A

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I declare this is my own work.

Level 3 Certificate

MATHEMATICAL STUDIES

Paper 2A Statistical Techniques

1350/2A

Wednesday 24 May 2023 Afternoon

Time allowed: 1 hour 30 minutes

At the top of the page, write your surname and forename(s), your centre number, your candidate number and add your signature.

[Turn over]

JUN231350 2A 01

MATERIALS

For this paper you must have:

- a clean copy of the Preliminary Material, Formulae Sheet and Statistical Tables (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.
- Answer ALL questions.
- You must answer the questions in the spaces provided. Do not write on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- 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.**

INFORMATION

- **The marks for questions are shown in brackets.**

- **The maximum mark for this paper is 60.**

- **You may ask for more answer paper or graph paper, which must be tagged securely to this answer booklet.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

1 **The table shows information about the top four teams in the 2020 Olympic Games.**

		NUMBER OF MEDALS			NUMBER OF COMPETITORS
RANK	TEAM	GOLD	SILVER	BRONZE	
1	United States	39	41	33	613
2	China	38	32	18	406
3	Japan	27	14	17	556
4	Great Britain	22	20	22	376

1 (a) **Work out the ratio of gold medals to bronze medals for the UNITED STATES.**

Circle your answer. [1 mark]

11 : 13 **13 : 11** **24 : 11** **13 : 24**

1 (b) A British newspaper made the following claim.

‘Great Britain won more medals per competitor than the United States.’

Does the data support this claim?

Show working to support your answer. [3 marks]

_____

_____ 4

[Turn over]

2 **Use ONLINE NATION from the Preliminary Material.**

2 (a) **Suggest TWO improvements that could be made to the GRAPHS in the Preliminary Material. [2 marks]**

Improvement 1

Improvement 2

2 (b) GRAPH 1 in the Preliminary Material is based on the results of a survey.

35 children aged 7 said they use MESSAGING OR SOCIAL MEDIA.

Estimate the number of children aged 7 that took part in the survey. [3 marks]

Answer _____

2 (c) Mark works for a children's charity.

The charity is concerned by the amount of time that children spend online.

He calculates the percentage increase in time that children aged 15–16 spend online compared to children aged 7–8

Here is his calculation, which uses information from the last sentence in the Preliminary Material.

$$\frac{4.54 - 2.54}{2.54} = 0.787$$

$$0.787 \times 100 = 78.7$$

So, children aged 15–16 spend 78.7% longer online than those aged 7–8

Identify ONE mistake in Mark's calculation and work out the correct percentage increase.
[3 marks]

Mistake _____

_____

_____

12

Correct calculation and answer

2 (d) Ayesha, a radio journalist, produces a report based on the ONLINE NATION extract in the Preliminary Material.

The report used GRAPH 1 to make the claim,

“There are more 13-year-olds using messaging or social media than 12-year-olds.”

Give ONE reason why this might NOT be true. [1 mark]

2 (e) **Ayesha commented that the ONLINE NATION extract was difficult to follow in places.**

Give TWO reasons why she might have said this.

You should NOT comment on the graphs. [2 marks]

Reason 1 _____

_____

_____

_____

_____

Reason 2 _____

_____

_____

_____

_____

[Turn over]

2 (f) Ayesha wants to comment on how much money social media companies make from children in the UK

She finds the following information for 2020

- There were approximately 3.2 million children aged 12–15 in the UK

- Instagram made $24 billion from their 1.41 billion users around the world.

- The average exchange rate was £1 = $1.28

Use this information, together with the data from the Preliminary Material, to estimate how much Instagram made from children aged 12–15 in the UK

Give your answer to the NEAREST MILLION pounds.
[5 marks]

Answer £ _____ million

16

3 (a) Here are four product moment correlation coefficients.

Circle the value that represents the strongest correlation.
[1 mark]

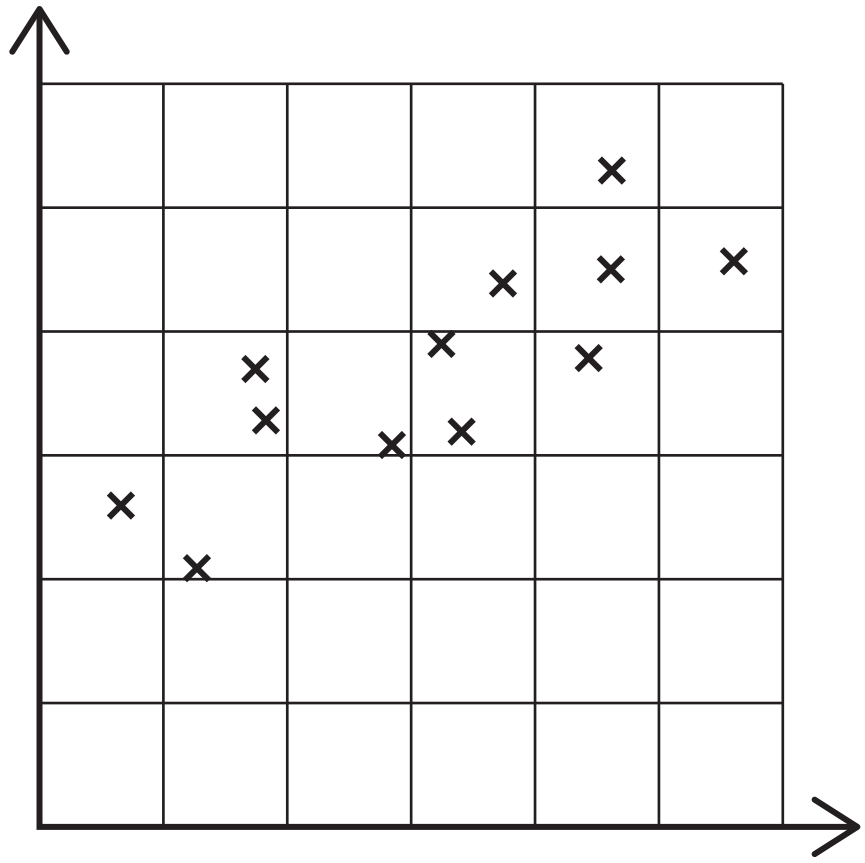
−0.983 −0.046

0.276 0.971

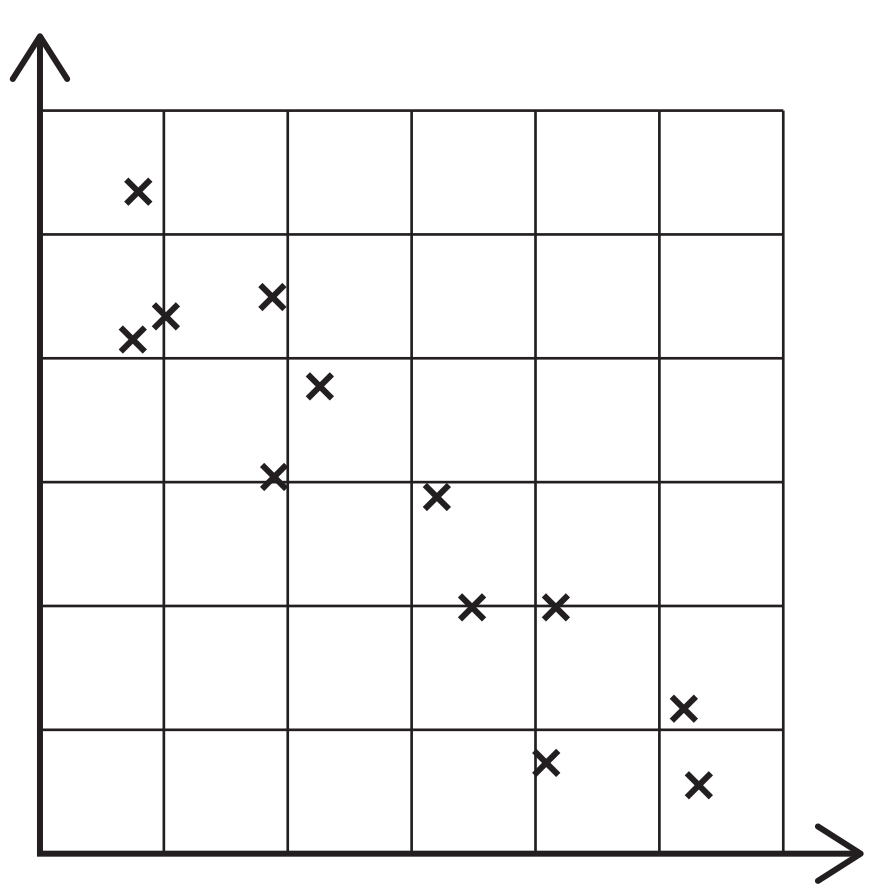
3 (b) Here are three scatter diagrams, A, B and C.

Circle the LETTER of the diagram that has a product moment correlation coefficient closest to zero. [1 mark]

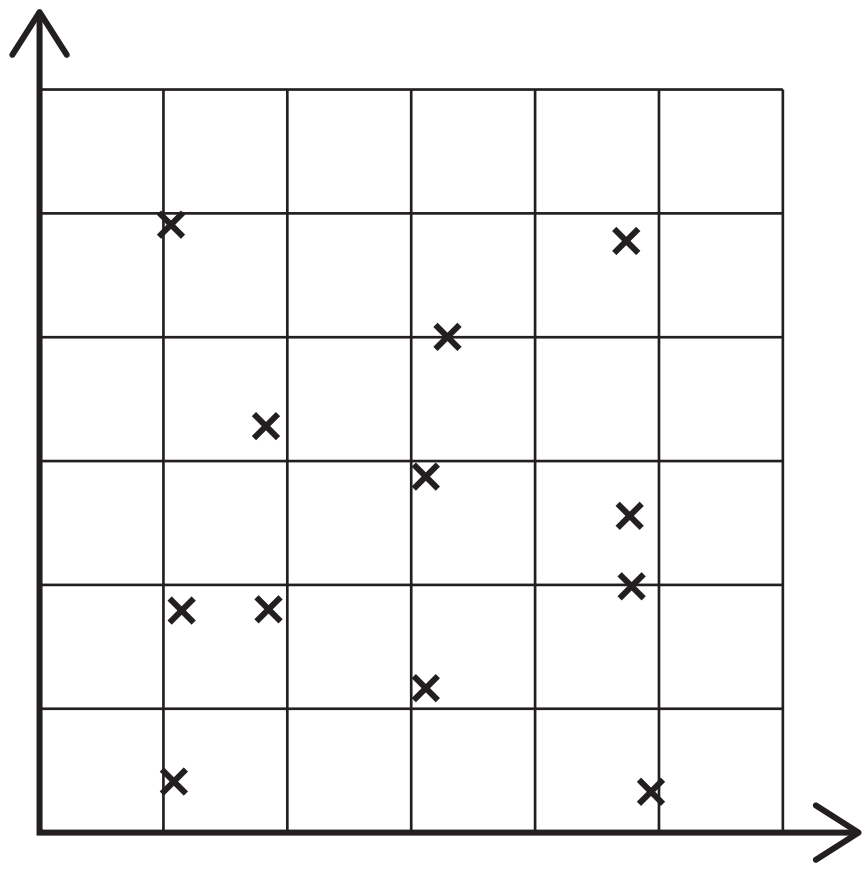
A



B

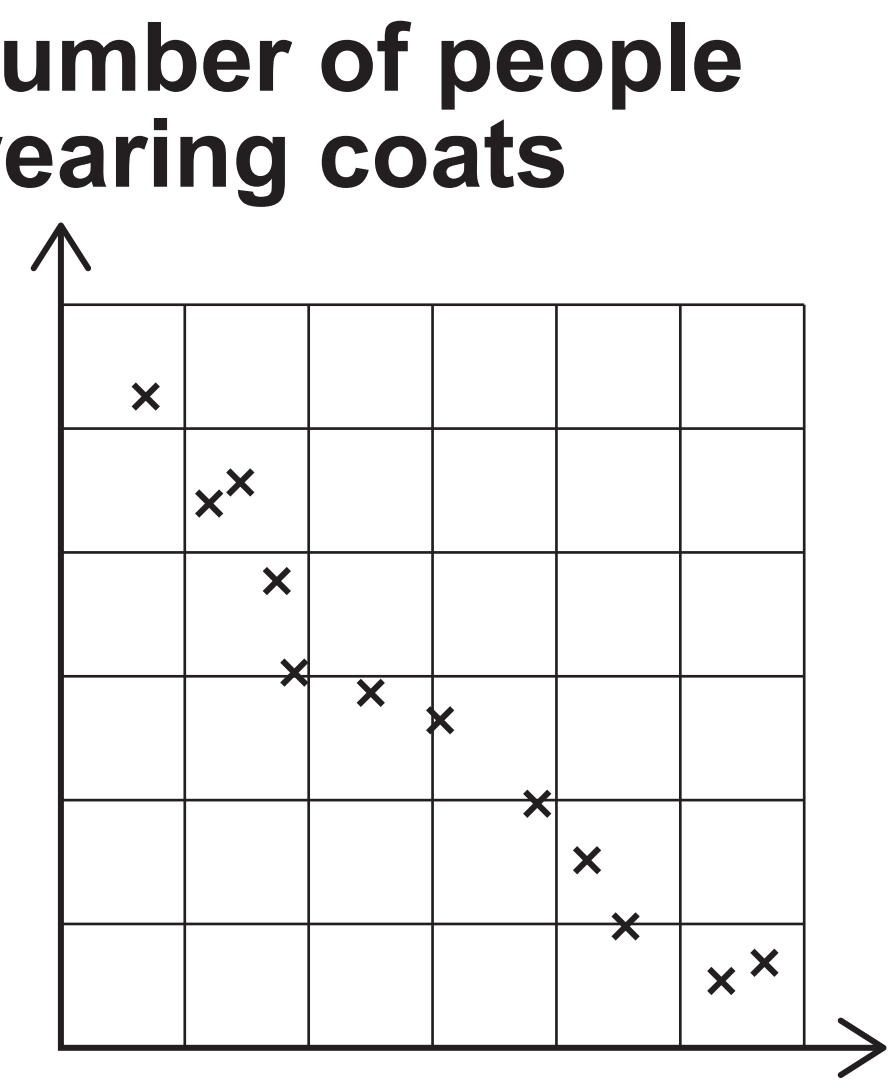


C



[Turn over]

3 (c) This scatter diagram shows the number of ice creams sold and the number of people wearing coats on 12 days at a theme park.



Tom looks at the diagram and says,

“Eating ice cream causes fewer people to wear coats.”

Is Tom correct?

Give a reason for your answer.
[1 mark]

3

4 Scafell Pike in the Lake District is the highest mountain in England.

The maximum daily temperature (°C) in winter, W, at Scafell Pike can be modelled by a normal distribution with mean 2.5 and standard deviation 1.4

4 (a) State the percentage of days in winter you would expect Scafell Pike to reach a maximum temperature within two standard deviations of the mean.

Give your answer to the nearest integer. [1 mark]

Answer _____ %

4 (b) Calculate P($W < 1.5$) [2 marks]

Answer _____

4 (c) Calculate P($W > 5.3$) [2 marks]

Answer _____

4 (d) Calculate P(–0.5 < W < 5.5)
[2 marks]

Answer

4 (e) The maximum daily temperature (°C) in summer, S, at Scafell Pike can be modelled by a normal distribution with mean 12.7 and standard deviation 2.1

$\mathrm{P}(S < x) = 0.04$

Work out the value of x.
[3 marks]

$x =$ _____

10

[Turn over]

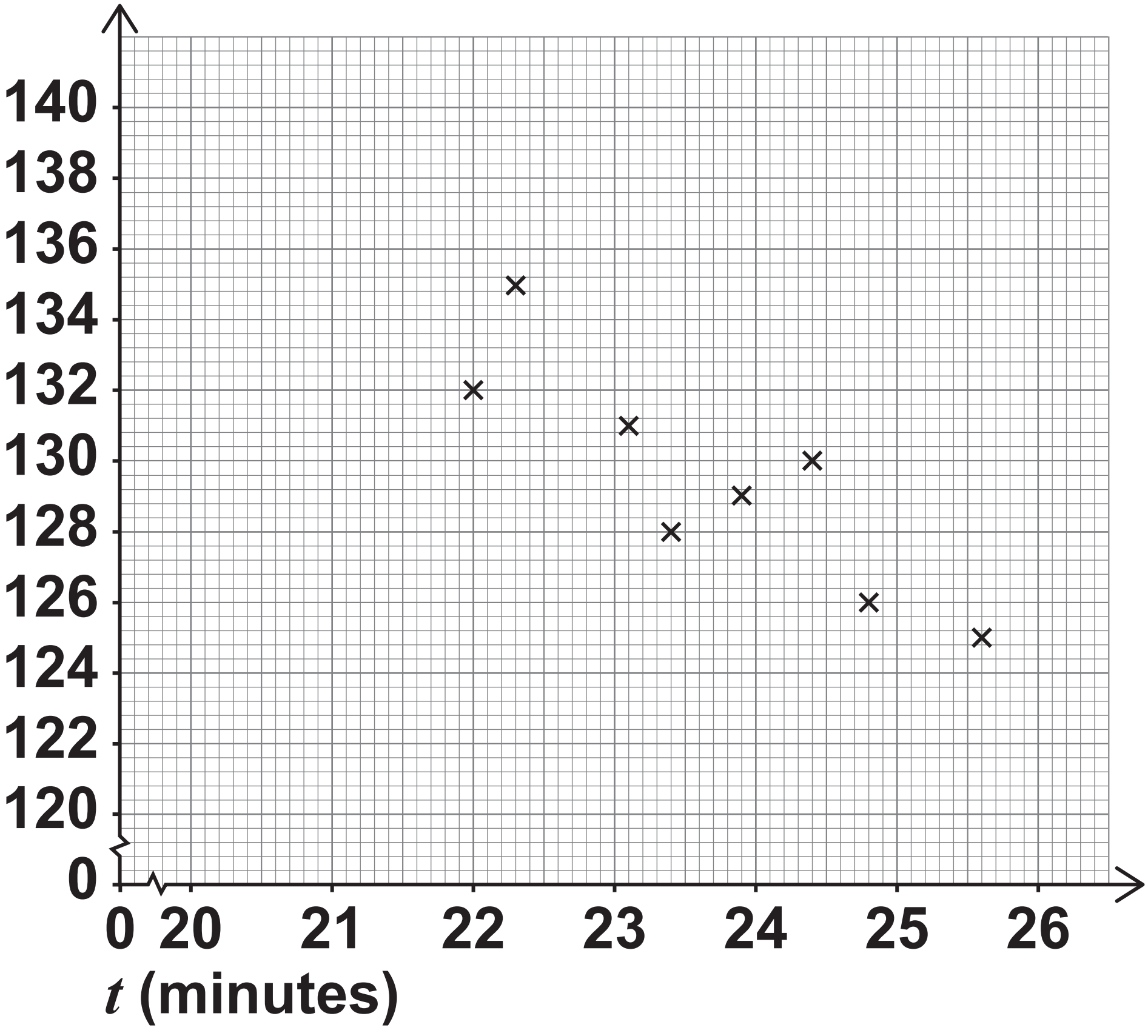
5 Femi does a 5 km run each week.

The table shows, for ten weeks,
the time taken for each run
and
her average heart rate during each run.

TIME TAKEN, t (MINUTES)	AVERAGE HEART RATE, h (BEATS PER MINUTE)
25.6	125
23.4	128
24.8	126
23.1	131
22.3	135
24.4	130
22.0	132
23.9	129
24.7	124
22.6	131

5 (a) The scatter diagram shows h against t for the first eight weeks.

Complete the diagram by plotting the points for the final two weeks. [1 mark]



5 (b) (i) Calculate the equation of the regression line of h on t.
[2 marks]

Answer

5 (b) (ii) Draw the regression line on the scatter diagram. [2 marks]

[Turn over]

5 (c) The next week, Femi takes 20.5 minutes to do the 5 km run.

5 (c) (i) Estimate her average heart rate during this run. [2 marks]

Answer _____

beats per minute

5 (c) (ii) Explain why your estimate is likely to be unreliable. [1 mark]

_____

_____

_____

8

[Turn over]

6 Alan is conducting research among Year 12 students at his school into their awareness of climate change.

The school has 180 Year 12 students.

Explain how Alan could select a simple random sample of 30 students for his research.
[3 marks]

3

[Turn over]

7 In 1982 a survey was carried out in a local football league.

The age of players who retired from playing during that year was recorded.

The ages, in years, are normally distributed with mean μ and variance 8

Here is a random sample of 10 ages from the survey.

32	30	39	31	29
35	27	31	42	34

7 (a) Construct a 98% confidence interval for μ [5 marks]

Answer

(_____ , _____)

7 (b) Using your answer to QUESTION 7(a), comment on the claim that $\mu = 32$ [2 marks]

7 (c) The same survey was carried out in 2022

A random sample of 10 ages from the survey gave a 98% confidence interval for μ of (37.3, 40.4)

What do you conclude about the change in the value of μ since 1982?

Give a reason for your conclusion. [2 marks]

9

[Turn over]

8 Year 9 students in the secondary schools in a city all take the same maths test.

Here are some point estimates of the mean score of all these Year 9 students.

No student is in more than one sample.

SAMPLE SIZE	POINT ESTIMATE
30	36.2
50	41.4
20	38.3
75	38.4

8 (a) Using this data, what is the best possible estimate of the population mean? [4 marks]

Answer _____

8 (b) Explain how the accuracy of the estimate of the population mean could be improved. [1 mark]

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[Turn over]

8 (c) Eight of the students who took the maths test take an additional test.

The scores of these students in the two tests are shown in the table.

M is the score in the Maths test.

A is the score in the Additional test.

M	31	11	14	7	12	46	9	13
A	56	75	37	42	23	33	81	42

By calculating the product moment correlation coefficient, describe the correlation between M and A. [2 marks]

7

END OF QUESTIONS

Additional page, if required. Write the question numbers in the left-hand margin.

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Question	Mark
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