AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

Level 3 Certificate
MATHEMATICAL STUDIES

Paper 2C Graphical techniques

Wednesday 22 May 2019 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a clean copy of the Preliminary Material and the Formulae Sheet (enclosed)
- a scientific calculator or a graphics calculator
- a ruler.

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 outside the box around each page or on blank pages.
- Show all necessary working; otherwise, marks for method may be lost.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- The **final** answer to questions should be given to an appropriate degree of accuracy.
- You may **not** refer to the copy of the Preliminary Material that was available prior to this examination. A clean copy is enclosed for your use.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You may ask for more answer or graph paper, which must be tagged securely to this answer booklet.

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

1 Helen is researching the amount of fat in 25-gram packets of ready salted and prawn cocktail crisps for three brands, **A**, **B** and **C**.

The table shows the amount of fat for each of the six packets.

	Ready salted (g)	**Prawn cocktail (g)**
A	10.4	9.5
B	9.6	10.8
C	10.3	10.6

1 (a) Draw lines below to match each box on the left to the correct box on the right.

[3 marks]

Mean fat content of the six packets	0.15 g
Median fat content of the six packets	0.20 g
Difference in the mean fat content between the ready salted packets and the prawn cocktail packets	1.30 g
	10.20 g
	10.30 g
	10.35 g

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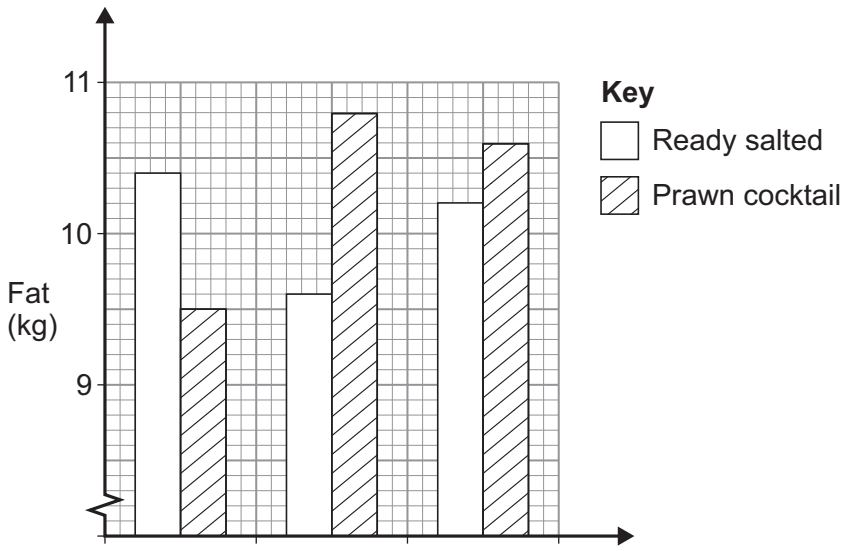
1 (b) Helen produces a bar chart to show the information for the six packets.



Identify **two** errors in the bar chart.

[2 marks]

Error 1

Error 2

Question 1 continues on the next page

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1 (c) Helen buys a packet of brand **B**'s prawn cocktail crisps weighing 160 grams.

This packet costs £2.30

Helen thinks that for every 10 pence worth of crisps in this packet, there are approximately 3 grams of fat.

Is Helen correct?

Assume that this packet and brand **B**'s 25-gram packet of prawn cocktail crisps have the same fat content **per gram**.

Show working to support your answer.

[4 marks]

9

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2 Use **PISA** from the Preliminary Material.

2 (a) Suggest **three** improvements that could be made to the article in the Preliminary Material, including the graphs.

[3 marks]

Improvement 1

Improvement 2

Improvement 3

Question 2 continues on the next page

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2 (b) A research assistant is comparing the UK average science score with the overall OECD average science score.

She wants to find out how many per cent higher the UK average is than the overall average.

Here is her calculation.

509 − 493 = 16

16 ÷ 509 = 0.0314

So 0.0314% higher

Critically analyse her calculation, making corrections where necessary.

[3 marks]

Do not write outside the box

2 (c) The following comments were made on social media after the 2015 results were published.

'For PISA maths in 2015, the range of average scores of the four UK nations is above 10'

Simon

'If Scotland's percentage decline in reading score from 2012 to 2015 is repeated in the next PISA test, the score will drop below 485'

Rukshana

2 (c) (i) Is Simon correct?
Show working to support your answer.

[2 marks]

2 (c) (ii) Is Rukshana correct?
Show working to support your answer.

[3 marks]

11

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3 A stone is dropped from a bridge into a river.

The distance, d metres, that the stone has fallen after t seconds is modelled by

$$d = 4.9t^2$$

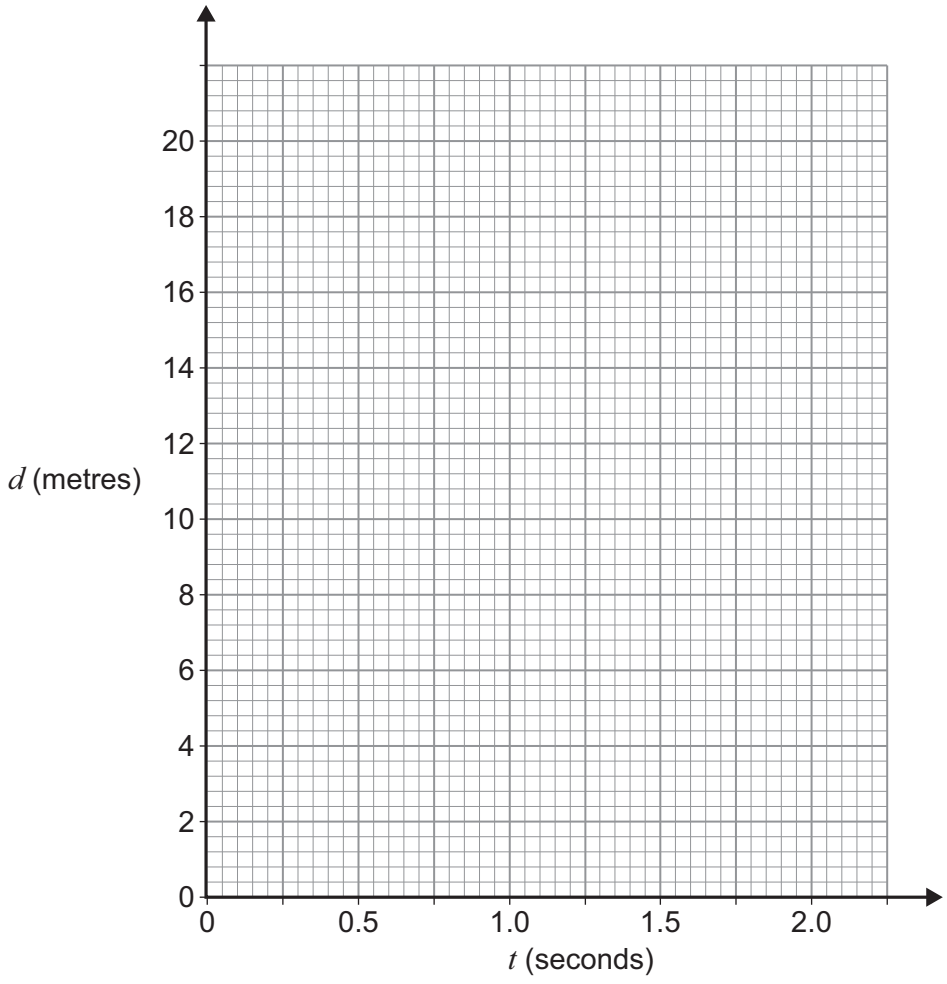
3 (a) Complete the table below.

[2 marks]

t	0	0.5	1.0	1.5	2.0
d				11.025	

3 (b) Draw a graph of d against t on the grid below.

[2 marks]



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3 (c) The stone hits the water when it has fallen 15 metres.

Use your graph to estimate the **speed** at which the stone hits the water.

[3 marks]

Answer _____ m s^{-1}

3 (d) Calculate the average speed of the stone from the moment it is dropped until it hits the water.

[3 marks]

Answer _____ m s^{-1}

10

Turn over for the next question

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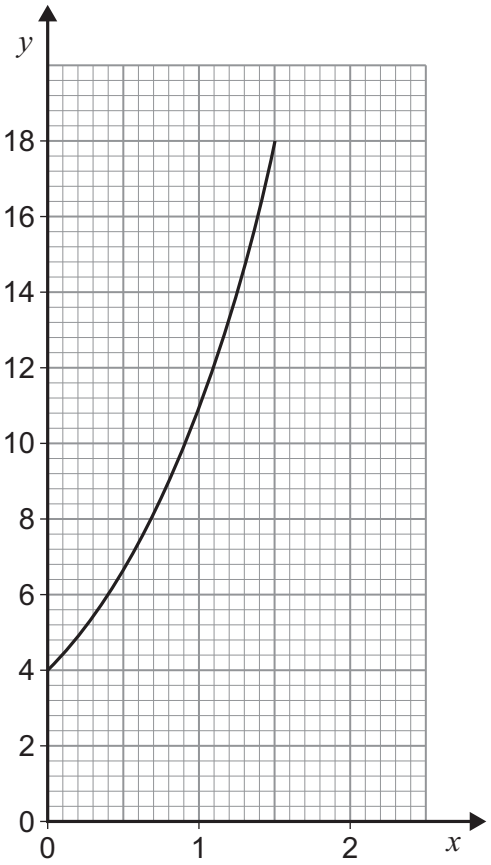
4 The graph shows an example of exponential growth.



A student models this using the equation $y = Ae^x$

4 (a) State the value of the constant A.

[1 mark]

Answer _____

4 (b) What is the gradient of the curve when $y = 10$?
Circle your answer.

[1 mark]

2.5 4 10 40

Do not write outside the box

4 (c) Work out the value of x when $y = 10$

Give your answer as a decimal to 3 decimal places.

[3 marks]

Answer _____

5

Turn over for the next question

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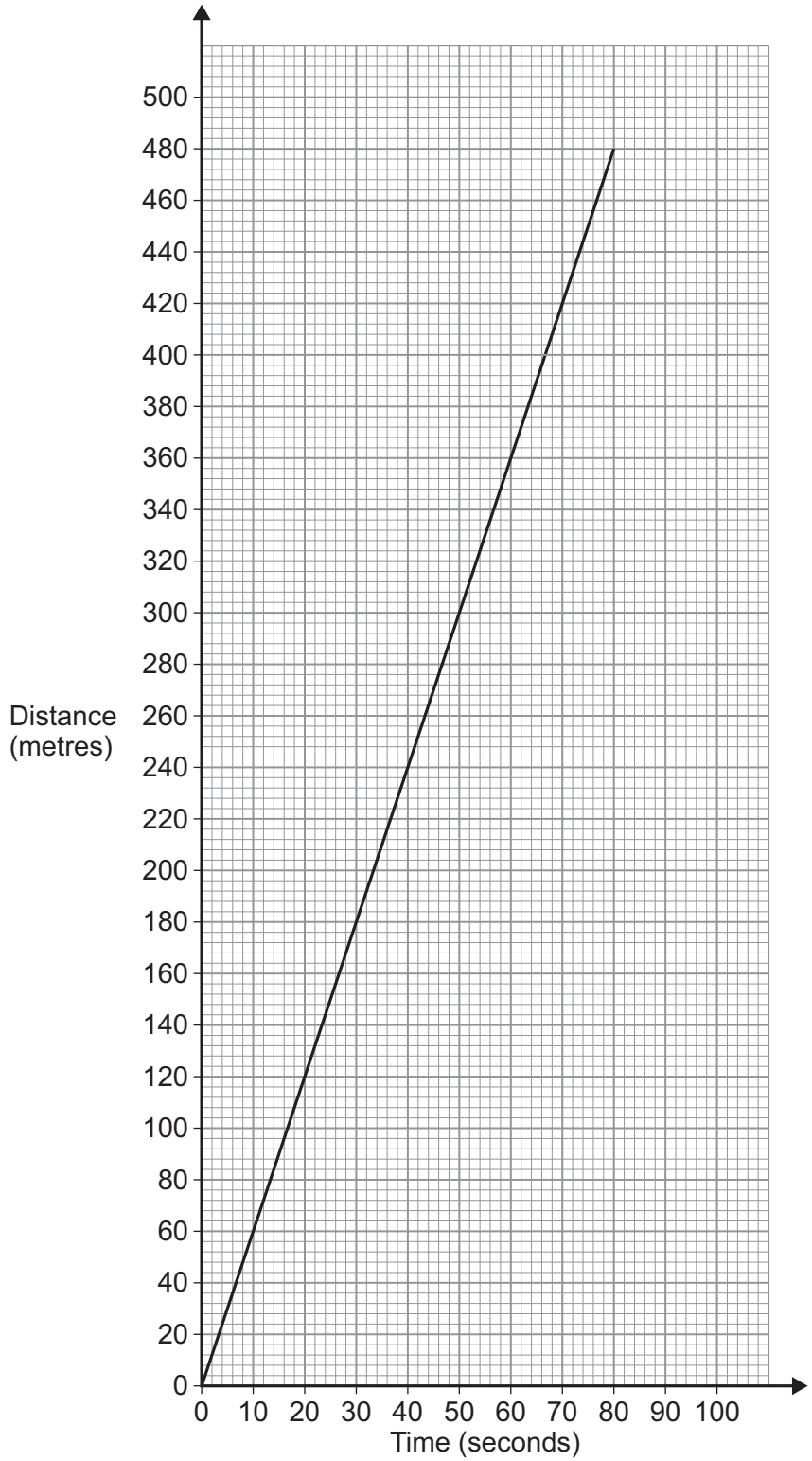
5 Emma and Andrew live in houses at opposite ends of a straight street.

The distance between their houses is 500 metres.

Andrew starts cycling from his house towards Emma's house.

He cycles at 6 m s^{-1}

The graph shows the distance between Andrew and his house if he cycles for 80 seconds at this speed.



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5 (a) Emma starts cycling at the same time as Andrew.

She cycles from her house towards Andrew's house at 4 m s^{-1}

On the same grid, draw a graph that shows the distance between Andrew's house and Emma, if she cycles at 4 m s^{-1} for 80 seconds.

[3 marks]

5 (b) Andrew and Emma stop when they meet.

State the distances that Andrew and Emma cycle before they meet.

[2 marks]

Andrew _____ metres

Emma _____ metres

5

Turn over for the next question

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6 The Highway Code recommends that drivers on motorways allow at least a two-second gap between their vehicle and the vehicle in front.

6 (a) Work out the recommended distance, in metres, between two vehicles which are both moving at the maximum legal speed of 112 km/h

[3 marks]

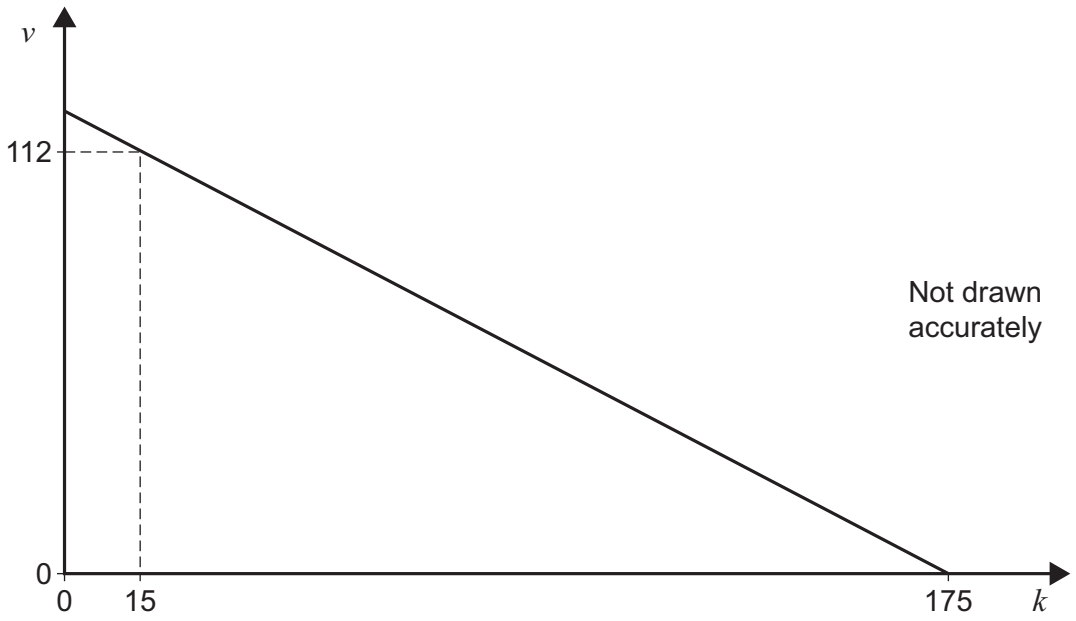
Answer _____ metres

6 (b) Research suggests that having variable speed limits on motorways can maximise the flow of traffic.

Traffic on motorways can be modelled using

- density, k vehicles per kilometre
- flow, q vehicles per hour
- speed of traffic, v kilometres per hour.

The graph shows a simplified relationship between v and k.



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6 (b) (i) Explain what is happening when the density is 175 vehicles per kilometre.

[1 mark]

6 (b) (ii) Traffic speed and density follow the model

$$v = Ak + B$$

where A and B are constants.

Use the graph to work out the value of A and the value of B.

[3 marks]

A = _____

B = _____

6 (b) (iii) Interpret your value of A.

[1 mark]

Question 6 continues on the next page

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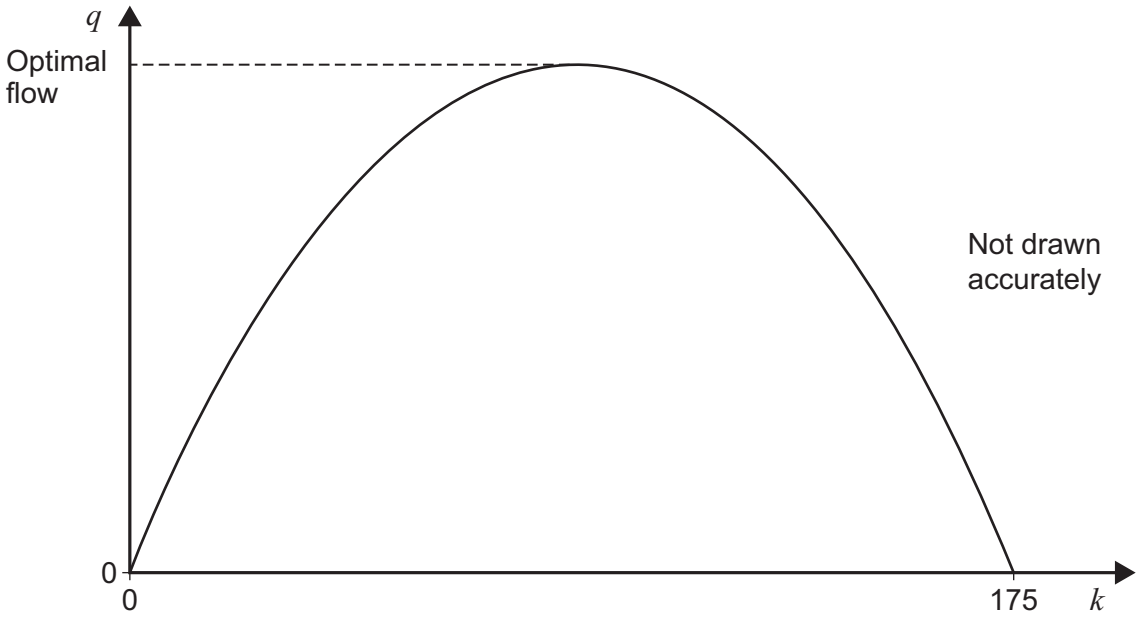
6 (b) (iv) Flow, q, and density, k, are connected by the formula

$$q = Ak^2 + Bk$$

where A and B are the values you worked out in **question 6(b)(ii)**.

This model is represented in the graph below.



Calculate the optimal flow as suggested by this model.

[3 marks]

Answer _____ vehicles per hour

Do not write outside the box

6 (b) (v) Work out the speed of traffic for optimal flow.

[2 marks]

Answer _____ km/h

13

Turn over for the next question

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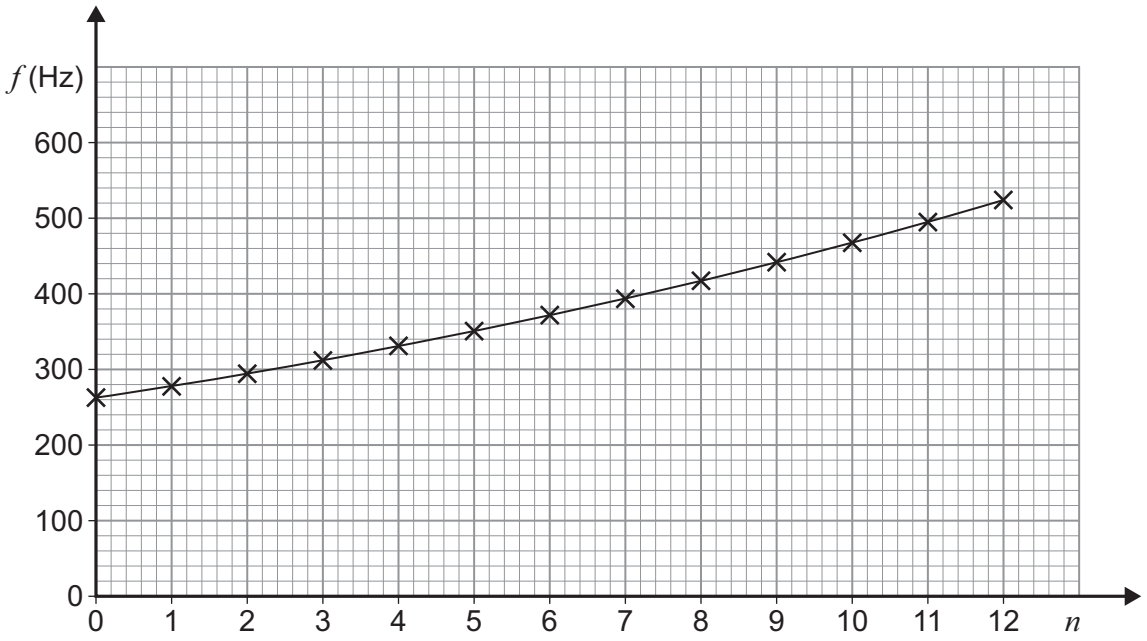
7 Musical instruments are used to play notes which have different frequencies.

Each note has its own frequency, measured in hertz (Hz).

The frequencies of 13 consecutive notes on a piano can be modelled by the function $f(n)$, where n takes integer values from 0 to 12

The frequencies of these notes are shown in the graph below.

The frequency of note 0 is given by $f(0) = 262$



The function $f(n)$ is defined as

$$f(n) = 262e^{Qn}$$

where Q is a constant.

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7 (a) State whether Q is positive or negative.
Give a reason for your answer.

[2 marks]

7 (b) The frequency of note 12 is double the frequency of note 0

Work out the value of Q to 2 decimal places.

[5 marks]

Answer _____

7

END OF QUESTIONS

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