Level 3 Certificate
MATHEMATICAL STUDIES

Paper 2A

Name: _____

Class: _____

Date: _____

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a clean copy of the Preliminary material
- a scientific calculator or a graphics calculator
- a copy of the formulae sheet
- a ruler.

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
Total	

Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in your name, class and the date at the top of this page.
- Answer all the questions.
- Do all rough work on this paper. Cross through any work that you do not want to be marked.
- In all calculations, show clearly how you work out your answer.
- 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 maximum mark for this paper is 60.
- The marks for each question are shown in brackets [ ].
- Use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Paper 2A

1 James has been asked to write a short report about the average time per day students in his class spend on social websites.

James asked the students in his class to record how many minutes they spent on social websites on one day. His results are given below.

37   0   25   69   35   16   28   39   58   18   43   35   52   47   36
24   38   72   60   48   51   59   63   75   56   30   41   45   32   35

James draws a stem-and-leaf diagram and works out the median time.

Times in minutes
7 │ 2 5
6 │ 0 3 9
5 │ 1 2 6 8 9
4 │ 1 3 5 7 8
3 │ 0 2 5 6 7 8 9
2 │ 4 5 8
1 │ 6 8
Median time = 43 minutes

a) Identify any errors that James has made and suggest improvements he could make.

[3 marks]

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b) Find the correct median time.

[2 marks]

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2 Lucy is investigating how transport prices have increased since 2010.
She finds the following information about the Consumer Price Index (CPI) on the internet.

Year	2010	2011	2012	2013	2014
Transport Price Index	122.1	131.7	134.7	136.0	136.4

Source: www.ons.gov.uk

In 2014 Lucy's rail season ticket cost £480.

Lucy uses this information to estimate the price of a season ticket for the same journey in 2010.
Here is her working.

% increase from 2010 to 2014 = 136.4 – 122.1 = 14.3%

Increase was 14.3% of £480 = £68.64

Price in 2010 was £480 – £68.64 = £412.36, about £410

Critically analyse Lucy's method. State any assumptions and mistakes she has made and find a correct estimate of the 2010 price of her season ticket.

[5 marks]

3 Use **Defining poverty** on the Preliminary Material.

a) Assume £1 ≈ $1.5

   i Find the annual income in pounds that is equivalent to 1.25 dollars per day.

                                                             [2 marks]

   ii State whether the first newspaper report is based on absolute poverty or relative poverty. Use your answer to part **i** to justify your answer.

                                                             [2 marks]

b) Assume that the percentiles for disposable, equivalised household incomes are as given in the table below.

Percentile	10th	20th	30th	40th	50th	60th	70th	80th	90th
Household income (£/week)	142	189	231	278	319	369	432	520	664

Source: ONS

Comment on the validity of the statement made by the official spokeswoman in the second newspaper report.

Show working to justify your comments.

                                                             [6 marks]

4 A roulette wheel has 37 equally likely numbers. 18 are black, 18 are red and 1 (the zero) is green.
The wheel is spun 100 times.

a) How many black numbers would you expect, on average?

[2 marks]

b) The distribution $N(48.6, 5^2)$ is used to model the number of times, B, that a black number occurs.
Find $P(B < 34.5)$.

[5 marks]

c) Suspecting that the wheel may be biased, an onlooker counts the occurrences and
finds that 33 of the 100 numbers are black.
Comment on this result in the light of your answer to part (**b**).

[2 marks]

5 **a)** Explain what is meant by the term 'population'.

[1 mark]

b) Describe how you could take a random sample of 10 oranges from a batch.

[2 marks]

c) The weights of oranges in a batch are normally distributed with mean μ grams and standard deviation 12 grams. A random sample of 10 oranges has mean 201 grams. Find a 90% confidence interval for μ.

[6 marks]

6 a) A sample of size 6 is taken from a normal distribution with mean 11 and standard deviation 4.
Find the standard error of the mean and explain what it means.

[3 marks]

b) The time to interview each applicant for a job is modelled by a normal distribution
with mean 11 minutes and standard deviation 4 minutes.
What is the probability that 6 randomly chosen applicants are interviewed in
less than 1 hour?

[5 marks]

7 The table gives the average price of wheat and the quantity sold in the UK in 2014.

2014	Average price (£P per tonne)	Quantity sold (Q thousand tonnes)
Jan	158	384
Feb	158	342
Mar	163	654
Apr	168	222
May	161	232
Jun	147	203
Jul	132	332
Aug	122	527
Sep	119	836
Oct	119	893
Nov	129	537
Dec	140	375

Source: www.defra.gov.uk

a) i Calculate the product moment correlation coefficient (pmcc).

[1 mark]

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ii Interpret the value of the pmcc in the real context.

[2 marks]

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b) For barley, the pmcc is −0.589
What does this tell you about the way in which the price of barley and the quantity sold are related when compared with wheat?

[1 mark]

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c) The data in the table give the equation of the regression line of quantity sold on average price to be $Q = 1620 – 8.13P$.

i Use this equation to predict the quantity of wheat that will be sold at a price of £170 per tonne.

[2 marks]

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ii Explain why this prediction may not be reliable.

[1 mark]

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8 The scatter diagram below shows the points achieved by Aston Villa in the Premiership league and the average attendance at home matches in 14 football seasons.

Aston Villa 2001–2015
Scatter graph of average home
attendances against points
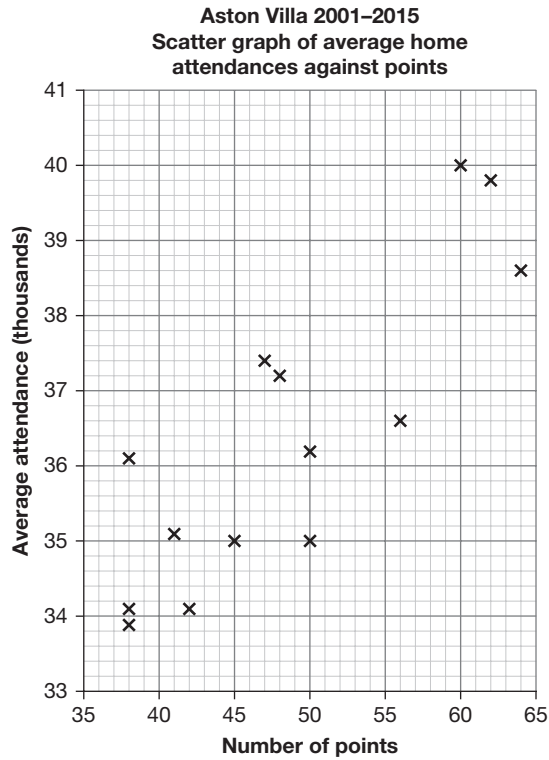
a) Calculate the regression line of *y* on *n* and plot the line on the scatter graph.

[5 marks]

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b) For Tottenham Hotspur, the regression line of *y* on *n* has the equation $y = 0.017n + 34.7$.

Compare the gradients of the regression lines and interpret them in the real context.

[2 marks]

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