Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2013

Use of Mathematics (Pilot) USE1

Algebra

Monday 20 May 2013 9.00 am to 10.00 am

For this paper you must have:
- a clean copy of the Data Sheet (enclosed)
- a calculator
- a ruler.

Time allowed
- 1 hour

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.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- 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 requiring the use of tables or calculators should normally be given to three significant figures.
- You may **not** refer to the copy of the Data Sheet 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 40.
- You may use either a scientific calculator or a graphics calculator.

Advice
- You do not necessarily need to use all the space provided.

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Section A

Answer **all** questions.

Answer each question in the space provided for that question.

Use **Google Chrome** *on page 2 of the Data Sheet.*

1 The market share can be modelled by the equation

$$M = aT^2 + b$$

where M is the percentage market share, T is the number of months after October 2008, and a and b are constants.

(a) Complete the table of values below. *(1 mark)*

(b) (i) Use the grid opposite to plot M against T^2.

Draw a line of best fit on your graph. *(2 marks)*

(ii) Use your graph to estimate the values of a and b. *(3 marks)*

(c) Use your values of a and b to estimate the value of M in June 2011, that is when $T = 32$. *(2 marks)*

(d) State a reason why this model would not be valid for large values of T. *(1 mark)*

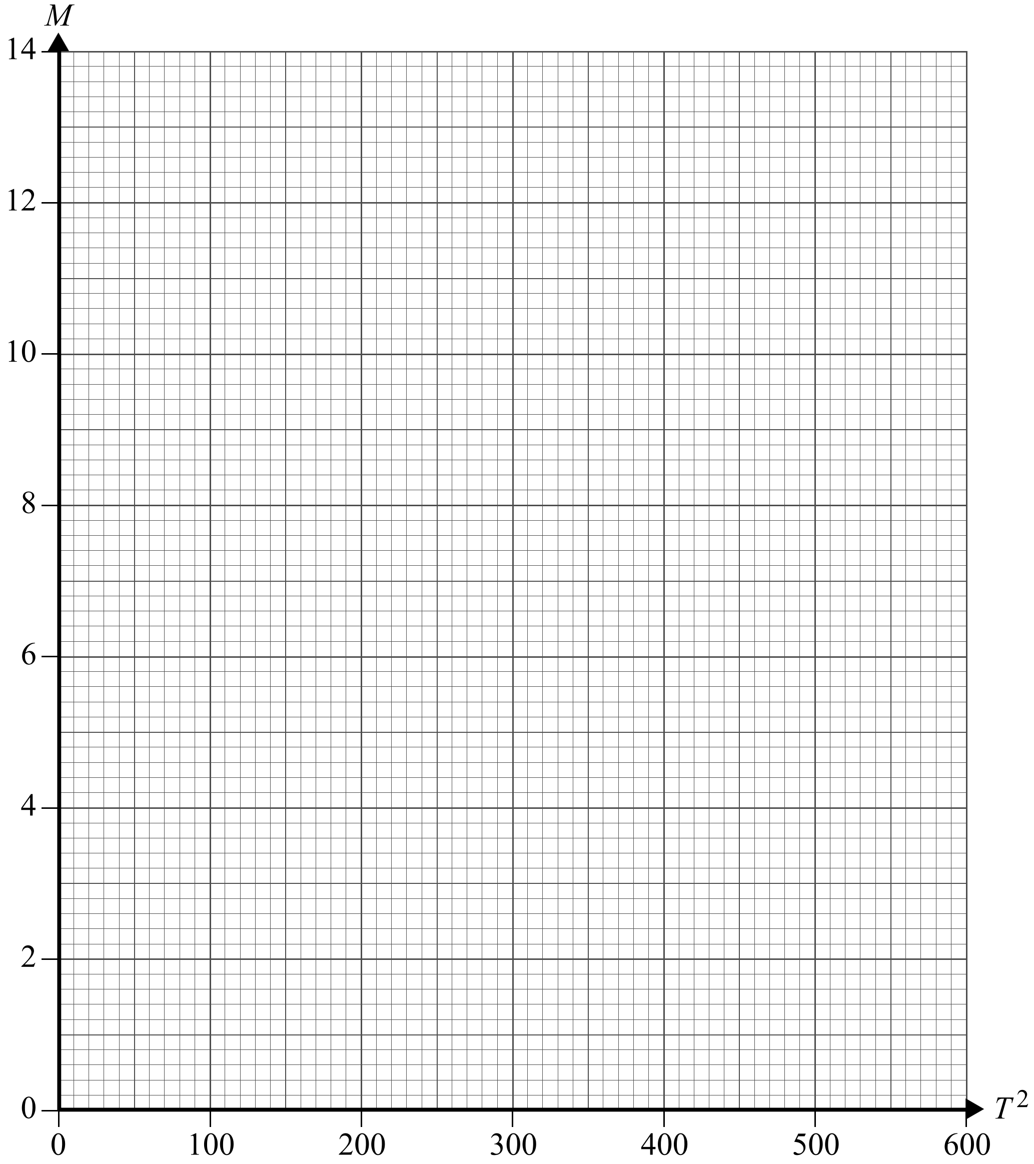
QUESTION PART REFERENCE

Answer space for question 1

T	4	8	12	16	20
T^2	16				
M	1.5	2.7	4.4	6.8	9.5

QUESTION PART REFERENCE

Answer space for question 1



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QUESTION PART REFERENCE

Answer space for question 1

Do not write outside the box

QUESTION PART REFERENCE

Answer space for question 1

Turn over ▶

Section B

Answer **all** questions.

Answer each question in the space provided for that question.

Use **Growth of bacteria** *on page 2 of the Data Sheet.*

2 The number of bacteria, N, after time t hours, can be modelled by the equation

$$N = 4000e^{0.034t}$$

for values of $t \geqslant 0$.

(a) On the axes below, sketch the graph of $N = 4000e^{0.034t}$ for values of $t \geqslant 0$.

Show the coordinates of any points where the curve crosses the axes. *(2 marks)*

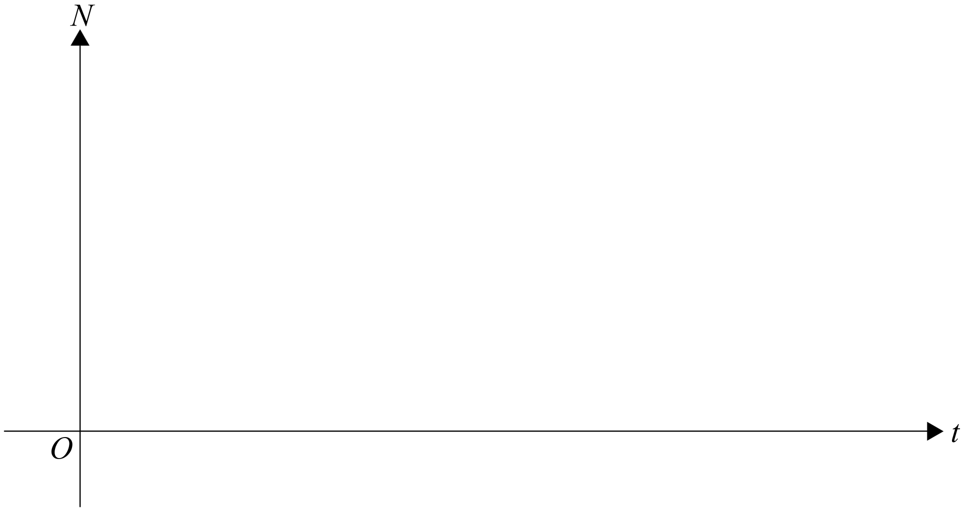
(b) Use this model to find:

(i) the number of bacteria after 6 hours; *(2 marks)*

(ii) how long it takes for the number of bacteria to double from its initial value. *(3 marks)*

QUESTION PART REFERENCE

Answer space for question 2



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QUESTION PART REFERENCE

Answer space for question 2

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Section C

Answer **all** questions.

Answer each question in the space provided for that question.

Use **Fountains** *on page 3 of the Data Sheet.*

3 The shape of a water spout in a fountain can be modelled by the equation

$$y = 0.6x(3.6 - x)$$

where x metres and y metres are the horizontal and vertical displacements from the starting point of the water spout.

(a) (i) Complete the table of values opposite. *(2 marks)*

(ii) On the grid opposite, draw the graph of $y = 0.6x(3.6 - x)$ for $0 \leqslant x \leqslant 4$. *(2 marks)*

(iii) Use your graph to find x when $y = -0.5$. *(1 mark)*

(b) (i) Find the maximum value of y. *(1 mark)*

(ii) State the value of x where y is a maximum. *(1 mark)*

(c) Hence or otherwise, express y in the form

$$y = q - 0.6(p - x)^2$$

where p and q are constants. *(3 marks)*

(d) Another water spout has a maximum height of 2.7 metres above its starting point. This maximum height occurs at a horizontal distance of 1.2 metres from the start of the water spout.

This water spout can be modelled by the equation

$$y = kx(a - x)$$

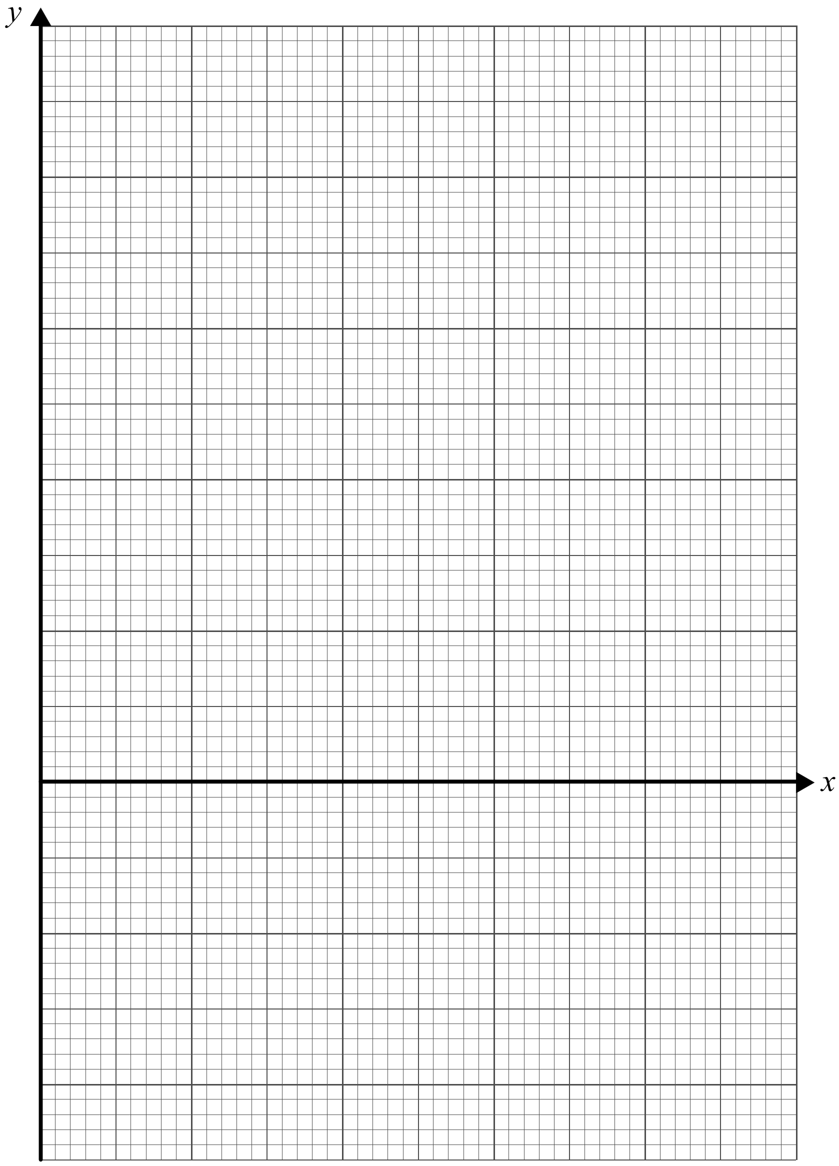
where a and k are constants.

Find the values of the constants a and k. *(2 marks)*

QUESTION PART REFERENCE

Answer space for question 3

x	0	0.5	1	1.5	2	2.5	3	3.5	4
y	0	0.93	1.56						



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QUESTION PART REFERENCE

Answer space for question 3

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QUESTION PART REFERENCE

Answer space for question 3

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Section D

Answer **all** questions.

Answer each question in the space provided for that question.

Use **Construction output** *on page 4 of the Data Sheet.*

4 Construction output, C, in £ (billions) can be modelled by

$$C = 106 + 9\cos\left(\frac{180t}{1.6}\right)^\circ$$

where t is the time in years after July 2008 for $0 \leqslant t \leqslant 1.6$.

(a) Complete the table of values opposite, giving the values of C to one decimal place. *(1 mark)*

(b) Use the grid opposite to plot C against t for $0 \leqslant t \leqslant 1.6$. *(2 marks)*

(c) (i) Estimate the minimum gradient of the graph for $0 \leqslant t \leqslant 1.6$. *(2 marks)*

(ii) State the units of this gradient. *(1 mark)*

(iii) Interpret the meaning of this gradient. *(1 mark)*

(d) Describe fully the transformation that maps the graph of the function $C = 9\cos\left(\frac{180t}{1.6}\right)^\circ$ onto the graph of the function $C = 106 + 9\cos\left(\frac{180t}{1.6}\right)^\circ$. *(2 marks)*

(e) For $1.6 \leqslant t \leqslant 3.0$, construction output, C, can be modelled by

$$C = 102 - 5\cos\left(\frac{180(t-1.6)}{1.2}\right)^\circ$$

(i) Find the maximum value of C for $1.6 \leqslant t \leqslant 3.0$. *(1 mark)*

(ii) For what value of t does this maximum value of C occur? *(2 marks)*

QUESTION PART REFERENCE

Answer space for question 4

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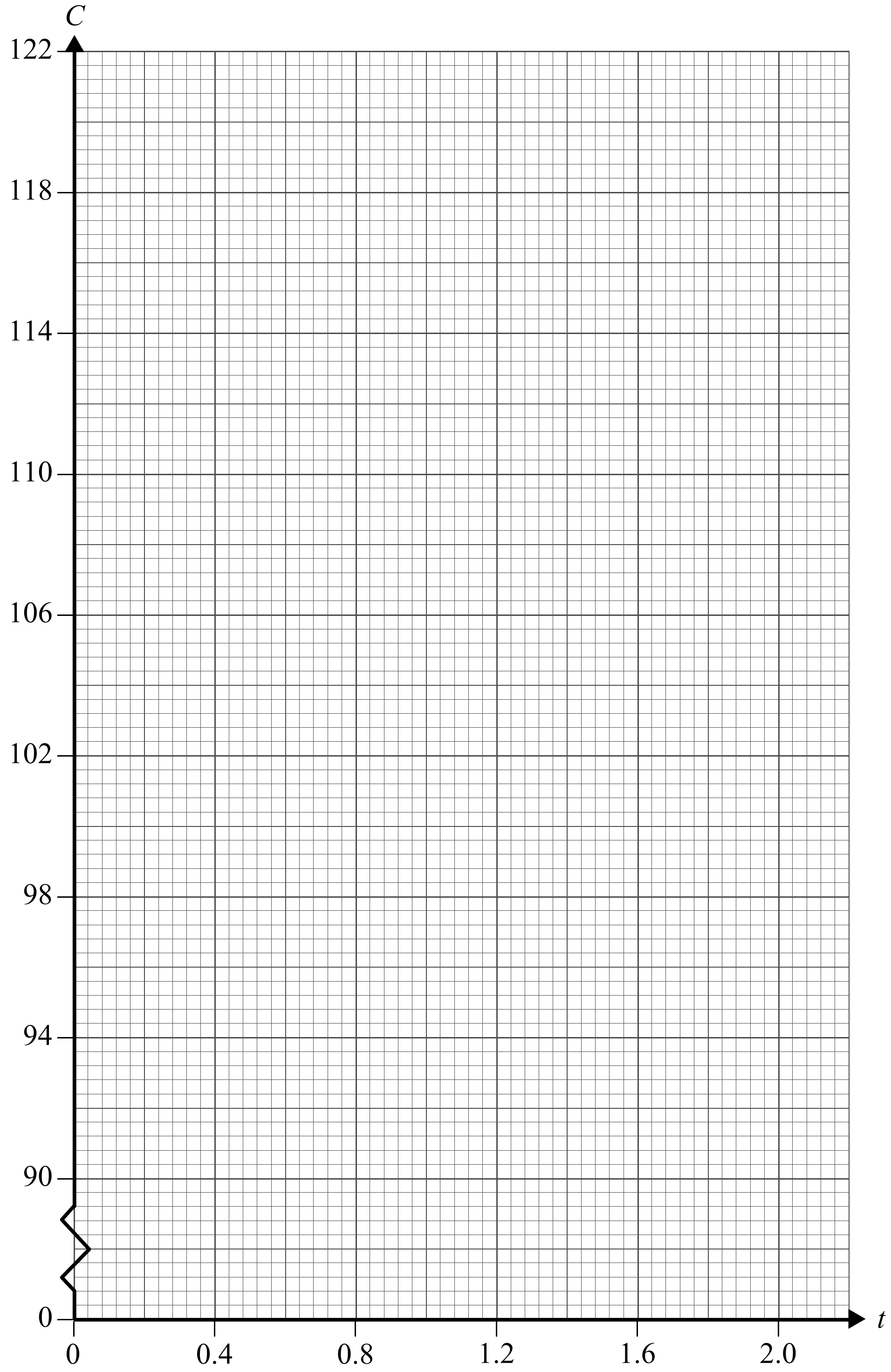
QUESTION PART REFERENCE

Answer space for question 4

***t* (years)**	0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6
***C* (£ bn)**	115.0	114.3	112.4	109.4	106.0				



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QUESTION PART REFERENCE

Answer space for question 4

QUESTION PART REFERENCE

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END OF QUESTIONS

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