

Pearson Edexcel Level 3 GCE

Mathematics

Advanced Subsidiary

Paper 1: Pure Mathematics

Sample assessment material for first teaching
September 2017
Time: 2 hours

Paper Reference(s)

8MA0/01

You must have:

Mathematical Formulae and Statistical Tables
Calculator

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic 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** the 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 17 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Answer ALL questions. Write your answers in the spaces provided.

- 1.** The line l passes through the points $A (3, 1)$ and $B (4, -2)$.

Find an equation for l .

(3)

(Total for Question 1 is 3 marks)

2. The curve C has equation

$$y = 2x^2 - 12x + 16$$

Find the gradient of the curve at the point $P(5, 6)$.

(Solutions based entirely on graphical or numerical methods are not acceptable.)

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(Total for Question 2 is 4 marks)

3. Given that the point A has position vector $3\mathbf{i} - 7\mathbf{j}$ and the point B has position vector $8\mathbf{i} + 3\mathbf{j}$,

(a) find the vector \overline{AB} .

(2)

(b) Find $|\overline{AB}|$. Give your answer as a simplified surd.

(2)

(Total for Question 3 is 4 marks)

4.

$$f(x) = 4x^3 - 12x^2 + 2x - 6$$

(a) Use the factor theorem to show that $(x - 3)$ is a factor of $f(x)$. (2)

(b) Hence show that 3 is the only real root of the equation $f(x) = 0$ (4)

(Total for Question 4 is 6 marks)

5. Given that

$$f(x) = 2x + 3 + \frac{12}{x^2}, \quad x > 0$$

show that $\int_1^{2\sqrt{2}} f(x) dx = 16 + 3\sqrt{2}$

(5)

(Total for Question 5 is 5 marks)

7. (a) Find the first 3 terms, in ascending powers of x , of the binomial expansion of

$$\left(2 - \frac{x}{2}\right)^7, \text{ giving each term in its simplest form.}$$

(4)

(b) Explain how you would use your expansion to give an estimate for the value of 1.995^7

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Question 7 continued

Dotted lines for writing.

(Total for Question 7 is 5 marks)

8.

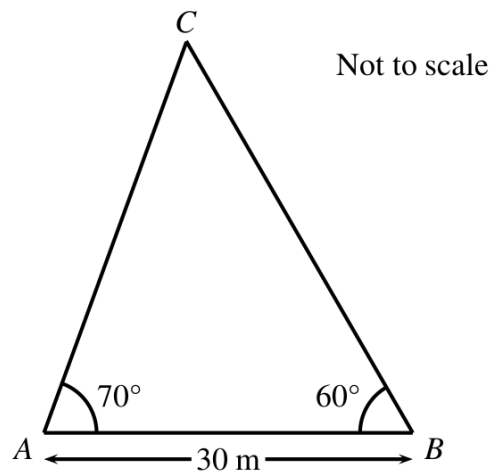


Figure 1

A triangular lawn is modelled by the triangle ABC , shown in Figure 1. The length AB is to be 30 m long.

Given that angle $BAC = 70^\circ$ and angle $ABC = 60^\circ$,

(a) calculate the area of the lawn to 3 significant figures.

(4)

(b) Why is your answer unlikely to be accurate to the nearest square metre?

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9. Solve, for $360^\circ \leq x < 540^\circ$,

$$12 \sin^2 x + 7 \cos x - 13 = 0$$

Give your answers to one decimal place.

(Solutions based entirely on graphical or numerical methods are not acceptable.)

(5)

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Question 9 continued

A series of 25 horizontal dotted lines for writing answers.

(Total for Question 9 is 5 marks)

10. The equation $kx^2 + 4kx + 3 = 0$, where k is a constant, has no real roots.

Prove that

$$0 \leq k < \frac{3}{4}$$

(4)

(Total for Question 10 is 4 marks)

11. (a) Prove that for all positive values of x and y

$$\sqrt{xy} \leq \frac{x+y}{2}$$

(2)

(b) Prove by counter example that this is not true when x and y are both negative.

(1)

(Total for Question 11 is 3 marks)

12. A student was asked to give the exact solution to the equation

$$2^{2x+4} - 9(2^x) = 0$$

The student's attempt is shown below:

$$2^{2x+4} - 9(2^x) = 0$$

$$2^{2x} + 2^4 - 9(2^x) = 0$$

$$\text{Let } 2^x = y$$

$$y^2 - 9y + 8 = 0$$

$$(y - 8)(y - 1) = 0$$

$$y = 8 \text{ or } y = 1$$

$$\text{So } x = 3 \text{ or } x = 0$$

(a) Identify the two errors made by the student.

(2)

(b) Find the exact solution to the equation.

(2)

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Question 12 continued

A series of 22 horizontal dotted lines for writing.

(Total for Question 12 is 4 marks)

13. (a) Factorise completely $x^3 + 10x^2 + 25x$

(2)

(b) Sketch the curve with equation

$$y = x^3 + 10x^2 + 25x$$

showing the coordinates of the points at which the curve cuts or touches the x -axis.

(2)

The point with coordinates $(-3, 0)$ lies on the curve with equation

$$y = (x+a)^3 + 10(x+a)^2 + 25(x+a)$$

where a is a constant.

(c) Find the two possible values of a .

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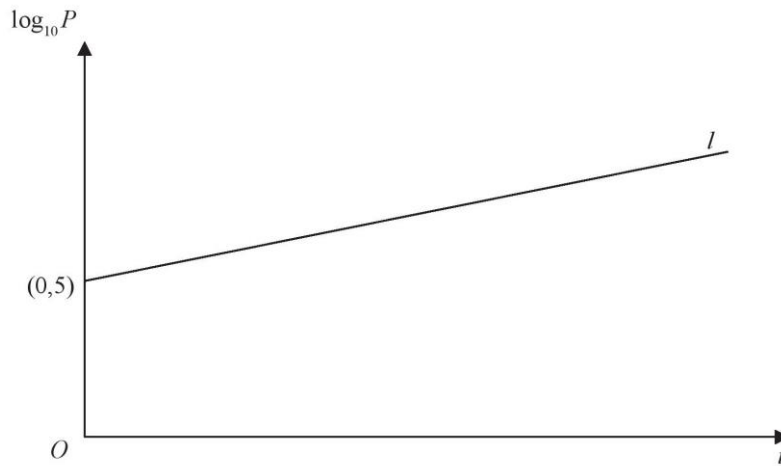


Figure 2

A town's population, P , is modelled by the equation $P = ab^t$, where a and b are constants and t is the number of years since the population was first recorded.

The line l shown in Figure 2 illustrates the linear relationship between t and $\log_{10} P$ for the population over a period of 100 years.

The line l meets the vertical axis at $(0, 5)$ as shown. The gradient of l is $\frac{1}{200}$.

- (a) Write down an equation for l . (2)
- (b) Find the value of a and the value of b . (4)
- (c) With reference to the model interpret
- (i) the value of the constant a ,
 - (ii) the value of the constant b (2)
- (d) Find
- (i) the population predicted by the model when $t = 100$, giving your answer to the nearest hundred thousand,
 - (ii) the number of years it takes the population to reach 200 000, according to the model. (3)
- (e) State two reasons why this may not be a realistic population model. (2)

15.

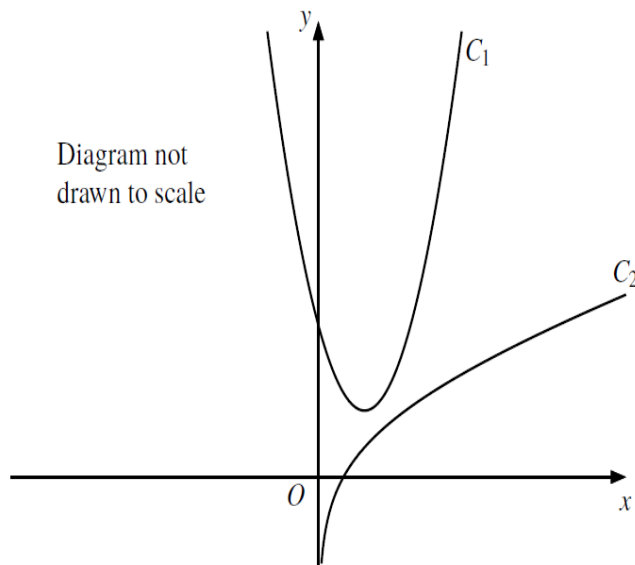


Figure 3

The curve C_1 , shown in Figure 3, has equation $y = 4x^2 - 6x + 4$.

The point $P\left(\frac{1}{2}, 2\right)$ lies on C_1

The curve C_2 , also shown in Figure 3, has equation $y = \frac{1}{2}x + \ln(2x)$.

The normal to C_1 at the point P meets C_2 at the point Q .

Find the exact coordinates of Q .

(Solutions based entirely on graphical or numerical methods are not acceptable.)

(8)

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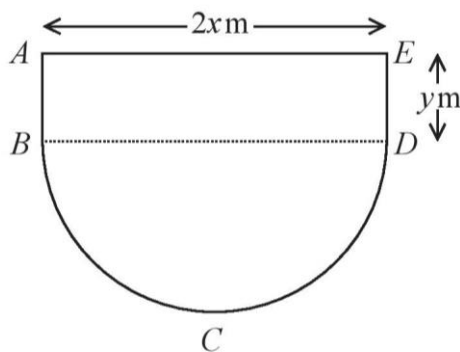


Figure 4

Figure 4 shows the plan view of the design for a swimming pool.

The shape of this pool $ABCDEA$ consists of a rectangular section $ABDE$ joined to a semicircular section BCD as shown in Figure 4.

Given that $AE = 2x$ metres, $ED = y$ metres and the area of the pool is 250 m^2 ,

(a) show that the perimeter, P metres, of the pool is given by

$$P = 2x + \frac{250}{x} + \frac{\pi x}{2} \tag{4}$$

(b) Explain why $0 < x < \sqrt{\frac{500}{\pi}}$ (2)

(c) Find the minimum perimeter of the pool, giving your answer to 3 significant figures. (4)

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17. A circle C with centre at $(-2, 6)$ passes through the point $(10, 11)$.

(a) Show that the circle C also passes through the point $(10, 1)$.

(3)

The tangent to the circle C at the point $(10, 11)$ meets the y axis at the point P
and the tangent to the circle C at the point $(10, 1)$ meets the y axis at the point Q .

(b) Show that the distance PQ is 58 explaining your method clearly.

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Question 17 continued

Dotted lines for writing.

(Total for Question 17 is 10 marks)

TOTAL FOR PAPER IS 100 MARKS