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Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

Level 3 Certificate MATHEMATICAL STUDIES

Paper 2C Graphical Techniques

Thursday 22 May 2025

Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a clean copy of the Preliminary Material and the Formulae Sheet (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	
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7	
TOTAL	



J U N 2 5 1 3 5 0 2 C 0 1

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1350/2C

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

- 1** Total solar eclipses happen when the moon fully blocks the Sun's light on Earth.
They occur approximately every 18 months.

The table below shows where and when total solar eclipses can be seen in the years 2026 to 2035

It also includes the maximum length of time the eclipses can be seen in one place, stated as duration in minutes (m) and seconds (s).

There can only be one total solar eclipse in any year, but it may be visible in more than one continent.

Year	Continents where the total solar eclipses can be seen					Duration
	Europe	North America	Asia	Africa	Australia	
2026	✓	✓				2m 18s
2027	✓		✓	✓		6m 23s
2028			✓		✓	5m 10s
2029						–
2030				✓	✓	3m 44s
2031						–
2032						–
2033		✓	✓			2m 36s
2034			✓	✓		4m 09s
2035			✓			3m 53s

- 1 (a)** What fraction of the total solar eclipses that can be seen in **Asia** in these years will last longer than 4.5 minutes?

Circle your answer.

[1 mark]

$$\frac{2}{7}$$

$$\frac{3}{7}$$

$$\frac{2}{5}$$

$$\frac{3}{5}$$



Jaydon is analysing the data in the table.

- 1 (b) He claims that the range of eclipse duration in Europe is **more than double** the range of eclipse duration in Africa.

Does the data support this claim?

Show working to justify your answer.

[2 marks]

- 1 (c) Jaydon incorrectly works out the median duration of total solar eclipses in Europe **and/or** North America in these years as 2 m 27 s

Explain the mistake Jaydon has made in his **method** and state the correct median duration.

[2 marks]

Mistake _____

Correct median _____ m _____ s

5

Turn over for the next question

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2 Use **European Champions Report, 2023**, from the Preliminary Material.

Charlie is writing a report on the finances of football clubs.

She uses information from the European Champions Report, 2023

2 (a) Charlie's report states

The proportion of revenue received from broadcasting is approximately equal for Manchester City FC and AFC Ajax.

Is this correct?

You **must** show your working.

[3 marks]

2 (b) Charlie analyses the ratio of revenue sources

Commercial : Broadcasting : Matchday

Show that for one club this ratio is approximately 3 : 4 : 1 and state the club.

[3 marks]

Club _____



- 2 (c)** Charlie notices that the total revenue stated for Real Madrid CF in **Table 1** and **Extract 1** does not match the figures in **Graph 1**.
She assumes this must be due to rounding of the raw data values used in **Graph 1**.
Give an example calculation that would justify her assumption.

[1 mark]

- 2 (d)** From the 2020/21 season to the 2021/22 season, the total revenue of AC Milan increased by 16% and the total revenue of FC Porto decreased by 6%.
- Work out the difference between AC Milan's total revenue and FC Porto's total revenue for the **2020/21** season.
- Give your answer to the **nearest million** euros (€).
- You **must** show your working.

[3 marks]

Answer € _____ million

Question 2 continues on the next page

Turn over ►



- 2 (e)** Make two criticisms of **Graph 2** from the Preliminary Material.

[2 marks]

Criticism 1 _____

Criticism 2 _____

- 2 (f)** Use **Extract 2** and **Graph 2** from the Preliminary Material.

Charlie analyses the profit/loss of the eight clubs.

Her report states

On average, clubs in Europe that win their league
make a loss of about €50 m every year.

- 2 (f) (i)** Show how one statistical measure supports this statement.

[2 marks]

- 2 (f) (ii)** Give **one** reason why this statement might be misleading.

[1 mark]



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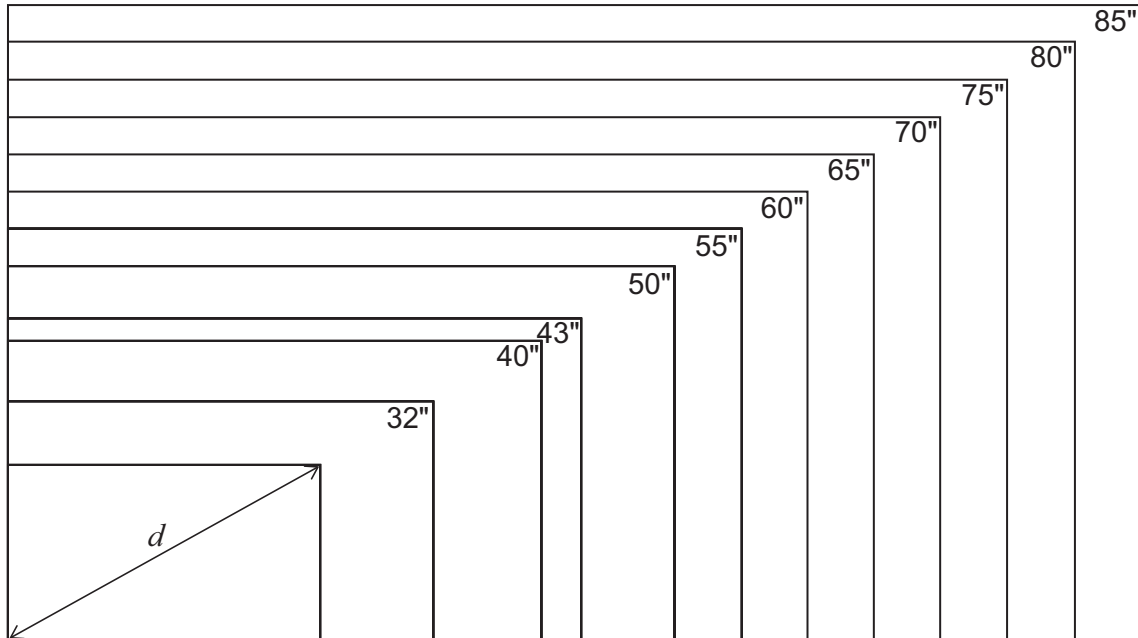
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- 3** Television (TV) screen sizes represent the diagonal distance between corners, d , measured in inches (").

A guide for standard TV screen sizes is shown below.

**Not drawn
accurately**

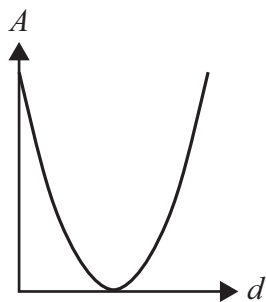
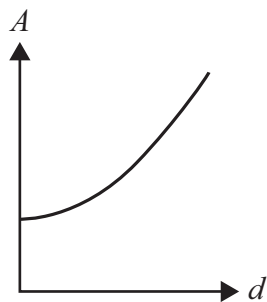
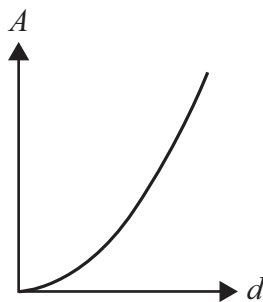
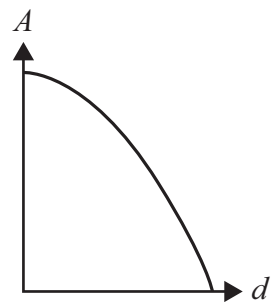


The screen area, A , measured in square inches, can be calculated using the equation

$$A = \frac{144d^2}{337}$$

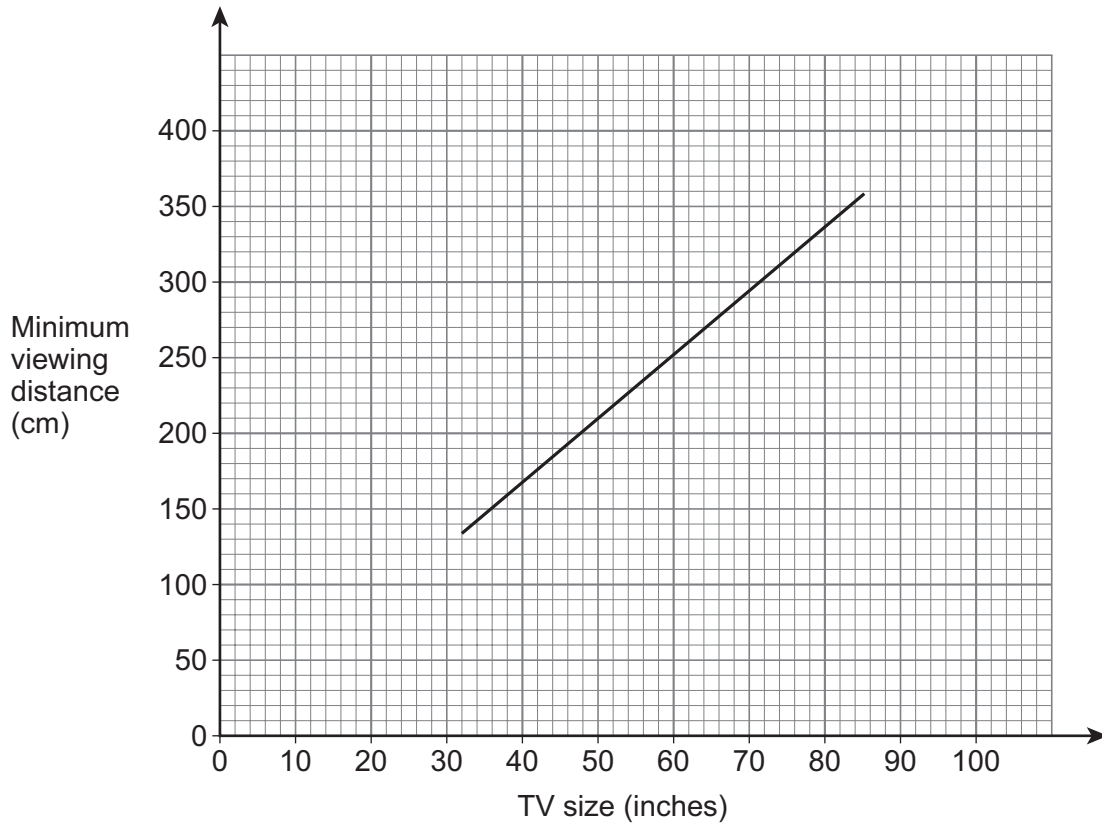
- 3 (a)** Tick (✓) the box under the graph which represents this equation.

[1 mark]


☐

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3 (b) New TVs come with a recommended minimum viewing distance.

The graph shows how the minimum viewing distance changes depending on TV size.



Work out the **maximum** standard TV size with a minimum viewing distance under 2 metres.

[3 marks]

Answer _____ inches

4

Turn over ►



4 Malta is the country with the smallest population in the European Union.

People from other countries move to Malta to work.

Every ten years a census records how many of the population are Maltese citizens.

Year	Maltese citizens (M)	Non-Maltese citizens (N)	Total population
2011	396 978	20 454	417 432
2021	404 219	115 343	519 562

Government statisticians suggest that the number of **Maltese** citizens, M , can be modelled by the linear equation

$$M = aY + b$$

where Y is the number of years since 2011

4 (a) Work out the values of a and b .

[4 marks]

$a =$ _____

$b =$ _____



- 4 (b)** Government statisticians suggest that the number of **non-Maltese** citizens, N , can be modelled by the exponential equation

$$N = 1000 \times 20.454e^{0.173Y}$$

- 4 (b) (i)** Complete the table.

Round your values of N to the nearest 1000

[3 marks]

Year	Y	N
2027		
2029		
2031		

Question 4 continues on the next page

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4 (b) (ii) By drawing the graphs of

M against Y

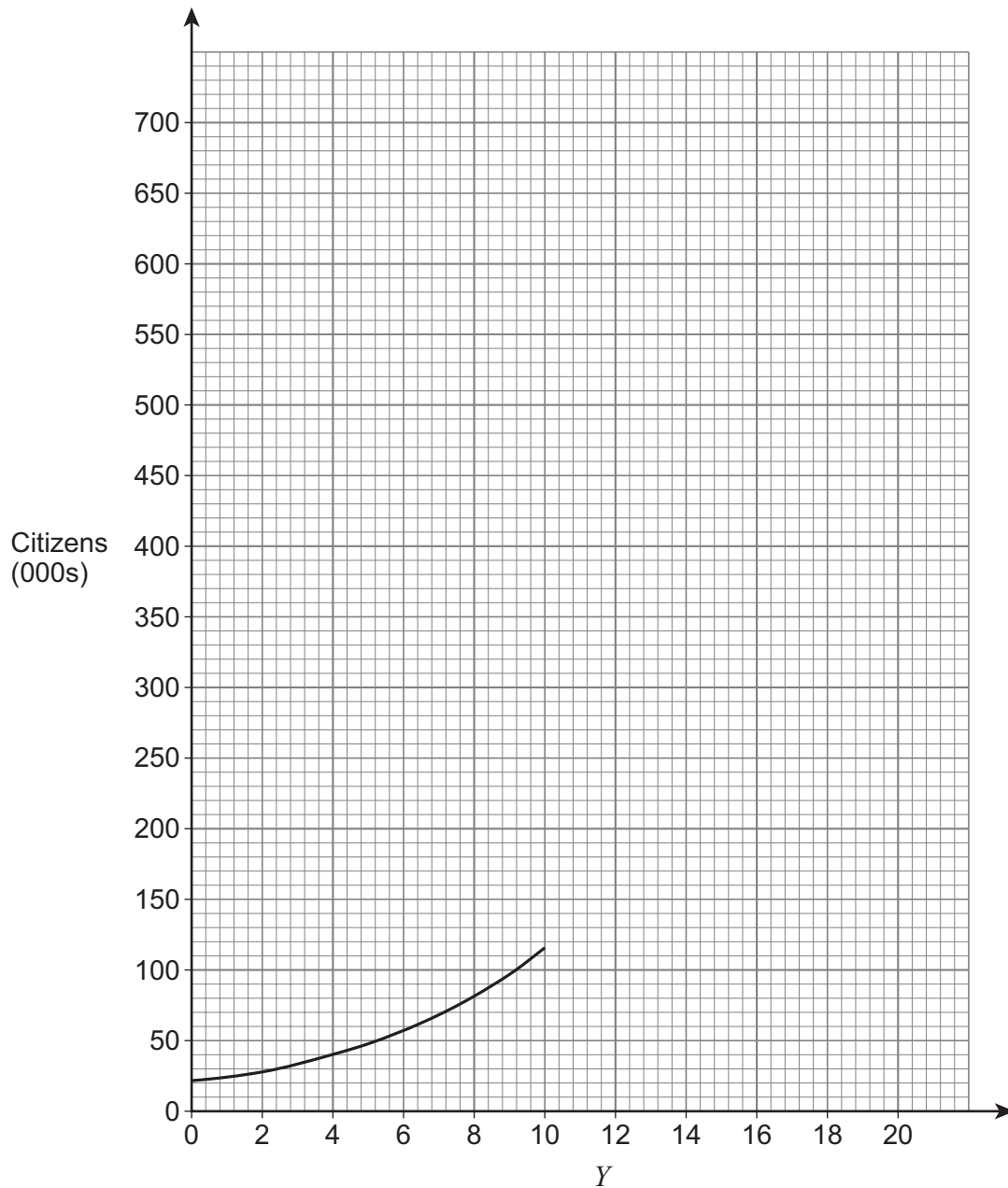
and

N against Y

on the grid below for $0 \leq Y \leq 20$, estimate the year in which the non-Maltese citizens will make up 50% of the total population.

Part of the graph of N against Y has been drawn for you.

[5 marks]



Answer _____

4 (b) (iii) State **one** reason why your answer to **question 4(b)(ii)** may not be reliable.

[1 mark]

4 (b) (iv) Describe how the **rate** of increase of the non-Maltese citizens differs to the **rate** of increase of the Maltese citizens between 2011 and 2021

[2 marks]

15

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- 5 Naismith's rule is a formula used to predict the time, t hours, it takes to complete a mountain walk.

t can be estimated using

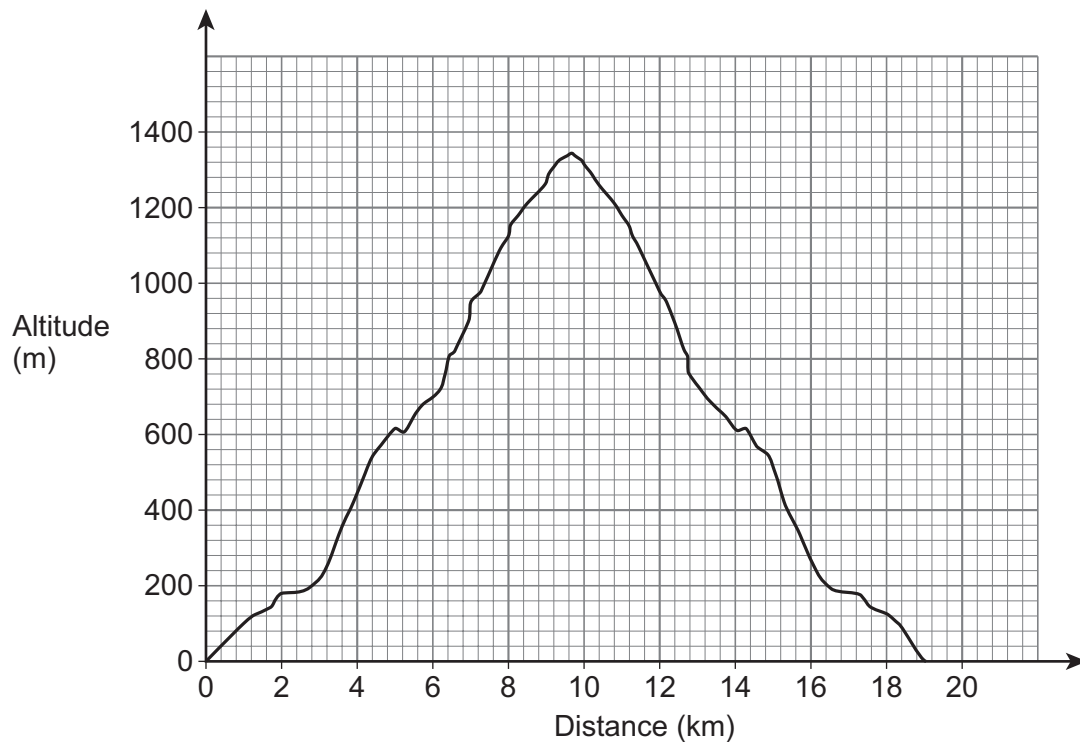
$$t = \frac{d}{4} + \frac{a}{600}$$

where a is the altitude of the mountain in metres

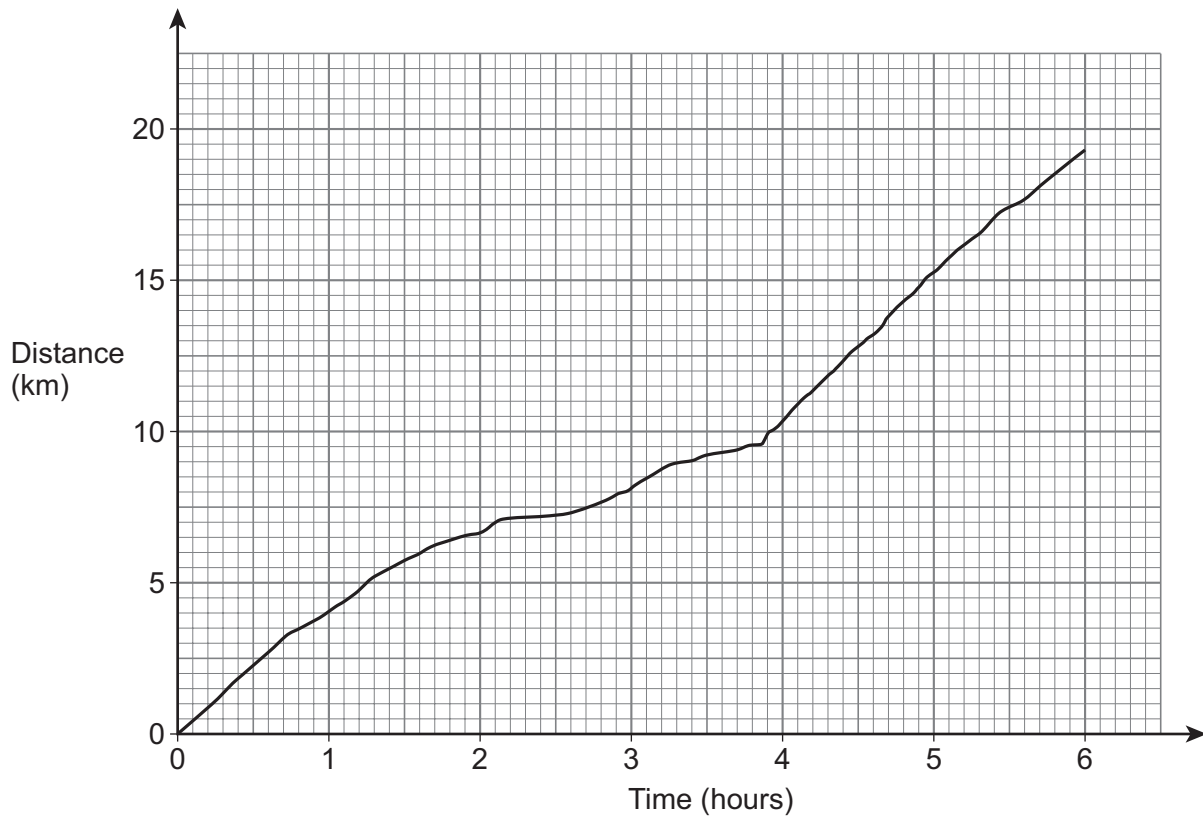
and d is the distance of the full walk in kilometres.

Graham walks up and down Britain's highest mountain, Ben Nevis.

The graph shows the altitude and distance of his route.



After completing the walk, Graham uses data from his smart watch to produce a distance-time graph.



- 5 (a)** Compare the average walking speed predicted by Naismith's rule to the actual average walking speed of Graham's walk.

State which speed is greater and by how much.

[7 marks]

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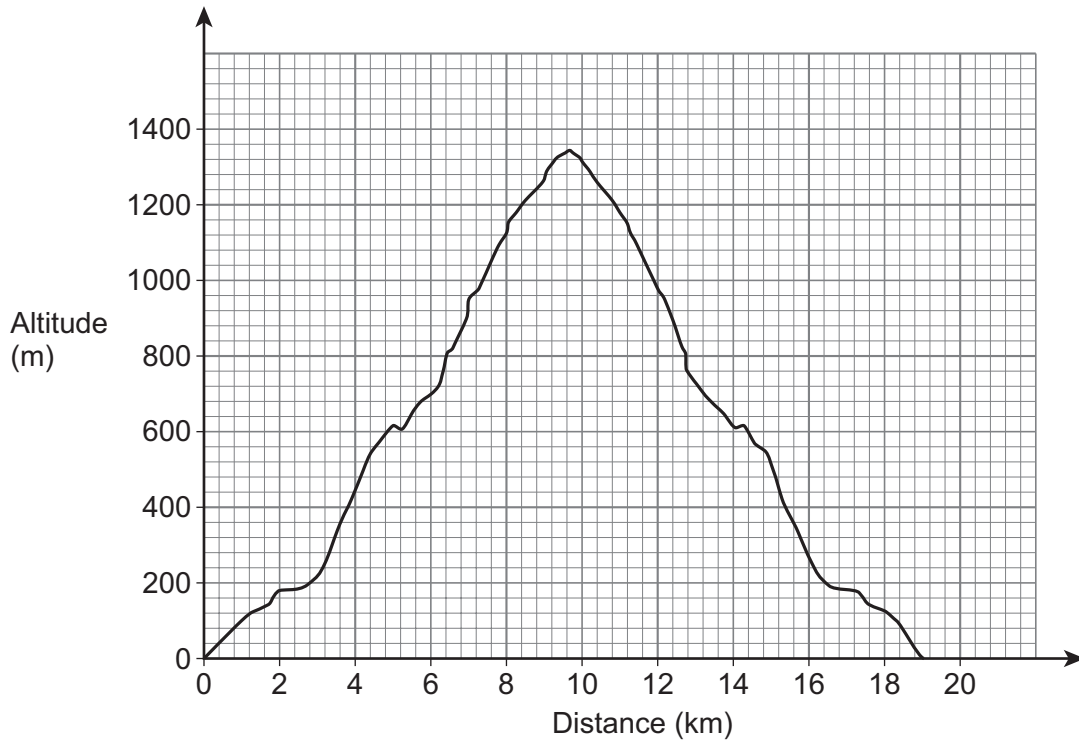


5 (b) The average gradient of a mountain path can be described using the unit ratio

Altitude gained : Walking distance

For example, $1 : 5$ means that for every 1 m of altitude gained you walk 5 m

The graph showing the altitude and distance of the route is repeated here.



Estimate the unit ratio for the average gradient for the **first 6 km** up the Ben Nevis mountain path.

Give your answer in the form $1 : n$ where n is given to 2 significant figures.

[3 marks]

Answer 1 : _____



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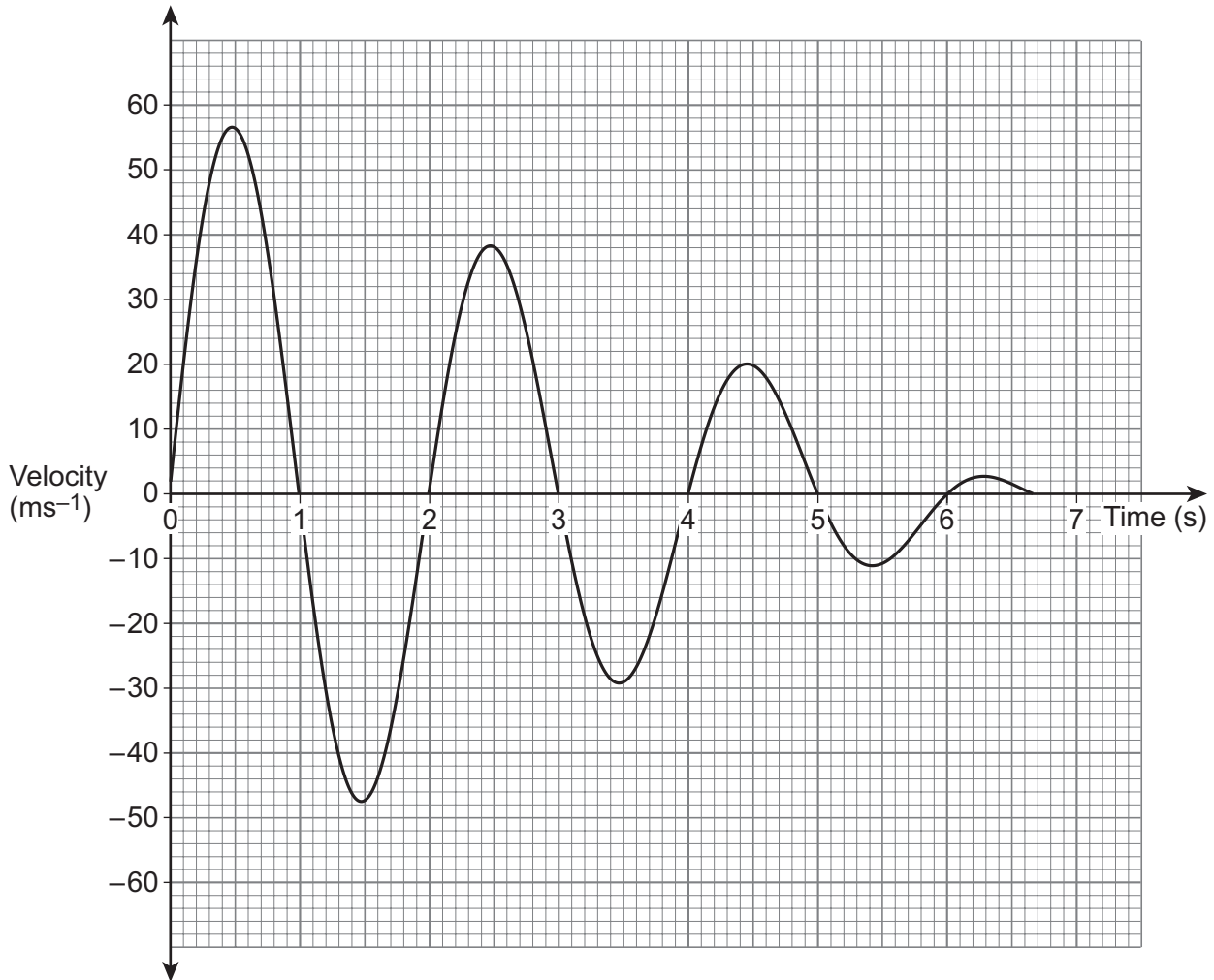
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- 6** Bungee jumping is the activity of leaping from high structures attached to an elastic cord. The velocity of a bungee jumper is recorded from the moment they leap, shown in the graph. Positive velocity indicates movement in the downwards direction.



- 6 (a)** State the value of **acceleration** of the bungee jumper at the instant they are travelling fastest.

By referring to the graph, give a reason for your answer.

[2 marks]

Acceleration _____ ms^{-2}

Reason _____



- 6 (b)** Estimate the **acceleration** of the bungee jumper 4 seconds after they leap.
You **must** show your working.

[3 marks]

Answer _____ ms⁻²

5

Turn over for the next question**Turn over ►**

7 James grows chilli plants.

The heat of a chilli is measured using Scoville units.

The table shows 5 types of chilli that James grows and their heat in Scoville units.

Chilli name	Scoville Units (S)
Pimento	250
Jalapeño	8000
Cayenne	50 000
Scotch Bonnet	350 000
Carolina Reaper	2 220 000

James wants to use a simpler scale to record the heat of his chillies.

To do this he gives each chilli a heat rating, H , from 0 to 10, based on how many Scoville units it has, S .

James uses the equation

$$S = Ae^{kH}$$

James wants

the Pimento to have a heat rating of 0

and

the Carolina Reaper to have a heat rating of 10

7 (a) Work out the values he should use for A and k .

[4 marks]

$A =$ _____

$k =$ _____



- 7 (b)** In 2023 a new type of chilli, Pepper-X, was grown.
Pepper-X has 1.3 times as many Scoville units as the Carolina Reaper.
James does the calculation

$$10 \times 1.3 = 13$$

and concludes that Pepper-X would have a heat rating of 13 on his scale.

Explain why James is wrong and state if the rating would be more or less than 13

You **do not need** to calculate the rating.

[2 marks]

6

END OF QUESTIONS



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