Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | Candidate Number

Wednesday 20 May 2020

Morning (Time: 2 hours 30 minutes) | Paper Reference **WMA01/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Core Mathematics C12

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

Total Marks

Candidates may use any calculator permitted 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 125.
- 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.

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1. (a) Solve, using algebra,

$$6x^3 + 5x^2 - 6x = 0$$

(3)

(b) Hence solve, for $0 \leqslant \theta < \pi$,

$$6\sin^3\theta + 5\sin^2\theta - 6\sin\theta = 0$$

giving your answers, as appropriate, to 3 significant figures.

(3)

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Question 1 continued

Q1

(Total 6 marks)

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2. Find

$$\int\left(15x^4 + \frac{4}{3x^3} - 4\right)\mathrm{d}x \qquad x > 0$$

writing each term in simplest form.

(4)

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Question 2 continued

(Total 4 marks)

Q2

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3. A sequence is defined by

$$u_1 = 5$$
$$u_{n+1} = ku_n + 2$$

where k is a non-zero constant.

(a) Find u_2 and u_3 in terms of k, simplifying your answers as appropriate.

(3)

Given that $u_3 = 2$

(b) find the value of $\sum_{n=1}^{3} u_n$

(3)

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Question 3 continued

Q3

(Total 6 marks)

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

Solutions relying on calculator technology are not acceptable.

(i) Given

$$\frac{8^y}{4^{2x}} = \frac{\sqrt{2}}{32}$$

find y in terms of x, giving your answer in simplest form.

(4)

(ii) Solve the equation

$$x\sqrt{3} = 4\sqrt{2} + x$$

writing your answer in the form $a\sqrt{b} + c\sqrt{d}$ where a, b, c and d are integers to be found.

(4)

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Question 4 continued

(Total 8 marks)

Q4

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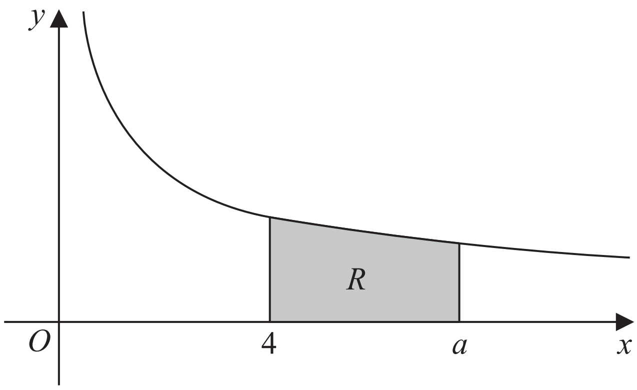

Figure 1

Figure 1 shows a sketch of the curve with equation

$$y = \frac{4}{\sqrt{x}} \qquad x > 0$$

The region R, shown shaded in Figure 1, is bounded by the curve, the line with equation $x = 4$, the x-axis and the line with equation $x = a$, where a is a constant greater than 4

Given that the area of R is 9

(a) find, in simplest form, the numerical value of

(i) $\displaystyle\int_4^a \frac{4}{\sqrt{3x}}\,dx$

(ii) $\displaystyle\int_1^a \frac{4}{\sqrt{x}}\,dx$

(5)

(b) find the exact value of a.

(4)

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Question 5 continued

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Question 5 continued

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Question 5 continued

Q5

(Total 9 marks)

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6. A curve has equation

$$y = x(x + 3)(x - 2)$$

(a) Find, in simplest form, $\frac{dy}{dx}$ **(3)**

(b) Hence find the range of values for x such that

$$\frac{dy}{dx} \geqslant 2$$

(4)

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Question 6 continued

Q6

(Total 7 marks)

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7. (i) Solve

$$3 \times \left(\frac{1}{2}\right)^{p-1} = 1.3$$

giving your answer to 3 decimal places.

(3)

(ii) Find the exact value of x for which

$$\log_4 2x + 2\log_4 x = 8$$

(3)

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Question 7 continued

Q7

(Total 6 marks)

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8. In a parallelogram *ABCD*,

- side *AB* has length 8.6 cm
- side *BC* has length 6 cm
- angle *CAB* is 23°

(a) Find possible sizes of angle *ABC*, giving each answer, in degrees, to one decimal place.

(4)

Given that angle *ABC* is obtuse, find

(b) the length of diagonal *AC*, in cm, to 2 decimal places,

(2)

(c) the area of the parallelogram *ABCD*, in cm^2, to 3 significant figures.

(2)

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Question 8 continued

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Question 8 continued

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Question 8 continued

Q8

(Total 8 marks)

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9. A curve C has equation

$$y = \frac{2}{x} + k$$

where k is a positive constant.

(a) Sketch a graph of the curve C.

Show clearly the coordinates of the point where the curve crosses the x-axis and state the equations of both asymptotes to the curve.

(4)

The straight line l has equation $y = 5 - 3x$

Given that l and C do not meet,

(b) find the range of possible values for k.

(5)

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Question 9 continued

Q9

(Total 9 marks)

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10. (a) Use the binomial expansion to find the first four terms, in ascending powers of x, of

$$\left(2 - \frac{1}{3}x\right)^9$$

giving each term in simplest form.

(5)

$$f(x) = \left(3 + \frac{a}{x}\right)\left(2 - \frac{1}{3}x\right)^9 \qquad \text{where } a \text{ is a constant}$$

Given that the coefficient of x in the series expansion of $f(x)$ is zero,

(b) find the value of a, writing the answer as a fully simplified fraction.

(3)

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Question 10 continued

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Question 10 continued

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Question 10 continued

(Total 8 marks)

Q10

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11. $f(x) = 13 + 3x + (x + 2)(x + k)^2$ where k is a constant

Given that $(x + 3)$ is a factor of $f(x)$,

(a) (i) show that a possible value of k is 5

(ii) find the other possible value of k.

(3)

Given that $k = 5$

(b) (i) write $f(x)$ as the product of two algebraic factors

(ii) show that the equation $f(x) = 0$ has only one real solution.

(6)

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Question 11 continued

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Question 11 continued

Q11

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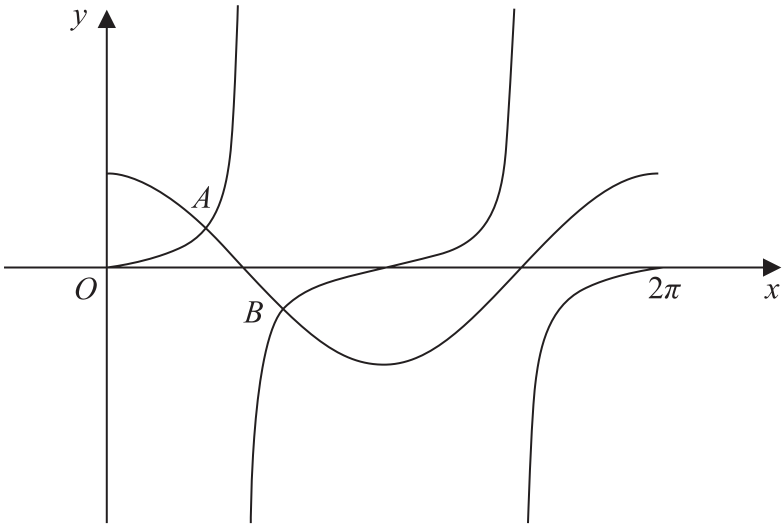

Figure 2

Figure 2 shows a sketch of the curve with equation $y = \tan x$, $0 < x \leqslant 2\pi$ and the curve with equation $y = 5\cos x$, $0 < x \leqslant 2\pi$

The curves meet at the points A and B shown in Figure 2.

(a) Show that the x coordinates of points A and B satisfy the equation

$$5\sin^2 x + \sin x - 5 = 0$$

(4)

(b) Hence find, to 2 decimal places, the x coordinate of A and the x coordinate of B.

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

(4)

(c) Find the number of solutions of the equation

(i) $\tan x = 5\cos x$ in the interval $0 < x \leqslant 21\pi$

(ii) $\tan 2x = 5\cos 2x$ in the interval $0 < x \leqslant 20\pi$

Explain briefly the reason for your answer in each case.

(4)

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Question 12 continued

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Question 12 continued

(Total 12 marks)

Q12

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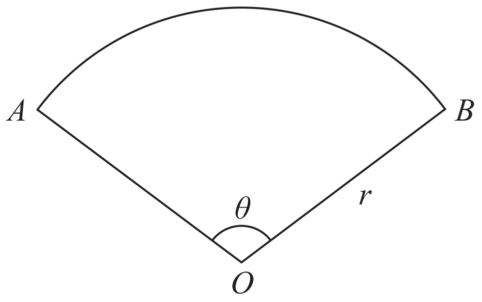

Figure 3

Figure 3 shows the plan view of a design for the stage at a concert.

The shape of this design is a sector AOB of a circle with centre O.

The radius of the sector is r m and the angle AOB is θ radians.

Given that the sector has area $200\,\text{m}^2$

(a) show that the perimeter of the sector, P m, is given by

$$P = 2r + \frac{400}{r}$$

(4)

(b) Using calculus, find the exact minimum possible value of P.

(5)

(c) Justify, by further use of calculus, that the value of P you have found in part (b) is the minimum.

(2)

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Question 13 continued

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Question 13 continued

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Question 13 continued

Q13

(Total 11 marks)

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14. (i) A car has five gears. Given that

- the maximum speed of the car in first gear is $22\,\text{km h}^{-1}$
- the maximum speed in each successive gear forms a geometric sequence
- the maximum speed of the car in fifth gear is $130\,\text{km h}^{-1}$

find the maximum speed of the car in second gear, giving your answer, in km h^{-1}, to one decimal place.

(4)

(ii) The first two terms of an arithmetic sequence are 208 and 207.2

Given that S_n is the sum to n terms,

(a) find the maximum value of S_n

(4)

(b) Hence or otherwise state the smallest value of N such that $S_N < 0$

(1)

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Question 14 continued

Q14

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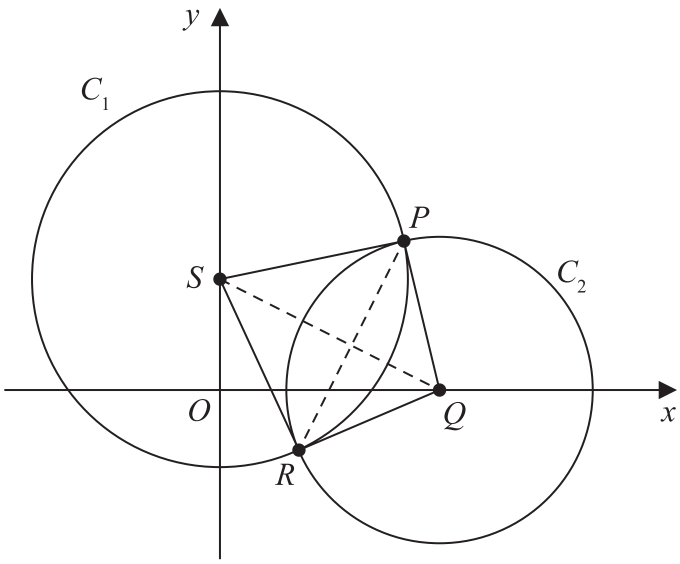

Figure 4

Figure 4 shows a sketch of

- the circle C_1 with equation $x^2 + (y - 3)^2 = 26$
- the circle C_2 with equation $(x - 6)^2 + y^2 = 17$

The points S and Q are the centres of C_1 and C_2 respectively.

(a) Find the length SQ, writing your answer as a fully simplified surd.

(3)

The circles meet at points P and R shown on Figure 4.

(b) Using algebra,

(i) show that the coordinates of the points P and R satisfy

$$y = 2x - 6$$

(ii) find the coordinates of point P and the coordinates of point R.

(7)

(c) Hence find the exact area of the kite $SPQR$.

(3)

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Question 15 continued

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Q15

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TOTAL FOR PAPER: 125 MARKS

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