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Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Core Mathematics C12

Advanced Subsidiary

Tuesday 13 January 2015 – Morning
Time: 2 hours 30 minutes

Paper Reference
WMA01/01

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

Total Marks

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. 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). Coloured pencils and highlighter pens must not be used.
- **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.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- 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.

Turn over ▶

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1. Simplify the following expressions fully.

(a) $(x^6)^{\frac{1}{3}}$

(1)

(b) $\sqrt{2}(x^3) \div \sqrt{\frac{32}{x^2}}$

(2)

Leave blank

2.

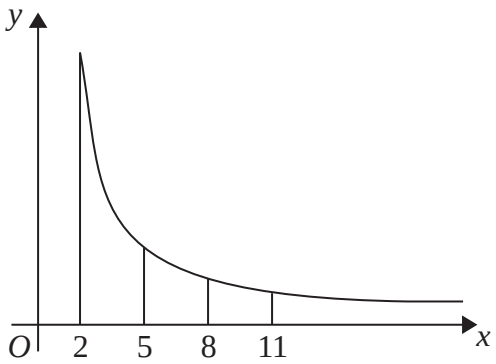

Figure 1

Figure 1 shows a sketch of part of the graph of $y = \dfrac{12}{\sqrt{(x^2 - 2)}}, \ x \geqslant 2$

The table below gives values of y rounded to 3 decimal places.

x	2	5	8	11
y	8.485	2.502	1.524	1.100

(a) Use the trapezium rule with all the values of y from the table to find an approximate value, to 2 decimal places, for

$$\int_2^{11} \frac{12}{\sqrt{(x^2 - 2)}} \mathrm{d}x$$

(4)

(b) Use your answer to part (a) to estimate a value for

$$\int_2^{11} \left(1 + \frac{6}{\sqrt{(x^2 - 2)}}\right) \mathrm{d}x$$

(3)

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Question 2 continued

Q2

(Total 7 marks)

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3.

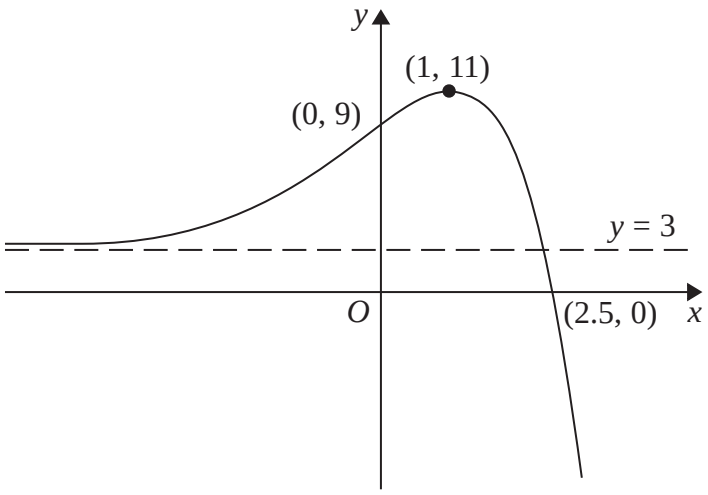

Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = f(x)$.
The curve crosses the coordinate axes at the points (2.5, 0) and (0, 9), has a stationary point at (1, 11), and has an asymptote $y = 3$

On **separate** diagrams, sketch the curve with equation

(a) $y = 3f(x)$

(3)

(b) $y = f(-x)$

(3)

On each diagram show clearly the coordinates of the points of intersection of the curve with the two coordinate axes, the coordinates of the stationary point, and the equation of the asymptote.

Leave blank

Question 3 continued

Q3

(Total 6 marks)

Leave blank

4. (a) Find the first 4 terms in ascending powers of x of the binomial expansion of

$$\left(2 + \frac{x}{4}\right)^{10}$$

giving each term in its simplest form.

(4)

(b) Use your expansion to find an estimated value for 2.025^{10}, stating the value of x which you have used and showing your working.

(3)

Leave blank

5. (a) Prove that the sum of the first n terms of an arithmetic series is given by the formula

$$S_n = \frac{n}{2}[2a + (n-1)d]$$

where a is the first term of the series and d is the common difference between the terms.

(4)

(b) Find the sum of the integers which are divisible by 7 and lie between 1 and 500

(3)

Leave blank

6. Given that

$$2\log_4(2x+3) = 1 + \log_4 x + \log_4(2x-1), \quad x > \frac{1}{2}$$

(a) show that

$$4x^2 - 16x - 9 = 0$$

(5)

(b) Hence solve the equation

$$2\log_4(2x+3) = 1 + \log_4 x + \log_4(2x-1), \quad x > \frac{1}{2}$$

(2)

Leave blank

7. The circle C has equation

$$x^2 + y^2 + 10x - 6y + 18 = 0$$

Find

(a) the coordinates of the centre of C,

(2)

(b) the radius of C.

(2)

The circle C meets the line with equation $x = -3$ at two points.

(c) Find the exact values for the y coordinates of these two points, giving your answers as fully simplified surds.

(4)

Leave blank

Question 7 continued

Q7

(Total 8 marks)

Leave blank

8. A sequence is defined by

$$u_1 = k$$
$$u_{n+1} = 3u_n - 12, \quad n \geqslant 1$$

where k is a constant.

(a) Write down fully simplified expressions for u_2, u_3 and u_4 in terms of k.

(4)

Given that $u_4 = 15$

(b) find the value of k,

(2)

(c) find $\sum_{i=1}^{4} u_i$, giving an exact numerical answer.

(3)

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9.

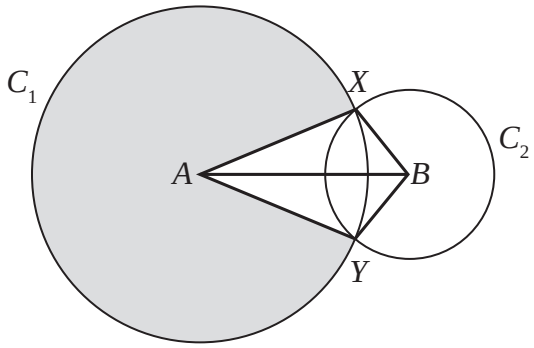

Figure 3

In Figure 3, the points A and B are the centres of the circles C_1 and C_2 respectively. The circle C_1 has radius 10 cm and the circle C_2 has radius 5 cm. The circles intersect at the points X and Y, as shown in the figure.

Given that the distance between the centres of the circles is 12 cm,

(a) calculate the size of the acute angle XAB, giving your answer in radians to 3 significant figures,

(2)

(b) find the area of the major sector of circle C_1, shown shaded in Figure 3,

(3)

(c) find the area of the kite $AYBX$.

(3)

Leave blank

Question 9 continued

Leave blank

10.

$$f(x) = 6x^3 + ax^2 + bx - 5$$

where a and b are constants.

When $f(x)$ is divided by $(x + 1)$ there is no remainder.

When $f(x)$ is divided by $(2x - 1)$ the remainder is -15

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

(5)

(b) Factorise $f(x)$ completely.

(4)

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11.

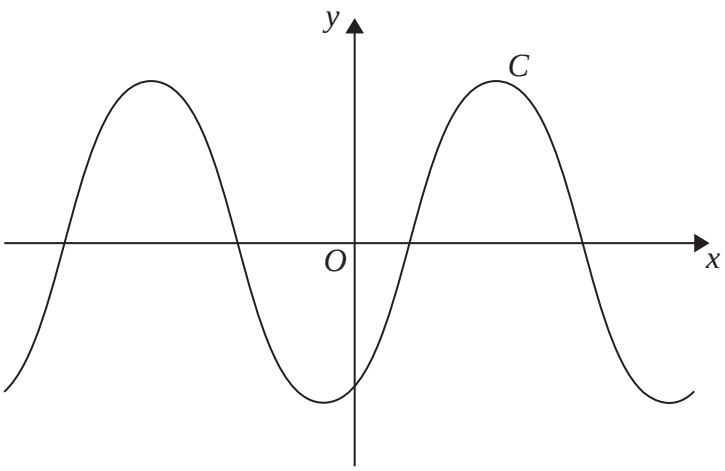

Figure 4

Figure 4 shows a sketch of the curve C with equation $y = \sin(x - 60°)$, $-360° \leqslant x \leqslant 360°$

(a) Write down the exact coordinates of the points at which C meets the two coordinate axes.

(3)

(b) Solve, for $-360° \leqslant x \leqslant 360°$,

$$4\sin(x - 60°) = \sqrt{6} - \sqrt{2}$$

showing each stage of your working.

(5)

Leave blank

Question 11 continued

Q11

(Total 8 marks)

Leave blank

12. A business is expected to have a yearly profit of £275 000 for the year 2016. The profit is expected to increase by 10% per year, so that the expected yearly profits form a geometric sequence with common ratio 1.1

(a) Show that the difference between the expected profit for the year 2020 and the expected profit for the year 2021 is £40 300 to the nearest hundred pounds.

(3)

(b) Find the first year for which the expected yearly profit is more than one million pounds.

(4)

(c) Find the total expected profits for the years 2016 to 2026 inclusive, giving your answer to the nearest hundred pounds.

(3)

Leave blank

Question 12 continued

Leave blank

13. The curve C has equation

$$y = 3x^2 - 4x + 2$$

The line l_1 is the normal to the curve C at the point $P(1, 1)$

(a) Show that l_1 has equation

$$x + 2y - 3 = 0$$

(5)

The line l_1 meets curve C again at the point Q.

(b) By solving simultaneous equations, determine the coordinates of the point Q.

(4)

Another line l_2 has equation $kx + 2y - 3 = 0$, where k is a constant.

(c) Show that the line l_2 meets the curve C once only when

$$k^2 - 16k + 40 = 0$$

(4)

(d) Find the two exact values of k for which l_2 is a tangent to C.

(2)

Leave blank

Question 13 continued

Leave blank

14. *In this question, solutions based entirely on graphical or numerical methods are not acceptable.*

(i) Solve, for $0 \leqslant x < 360°$,

$$3\sin x + 7\cos x = 0$$

Give each solution, in degrees, to one decimal place.

(4)

(ii) Solve, for $0 \leqslant \theta < 2\pi$,

$$10\cos^2\theta + \cos\theta = 11\sin^2\theta - 9$$

Give each solution, in radians, to 3 significant figures.

(6)

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Question 14 continued

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15.

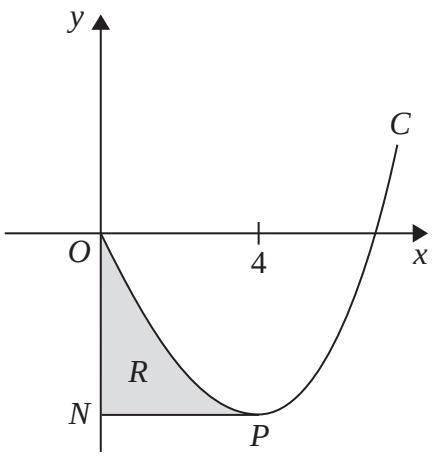

Figure 5

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

$$y = x^3 + 10x^{\frac{3}{2}} + kx, \qquad x \geqslant 0$$

where k is a constant.

(a) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$

(2)

The point P on the curve C is a minimum turning point.
Given that the x coordinate of P is 4

(b) show that $k = -78$

(2)

The line through P parallel to the x-axis cuts the y-axis at the point N.

The finite region R, shown shaded in Figure 5, is bounded by C, the y-axis and PN.

(c) Use integration to find the area of R.

(7)

Leave blank

Question 15 continued

Q15

(Total 11 marks)

TOTAL FOR PAPER: 125 MARKS

END