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Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

PRE DESIGN VERSION

Paper Reference **9MA0/02**

Mathematics

Advanced

Paper 2: Pure Mathematics 2

You must have:
Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

1. (a) Given that

$$2\log(3-x)-\log(21-2x)=0$$

show that

$$x^2-4x-12=0$$

(3)

(b) (i) Write down the roots of $x^2-4x-12=0$

(ii) Which of these two roots is **not** a solution of

$$2\log(3-x)-\log(21-2x)=0$$

giving a reason for your answer.

(2)

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Question 1 continued

(Total for Question 1 is 5 marks)

2.

$$\mathrm{f}(x) = 3x^4 + 2x^2 - 12x + 8$$

Given that $y = \mathrm{f}(x)$ has a single turning point at $x = \alpha$,

(a) show that α is a solution of the equation

$$x = \sqrt[3]{1 - \frac{x}{3}}$$

(3)

The iterative formula

$$x_{n+1} = \sqrt[3]{1 - \frac{x_n}{3}}$$

is used with $x_1 = 1$ to find an approximate value for α.

(b) Calculate the value of x_2 and the value of x_5, giving each answer to 4 decimal places.

(3)

(c) Using a suitable interval and a suitable function that should be stated, show that to 3 decimal places α is 0.889

(2)

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Question 2 continued

(Total for Question 2 is 8 marks)

3.

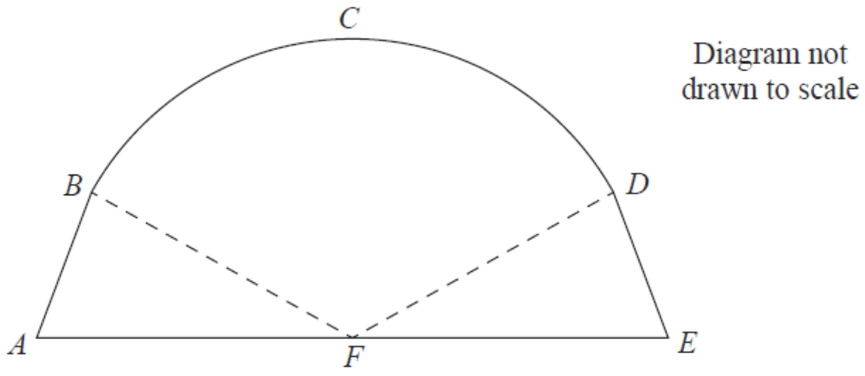

Figure 1

Figure 1 shows the plan view of a design for a stage at a concert.

The stage is modelled as a sector *BCDF*, of a circle centre *F*, joined to two congruent triangles *ABF* and *EDF*.

Given that

$$AFE \text{ is a straight line}$$

$$AF = FE = 10.7\,\text{m}$$

$$BF = FD = 9.2\,\text{m}$$

$$\text{angle } BFD = 1.82 \text{ radians}$$

find

(a) the perimeter of the stage, in metres, to one decimal place,

(5)

(b) the area of the stage, in m^2, to one decimal place.

(4)

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Question 3 continued

(Total for Question 3 is 9 marks)

4.

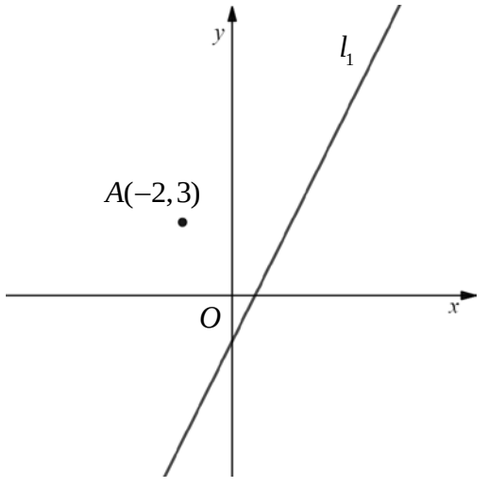

Figure 2

Figure 2 is a sketch showing the line l_1 with equation $y = 2x - 1$ and the point A with coordinates $(-2, 3)$.

The line l_2 passes through A and is perpendicular to l_1

(a) Find the equation of l_2 writing your answer in the form $y = mx + c$, where m and c are constants to be found.

(3)

The point B and the point C lie on l_1 such that ABC is an isosceles triangle with $AB = AC = 2\sqrt{13}$

(b) Show that the x coordinates of points B and C satisfy the equation

$$5x^2 - 12x - 32 = 0$$

(4)

Given that B lies in the 3rd quadrant

(c) find, using algebra and showing your working, the coordinates of B.

(4)

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Question 4 continued

(Total for Question 4 is 11 marks)

5. Vectors $\overrightarrow{AB}$ and $\overrightarrow{BC}$ are given by

$$\overrightarrow{AB} = \begin{pmatrix} 2p \\ q \\ 4 \end{pmatrix} \qquad \overrightarrow{BC} = \begin{pmatrix} q \\ -3p \\ 2 \end{pmatrix} \qquad \text{where } p \text{ and } q \text{ are constants}$$

Given that $\overrightarrow{AC}$ is parallel to $\begin{pmatrix} 3 \\ -4 \\ 3 \end{pmatrix}$ find the value of p and the value of q.

(5)

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Question 5 continued

Question 5 continued

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Question 5 continued

(Total for Question 5 is 5 marks)

6. A small company which makes batteries for electric cars has a 10-year plan for growth.

- In year 1 the company will make 2 600 batteries
- In year 10 the company aims to make 12 000 batteries

In order to calculate the number of batteries it will need to make each year, from year 2 to year 9, the company considers two models, Model *A* and Model *B*.

In Model *A* the number of batteries made will increase by the same **number** each year.

(a) Using Model *A*, determine the number of batteries the company will make in year 2

(3)

In Model *B* the number of batteries made will increase by the same **percentage** each year.

(b) Using Model *B*, determine the number of batteries the company will make in year 2

Give your answer to the nearest 10 batteries.

(3)

Sam calculates the total number of batteries made from year 1 to year 10 inclusive using each of the two models.

(c) Calculate the difference between the two totals, giving your answer to the nearest 100 batteries.

(3)

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 9 marks)

7.

$$g(x) = 4x^3 + ax^2 + 4x + b$$

where a and b are constants.

Given that

- $(2x+1)$ is a factor of $g(x)$
- the curve with equation $y = g(x)$ has a point of inflection at $x = \frac{1}{6}$

(a) find the value of a and the value of b

(5)

(b) Show that there are no stationary points on the curve with equation $y = g(x)$.

(2)

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Question 7 continued

(Total for Question 7 is 7 marks)

8. (a) Sketch the curve with equation

$$y = k - \frac{1}{2x} \qquad \text{where } k \text{ is a positive constant}$$

State, in terms of k, the coordinates of any points of intersection with the coordinate axes and the equation of the horizontal asymptote.

(3)

The straight line l has equation $y = 2x + 3$

Given that l cuts the curve in two distinct places,

(b) find the range of values of k, writing your answer in set notation.

(6)

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Question 8 continued

(Total for Question 8 is 9 marks)

9.

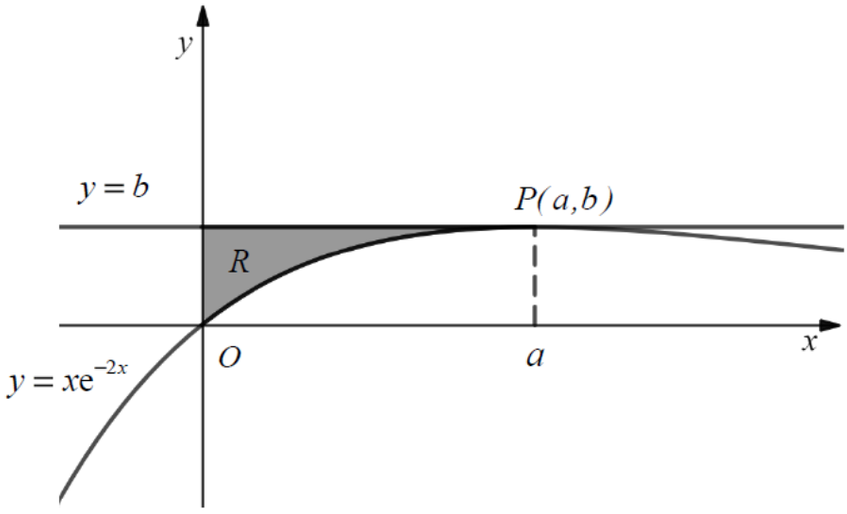

Figure 3

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

Solutions relying on calculator technology are not acceptable.

Figure 3 shows a sketch of part of the curve with equation

$$y = x\mathrm{e}^{-2x}$$

The point $P(a,b)$ is the turning point of the curve.

(a) Find the value of a and the exact value of b

(4)

The finite region R, shown shaded in Figure 3, is bounded by the curve, the line with equation $y = b$ and the y-axis.

(b) Find the exact area of R.

(5)

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Question 9 continued

Question 9 continued

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Question 9 continued

(Total for Question 9 is 9 marks)

10.

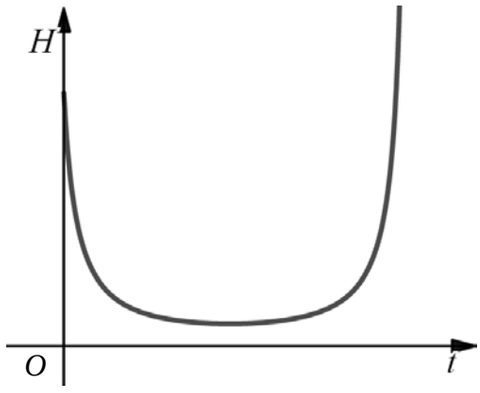

Figure 4

A scientist is studying the flight of seabirds in a colony.

She models the height above sea level, H metres, of one of the birds in the colony by the equation

$$H = \frac{140}{A + 45\sin 2t° - 28\cos 2t°} \qquad 0 \leqslant t \leqslant T$$

where t seconds is the time after the bird leaves its nest and A and T are constants.

Figure 4 is a sketch showing the graph of H against t.

Given that this seabird's nest is 20 m above sea level,

(a) find a complete equation for H.

(3)

Given that

$$45\sin 2t° - 28\cos 2t° \equiv 53\sin(2t - \alpha)° \qquad 0 < \alpha < 90$$

(b) find the value of α to one decimal place.

(2)

Find, according to this model,

(c) the minimum height of the sea bird above sea level giving your answer to the nearest cm,

(2)

(d) the limitation on the value of T.

(2)

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Question 10 continued

Question 10 continued

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Question 10 continued

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11.

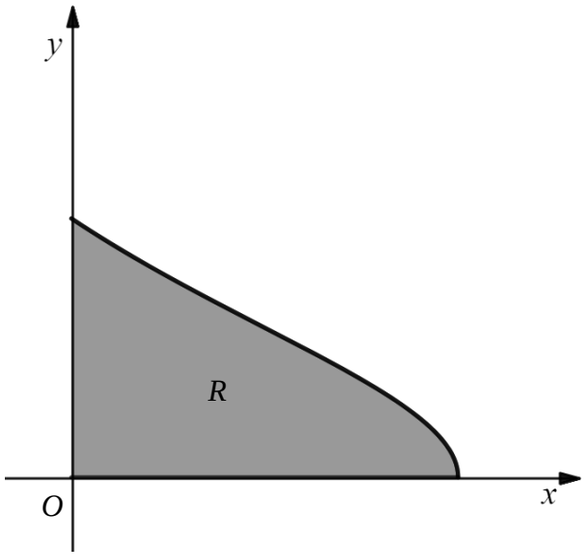

Figure 5

Figure 5 shows a sketch of the curve with parametric equations

$$x = 3\cos 2t, \quad y = 2\tan t \qquad 0 \leqslant t \leqslant \frac{\pi}{4}$$

The region R, shown shaded in Figure 5, is bounded by the curve, the x-axis and the y-axis.

(a) Show that the area of R is given by

$$\int_0^{\frac{\pi}{4}} 24\sin^2 t \, \mathrm{d}t$$

(4)

(b) Hence, using algebraic integration, find the exact area of R.

(3)

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Question 11 continued

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12.

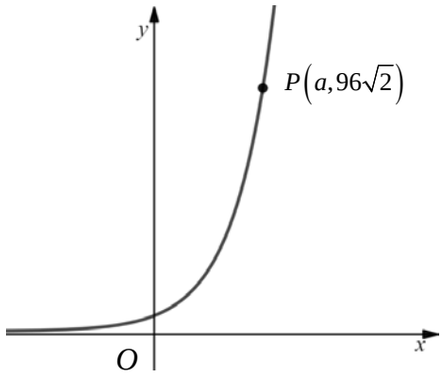

Figure 6

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

Solutions relying on calculator technology are not acceptable.

Figure 6 shows a sketch of part of the curve with equation

$$y = 3 \times 2^{2x}$$

The point $P\left(a,\ 96\sqrt{2}\right)$ lies on the curve.

(a) Find the exact value of a.

(3)

The curve with equation $y = 3 \times 2^{2x}$ meets the curve with equation $y = 6^{3-x}$ at the point Q.

(b) Show that the x coordinate of Q is

$$\frac{3 + 2\log_2 3}{3 + \log_2 3}$$

(5)

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Question 12 continued

(Total for Question 12 is 8 marks)

13. Prove by contradiction that there are no positive integers a and b with a odd such that

$$a + 2b = \sqrt{8ab}$$

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Question 13 continued

Question 13 continued

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