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 2C Graphical Techniques

Thursday 23 May 2024 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	
3	
4	
5	
6	
7	
8	
TOTAL	

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

1 Use **Economics of music streaming** from the Preliminary Material.

1 (a) Use the information in **Graph 2** to estimate the number of premium Google (including YouTube Music) subscriptions there were in the UK in January 2020

Which is the best estimate?

Tick (✓) **one** box.

[1 mark]

Nine million ☐

Nine hundred thousand ☐

Ninety thousand ☐

Nine thousand ☐

1 (b) Suggest two improvements that could be made to the **graphs** on pages 2 and 3 of the Preliminary Material.

[2 marks]

Improvement 1 _____

_____

_____

_____

Improvement 2 _____

_____

_____

_____

Do not write outside the box

1 (c) Readers of the extract commented that it was difficult to follow **Diagram 1**

Give **one** reason why they might have said this.

[1 mark]

_____

_____

_____

1 (d) In a sports club,

20 players are daily active users of BBC Sounds

27 players are weekly active users of BBC Sounds.

Compare

the proportion of listeners at the sports club who are daily active users

with

the proportion of all consumers who are daily active users.

Use the information in **Graph 1** to justify your comparison.

[2 marks]

_____

_____

_____

_____

_____

Question 1 continues on the next page

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1 (e) Two music websites commented on the report.

> Streaming services kept more money than was given to recording artists and songwriters/composers combined.
>
> *The Recorder*

> For every 4 Amazon Music Prime subscriptions, there were about 7 Spotify subscriptions.
>
> *Waxing Lyrical*

Using the Preliminary Material, comment on the validity of each website's claim.

You **must** show your working.

[4 marks]

The Recorder

Waxing Lyrical

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1 (f) Another music website made this claim.

> Only 13% of consumers do **not** use a streaming service daily.
>
> *The Daily Fret*

Is the website's claim correct?

Use **Graph 1** to justify your answer.

[1 mark]

_____

_____

_____

11

Turn over for the next question

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2 Use **Economics of music streaming** from the Preliminary Material.

Molly is researching how the income from Spotify was shared out in 2020

In 2020, the price of a Spotify premium subscription was £9.99 per month in the UK

2 (a) Molly disagreed with the report, saying,

> "As VAT is 20%, the Government should receive almost £2 for each monthly subscription, not £1.67"

Is Molly correct?

Show working to justify your answer.

[3 marks]

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2 (b) Molly used the following method to estimate the total amount of Spotify's UK subscription revenue that should have been received by **recording artists** in 2020

> Yearly subscription cost was £9.99 × 12 = £119.88
>
> There were 226 000 000 × 0.44 = 99 440 000 subscribers in the UK
>
> Total UK subscription revenue was 99 440 000 × £119.88 = £11 920 867 200
>
> Recording artists received £11 920 867 200 × 0.0165 = £196 694 308.80
>
> So, around £200 million.

Identify **two** mistakes in Molly's calculation.

You do **not** need to carry out any calculations.

[2 marks]

Mistake 1

Mistake 2

5

Turn over for the next question

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3 The table shows some information about the number of students who took GCSE French and GCSE Spanish in 2012 and 2022

		French	Spanish
2012	**Male and female**	153436	72606
2022	**Male**	55360	48078
	Female	74059	64767

Write a brief report to summarise the information in the table.

Your brief report should include

- how the number of students who took each qualification has changed from 2012 to 2022
- how the proportions of students who were male compared for the two qualifications in 2022

[4 marks]

4

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4 The height of ocean waves is affected by wind speed.

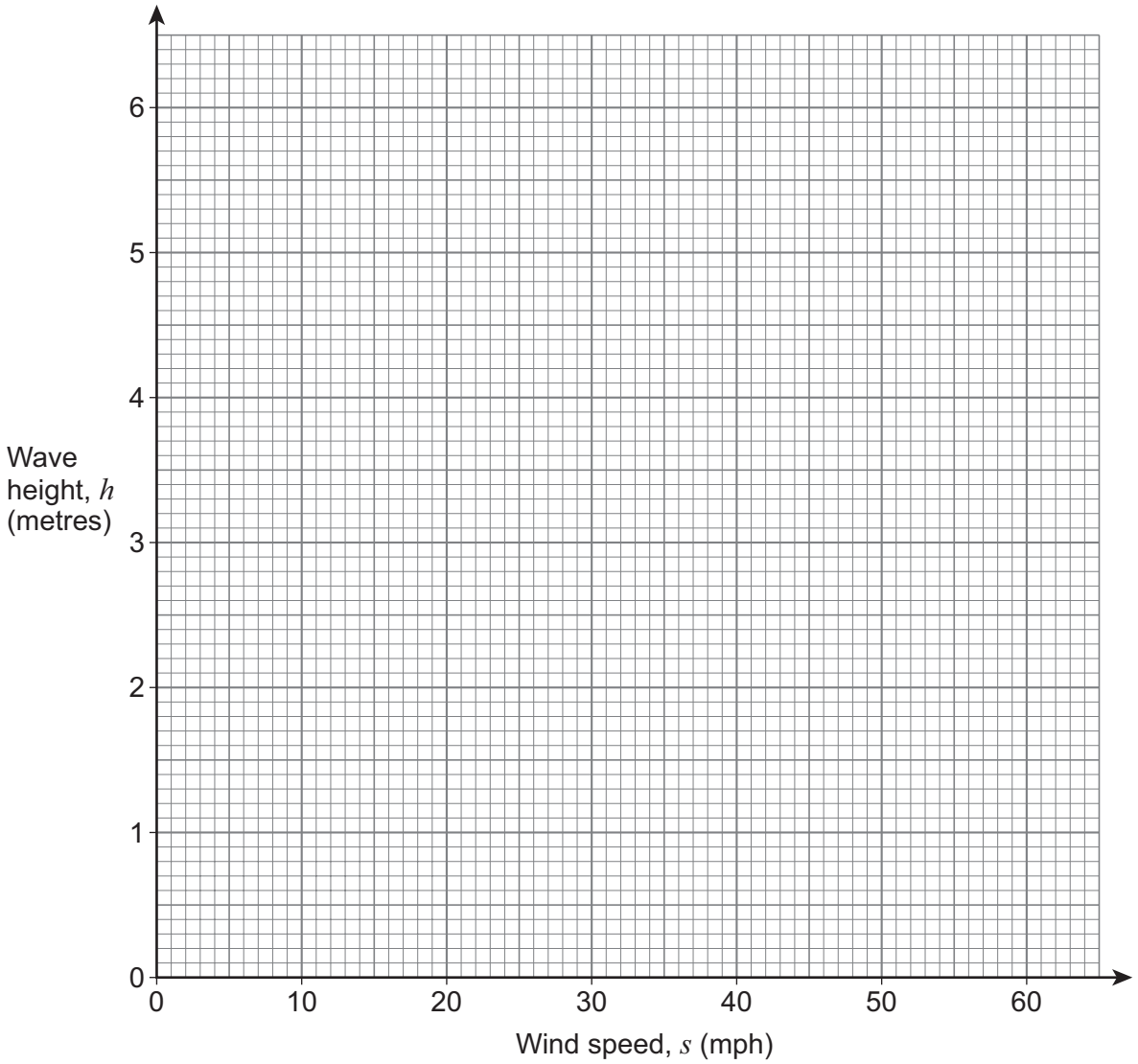
Wave height, h metres, can be modelled against wind speed, s miles per hour, using the equation

$$h = 0.001s^2 + 0.04s$$

4 (a) Complete the table and draw the graph of h against s.

[3 marks]

Wind speed s (mph)	0	10	20	30	40	50	60
Wave height h (metres)		0.5	1.2	2.1			



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4 (b) The Beaufort scale is used to classify and describe the force of winds.

The table shows the wind speed interval for some wind classifications.

Classification	Beaufort scale value	Wind speed, s (mph)
Strong breeze	6	$25 \leqslant s < 32$
Near gale	7	$32 \leqslant s < 39$
Gale	8	$39 \leqslant s < 47$
Strong gale	9	$47 \leqslant s < 55$
Storm	10	$55 \leqslant s < 63$

4 (b) (i) Work out an interval that describes the **height** of a wave in metres expected to be produced by a **strong gale**.

[3 marks]

_____

_____

_____ $\leqslant h <$ _____

4 (b) (ii) State what property of the graph indicates that small changes in wind speed have more effect on the wave height during a storm than during a gale.

[1 mark]

_____

_____

4 (c) Describe **one** limitation of the model for predicting wave heights.

[1 mark]

_____

_____

8

5 80 local football teams are ranked.

Each team has a ranking value, R, from 1 to 80, with $R = 1$ for the best performing team.

5 (a) In August 2022, the ranking of all teams was revised using a new points-based system.

For each team, the number of points, P, was initially determined using the equation

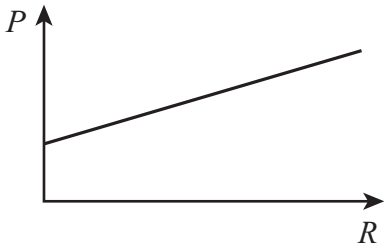
$$P = \frac{1}{4}(5001 - R)$$

where R was the ranking value in July 2022

Circle the graph which represents this equation.

[1 mark]

A



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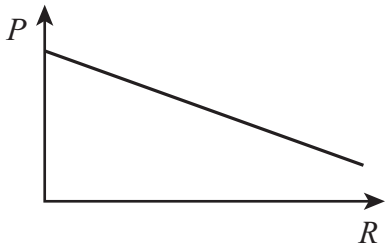

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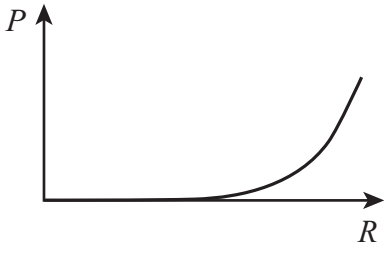

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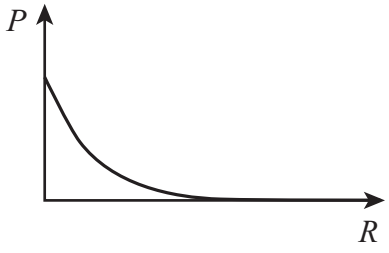

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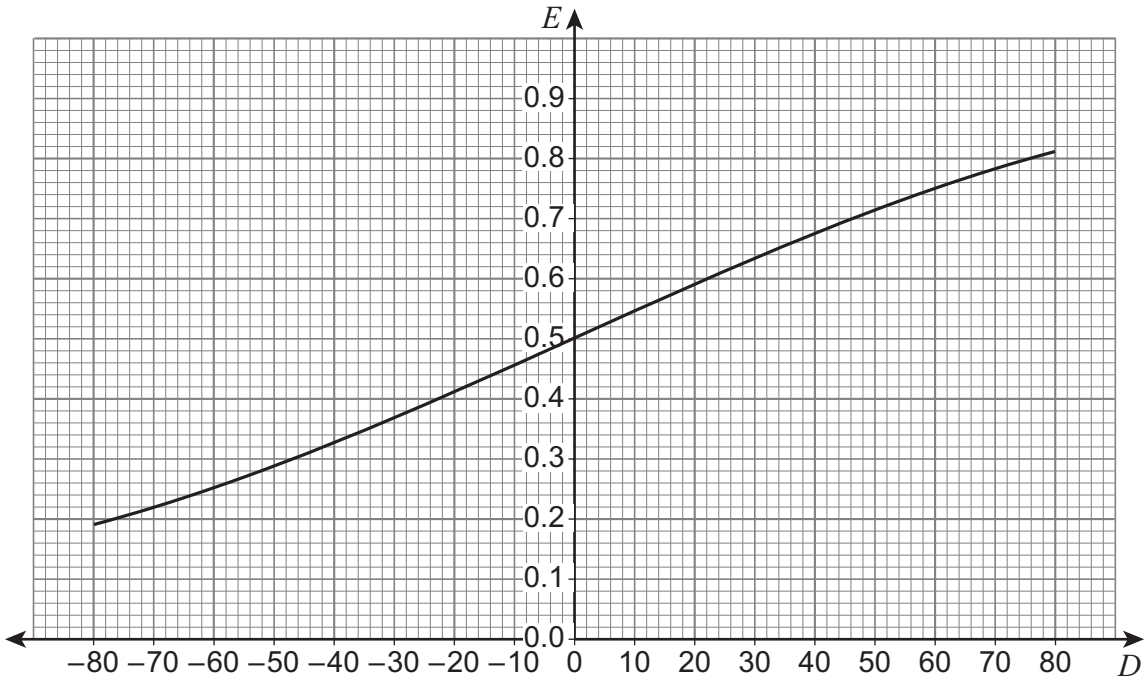
5 (b) For each game that a team plays, the expectation that the team wins, E, is determined by the difference in ranking between the two teams, D

For a team with ranking value R,

$$D = \text{Opponent ranking value} - R$$

The graph shows how E varies with D



Team A's ranking value is 12

Team B's ranking value is 48

Use the graph to work out the value of E for both teams when they play each other.

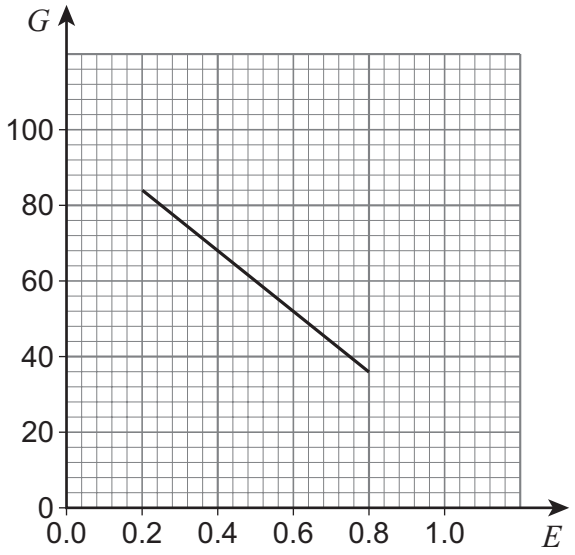
[3 marks]

Team A $E =$ _____

Team B $E =$ _____

Question 5 continues on the next page

5 (c) The graph below represents the points a team gains, G, if they win a game, based on the expectation of the team to win, E



This data can also be represented by the equation

$$G = mE + c$$

Use the graph to work out the values of the constants m and c

[3 marks]

$m =$ _____ $c =$ _____

7

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6 An online shop opened on 1 January 2014

The number of customers using the shop each day, C, increased exponentially between 2019 and 2022

An approximate value of C can be found using

$$C = e^{y} \qquad \text{for } 5 < y < 8$$

where y is the number of years the shop has been open.

6 (a) Estimate the number of customers using the shop on 1 July 2021

State your answer to two significant figures.

[3 marks]

Answer _____ customers

6 (b) Explain how your answer to **question 6(a)** relates to the **rate** at which the number of customers is increasing on 1 July 2021

[1 mark]

4

Turn over ▶

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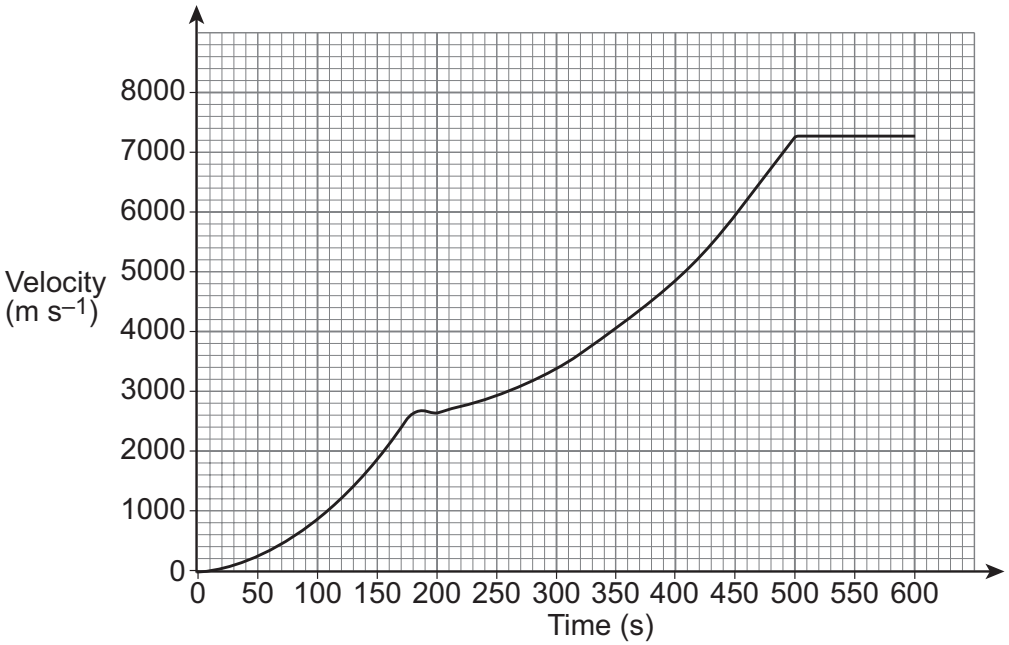
7 A satellite is released into orbit from a rocket that accelerates in two stages.

During the first stage, the rocket accelerates for 180 seconds.

The second stage of acceleration begins 200 seconds into the flight.

The graph represents the first 600 seconds of the rocket's flight after its launch.



7 (a) The rocket releases the satellite as soon as it reaches its final, constant velocity.

Work out how long after its launch the rocket releases the satellite.

Give your answer in minutes and seconds.

[2 marks]

Answer _____ minutes _____ seconds

7 (b) At which of these four times does the rocket have the **greatest** acceleration?

Circle your answer.

[1 mark]

50 seconds 150 seconds 250 seconds 550 seconds

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7 (c) Work out an estimate for the acceleration 400 seconds into the rocket's flight.

State the units of your answer.

[4 marks]

Answer _____

7 (d) The satellite orbits Earth at a velocity equal to the final velocity shown on the graph.

Each time the satellite orbits Earth it travels a distance of 48 350 **kilometres**.

Estimate the time in **minutes** it takes the satellite to orbit Earth once.

[5 marks]

Answer _____ minutes

12

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8 A study has shown that temperatures greater than 24°C can have an impact on students' learning.

The study used a measure called 'Ability to learn', L, which is measured as a **percentage**.

L can be modelled by the equation

$$L = k \times 0.98^{T} \qquad \text{for } 24 \leqslant T \leqslant 40$$

where T is the temperature in degrees Celsius (°C) and k is a constant.

8 (a) Explain fully what the value 0.98 tells us about the value of L as T increases.

[2 marks]

8 (b) When $T = 24$, $L = 100$

Work out the value of k

[3 marks]

$k =$ _____

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8 (c) A different study led to the model

$$L = 180\,e^{-0.035T} \qquad \text{for } 24 \leqslant T \leqslant 40$$

Use this model to work out the value of T that gives $L = 75$

[4 marks]

$T =$ _____

9

END OF QUESTIONS

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