AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

Level 3 Certificate
MATHEMATICAL STUDIES

Paper 2A Statistical Techniques

Time allowed: 1 hour 30 minutes

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.
- 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.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

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

1 The plans for a new housing estate include 80 properties of different types.
The table shows the planned number of each type of property.

Type of property	Planned number of this type
1-bedroom flat	10
2-bedroom flat	15
2-bedroom house	25
3-bedroom house	20
4-bedroom house	5
5-bedroom house	5

1 (a) Work out the ratio of houses to flats.
Circle your answer.

[1 mark]

5 : 11 11 : 5 5 : 16 16 : 11

Do not write outside the box

The local council must approve the plans for the housing estate.

To be approved, the plans must meet some minimum requirements.

1 (b) Here are the minimum requirements for the number of cycle parking spaces.

- 1 space **per bedroom** up to and including 3-bedroom properties
- 3 spaces for 4-bedroom properties
- 4 spaces for 5-bedroom properties
- **plus** some visitor cycle parking

The plans for the housing estate include 185 cycle parking spaces.

Do the plans meet the minimum requirements?

You **must** show your working.

[3 marks]

Question 1 continues on the next page

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1 (c) The developers building the housing estate want to change their plans.

They make more profit on 2-bedroom houses than on 2-bedroom flats.

To approve the plans, the local council insists that

- there must still be 80 properties
- at least 23% of the properties are classified as 'affordable housing'.

The table shows which properties are classified as 'affordable housing'.

Type of property	Affordable housing	Planned number of this type
1-bedroom flat	✓	10
2-bedroom flat	✓	
2-bedroom house	×	
3-bedroom house	×	20
4-bedroom house	×	5
5-bedroom house	×	5

Complete the table to show the number of 2-bedroom flats and 2-bedroom houses that would be approved and make the greatest profit.

[3 marks]

7

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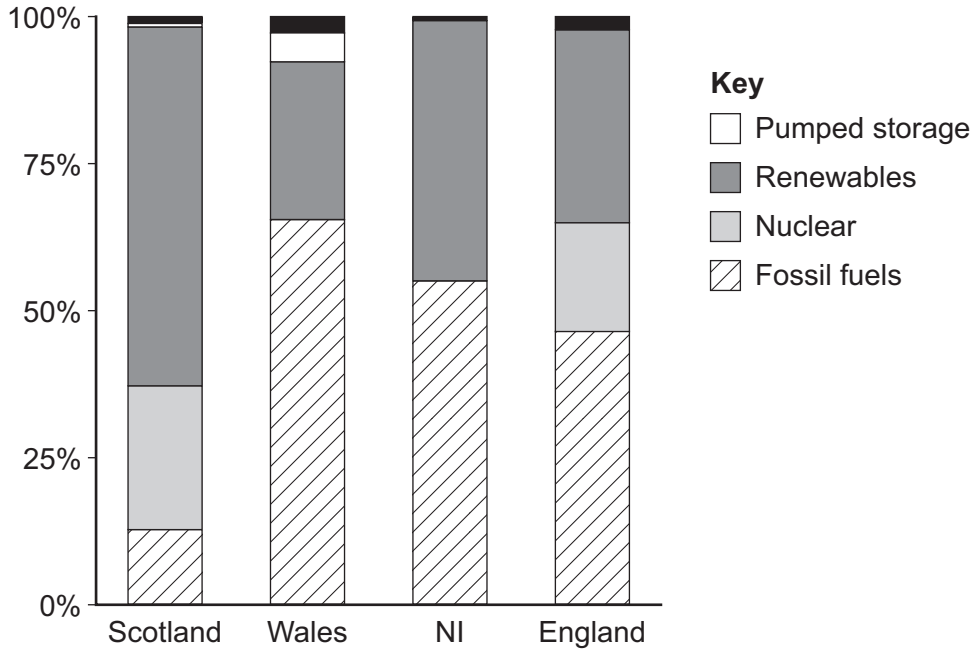
2 Use **Electricity generation** from the Preliminary Material.

2 (a) The bar chart shows how each of the four nations of the United Kingdom generated electricity in 2019



Suggest **two** improvements that could be made to the bar chart.

[2 marks]

Improvement 1

Improvement 2

Question 2 continues on the next page

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2 (b) Two newspapers reported on electricity generation in England in 2019

> Electricity generated by renewables reached more than 70% of that generated from fossil fuels.
>
> *Morning Record*

> The ratio of wind to other renewables is about 13 : 17
>
> *Daily Bulletin Review*

Using **Table 1** in the Preliminary Material, comment on the validity of each newspaper's claim.

You **must** show your working.

[5 marks]

Morning Record

Daily Bulletin Review

Do not write outside the box

2 (c) In 2019, Northern Ireland generated 4189 GWh of electricity by renewables.

The average cost of electricity was 14.4p per kWh

1 GWh = 1 000 000 kWh

Anna says,

> "In 2019, Northern Ireland generated electricity by renewables worth over 600 million pounds."

Is she correct?

You **must** show your working.

[3 marks]

Question 2 continues on the next page

Do not write outside the box

2 (d) In 2019, Wales generated 7700 GWh of electricity by renewables.

Work out the total amount of electricity generated in Wales from all fuels.

[2 marks]

Answer _____ GWh

Do not write outside the box

2 (e) Bobby wants to work out the mean percentage of electricity generated by renewables in the UK.

Here is his calculation, which uses the values from **Chart 1** in the Preliminary Material.

$61.1 + 44.6 + 33.0 + 26.9 = 165.6$

$165.6 \div 4 = 41.4$

So 41.4% of energy generated in the UK in 2019 was by renewables.

The article states that 37.1% of energy generated in the UK in 2019 was by renewables.

Critically analyse Bobby's method, explaining why his percentage does not agree with the article.

You do **not** need to carry out any calculations.

[1 mark]

13

Turn over for the next question

Do not write outside the box

3 The normal distribution is one of the most important probability distributions in statistics.

Draw a line from each box on the left to the correct value on the right.

[2 marks]

Mean of the standardised normal distribution	0
	0.5
Standard deviation of the standardised normal distribution	0.67
	1

2

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4 The Intelligence Quotient (IQ) of staff in an office is normally distributed with mean μ and variance 340

A random sample of 20 staff have their IQ measured.

The mean of their results was 103

The office manager wants to construct a 90% confidence interval for μ

4 (a) Circle the z-value, correct to two decimal places, needed to construct a 90% confidence interval.

[1 mark]

0.90 1.28 1.64 2.58

4 (b) Calculate a 90% confidence interval for μ

[3 marks]

Answer _____

4 (c) The manager claims that the mean IQ of staff in the office is 120

Use your answer to **Question 4(b)** to comment on this claim.

[2 marks]

6

Turn over ▶

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5 An ordinary 6-sided dice is thrown 150 times.

The scores are shown below.

4	5	2	4	3	3	4	6	6	3	5	1	4	4	5
6	5	3	2	6	3	6	2	6	5	3	6	1	5	4
2	6	2	4	2	1	3	6	1	2	6	6	5	2	2
5	4	4	5	5	5	3	1	1	2	1	1	3	5	6
6	6	1	6	1	3	5	5	5	6	4	5	5	3	2
3	6	1	5	5	6	5	1	3	1	6	3	3	2	6
3	1	3	4	5	2	4	1	2	2	5	2	5	2	5
2	1	2	5	6	6	6	3	2	1	4	5	4	6	4
1	3	6	5	6	6	5	3	3	3	4	3	4	4	4
6	4	1	4	5	5	5	5	6	4	2	5	4	2	5

5 (a) A random number generator is used to choose a random sample of three scores.

The numbers generated are 98, 147 and 6

State their corresponding dice scores.

[2 marks]

98 → _____

147 → _____

6 → _____

Do not write outside the box

5 (b) Ali, Becky and Carly choose random samples from the 150 dice scores.

They each calculate a point estimate of the mean score using their sample.

	Sample size	Point estimate
Ali	10	3.6
Becky	10	4.3
Carly	25	3.8

Whose point estimate is likely to be closest to the mean score of all 150 throws?

Give a reason for your answer.

[1 mark]

5 (c) Use your scores in **Question 5(a)** and the point estimates from the table in **Question 5(b)** to calculate a more representative point estimate of the mean.

You may assume that each score is in at most one sample.

[4 marks]

Answer _____

5 (d) Is the dice fair?

Give a reason for your answer.

[2 marks]

9

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6 (a) State the value of perfect negative correlation.

[1 mark]

Answer _____

6 (b) The table gives the time spent running and distance travelled for 8 members of a running club.

Time (minutes)	Distance (km)
28	3.4
31	4.7
35	6.2
40	9.1
45	8.0
49	4.3
52	6.1
57	7.7

Using the product moment correlation coefficient, state the **type** and **strength** of the correlation between time and distance.

[2 marks]

_____

_____

_____

_____

3

7 The heights, X metres, of yucca plants at a garden centre are normally distributed with mean 1.58 and standard deviation 0.31

7 (a) Write the distribution in notation form.

[1 mark]

Answer _____

7 (b) Calculate P($X < 2$)

[2 marks]

_____

_____

_____

_____

Answer _____

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7 (c) Calculate P($X < 1.3$)

[2 marks]

Answer _____

7 (d) 60% of the yucca plants have a height of **more than** k metres.

Work out the value of k

[3 marks]

k = _____

8

Turn over for the next question

8 12 students in a class were due to sit two tests.

One student was absent for test 1

A different student was absent for test 2

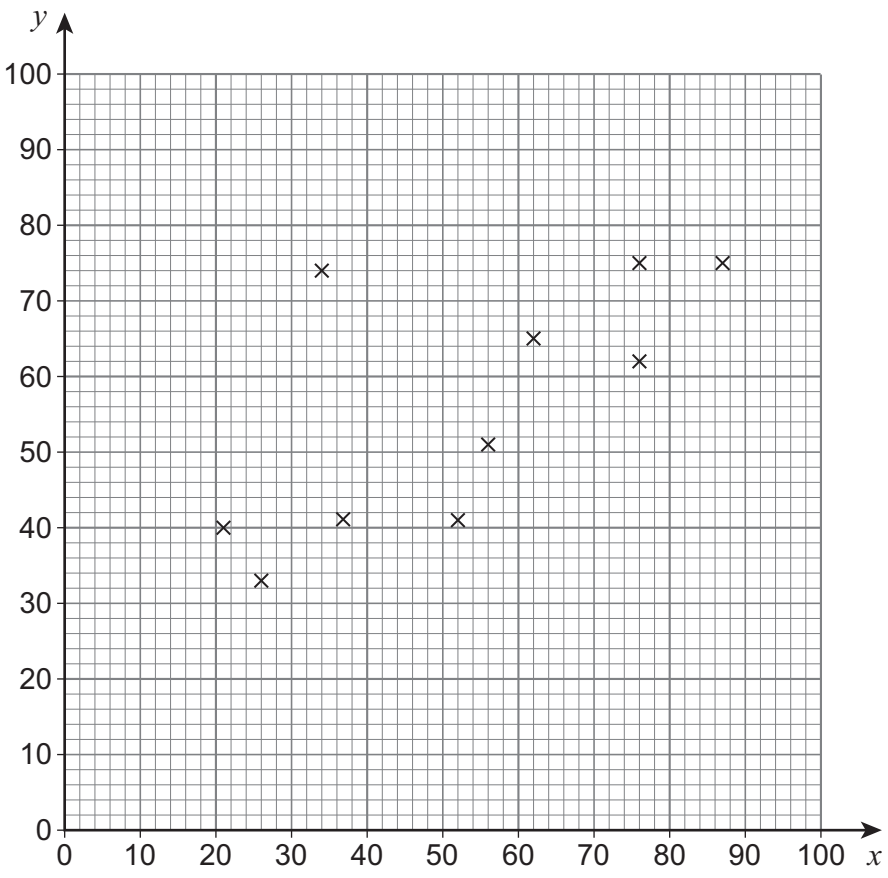
The marks are shown in the table.

x is the mark for test 1

y is the mark for test 2

Student	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
x	21	87	52	76	34	56	76	27	26	37	62	abs
y	40	75	41	75	74	51	62	abs	33	41	65	49

The marks of the 10 students that sat both tests are shown on the scatter diagram.



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8 (a) The class teacher says that one student's pair of marks could be an outlier.

Which student is this?

[1 mark]

Answer _____

8 (b) Calculate the equation of the regression line of y on x

Do **not** include the outlier.

[2 marks]

_____

_____

_____

_____

Answer _____

8 (c) Use your equation of the regression line to estimate the missing marks.

[3 marks]

_____

_____

_____

_____

_____

_____

Test 2 mark for student **H** _____

Test 1 mark for student **L** _____

Question 8 continues on the next page

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8 (d) Each student was awarded an overall grade based on the total mark, t, of their two tests.

m is the mean of the values of t, including the outlier and the two estimated marks.

Grade 5	Grade 4	Grade 3	Grade 2	Grade 1
$t \geqslant 1.4m$	$1.1m \leqslant t < 1.4m$	$0.8m \leqslant t < 1.1m$	$0.6m \leqslant t < 0.8m$	$t < 0.6m$

Which students were awarded **Grade 3**?

You **must** show your working.

You may use the table below.

Student	A	B	C	D	E	F	G	H	I	J	K	L
x	21	87	52	76	34	56	76	27	26	37	62	
y	40	75	41	75	74	51	62		33	41	65	49

[6 marks]

Answer _____

12

END OF QUESTIONS

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