

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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**Pearson Edexcel Level 3 GCE**

**Tuesday 11 June 2024**

Afternoon (Time: 2 hours)

Paper  
reference

**9MA0/02**

**Mathematics**

**Advanced**

**PAPER 2: Pure Mathematics 2**

**You must have:**

Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

**Candidates may use any calculator allowed by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

### Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

### Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 15 questions in this question paper. The total mark for this paper is 100.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

### Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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5. Given that  $\theta$  is small and in radians, use the small angle approximations to find an approximate numerical value of

$$\frac{\theta \tan 2\theta}{1 - \cos 3\theta}$$

(3)

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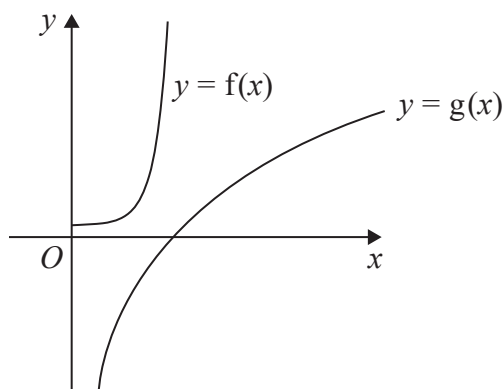


Figure 1

Figure 1 shows a sketch of the curves with equations  $y = f(x)$  and  $y = g(x)$  where

$$f(x) = e^{4x^2-1} \quad x > 0$$

$$g(x) = 8 \ln x \quad x > 0$$

(a) Find

(i)  $f'(x)$

(ii)  $g'(x)$

(2)

Given that  $f'(x) = g'(x)$  at  $x = \alpha$

(b) show that  $\alpha$  satisfies the equation

$$4x^2 + 2 \ln x - 1 = 0$$

(2)

The iterative formula

$$x_{n+1} = \sqrt{\frac{1 - 2 \ln x_n}{4}}$$

is used with  $x_1 = 0.6$  to find an approximate value for  $\alpha$

(c) Calculate, giving each answer to 4 decimal places,

(i) the value of  $x_2$

(ii) the value of  $\alpha$

(3)





















9.

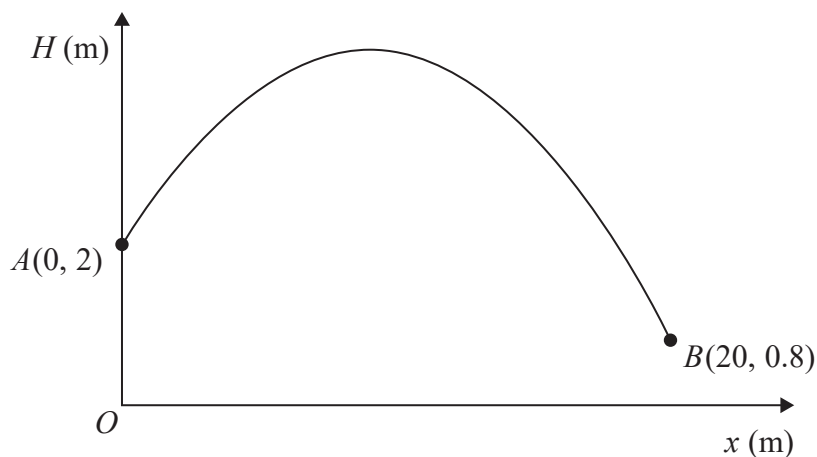


Figure 3

The graph in Figure 3 shows the path of a small ball.

The ball travels in a vertical plane above horizontal ground.

The ball is thrown from the point represented by  $A$  and caught at the point represented by  $B$ .

The height,  $H$  metres, of the ball above the ground has been plotted against the horizontal distance,  $x$  metres, measured from the point where the ball was thrown.

With respect to a fixed origin  $O$ , the point  $A$  has coordinates  $(0, 2)$  and the point  $B$  has coordinates  $(20, 0.8)$ , as shown in Figure 3.

The ball reaches its maximum height when  $x = 9$

A quadratic function, linking  $H$  with  $x$ , is used to model the path of the ball.

(a) Find  $H$  in terms of  $x$ . (4)

(b) Give one limitation of the model. (1)

Chandra is standing directly under the path of the ball at a point 16 m horizontally from  $O$ .

Chandra can catch the ball if the ball is less than 2.5 m above the ground.

(c) Use the model to determine if Chandra can catch the ball. (2)

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11.

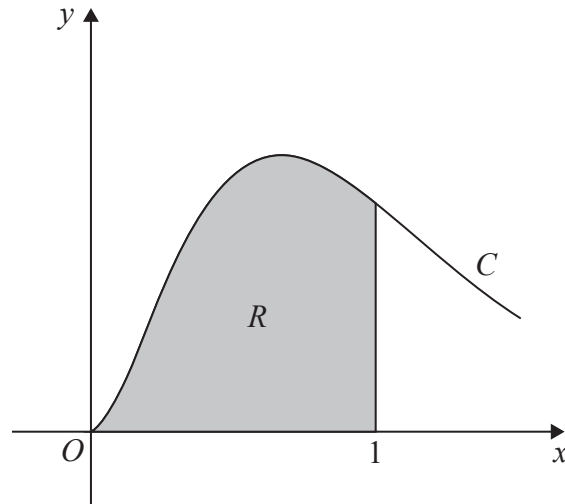


Figure 5

In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

Figure 5 shows a sketch of part of the curve  $C$  with equation

$$y = 8x^2e^{-3x} \quad x \geq 0$$

The finite region  $R$ , shown shaded in Figure 5, is bounded by

- the curve  $C$
- the line with equation  $x = 1$
- the  $x$ -axis

Find the exact area of  $R$ , giving your answer in the form

$$A + Be^{-3}$$

where  $A$  and  $B$  are rational numbers to be found.

(5)

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Question 13 continued

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Question 15 continued

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**Question 15 continued**

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**(Total for Question 15 is 12 marks)**

**TOTAL FOR PAPER IS 100 MARKS**

