A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____
I declare this is my own work.

# Level 3 Certificate
# MATHEMATICAL STUDIES

**Paper 2A Statistical Techniques**

## 1350/2A

**Time allowed: 1 hour 30 minutes**

**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.**

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

**[Turn over]**

JUN221350 2A01

## 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**

**BLANK PAGE**

**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

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]

[Turn over]

**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'.**

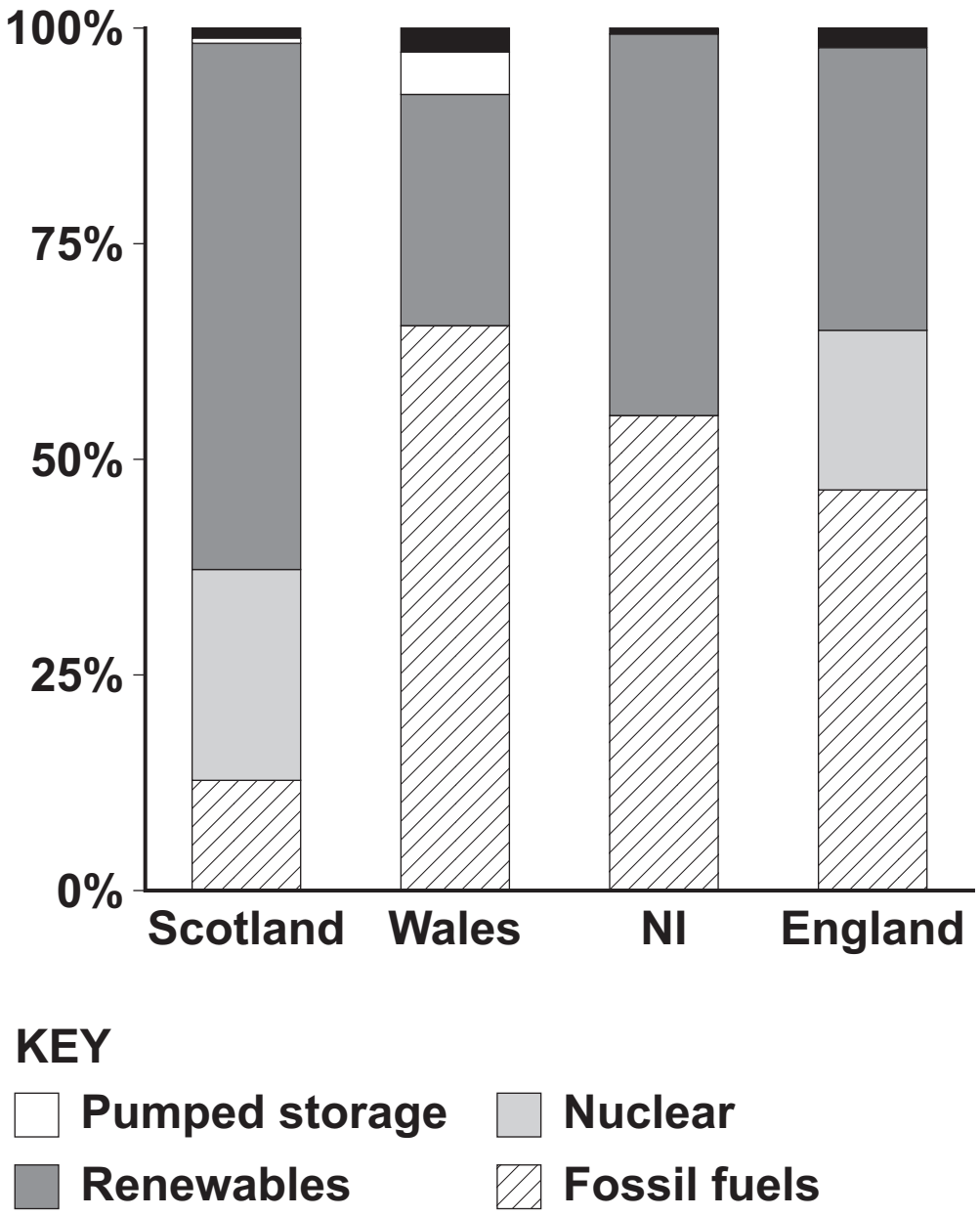
| TYPE OF PROPERTY | AFFORDABLE HOUSING | PLANNED NUMBER OF THIS TYPE |
|---|---|---|
| 1-bedroom flat | ✓ | 10 |
| 2-bedroom flat | ✓ | |
| 2-bedroom house | × | |
| 3-bedroom house | × | 20 |
| 4-bedroom house | × | 5 |
| 5-bedroom house | × | 5 |

**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

**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**

**[Turn over]**

**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

[Turn over]

**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]**

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



**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 ÷ 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

**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** |
| | **0.67** |
| **Standard deviation of the standardised normal distribution** | **1** |

2

**4** The Intelligence Quotient (IQ) of staff in an office is normally distributed with mean $\mu$ 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 $\mu$

**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 $\mu$
[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]**

**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 → _____

**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]

_____

_____

_____

[Turn over]

**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

**[Turn over]**

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

**[Turn over]**

**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 _____

**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

**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**

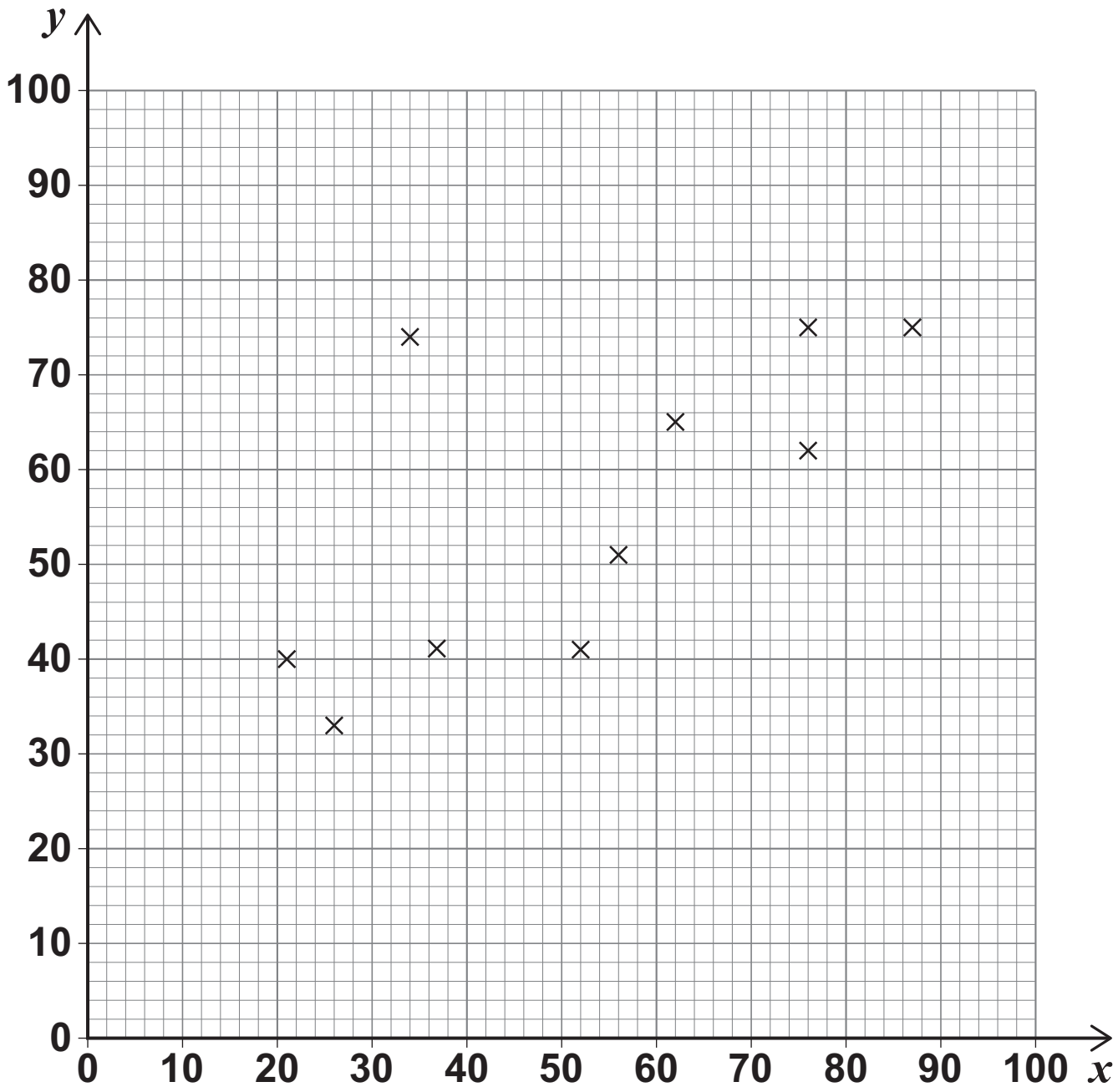
**The marks are shown in the table.**

**$x$ 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.**



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

[Turn over]

**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** | $t \geqslant 1.4m$ |
| **GRADE 4** | $1.1m \leqslant t < 1.4m$ |
| **GRADE 3** | $0.8m \leqslant t < 1.1m$ |
| **GRADE 2** | $0.6m \leqslant t < 0.8m$ |
| **GRADE 1** | $t < 0.6m$ |

**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**

**BLANK PAGE**

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

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

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

# BLANK PAGE

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