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Surname ______________________________

Other Names ______________________________

Centre Number ______________________________

Candidate Number ______________________________

Candidate Signature ______________________________

Level 3 Certificate
MATHEMATICAL STUDIES

Paper 2A Statistical techniques

1350/2A

Wednesday 22 May 2019 Morning

Time allowed: 1 hour 30 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

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.**
- **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 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 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

[Turn over]

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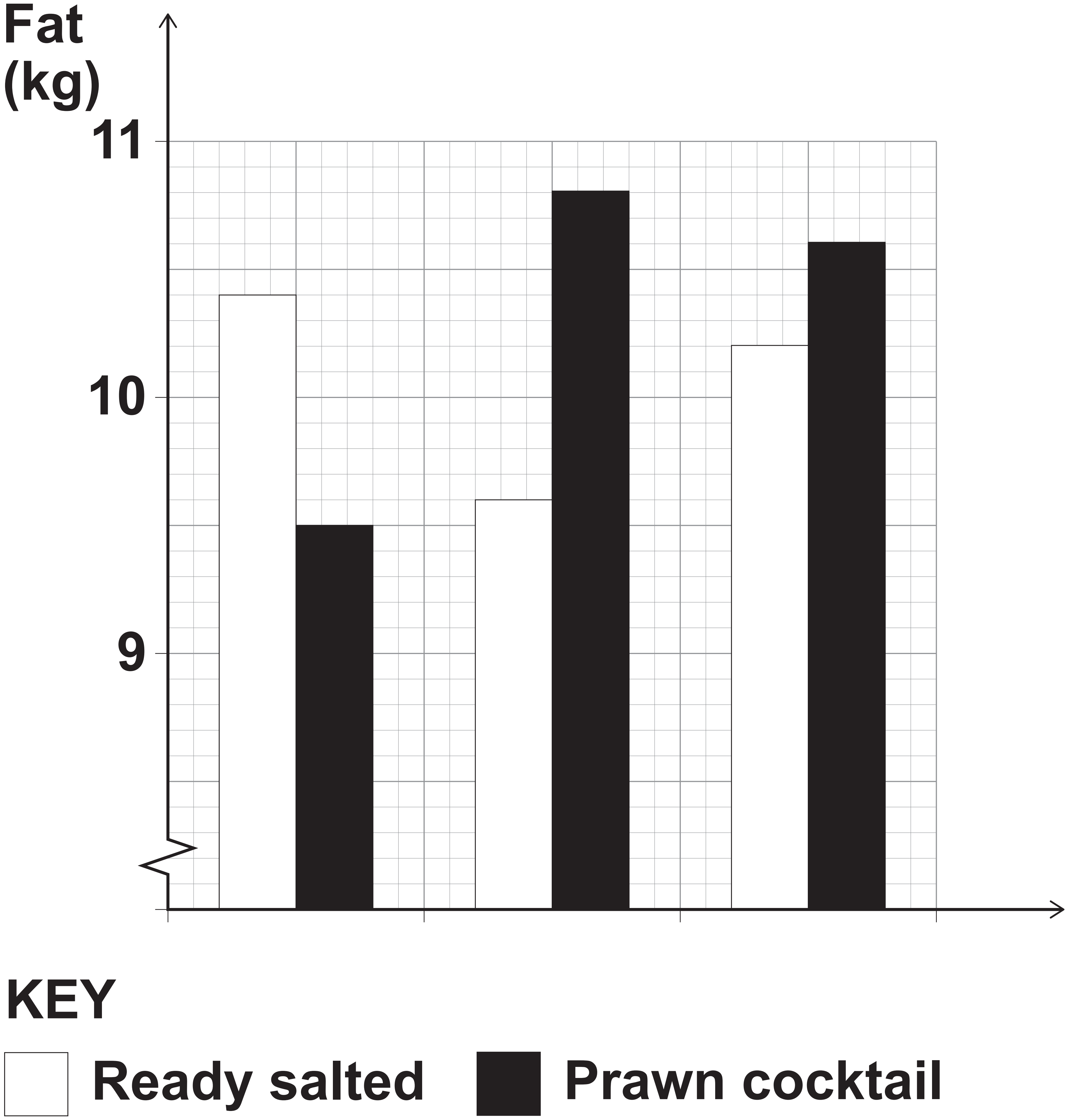
[Turn over]

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

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]

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9

[Turn over]

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

[Turn over]

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.

$509 - 493 = 16$
$16 \div 509 = 0.0314$
So 0.0314% higher

Critically analyse her calculation, making corrections where necessary. [3 marks]

[Turn over]

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]

[Turn over]

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2 (c) (ii) Is Rukshana correct?
Show working to support your answer. [3 marks]

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3 James is a decorator.

He has to prepare estimates of the final prices of jobs for potential customers.
In the past he based each estimate on the amount of time he thought the job would take.

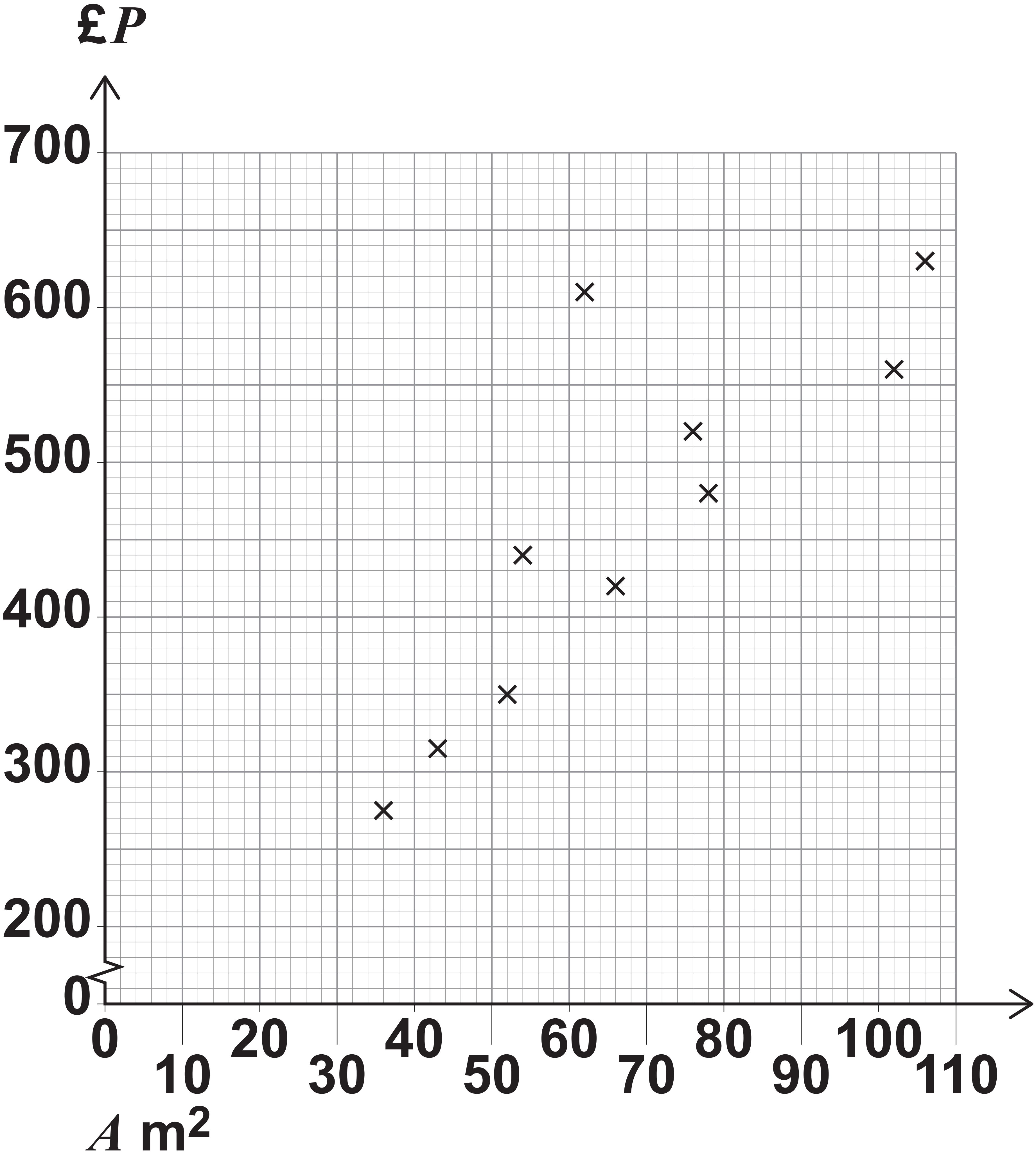
He wants to base future estimates on the surface area of the walls and ceilings that he has to decorate.

To work out how to do this, James uses data from his last 10 jobs, as shown in the table on page 22.

[Turn over]

Surface area, A m^2	Price, £P
36	275
66	420
62	610
106	630
43	315
76	520
52	350
54	440
78	480
102	560

A scatter diagram of P against A is shown below.



3 (a) One of the jobs required extra time to prepare the walls before decorating.

3 (a) (i) Using the other 9 points, calculate the equation of the regression line of P on A.
[2 marks]

Answer ______________________

3 (a) (ii) Draw your regression line on the scatter diagram on page 23. [2 marks]

[Turn over]

3 (b) **James decides to use the equation of the regression line as the basis for future estimates.**

He also decides to add an extra charge if a lot of preparation is needed.

The extra charge is based on the surface area, and the rates are shown in the table.

Preparation	Extra charge
Little or none	Zero
Medium amount	£3 per m^2
Large amount	£6 per m^2

James uses this new method to work out an estimate.

The surface area he has to decorate is 84 m^2

A large amount of preparation will be needed.

Work out his estimate.
[3 marks]

Answer £ ______

7

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[Turn over]

4 **Ambulance response time is the length of time between an emergency call being received and an ambulance arriving at the given location.**

In England, the National Health Service (NHS) has a target that 75% of emergency calls have a response time of 8 minutes or less.

4 (a) **In an urban area, a random sample of 14 ambulance response times, in minutes, were as follows.**

7.5	9	7.5	5	7	6	4
7.5	6.5	7	7.5	12	9	5

Comment on whether the NHS met the 75% target in this urban area.

You MUST show your working.
[2 marks]

[Turn over]

4 (b) **In a rural area, a random sample of 60 ambulance response times, in minutes, were recorded.**

In this area, the ambulance response time is assumed to be normally distributed with mean μ and variance 4

The total of these 60 ambulance response times was 470 minutes.

4 (b) (i) Construct a 90% confidence interval for μ. [5 marks]

Answer ______________________

4 (b) (ii) A spokesperson for the NHS claims that the mean ambulance response time for this rural area is 7.2 minutes.

Use your answer to question 4(b)(i) to comment on her claim.

You do NOT need to do any additional working to answer this question. [2 marks]

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5 **Anna looks after a forest of Scots pine trees.**

5 (a) **Anna wants to estimate the mean height of trees in the forest.**

She makes point estimates of the mean height of trees in different areas of the forest.

The table shows three of Anna's point estimates.

They were made on the same day.

Number of trees	Mean height (m)
10	16.8
15	18.4
5	15.9

Work out the best estimate of the population mean. [3 marks]

Answer ______________________ **m**

[Turn over]

5 (b) Each tree in the forest is numbered.

Trees numbered from 001 to 225 are between 20 and 40 years old.

Anna wants to choose a sample of 10 of these trees at random.

To do this she uses 3-digit random numbers.

Complete the table below to show the number of each tree in Anna's sample. [3 marks]

Random number	192	850	580	167	608	707	663	050	425	662
Tree number	192	175	130	167	158	032	213			

5 (c) The table shows the diameter, height and age of each tree in Anna's sample.

Diameter (cm)	Height (m)	Age (nearest year)
11.1	6.3	20
10.9	6.9	21
12.4	12.0	31
13.6	14.7	35
10.4	8.4	26
11.6	10.9	28
12.2	12.3	32
13.6	14.7	37
11.7	12.2	33
12.6	12.5	29

Anna wants to use the diameter of a tree to estimate

its height

its age.

Which of these estimates is likely to be more reliable?

Use product moment correlation coefficients to help you decide. [3 marks]

[Turn over]

9

6 (a) Give an example of two variables which have BOTH of the following features.

The CORRELATION between the variables is strong.

One of the variables CAUSES the other to change.

State the variable that causes the other to change. [2 marks]

[Turn over]

6 (b) Give an example of two variables which have BOTH of the following features.

The CORRELATION between the variables is strong.

The variables do NOT CAUSE a change in each other.

Explain why the variables do NOT cause a change in each other. [2 marks]

4

[Turn over]

7 **The annual salary of electrical technicians in the UK can be modelled by a normal distribution with mean £31 000 and standard deviation £7000**

7 (a) **Based on this model, what is the median annual salary of an electrical technician in the UK?**

Circle your answer. [1 mark]

£15 500 **£19 000**

£24 000 **£31 000**

7 (b) **An electrical technician is chosen at random.**

Calculate the probability that the annual salary of this technician is

7 (b) (i) more than £39 000 [2 marks]

Answer ______________________

7 (b) (ii) less than £26 000 [2 marks]

Answer ______________________

7 (b) (iii) between £26 000 and £39 000
[2 marks]

Answer

[Turn over]

7 (c) **Work out an estimate of the minimum annual salary of the 10% most highly paid electrical technicians in the UK.**

Give your answer to the nearest £1000 [4 marks]

Answer £ ______________________

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END OF QUESTIONS

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