

# Level 3 Certificate

## MATHEMATICAL STUDIES

### Paper 2C

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.

### 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.

Question	Mark
1	
2	
3	
4	
5	
6	
7	
<b>Total</b>	

### 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 2C

- 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  
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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4 Radioactive iodine can be used to treat some cancers.

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.

[2 marks]

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b) Find the time for the mass of radioactive iodine to decay to 1 gram.

[3 marks]

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c) 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]

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d) What do you think is the advantage of this relatively short half-life?

[2 marks]

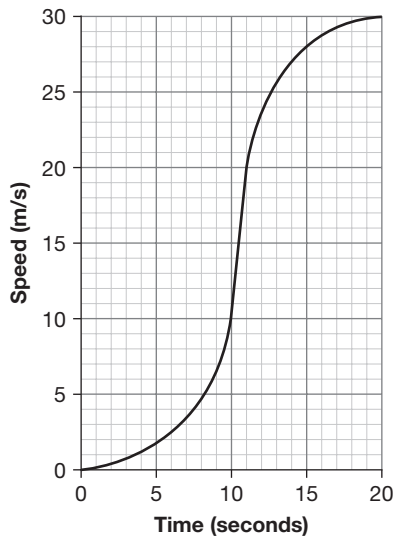
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The speed-time graph shows how the speed of a roller-coaster car varies with time, for 20 seconds of the ride.

a) What is the maximum speed of the car during this time?

[1 mark]

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b) Estimate the gradient of this graph at time 5 seconds and describe the motion of the car in an interval around this time.

[3 marks]

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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]

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- 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  $y$  cm is the distance of the wood from the string, and  $x$  cm is the distance from one end of the string.

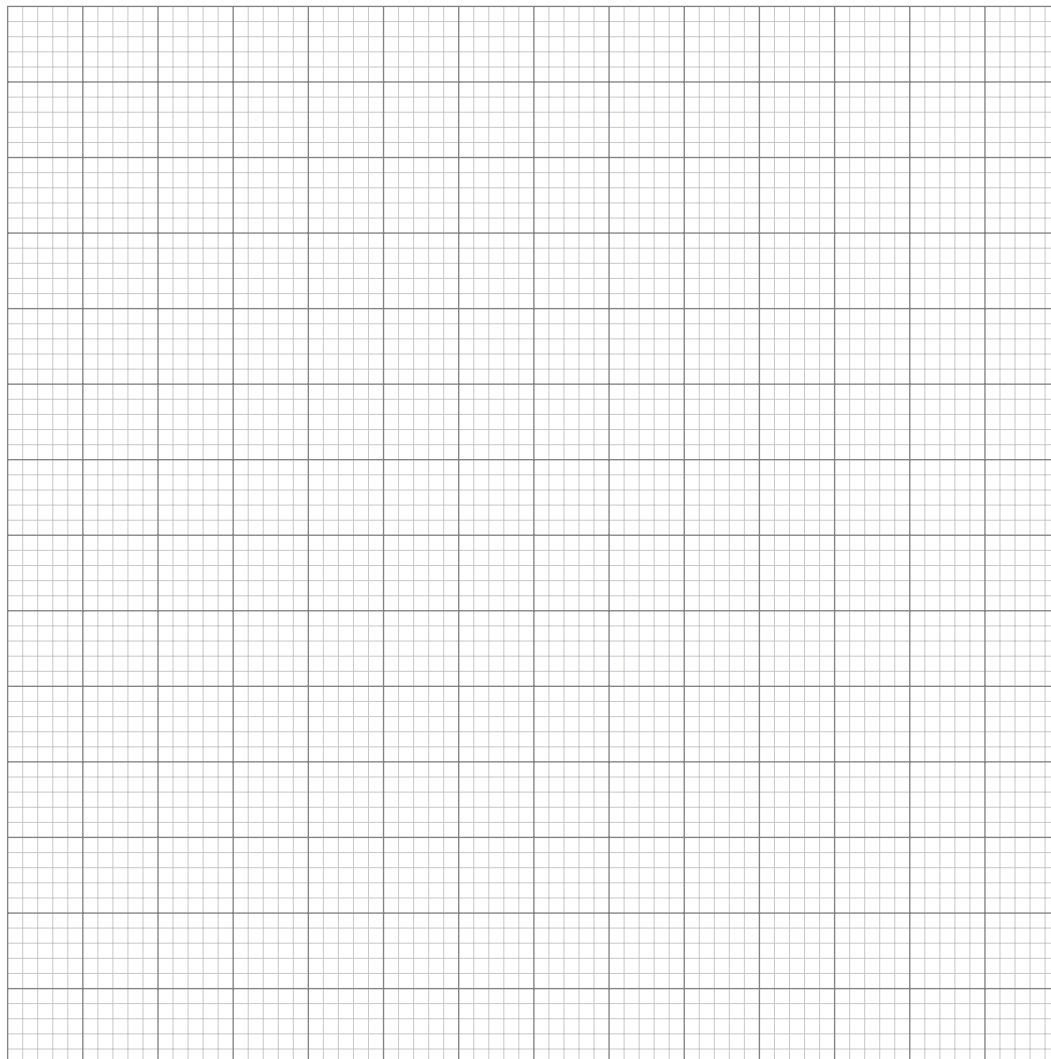
- a) Using this model, complete the table of values below.

[2 marks]

$x$	0	30	60	90	120	150	180
$y$	0	16.7					

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

[2 marks]







- 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, $d$ million kilometres	Time period, $T$ days
Mercury	58	88
Earth	150	365
Jupiter	778	4330
Saturn	1427	10753

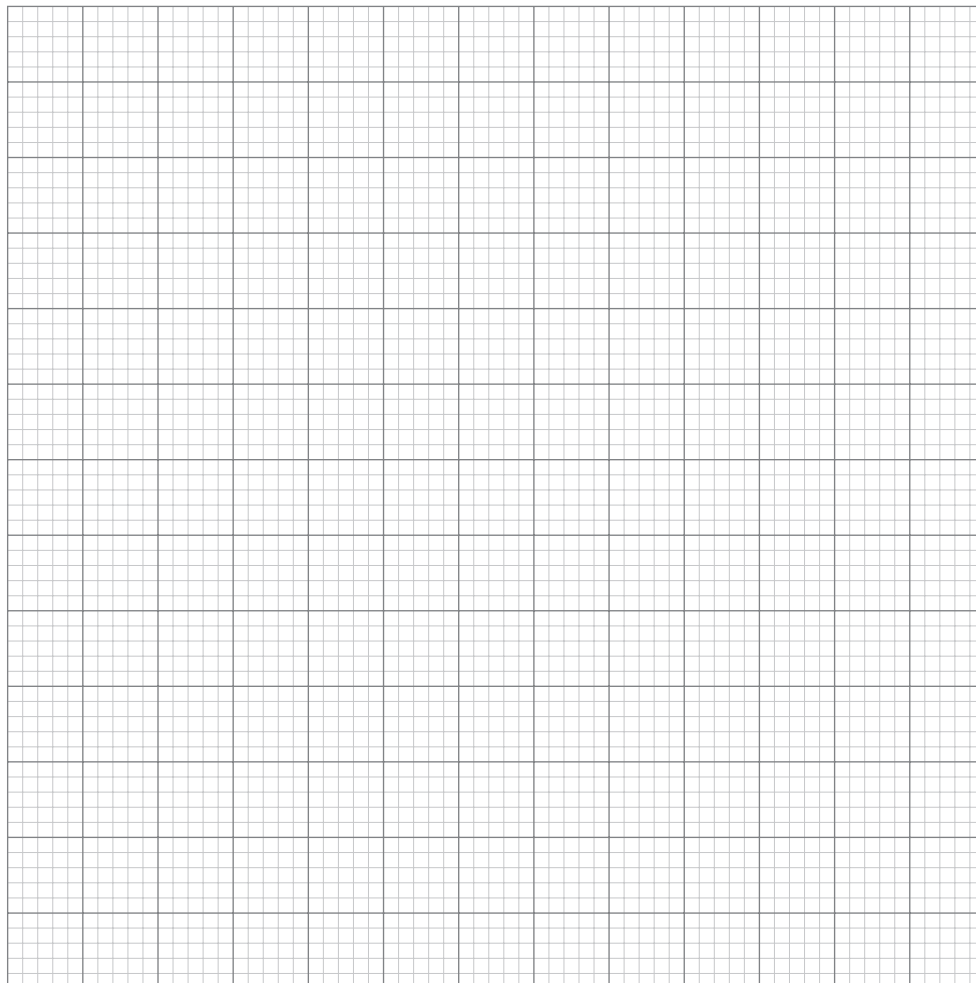
- a) Complete the table of  $\ln d$  and  $\ln T$  below, giving values to 3 significant figures.

[2 marks]

	Mercury	Earth	Jupiter	Saturn
$d$	58	150	778	1427
$\ln d$	4.06	5.01		
$T$	88	365	4330	10753
$\ln T$	4.48	5.90		

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

[4 marks]



- 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]

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- d) A model of the time period  $T$  in terms of average distance  $d$  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]

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- e) How many times does the Earth go round the Sun whilst Neptune goes round once?

[2 marks]

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