Write your name here

Surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number	Candidate Number

Core Mathematics C12
Advanced Subsidiary

Tuesday 12 January 2016 – 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.

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1. A sequence of numbers $u_1, u_2, u_3, \ldots$ satisfies

$$u_{n+1} = 2u_n - 6, \qquad n \geqslant 1$$

Given that $u_1 = 2$

(a) find the value of u_3

(2)

(b) evaluate $\sum_{i=1}^{4} u_i$

(3)

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Question 1 continued

Q1

(Total 5 marks)

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2. (i) Given that $\dfrac{49}{\sqrt{7}} = 7^a$, find the value of a.

(2)

(ii) Show that $\dfrac{10}{\sqrt{18} - 4} = 15\sqrt{2} + 20$

You must show all stages of your working.

(3)

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Question 2 continued

(Total 5 marks)

Q2

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3. Find, using calculus and showing each step of your working,

$$\int_1^4 \left(6x - 3 - \frac{2}{\sqrt{x}}\right) dx$$

(5)

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Question 3 continued

Q3

(Total 5 marks)

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4. The 4th term of an arithmetic sequence is 3 and the sum of the first 6 terms is 27

Find the first term and the common difference of this sequence.

(6)

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Question 4 continued

Q4

(Total 6 marks)

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5. (a) Sketch the graph of $y = \sin 2x, \quad 0 \leqslant x \leqslant \frac{3\pi}{2}$

Show the coordinates of the points where your graph crosses the x-axis.

(2)

The table below gives corresponding values of x and y, for $y = \sin 2x$.
The values of y are rounded to 3 decimal places where necessary.

x	0	$\frac{\pi}{12}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$
y	0	0.5	0.866	1

(b) Use the trapezium rule with all the values of y from the table to find an approximate value for

$$\int_0^{\frac{\pi}{4}} \sin 2x \, dx$$

(3)

P 4 6 9 5 7 A 0 1 0 5 2

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Question 5 continued

Q5

(Total 5 marks)

6. $$f(x) = x^3 + x^2 - 12x - 18$$

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

(2)

(b) Factorise $f(x)$.

(2)

(c) Hence find exact values for all the solutions of the equation $f(x) = 0$

(3)

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Question 6 continued

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Question 6 continued

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Question 6 continued

Q6

(Total 7 marks)

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7. (a) Find the first 4 terms, in ascending powers of x, of the binomial expansion of $(1 + kx)^8$, where k is a non-zero constant. Give each term in its simplest form.

(4)

Given that the coefficient of x^3 in this expansion is 1512

(b) find the value of k.

(3)

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Question 7 continued

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Question 7 continued

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Question 7 continued

Q7

(Total 7 marks)

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8. (a) Given that $7\sin x = 3\cos x$, find the exact value of $\tan x$.

(1)

(b) Hence solve for $0 \leqslant \theta < 360°$

$$7\sin(2\theta + 30°) = 3\cos(2\theta + 30°)$$

giving your answers to one decimal place.

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

(5)

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Question 8 continued

(Total 6 marks)

Q8

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9. The resident population of a city is 130 000 at the end of Year 1

A model predicts that the resident population of the city will increase by 2% each year, with the populations at the end of each year forming a geometric sequence.

(a) Show that the predicted resident population at the end of Year 2 is 132 600

(1)

(b) Write down the value of the common ratio of the geometric sequence.

(1)

The model predicts that Year N will be the first year which will end with the resident population of the city exceeding 260 000

(c) Show that

$$N > \frac{\log_{10} 2}{\log_{10} 1.02} + 1$$

(4)

(d) Find the value of N.

(1)

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Question 9 continued

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Question 9 continued

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Question 9 continued

(Total 7 marks)

Q9

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10. The curve C has equation

$$y = 12x^{\frac{5}{4}} - \frac{5}{18}x^2 - 1000, \qquad x > 0$$

(a) Find $\frac{dy}{dx}$

(2)

(b) Hence find the coordinates of the stationary point on C.

(5)

(c) Use $\frac{d^2y}{dx^2}$ to determine the nature of this stationary point.

(3)

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Question 10 continued

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Question 10 continued

Q10

(Total 10 marks)

11.

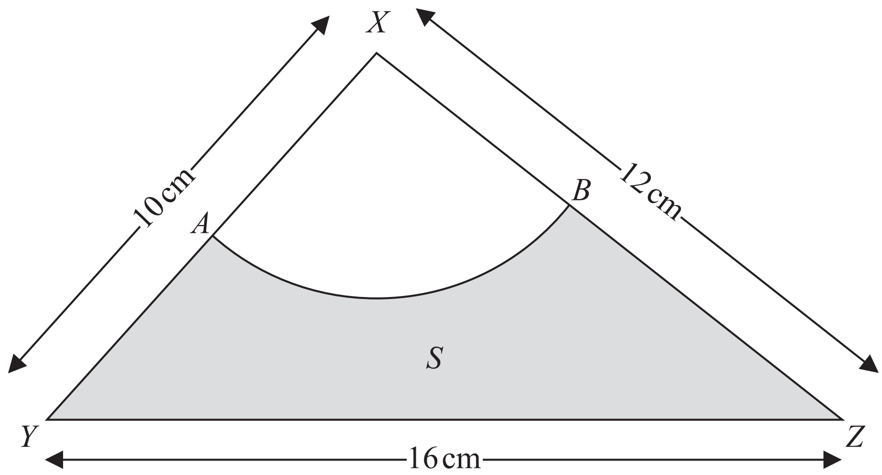

Figure 1

Figure 1 shows a triangle XYZ with $XY = 10$ cm, $YZ = 16$ cm and $ZX = 12$ cm.

(a) Find the size of the angle YXZ, giving your answer in radians to 3 significant figures.

(3)

The point A lies on the line XY and the point B lies on the line XZ and $AX = BX = 5$ cm. AB is the arc of a circle with centre X.

The shaded region S, shown in Figure 1, is bounded by the lines BZ, ZY, YA and the arc AB.

Find

(b) the perimeter of the shaded region to 3 significant figures,

(4)

(c) the area of the shaded region to 3 significant figures.

(4)

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Question 11 continued

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Question 11 continued

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Question 11 continued

Q11

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12.

$$\mathrm{f}(x) = \frac{(4 + 3\sqrt{x})^2}{x}, \qquad x > 0$$

(a) Show that $\mathrm{f}(x) = Ax^{-1} + Bx^{k} + C$, where A, B, C and k are constants to be determined.

(4)

(b) Hence find $\mathrm{f}'(x)$.

(2)

(c) Find an equation of the tangent to the curve $y = \mathrm{f}(x)$ at the point where $x = 4$

(4)

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Question 12 continued

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Question 12 continued

Q12

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13. The equation $k(3x^2 + 8x + 9) = 2 - 6x$, where k is a real constant, has no real roots.

(a) Show that k satisfies the inequality

$$11k^2 - 30k - 9 > 0$$

(4)

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

(4)

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Question 13 continued

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Question 13 continued

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Question 13 continued

Q13

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14. (i) Given that

$$\log_a x + \log_a 3 = \log_a 27 - 1, \text{ where } a \text{ is a positive constant}$$

find, in its simplest form, an expression for x in terms of a.

(4)

(ii) Solve the equation

$$(\log_5 y)^2 - 7(\log_5 y) + 12 = 0$$

showing each step of your working.

(4)

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Question 14 continued

Q14

(Total 8 marks)

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15. The points A and B have coordinates $(-8, -8)$ and $(12, 2)$ respectively.
AB is the diameter of a circle C.

(a) Find an equation for the circle C.

(6)

The point $(4, 8)$ also lies on C.

(b) Find an equation of the tangent to C at the point $(4, 8)$, giving your answer in the form $ax + by + c = 0$

(4)

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Question 15 continued

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Question 15 continued

Question 15 continued

(Total 10 marks)

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Q15

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16.

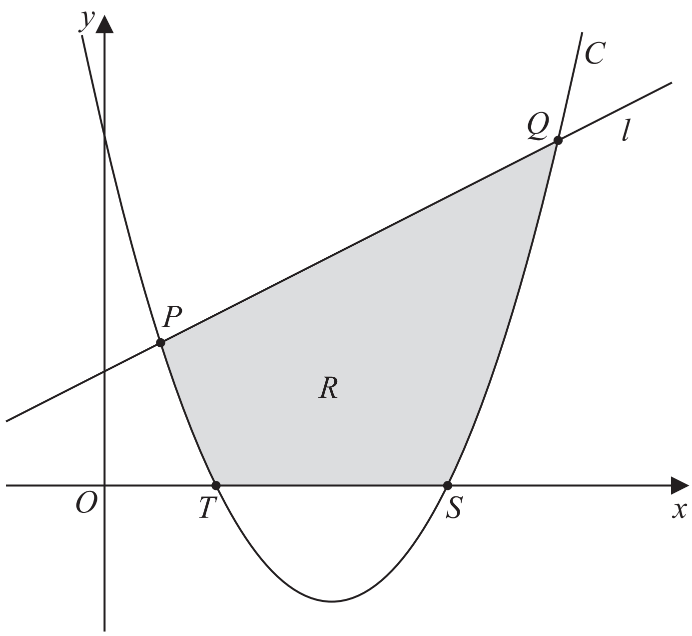

Figure 2

The straight line l with equation $y = \frac{1}{2}x + 1$ cuts the curve C, with equation $y = x^2 - 4x + 3$, at the points P and Q, as shown in Figure 2

(a) Use algebra to find the coordinates of the points P and Q.

(5)

The curve C crosses the x-axis at the points T and S.

(b) Write down the coordinates of the points T and S.

(2)

The finite region R is shown shaded in Figure 2. This region R is bounded by the line segment PQ, the line segment TS, and the arcs PT and SQ of the curve.

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

(8)

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Question 16 continued

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Question 16 continued

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Question 16 continued

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Question 16 continued

Q16

(Total 15 marks)

TOTAL FOR PAPER: 125 MARKS

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