Level 3 Certificate MATHEMATICAL STUDIES

Paper 2C

Name:	
Class:	
Date:	

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.

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.

Time allowed: 1 hour 30 minutes

Question	Mark
1	
2	
3	
4	
5	
6	
7	
Total	

OXFORD

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 list of the results is given below.

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

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

Times in minutes 7 2 5 6 0 3 9 5 2 6 8 9 1 4 3 578 1 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]

b) Find the correct median time.

[2 marks]

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 $\pounds 1 \approx \$1.5$
 - 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]

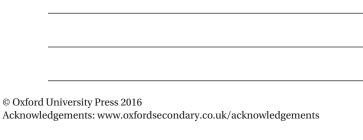
An initial mass of radioactive iodine is 4 grams. The mass, *m* grams, of radioactive iodine after *t* days is given by $m = 4 \times 0.917^{t}$.

a) Find the mass of radioactive iodine after 3 days.

))	Find the time for the mass of radioactive iodine to decay to 1 gram.	[3 marks
)	What is the half-life of radioactive iodine (that is the time taken for a mass to decay to half its original value)?	[2 marks
)	What do you think is the advantage of this relatively short half-life?	[2 marks

5

[2 marks]



6

The speed-time graph shows how the speed of a roller-coaster car varies with time, for 20 seconds of the ride.

- a) What is the maximum speed of the car during this time?
- **b)** Estimate the gradient of this graph at time 5 seconds and describe the motion of the car in an interval around this time.

c) Find the acceleration of the roller-coaster car at time 10.5 seconds and explain what

your answer indicates the roller-coaster is doing at this time.

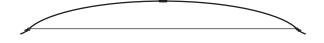
[3 marks]

[3 marks]

5

[1 mark]

6 A longbow consists of a length of flexible wood connected by a string attached to its ends.



The curve of the wood on a longbow can be modelled by the equation

$$y = \frac{x(180 - x)}{270}$$

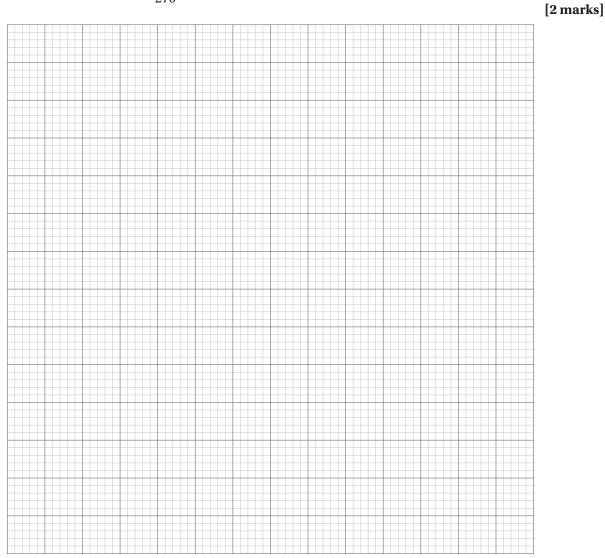
where $y \,\mathrm{cm}$ is the distance of the wood from the string, and $x \,\mathrm{cm}$ is the distance from one end of the string.

a) Using this model, complete the table of values below.

[2 marks]

x	0	30	60	90	120	150	180
У	0	16.7					

b) Draw the graph of $y = \frac{x(180 - x)}{270}$ for $0 \le x \le 180$.



_		[2 marks
— d) i	How long is the string?	
ii	What is the maximum distance from the string to the wood?	[2 marks
th	nother longbow has a string that is 110 cm long, and the maximum distance from he string to the wood is 20 cm. Yrite down an equation that models the curve of the wood on this longbow.	[3 marks
th	e string to the wood is 20 cm.	[3 marks
th	e string to the wood is 20 cm.	

(AQA, 2012)

8

7 The table shows the time periods, *T* days, of some planets to orbit the Sun and their average distances from the Sun.

Planet	Average distance, <i>d</i> million kilometres	Time period, <i>T</i> days
Mercury	58	88
Earth	150	365
Jupiter	778	4330
Saturn	1427	10753

a) Complete the table of ln *d* and ln *T* below, giving values to 3 significant figures.

[2 marks]

	Mercury	Earth	Jupiter	Saturn
d	58	150	778	1427
ln <i>d</i>	4.06	5.01		
τ	88	365	4330	10753
In T	4.48	5.90		

b) Plot ln *T* against ln *d* and draw a line of best fit on your graph.

[4 marks]

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C)	The average distance of Mars from the Sun is 228 million kilometres.	
	Use your line of best fit to find the time period of Mars.	
		[3 marks]
d)	A model of the time period <i>T</i> in terms of average distance <i>d</i> is	
	$T = 2.0 \sqrt{d^3}$	
	Use this model to estimate the time period of Neptune, which has an average distance of 4497 kilometres from the Sun.	
		[2 marks]
e)	How many times does the Earth go round the Sun whilst Neptune goes round once?	
•,	now many times does the bartingo round the bun whilst reptane goes round once.	[2 marks]
		[]