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.

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

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.

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

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]

8

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

Dynamic Youth

9

Question 2 continues on the next page

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

Improvement 3

3

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ANSWER IN THE SPACES PROVIDED

Turn over for the next question

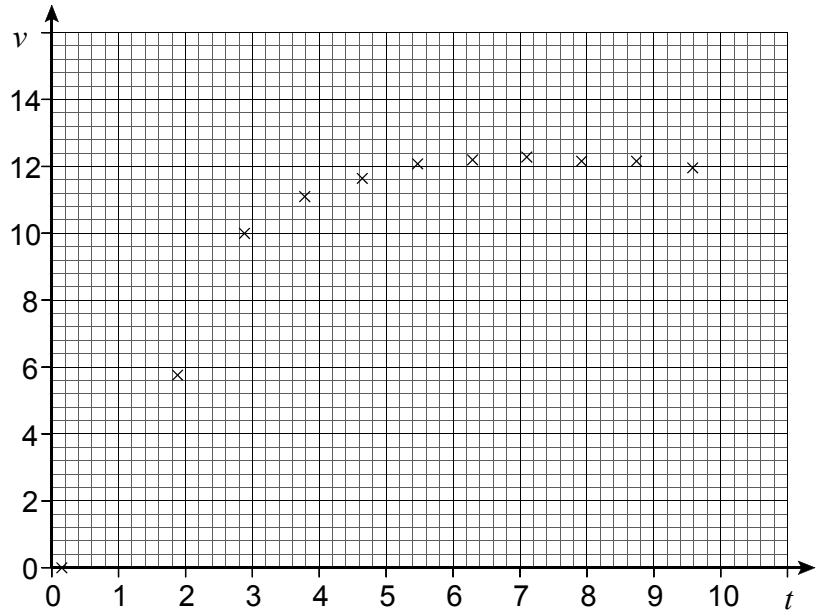
3 In 2009, Usain Bolt set a world record of 9.58 seconds for the 100-metre sprint.

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]

_____

_____

_____

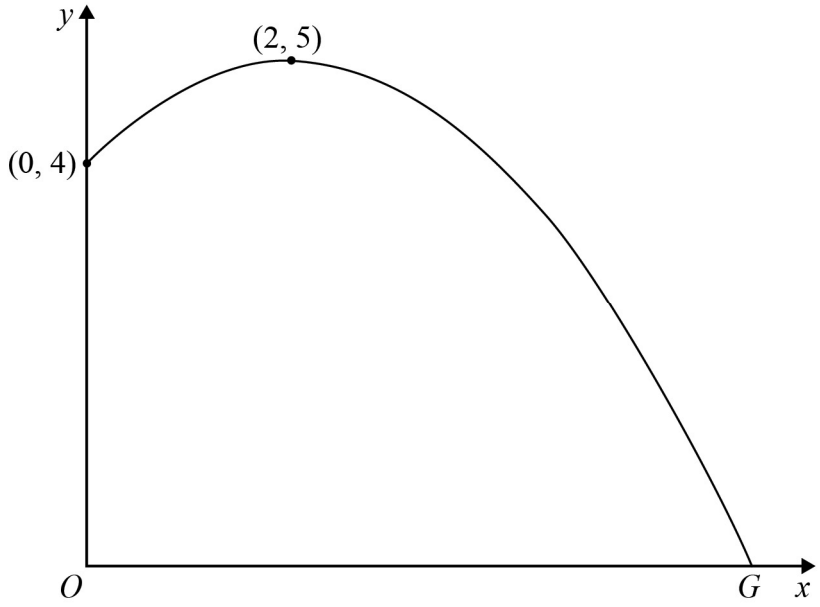
_____

5

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]

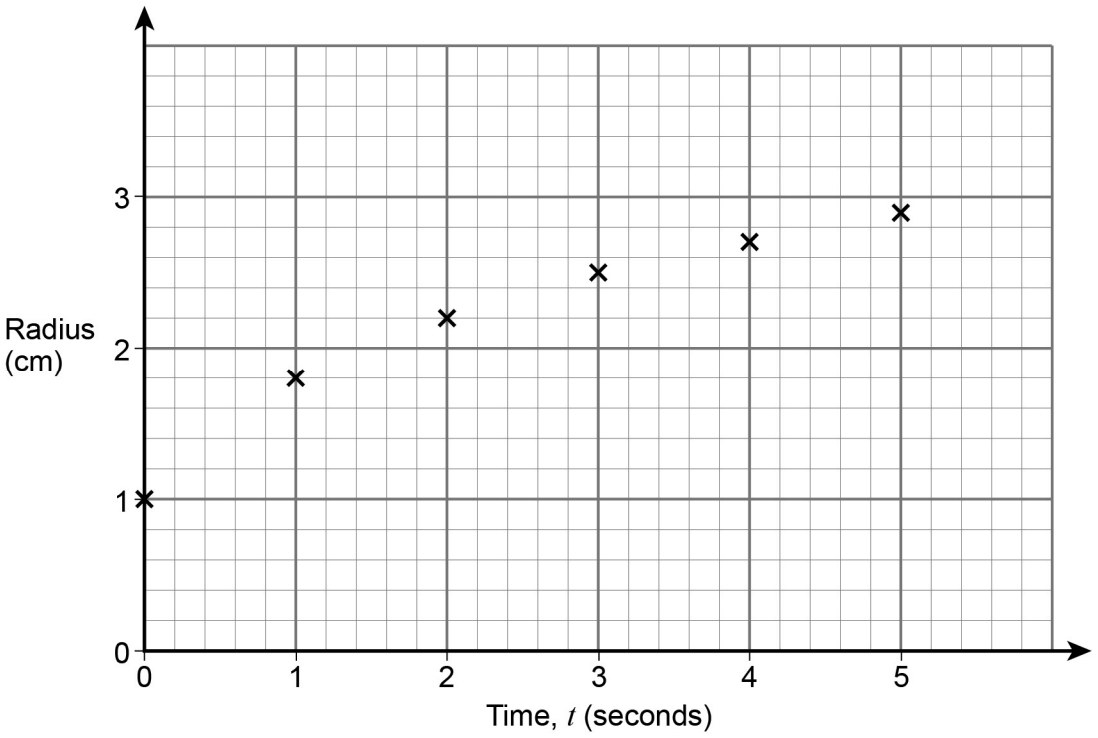
7

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 (cm^3)
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

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

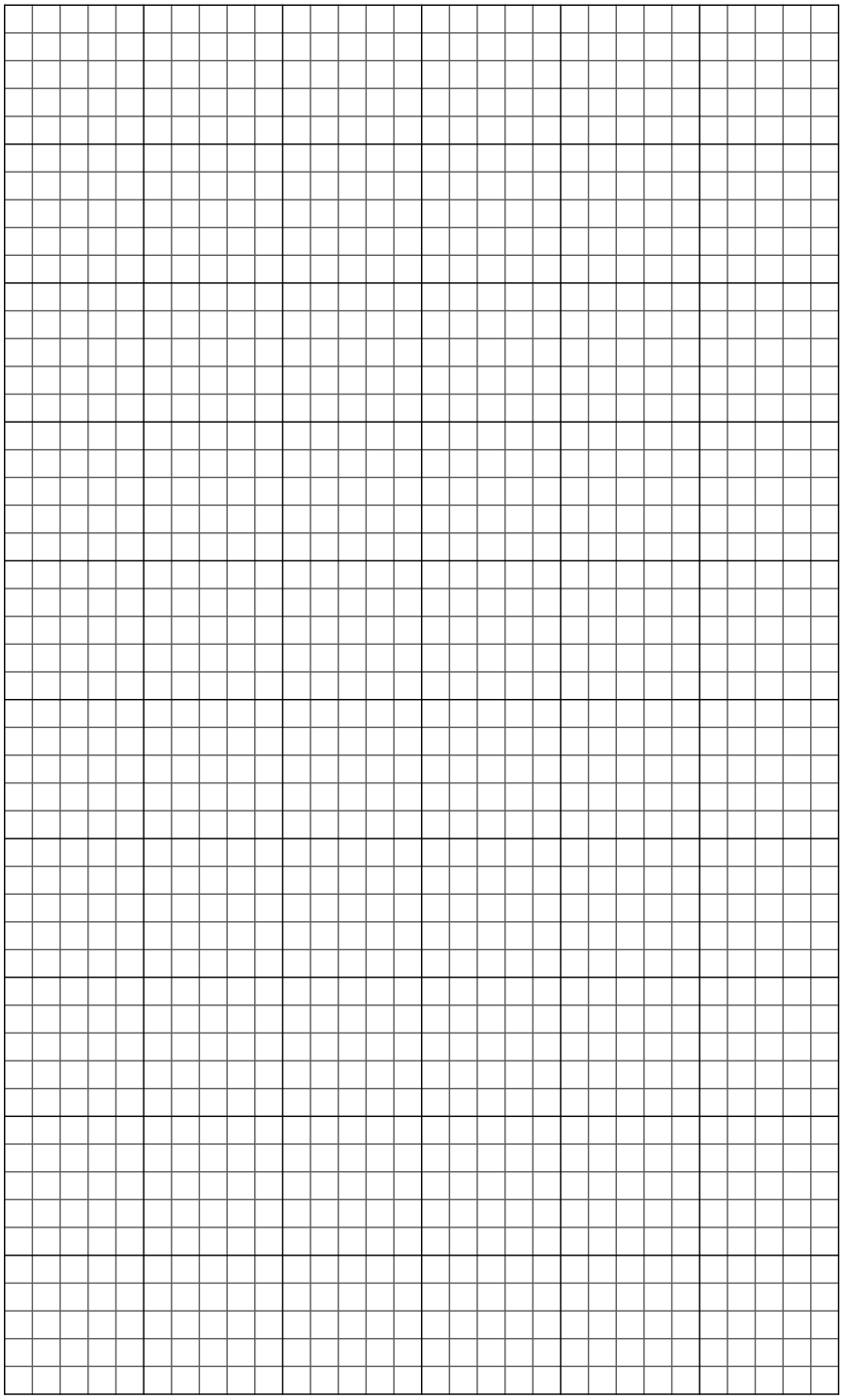
It starts to be inflated when $t = 1$

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



7

Turn over for the next question

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

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

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

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]

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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