AQA

Please write clearly in block capitals.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname _____

Forename(s) _____

Candidate signature _____

Level 3 Certificate
MATHEMATICAL STUDIES

Paper 2C Graphical Techniques

Wednesday 24 May 2017   Morning   Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
• a clean copy of the Preliminary Material and 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 questions in the space provided. Do not write outside the box around each page or on blank pages.
• Show all necessary working; otherwise, marks for method may be lost.
• Do all rough work in this book. Cross through any work that 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 or graph paper, which must be tagged securely to this answer booklet.
• The paper reference for this paper is 1350/2C.

For Examiner's Use	
Pages	Mark
2 – 3	
4 – 5	
6 – 7	
8 – 9	
10 – 11	
12 – 13	
14 – 15	
16 – 17	
TOTAL	

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

1 Oliver is researching costs for a new smartphone he is planning to buy.

He collects information from **five** mobile network operators.

The network operators offer the phone on a rental contract or on pay-as-you-go.

Users must also make a one-off payment for the phone.

He produces the table below.

Operator	One-off payment for the phone	Rental cost
A	£189.99p	£25
B	£129.99p	£36
C	£99.99p	£49
D	£9999p	£0 (pay-as-you-go)

1 (a) Analyse Oliver's table, identifying **two** errors.

Then suggest **two** improvements he could make to his table.

[4 marks]

Error 1

Error 2

Do not write outside the box

Improvement 1

_____

_____

_____

Improvement 2

_____

_____

_____

1 (b) Sam works for a different mobile network operator.

She can take out a 24-month contract which costs, before staff discount,

£109.99 one-off payment for the phone

£37.49 per month rental cost.

She receives a 30% staff discount on the monthly rental cost only.

Sam does **not** want to spend more than £700 on the phone over the 24 months.

Should she take out the contract?
You **must** show your working.

[4 marks]

_____

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8

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2   Use **Youth Unemployment** from the Preliminary Material.

2 (a)   Work out the decrease, between September–November 2014 and June–August 2015, in the number of people aged 16–24 who were unemployed.

Circle your answer.

[1 mark]

56 000   80 000   136 000   192 000

2 (b)   Two newsletters contained articles about the unemployment rate of the economically active population aged 16–24 in September–November 2015

Here are the two headlines.

> **Unemployment rate for 16–24 year olds declines by one fifth in one year!**

Always Young newsletter

> **For economically active 16–24 year olds, the ratio of men to women is about 11 : 10**

Dynamic Youth newsletter

Using the data given, comment on the validity of these headlines.

[8 marks]

Always Young

_____

_____

_____

_____

_____

_____

0 4

Dynamic Youth

Question 2 continues on the next page

Turn over ▶

9

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2 (c) An independent body overseeing the quality of government reports suggested that the briefing paper could have been improved.

Suggest **three improvements** for future briefing papers.

[3 marks]

Improvement 1

_____

_____

_____

_____

Improvement 2

_____

_____

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_____

Improvement 3

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3

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ANSWER IN THE SPACES PROVIDED

Turn over for the next question

Turn over ▶

3   In 2009, Usain Bolt set a world record of 9.58 seconds for the 100-metre sprint.

3 (a)   Calculate Bolt's average speed when he set this world record.

[2 marks]

Answer _____ ms^{-1}

The graph below shows the speed, v, in metres per second, against time, t, in seconds, at 10-metre intervals during this race.
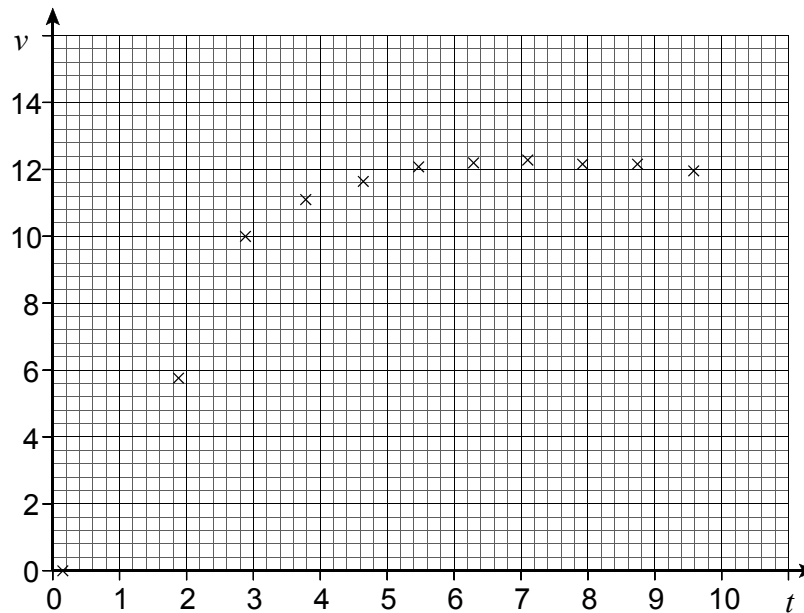
The linear equation below models Bolt's speed, v, in metres per second, against time, t, in seconds, during the first 3 seconds of the race.

$$v = 3.62t - 0.663$$

3 (b) Write down Bolt's average acceleration during this section of the race.

[1 mark]

Answer _____ ms^{-2}

3 (c) Describe how Bolt's acceleration varies during the rest of the race.

[2 marks]

_____

_____

_____

_____

5

Turn over ▶

4   A sculptor is designing a large structure in the shape of an arch.

The arch will have the shape shown by the curve below.

The points O and G are at ground level.
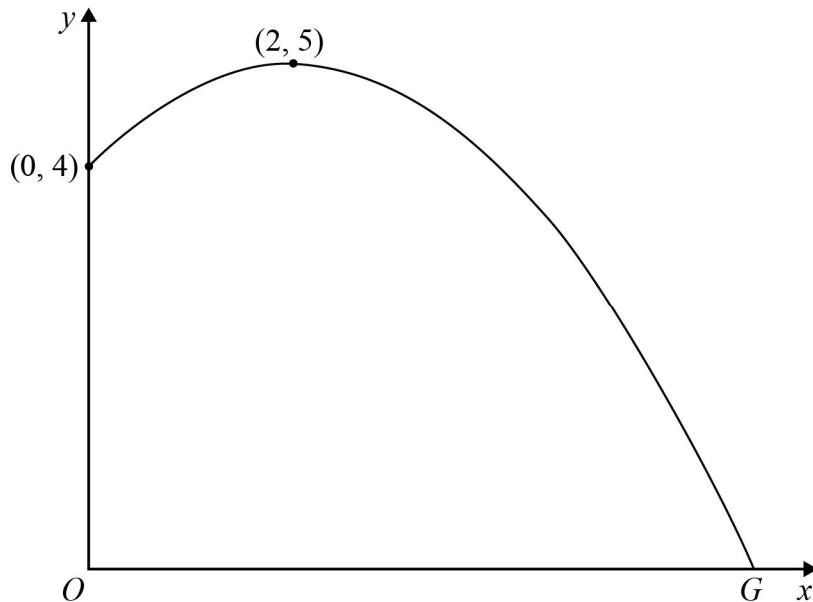
The arch can be modelled by an equation of the form

$$y = ax^2 + x + c$$

where x metres and y metres are the horizontal and vertical distances respectively from the point O, and a and c are constants.

The points (0, 4) and (2, 5) are on the arch as shown.

4 (a) Work out the values of a and c

[4 marks]

_____

_____

_____

_____

_____

_____

_____

$a =$ _____ $c =$ _____

4 (b) The arch meets the ground at the point G

Alex estimates that the distance OG is 6.5 metres.

Is this an overestimate or an underestimate?
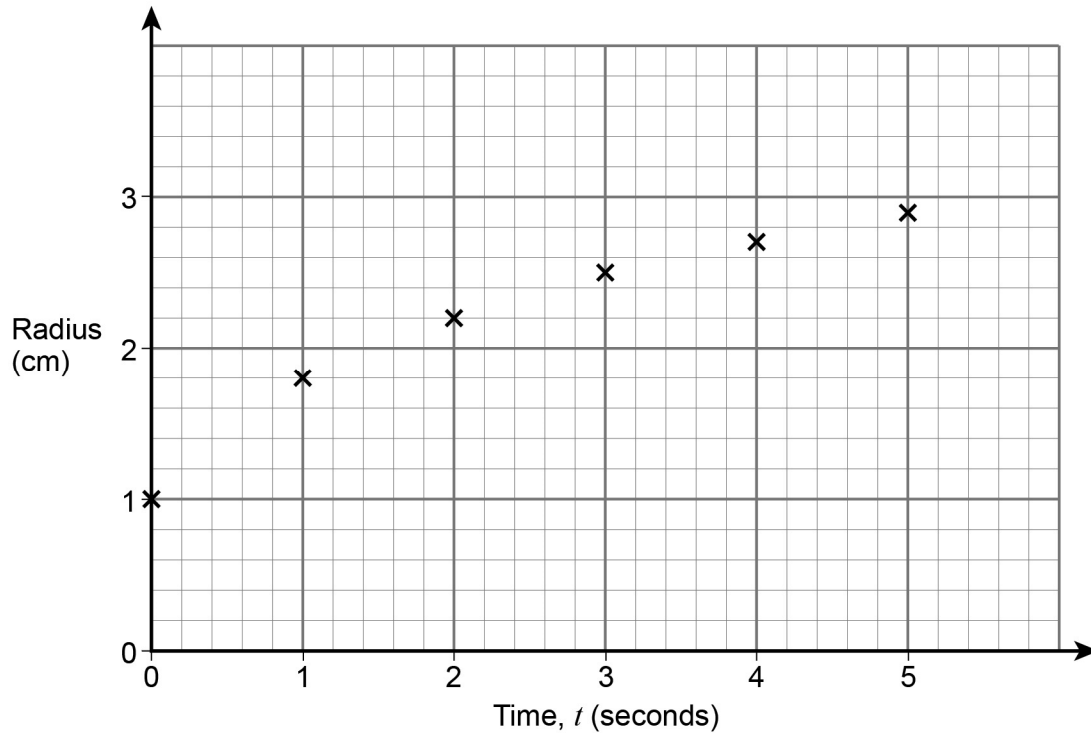You **must** show your working.

[3 marks]

_____

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Turn over ▶

7

1 1

5 A balloon is being inflated for 5 seconds.

Assume that the balloon is a sphere.

Sam investigates how the radius of the balloon changes with time as the balloon is inflated.

He plots the points on the graph below.

5 (a) Use the graph to estimate the rate at which the radius is increasing when $t = 2$

[3 marks]

_____

_____

_____

_____

_____

Answer _____ cms^{-1}

5 **(b)** Describe how the rate of change of the radius varies during the first 5 seconds.

[1 mark]

Sam then makes a table to show the volume of the balloon for different radii.

The volume, V, of a sphere of radius, r, is given by $V = \frac{4}{3}\pi r^3$

Time (seconds)	Radius (cm)	Volume (cm³)
0	0.98	4
2	2.19	
4	2.72	

5 **(c)** Complete the table, giving your answers to the nearest whole number.

[3 marks]

7

Question 5 continues on the next page

Turn over ▶

5 (d)   Work out the rate at which the volume of the balloon is increasing.
State the units of your answer.
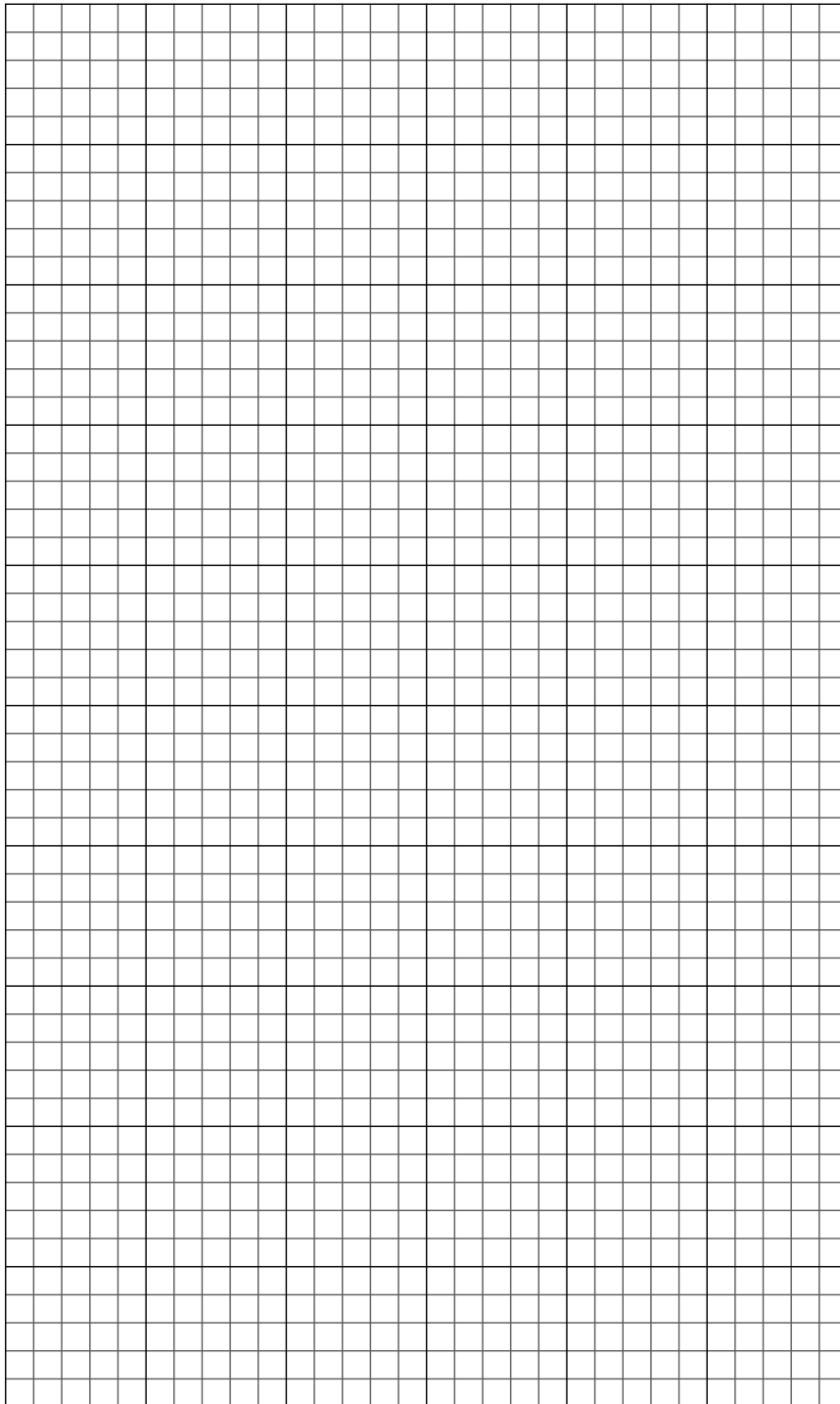
[3 marks]

Answer _____

5 (e)   The initial volume of another balloon is 4 cm^3

It starts to be inflated when $t = 1$

Its volume increases at a constant rate of 30 cm^3 each second.

Work out the non-zero time when the two balloons have the same volume.
You may use the grid on the opposite page if you wish.

[4 marks]

Answer _____ seconds

1 4

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7

Turn over ▶

6   Capacitors are used in electronic circuits.

The charge on a capacitor can increase and decrease and is measured in coulombs.

In a particular circuit, the charge on a capacitor increases for one millisecond and then decreases for one millisecond.

The charge, Q coulombs, at time t milliseconds after the capacitor starts to charge is given by

$$Q = 6(1 - e^{-3t}) \quad \text{for } 0 \leqslant t \leqslant 1$$

$$\text{and} \quad Q = Ae^{-3(t-1)} \quad \text{for } 1 \leqslant t \leqslant 2$$

6 (a)   Work out the charge on the capacitor when $t = 0$

[1 mark]

Answer _____ coulombs

6 (b)   Show that $A = 5.70$ correct to three significant figures.

[4 marks]

6 (c) Sketch a graph to show how the charge on the capacitor varies during the two millisecond period.

[3 marks]

Q

t

6 (d) The circuit designer wants the charge to be less than 4 coulombs for at least 60% of the two millisecond period.

Does the circuit satisfy this requirement?
You **must** show your working.

[6 marks]

END OF QUESTIONS

14

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