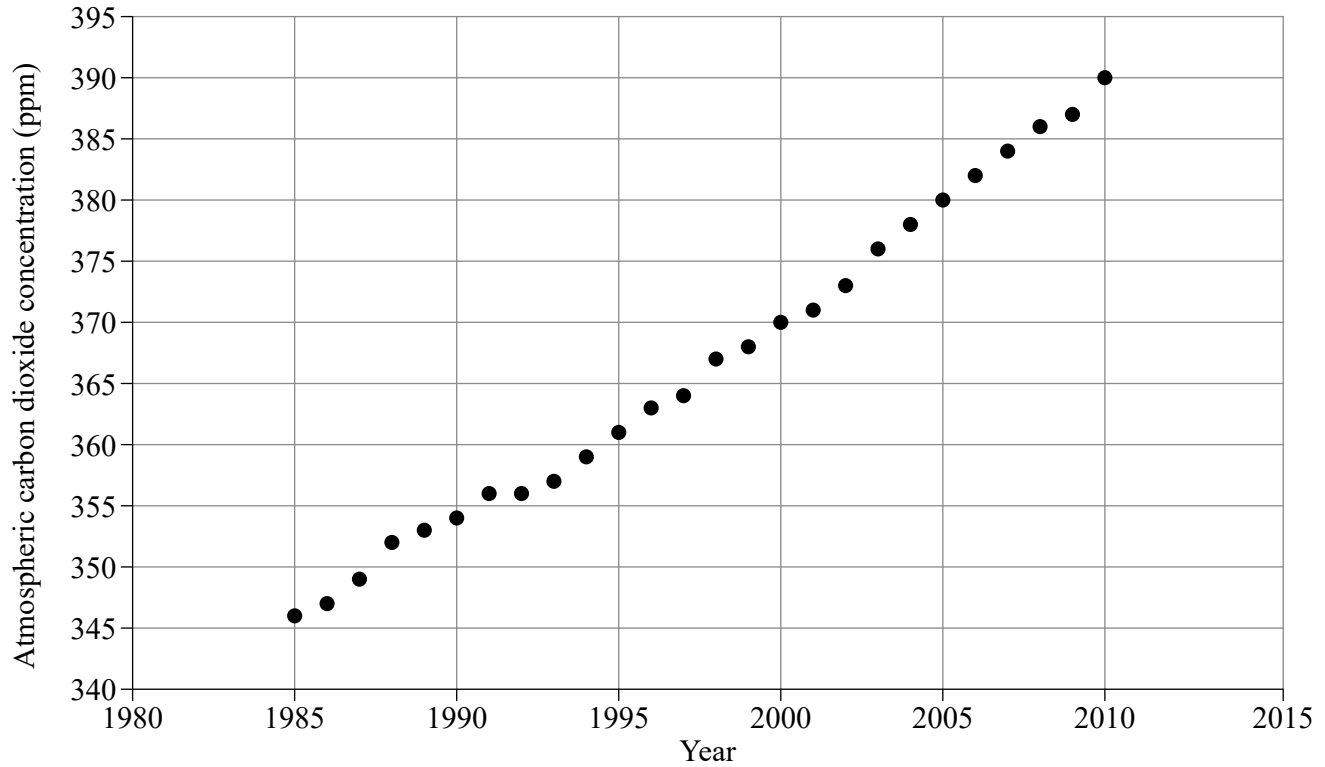
Note: If you make a mistake in the scatterplot, cancel it by ruling a single diagonal line through your work and use the additional response space on page 17 of this question and response book.

b) Given that the coefficient of determination for the least-squares regression equation from Question 2a) is 0.993, identify the degree to which the variation in atmospheric carbon dioxide concentration (ppm) can be explained by variation in the year. *[1 mark]*

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c) Use the coefficient value from Question 2b) to determine the correlation coefficient and describe the association between the two variables in terms of direction and strength. *[2 marks]*

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d) Use the least-squares regression equation from Question 2a) to predict atmospheric carbon dioxide concentration (ppm) in the year 2050. *[2 marks]*

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QUESTION 3 (19 marks)

a) Use Stimulus 2 in the stimulus book to model the relationship between atmospheric carbon dioxide concentration (ppm) and year from 2011 to 2019 by fitting a least-squares regression line to the data. Use x = years since 2000 (i.e. in 2011, x = 11).

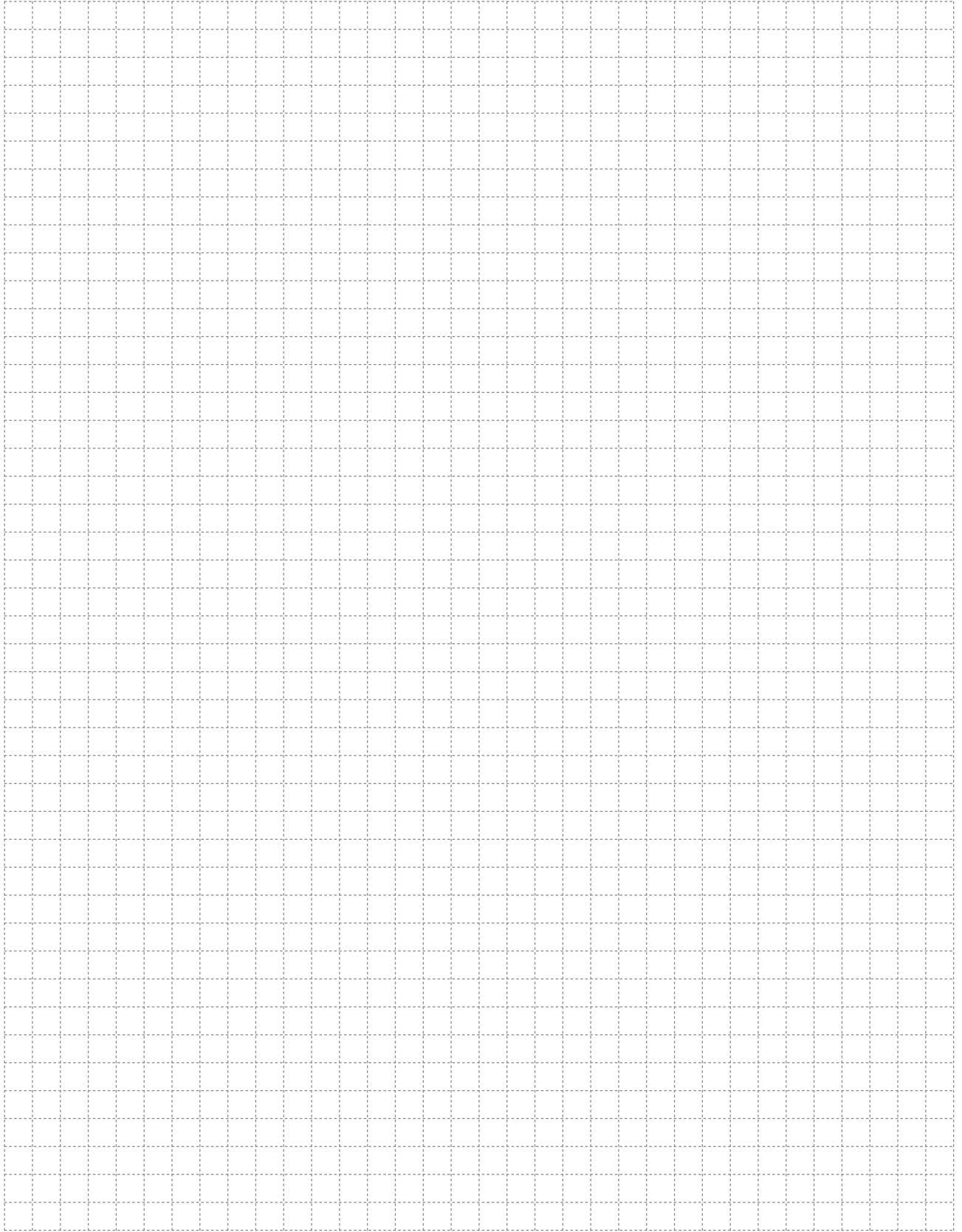Round the parameter values for the intercept and slope to three decimal places. Provide the correlation coefficient and define the variables used for the model. *[4 marks]*

b) Plot the least-squares regression line from Question 3a) and data from Stimulus 2 on the graph paper provided. *[6 marks]*

Do not write outside this box.

Note: If you make a mistake in the graph, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this question and response book.

Do not write outside this box.

c) Construct a residual plot on the graph paper provided to assess the appropriateness of fitting a linear model to the data from Stimulus 2 and the model from Question 3b). *[5 marks]*
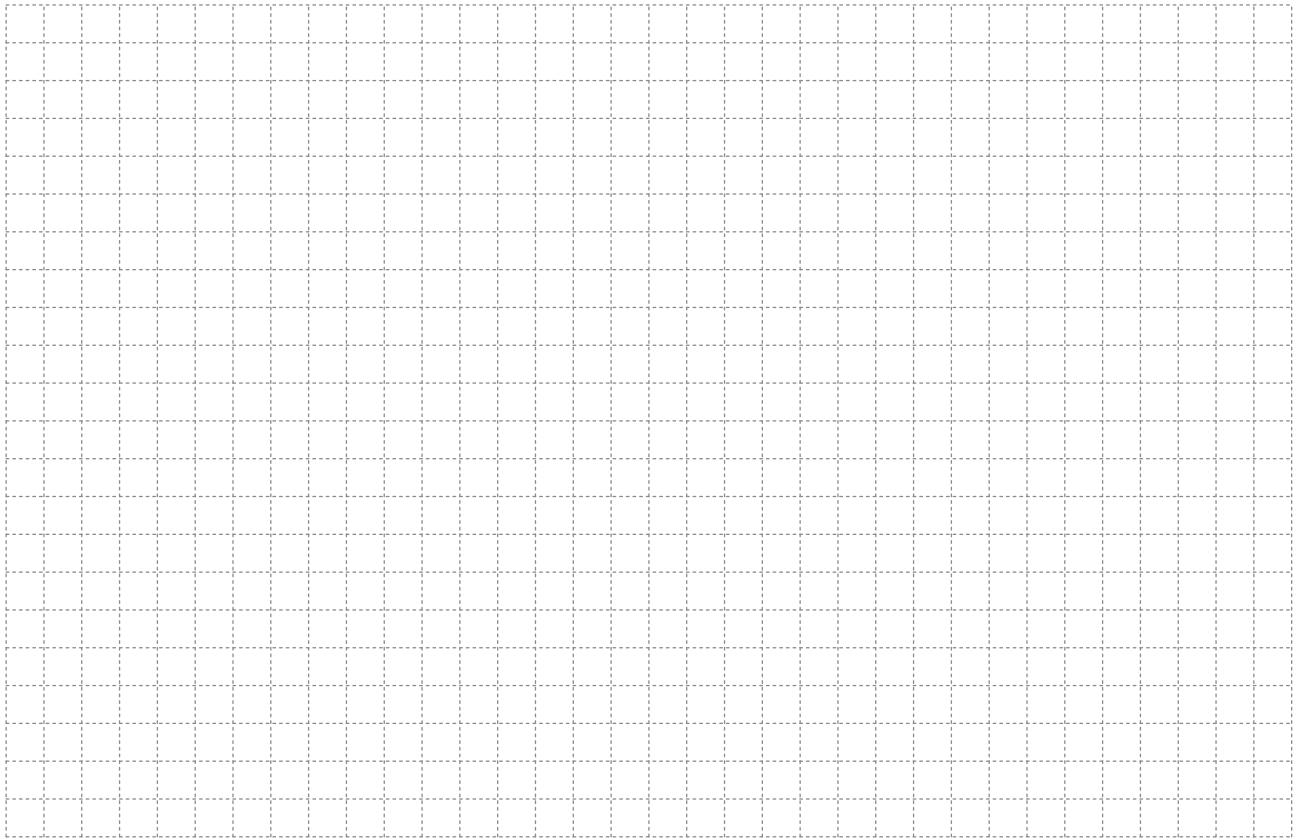
Note: If you make a mistake in the graph, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this question and response book.

d) Use the model from Question 3a) to predict atmospheric carbon dioxide concentration (ppm) in the year 2050. *[2 marks]*

e) Evaluate the reasonableness of the two atmospheric carbon dioxide concentration (ppm) predictions from Question 2d) and Question 3d). *[2 marks]*

QUESTION 4 (3 marks)

Using the data from Stimulus 2, the least-squares regression line of $y = 0.019x - 6.969$ can be used to model the relationship between temperature anomaly (°C) and atmospheric carbon dioxide concentration (ppm) from 2011 to 2019. Define the explanatory and response variables and interpret the slope of the fitted line.

QUESTION 5 (3 marks)

Use your result from Question 3d) and the model from Question 4 to predict the temperature anomaly in 2050. Comment on the predicted value when compared to the data in Stimulus 2.

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QUESTION 6 (7 marks)

A refined model for temperature anomaly that uses two explanatory values, atmospheric carbon dioxide concentration (ppm) and NINO3.4 value, is $T = 0.011C + 0.051N - 3.602$, where:

- T is temperature anomaly (°C)
- C is atmospheric carbon dioxide concentration (ppm)
- N is NINO3.4 value.

a) Use the refined model and Stimulus 2 to calculate the modelled temperature anomaly for 2011. *[2 marks]*

b) Use the refined model and Stimulus 2 to calculate the modelled temperature anomalies from 2012 to 2019. *[1 mark]*

Do not write outside this box.

c) A time series plot of the observed temperature anomalies from 2011 to 2019 is graphed on the Cartesian plane. Using the results from Questions 6a) and 6b), construct a time series plot for the modelled temperature anomalies from 2011 to 2019. *[2 marks]*
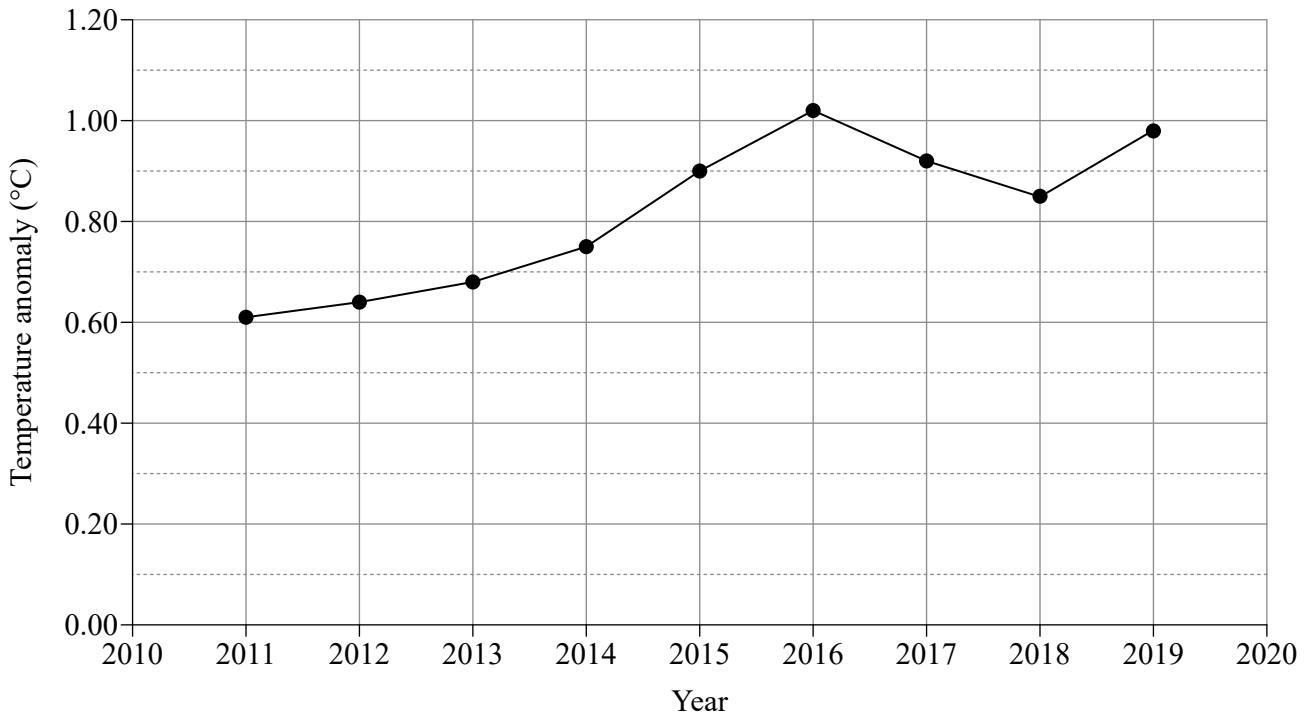
Note: If you make a mistake in the graph, cancel it by ruling a single diagonal line through your work and use the additional response space on page 17 of this question and response book.

d) Evaluate the reasonableness of the refined model using the graph from Question 6c). *[2 marks]*

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QUESTION 7 (4 marks)

Scientists predict that in a worst-case scenario, atmospheric carbon dioxide concentration will be 540.5 ppm in the year 2050. Using the refined model from Question 6 and the definitions from Stimulus 3 in the stimulus book, predict the range of global average temperature anomalies in a worst-case scenario if 2050 has a neutral ENSO phase strength.

END OF PAPER

Write the question number you are responding to.

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

Do not write outside this box.

Write the question number you are responding to.

Do not write outside this box.

ADDITIONAL RESPONSE SPACE FOR QUESTION 2a)

If you want this scatterplot to be marked, rule a single diagonal line through the scatterplot on page 2.
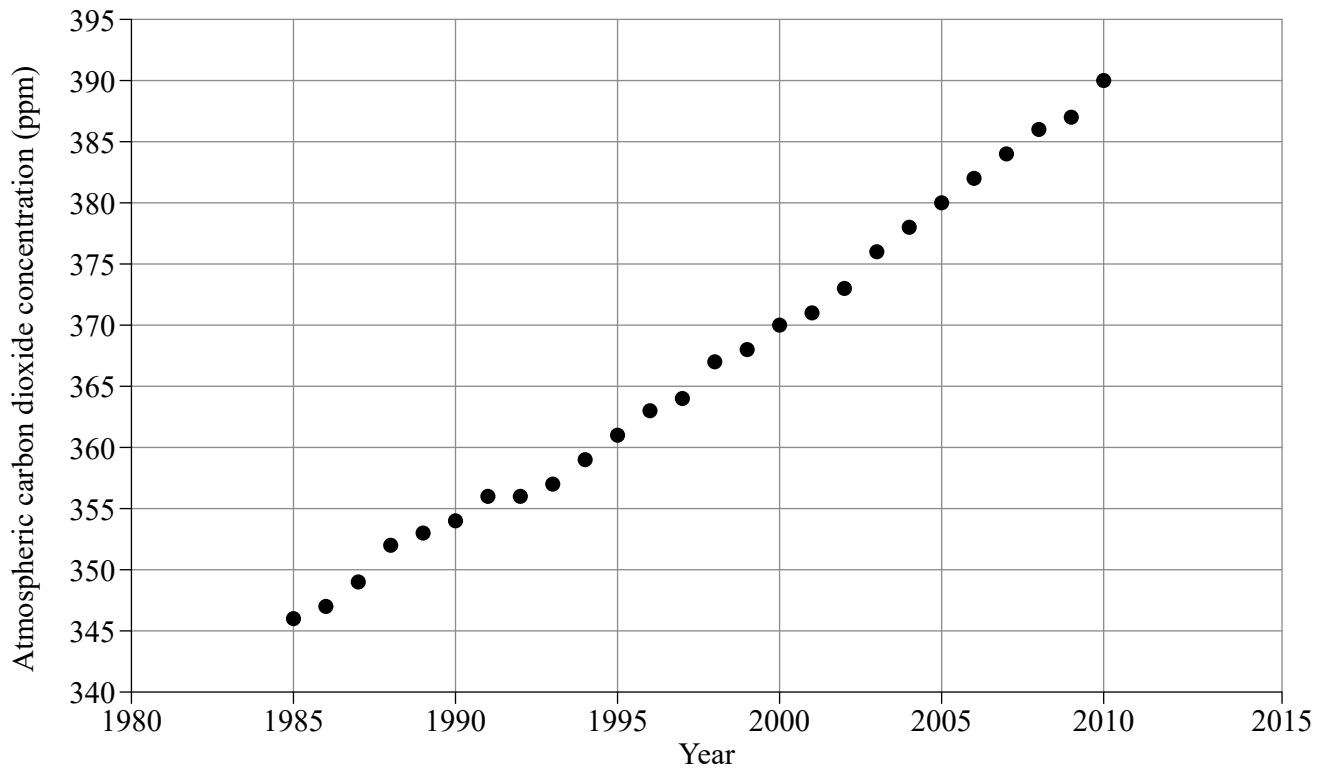
ADDITIONAL RESPONSE SPACE FOR QUESTION 6c)

If you want this graph to be marked, rule a single diagonal line through the graph on page 11.

Do not write outside this box.