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	
TOTAL	

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

1 Eva is a newspaper reporter.

She collected data about the degree results achieved by students at a university over 3 years.

Some students failed their course and were not awarded a degree.

Eva recorded the results in this table.

		Degree class awarded					
		First	**Upper Second**	**Lower Second**	**Third**	**Fail**	**Total completed**
Year course completed	**2018**	2615	1750	981	371	93	5810
	2019	3358	2300	1042	140	60	6900
	2020	5450	1509	375	229	77	7640

1 (a) Work out the ratio of students in **2019** awarded an Upper Second class degree to the total number of students completing their course that year.

Circle your answer.

[1 mark]

1 : 2 2 : 1 1 : 3 3 : 1

Do not write outside the box

1 (b) In an article on the data Eva made the following statements.

Statement 1

'The average amount a student paid for a degree course was £27 000. This means that the university collected more than half a billion pounds from these students.'

Statement 2

'The percentage of students in the year group awarded a First class degree increased by more than half from 2018 to 2020'

Does the data support these statements?

Show working to support your answers.

[6 marks]

Statement 1

Statement 2

7

Turn over for the next question

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2 Use **Plastic waste** from the Preliminary Material.

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

Improvement 1

Improvement 2

2 (b) Readers of the extract from the briefing paper commented that it was difficult to follow in places.

Give **three** reasons why they might have said this.

You should **not** comment on the charts.
[3 marks]

Reason 1

Reason 2

Reason 3

Do not write outside the box

2 (c) The following statements were made about the data on two online forums.

The amount of plastic waste going to landfill fell by more than 60% from 2012 to 2016

Ecofriends

UK production of plastic waste in 2016 had increased by about 0.3 million tonnes since 2010

Greenusers

Using the data given, comment on the validity of these statements.

[6 marks]

Ecofriends

Greenusers

Question 2 continues on the next page

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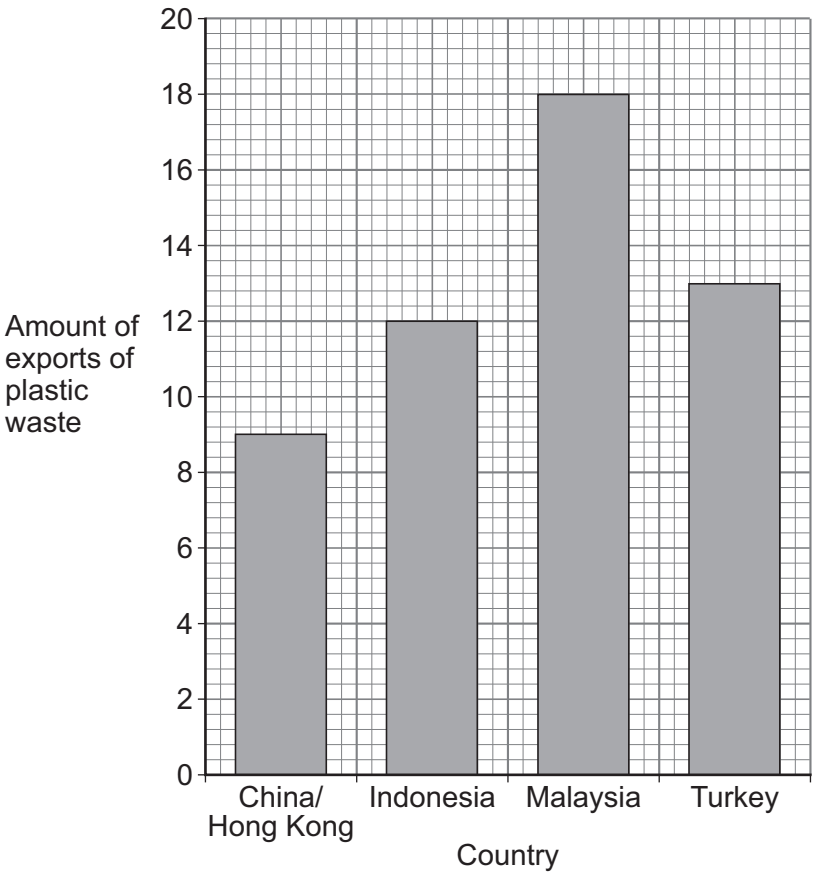
2 (d) The bar chart shows information about the exports of plastic waste from the UK in 2018



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

[2 marks]

Error 1

Error 2

13

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3 David, a personal trainer, is investigating the mean height of the members of his gym.

He wants to work out a point estimate.

3 (a) Explain the meaning of the term 'point estimate'.

[2 marks]

3 (b) Here are the heights of the members in centimetres.

168	172	179	166	158	174	163	159
163	176	167	161	154	159	170	166

David wants to use the heights of five of them to work out a point estimate of the mean height.

He starts by choosing the random numbers 13 08 03 01 11

3 (b) (i) Work out David's point estimate of the mean height.

Show clearly how you have used the random numbers to do this.

[2 marks]

3 (b) (ii) Explain **one** way that David could get a more accurate point estimate of the mean height.

[1 mark]

5

Turn over ▶

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4 Some scientists are studying the weights of rhinos born in an animal reserve in Africa.

The weights, in kg, of rhinos born in the reserve over time are normally distributed with mean μ and variance 290

A random sample of 14 rhinos born in the reserve in the last year had the following weights, to the nearest kg

25	61	27	20	45	67	59
18	25	56	25	34	52	32

4 (a) Calculate the mean weight, to the nearest kg, of the rhinos in the sample.

Circle your answer.

[1 mark]

25 33 39 49

4 (b) Construct a 95% confidence interval for μ

[4 marks]

Answer _____

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4 (c) Give a reason why the confidence interval is an approximation.

[1 mark]

4 (d) The scientists claim that the mean weight of rhinos born in the reserve is 45 kg

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

[2 marks]

8

Turn over for the next question

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5 Mrs Hintz gave her A-level class an algebra test, a calculus test and a statistics test. Each of the three tests had a maximum score of 100

The scores for the 10 students who completed all three tests are shown in the table.

Algebra score, a	22	34	38	56	62	73	74	81	82	88
Calculus score, c	23	27	39	33	41	53	51	66	79	67
Statistics score, s	28	32	44	40	66	38	52	69	75	59

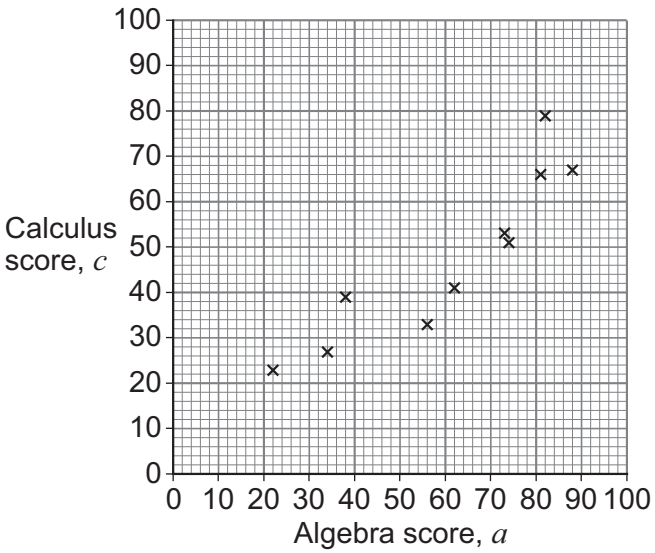
The scatter diagrams show

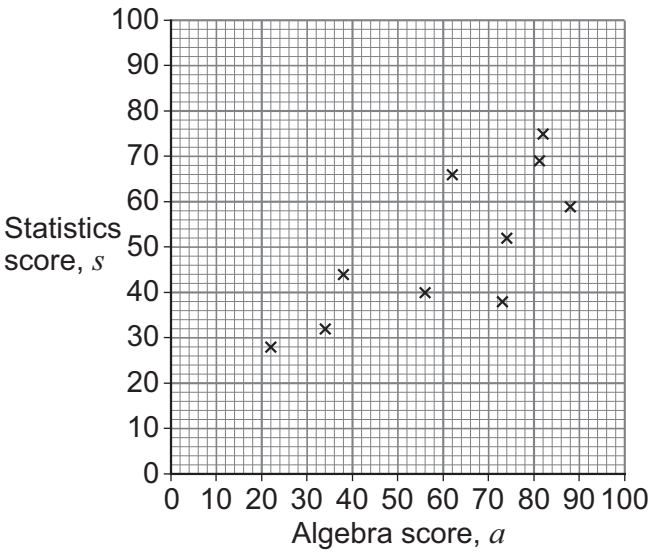
the calculus scores against the algebra scores

and

the statistics scores against the algebra scores

for the 10 students in the table.





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5 (a) Mrs Hintz expects a stronger positive correlation between the algebra and calculus scores for her class than between the algebra and statistics scores.

5 (a) (i) In terms of correlation, what does 'stronger positive' mean?

[2 marks]

5 (a) (ii) Use appropriate statistical calculations to check that she is correct.

[3 marks]

Question 5 continues on the next page

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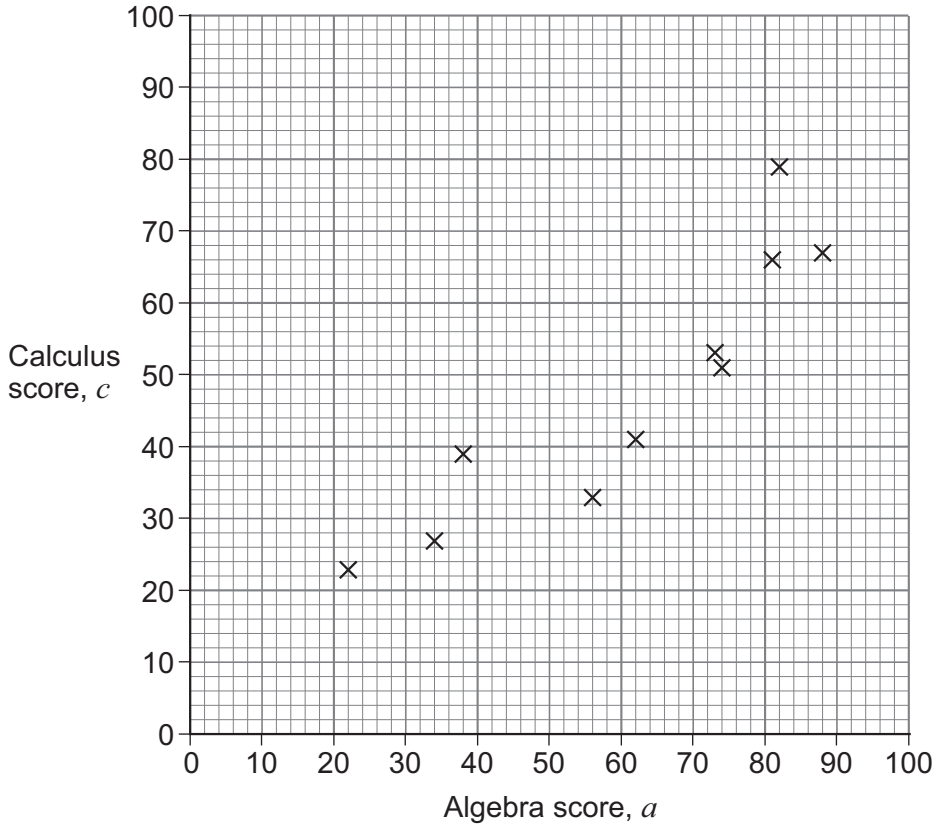
5 (b) (i) Work out the equation of the regression line of c on a

[2 marks]

Answer _____

5 (b) (ii) Draw your regression line on the scatter diagram below.

[2 marks]



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5 (c) Roy scored 51 in the statistics test.

He was absent for the other two tests.

5 (c) (i) The equation of the regression line of s on a is $s = 16.8 + 0.55a$

Use the equation of the regression line of s on a to estimate Roy's score in the algebra test.

[2 marks]

Answer _____

5 (c) (ii) Here are two methods to estimate Roy's score in the calculus test.

Method 1

Use his estimated algebra score with your equation of the regression line of c on a

Method 2

Use his statistics score with the equation of the regression line of c on s

This equation is $c = 0.930 + 0.934s$

Do these two methods give the same score?

You **must** show your working.

[4 marks]

15

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6 Research was carried out at a maternity hospital to find out the number of days that pregnancies last from conception to birth.

The data for this hospital's patients can be modelled by a normal distribution with mean 275 days and standard deviation 12 days.

6 (a) A patient at the hospital is chosen at random.

Calculate the probability that the number of days that the patient's pregnancy lasts is

6 (a) (i) **less than** 275

[1 mark]

Answer _____

6 (a) (ii) **more than** 290

[2 marks]

Answer _____

6 (a) (iii) within **two** standard deviations of the mean.

Give your answer as a decimal to four decimal places.

[3 marks]

Answer _____

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6 (b) At least 70% of pregnancies at the hospital did not exceed n days, where n is an integer.

Work out the lowest possible value of n

[3 marks]

Answer _____

6 (c) A research project was carried out at another maternity hospital.

At this hospital the number of days that pregnancies last is modelled by the distribution $\mathrm{N}(275, 15^2)$

80 patients in the project were expected to have their pregnancies last at least 270 days.

How many patients took part in the research project?

[3 marks]

Answer _____

12

END OF QUESTIONS

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