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 2014

Use of Mathematics (Pilot) USE1

Algebra

Monday 19 May 2014 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.

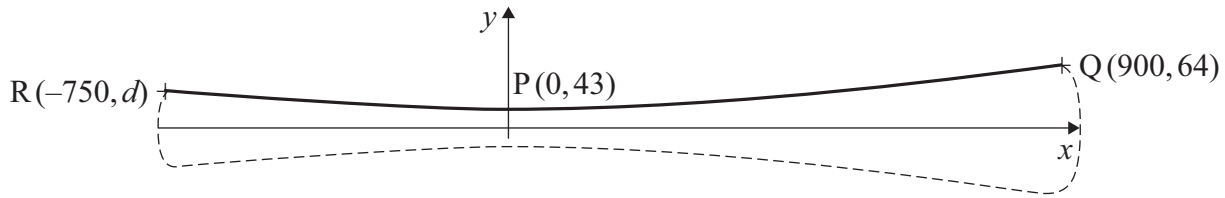
Section A

Answer **all** questions.

Answer each question in the space provided for that question.

Use **Shaped skis** *on page 2 of the Data Sheet.*

1



Not to scale

The sidecut of a shaped ski can be modelled by a parabola, as shown in the graph above, where x millimetres and y millimetres are measured from a point in the middle of the ski at its narrowest part.

The parabola passes through the points P, Q and R.
P is at the narrowest part of the ski, near its centre.
Q is at the widest part of the ski near the front, and R is at the widest part of the ski near the back.

The parabola has an equation of the form $y = ax^2 + c$, where a and c are constants.

(a) Write down the value of c.

[1 mark]

(b) Find the value of a, and hence write down an equation for y in terms of x.

[3 marks]

(c) Use your equation to find the value of d, the y-coordinate of point R.

[2 marks]

(d) The cross section of the ski is symmetrical about the x-axis.
Write down the statistics of the ski, as defined on the Data Sheet.

[1 mark]

QUESTION PART REFERENCE

Answer space for question 1

QUESTION PART REFERENCE

Answer space for question 1

Section B

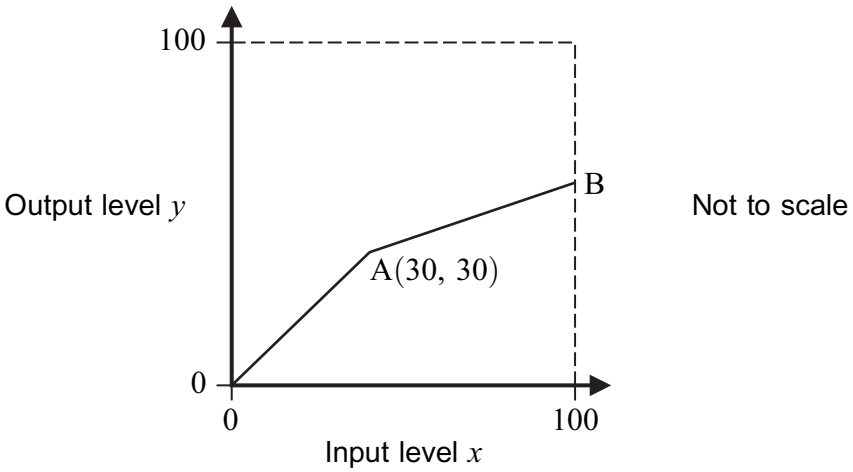
Answer **all** questions.

Answer each question in the space provided for that question.

Use **Audio compression** *on page 3 of the Data Sheet.*

2 (a) **Graph 1** shows how an audio compressor processes a signal in the first stage.

Graph 1



The horizontal axis shows the input level x as a percentage of the maximum possible level.

The vertical axis shows the output level y as a percentage of the maximum possible level.

The process can be modelled by the function $y = \mathrm{f}(x)$, where

$$\mathrm{f}(x) = x \qquad (0 \leqslant x \leqslant 30)$$

and $$\mathrm{f}(x) = \frac{1}{3}x + 20 \qquad (30 \leqslant x \leqslant 100)$$

(i) Find the value of y when $x = 100$.

[1 mark]

(ii) Find the value of x when $y = 50$.

[2 marks]

QUESTION PART REFERENCE

Answer space for question 2

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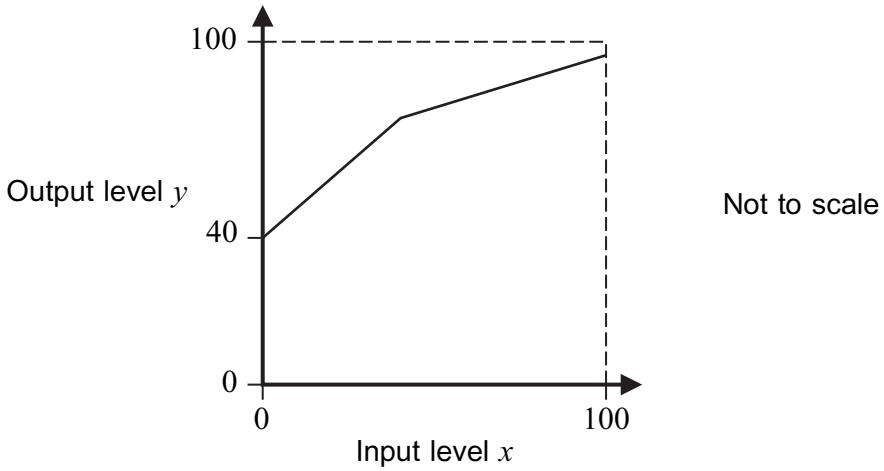
(b) In the second stage of processing, a gain of 40 units is applied.
The result of both processes is represented by **Graph 2**.

Graph 2



This graph is the result of a translation of $\begin{pmatrix} 0 \\ 40 \end{pmatrix}$ applied to the graph of $y = \mathrm{f}(x)$.

In the table below, write down equations to represent the two sections of **Graph 2**.

[2 marks]

Question 2 continues on the next page

QUESTION PART REFERENCE

Answer space for question 2

For $0 \leqslant x \leqslant 30$	$y =$ .....
For $30 \leqslant x \leqslant 100$	$y =$ .....

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2 (c) When the compressor is set to different values, the result of the processing can be represented by the function $y = \mathrm{g}(x)$, where

$$\mathrm{g}(x) = x + 25 \qquad (0 \leqslant x \leqslant 50)$$

and $\mathrm{g}(x) = \frac{1}{2}x + 50 \qquad (50 \leqslant x \leqslant 100)$

Graph 3 on page 7 shows the graph of $y = \mathrm{g}(x)$, drawn to scale.

For this case, state:

(i) the gain;

[1 mark]

(ii) the threshold;

[1 mark]

(iii) the compression ratio.

[1 mark]

(d) On the grid of **Graph 3**, draw the graph of the inverse function of $y = \mathrm{g}(x)$.

[2 marks]

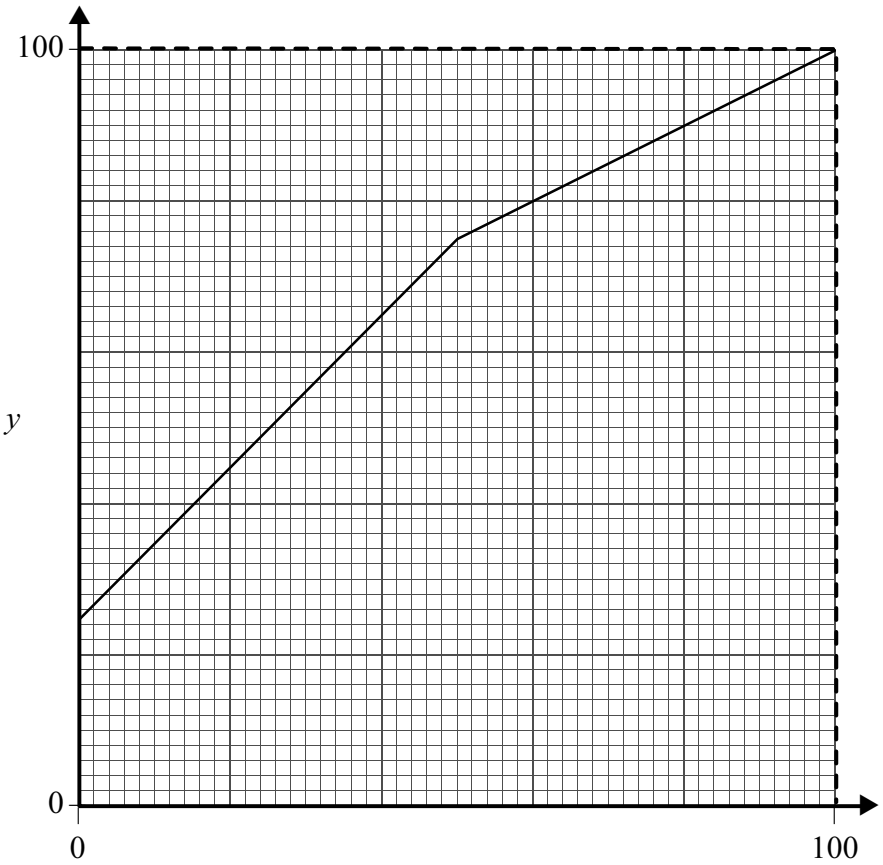
QUESTION PART REFERENCE

Answer space for question 2

QUESTION PART REFERENCE

Answer space for question 2

Graph 3



Section C

Answer **all** questions.

Answer each question in the space provided for that question.

Use **App downloads** *on page 4 of the Data Sheet.*

3 It is thought that the number of app downloads, N millions, at time t months after launch can be modelled by an equation of the form

$$N = At^b$$

where A and b are constants.

(a) For this model, show that

$$\ln N = \ln A + b \ln t$$

[1 mark]

(b) Using the values given on the Data Sheet, complete the table on the opposite page, giving values to three significant figures.

[2 marks]

(c) On the grid opposite, plot $\ln N$ against $\ln t$.

Draw a line of best fit.

[3 marks]

(d) Use your graph to estimate the constants A and b.

[4 marks]

(e) Substitute the constants A and b into the equation $N = At^b$ and use it to estimate the number of downloads 25 months after launch if the model continues to be valid.

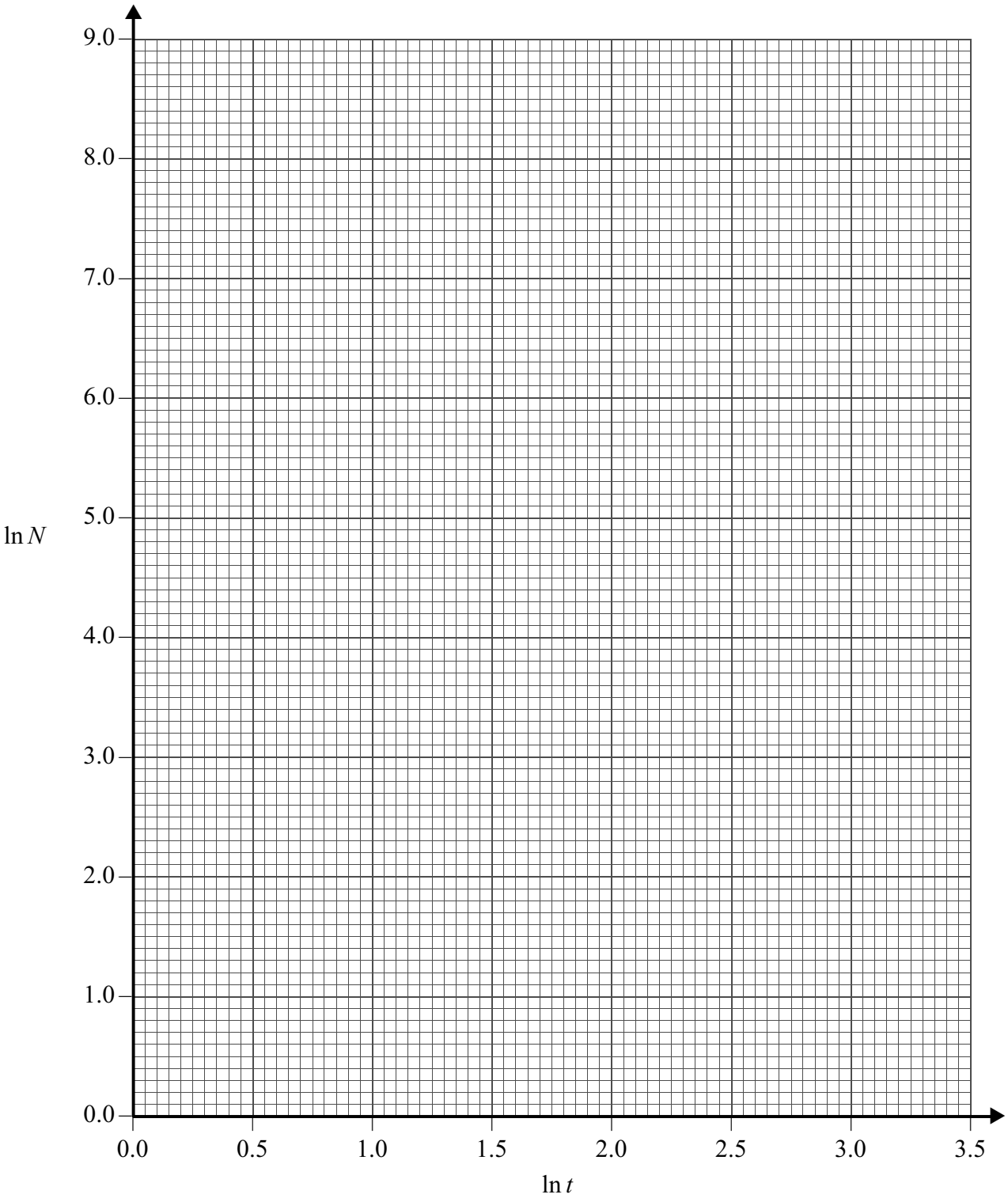
[2 marks]

QUESTION PART REFERENCE

Answer space for question 3

Answer space for question 3

t	5	7	9	13	18	22
$\ln t$	1.61		2.20		2.89	
$\ln N$	5.48		6.67		7.97	



QUESTION PART REFERENCE

Answer space for question 3

QUESTION PART REFERENCE

Answer space for question 3

Section D

Answer **all** questions.

Answer each question in the space provided for that question.

Use **Cortisol levels** *on page 4 of the Data Sheet.*

4 The graph of the cortisol level $y\,\mu g/cl$ at time t hours past midnight is shown on the opposite page for $5.8 \leqslant t \leqslant 12$.

(a) (i) Find the gradient of the graph when $t = 7$.

[2 marks]

(ii) Interpret the meaning of this gradient.

[1 mark]

(b) **For $8 \leqslant t \leqslant 12$**, the level of cortisol can be modelled by the function

$$y = 4.5\cos[16(t-8)]^\circ + 9.6$$

(i) Complete the table opposite, giving values of y to one decimal place.

[2 marks]

(ii) By how much does the value of y calculated in part **(b)(i)** for $t = 11$ differ from the actual value as shown on the graph?

[1 mark]

(iii) Using the grid opposite, plot y against t for $8 \leqslant t \leqslant 12$.

[2 marks]

(c) **For $5.8 \leqslant t < 8$**, the level of cortisol can be modelled by the function

$$y = 4.5\sin[45(t-5.8)]^\circ + 9.8$$

(i) State the amplitude of this function.

[1 mark]

(ii) Find the period of this function.

[2 marks]

QUESTION PART REFERENCE

Answer space for question 4

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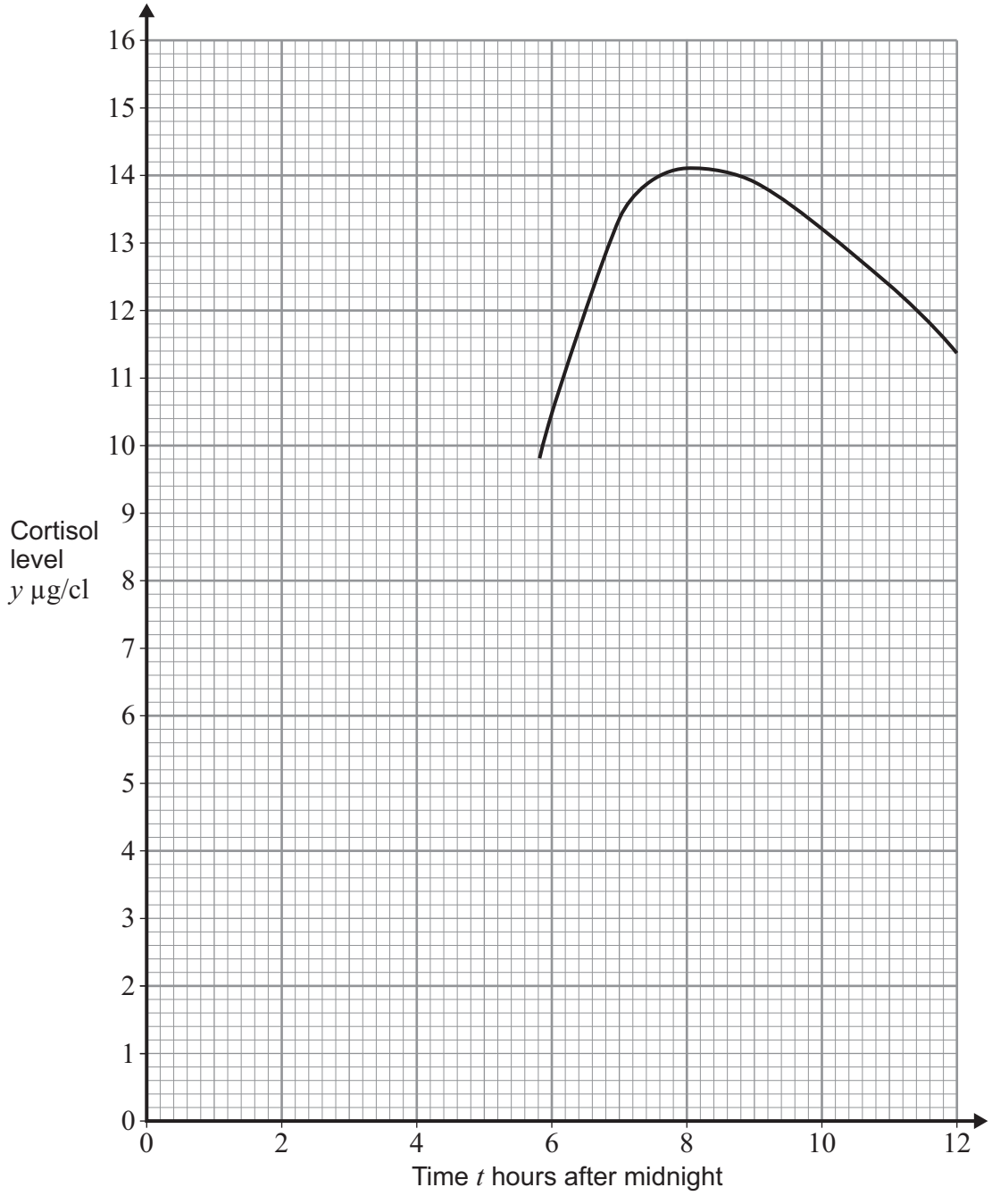
QUESTION PART REFERENCE

Answer space for question 4

t	8	9	10	11	12
y	14.1	13.9			



QUESTION PART REFERENCE

Answer space for question 4

QUESTION PART REFERENCE

Answer space for question 4

END OF QUESTIONS

There are no questions printed on this page

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