Write your name here

Surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number	Candidate Number

Core Mathematics C12

Advanced Subsidiary

Wednesday 25 May 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. The first three terms in ascending powers of x in the binomial expansion of $(1 + px)^8$ are given by

$$1 + 12x + qx^2$$

where p and q are constants.

Find the value of p and the value of q.

(5)

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2. Find the range of values of x for which

(a) $4(x - 2) \leqslant 2x + 1$

(2)

(b) $(2x - 3)(x + 5) > 0$

(3)

(c) **both** $4(x - 2) \leqslant 2x + 1$ **and** $(2x - 3)(x + 5) > 0$

(1)

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3. Answer this question without a calculator, showing all your working and giving your answers in their simplest form.

(i) Solve the equation

$$4^{2x+1} = 8^{4x}$$

(3)

(ii) (a) Express

$$3\sqrt{18} - \sqrt{32}$$

in the form $k\sqrt{2}$, where k is an integer.

(2)

(b) Hence, or otherwise, solve

$$3\sqrt{18} - \sqrt{32} = \sqrt{n}$$

(2)

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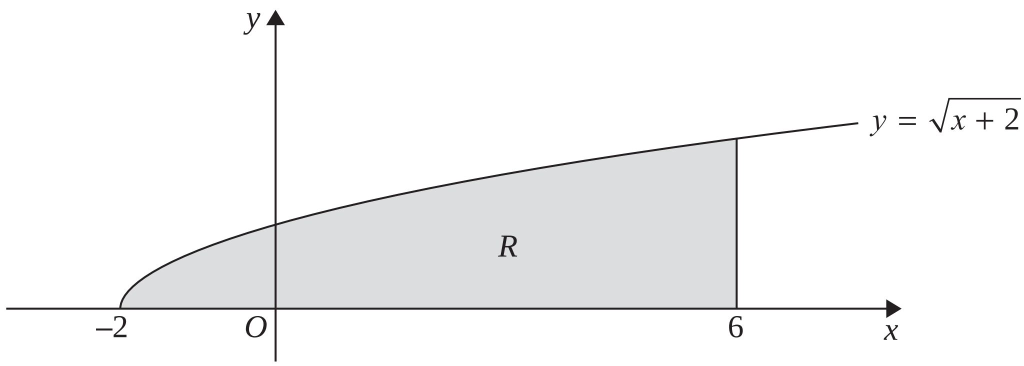

Figure 1

Figure 1 shows a sketch of part of the curve with equation $y = \sqrt{x+2}$, $x \geqslant -2$

The finite region R, shown shaded in Figure 1, is bounded by the curve, the x-axis and the line $x = 6$

The table below shows corresponding values of x and y for $y = \sqrt{x+2}$

x	–2	0	2	4	6
y	0	1.4142	2		2.8284

(a) Complete the table above, giving the missing value of y to 4 decimal places.

(1)

(b) Use the trapezium rule, with all of the values of y in the completed table, to find an approximate value for the area of R, giving your answer to 3 decimal places.

(3)

Use your answer to part (b) to find approximate values of

(c) (i) $\displaystyle\int_{-2}^{6} \frac{\sqrt{x+2}}{2}\,\mathrm{d}x$

(ii) $\displaystyle\int_{-2}^{6} \left(2 + \sqrt{x+2}\right)\mathrm{d}x$

(4)

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Question 4 continued

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5. (i)
$$U_{n+1} = \frac{U_n}{U_n - 3}, \quad n \geqslant 1$$

Given $U_1 = 4$, find

(a) U_2

(1)

(b) $\sum_{n=1}^{100} U_n$

(2)

(ii) Given

$$\sum_{r=1}^{n} (100 - 3r) < 0$$

find the least value of the positive integer n.

(3)

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Question 5 continued

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6. (a) Show that $\dfrac{x^2 - 4}{2\sqrt{x}}$ can be written in the form $Ax^p + Bx^q$, where A, B, p and q are constants to be determined.

(3)

(b) Hence find

$$\int \frac{x^2 - 4}{2\sqrt{x}}\,\mathrm{d}x, \quad x > 0$$

giving your answer in its simplest form.

(4)

P 4 6 7 1 3 R A 0 1 6 5 2

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7.

$$f(x) = 3x^3 + ax^2 + bx - 10, \text{ where } a \text{ and } b \text{ are constants.}$$

Given that $(x - 2)$ is a factor of $f(x)$,

(a) use the factor theorem to show that $2a + b = -7$

(2)

Given also that when $f(x)$ is divided by $(x + 1)$ the remainder is -36

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

(4)

$f(x)$ can be written in the form

$$f(x) = (x - 2)Q(x), \text{ where } Q(x) \text{ is a quadratic function.}$$

(c) (i) Find $Q(x)$.

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

You must justify your answer and show all your working.

(4)

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Question 7 continued

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8. In this question the angle θ is measured in degrees throughout.

(a) Show that the equation

$$\frac{5 + \sin\theta}{3\cos\theta} = 2\cos\theta, \qquad \theta \neq (2n + 1)90°, \quad n \in \mathbb{Z}$$

may be rewritten as

$$6\sin^2\theta + \sin\theta - 1 = 0$$

(3)

(b) Hence solve, for $-90° < \theta < 90°$, the equation

$$\frac{5 + \sin\theta}{3\cos\theta} = 2\cos\theta$$

Give your answers to one decimal place, where appropriate.

(4)

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9. The first term of a geometric series is 6 and the common ratio is 0.92

For this series, find

(a) (i) the 25^{th} term, giving your answer to 2 significant figures,

(ii) the sum to infinity.

(4)

The sum to n terms of this series is greater than 72

(b) Calculate the smallest possible value of n.

(4)

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10. The curve C has equation $y = \sin\left(x + \frac{\pi}{4}\right), \quad 0 \leqslant x \leqslant 2\pi$

(a) On the axes below, sketch the curve C.

(2)

(b) Write down the exact coordinates of all the points at which the curve C meets or intersects the x-axis and the y-axis.

(3)

(c) Solve, for $0 \leqslant x \leqslant 2\pi$, the equation

$$\sin\left(x + \frac{\pi}{4}\right) = \frac{\sqrt{3}}{2}$$

giving your answers in the form $k\pi$, where k is a rational number.

(4)

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Question 10 continued

11.

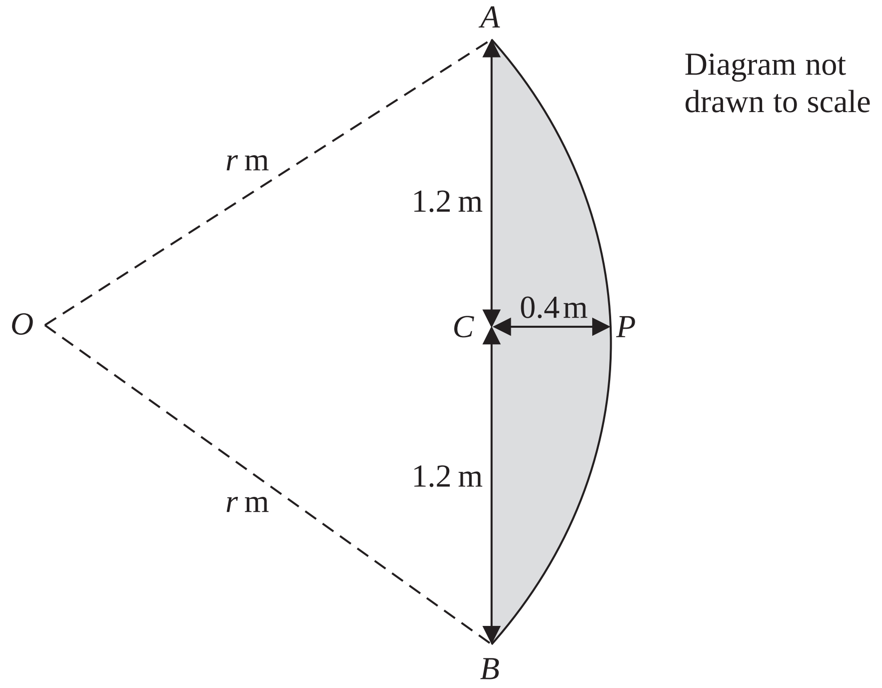

Figure 2

Figure 2 shows the design for a sail *APBCA*.

The curved edge *APB* of the sail is an arc of a circle centre *O* and radius *r* m.

The straight edge *ACB* is a chord of the circle.

The height *AB* of the sail is 2.4 m.

The maximum width *CP* of the sail is 0.4 m.

(a) Show that $r = 2$

(2)

(b) Show, to 4 decimal places, that angle *AOB* = 1.2870 radians.

(2)

(c) Hence calculate the area of the sail, giving your answer, in m^2, to 3 decimal places.

(4)

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Question 11 continued

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12.

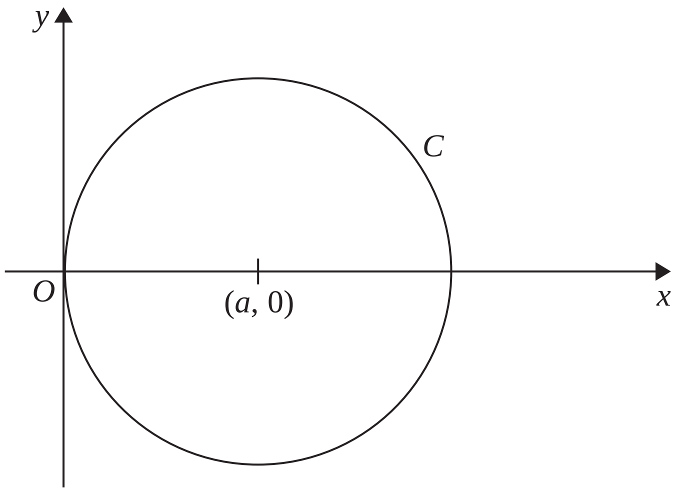

Figure 3

Figure 3 shows a circle C

C touches the y-axis and has centre at the point $(a, 0)$ where a is a positive constant.

(a) Write down an equation for C in terms of a

(2)

Given that the point $P(4, -3)$ lies on C,

(b) find the value of a

(3)

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13. (a) Show that the equation

$$2\log_2 y = 5 - \log_2 x \qquad x > 0, y > 0$$

may be written in the form $y^2 = \dfrac{k}{x}$ where k is a constant to be found.

(3)

(b) Hence, or otherwise, solve the simultaneous equations

$$2\log_2 y = 5 - \log_2 x$$

$$\log_x y = -3$$

for $x > 0, y > 0$

(5)

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Question 13 continued

P 4 6 7 1 3 R A 0 3 7 5 2

14.

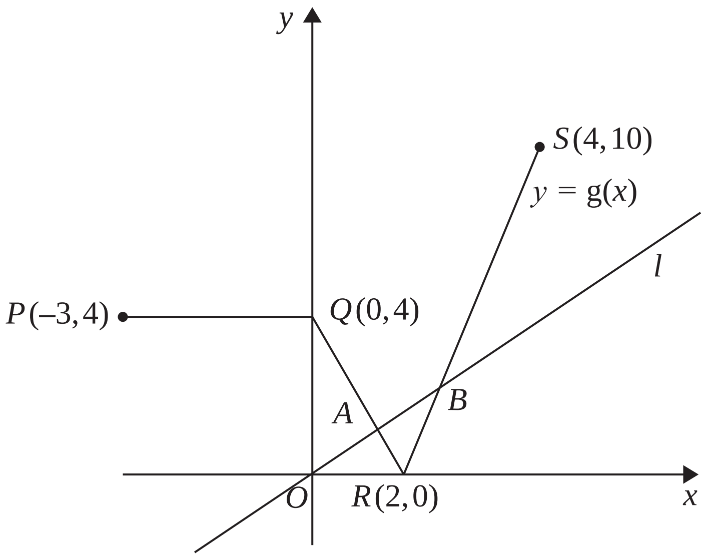

Figure 4

Figure 4 shows a sketch of the graph of $y = \mathrm{g}(x)$, $-3 \leqslant x \leqslant 4$ and part of the line l with equation $y = \frac{1}{2}x$

The graph of $y = \mathrm{g}(x)$ consists of three line segments, from $P(-3, 4)$ to $Q(0, 4)$, from $Q(0, 4)$ to $R(2, 0)$ and from $R(2, 0)$ to $S(4, 10)$.

The line l intersects $y = \mathrm{g}(x)$ at the points A and B as shown in Figure 4.

(a) Use algebra to find the x coordinate of the point A and the x coordinate of the point B.

Show each step of your working and give your answers as exact fractions.

(6)

(b) Sketch the graph with equation

$$y = \frac{3}{2}\mathrm{g}(x), \quad -3 \leqslant x \leqslant 4$$

On your sketch show the coordinates of the points to which P, Q, R and S are transformed.

(2)

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Question 14 continued

15.

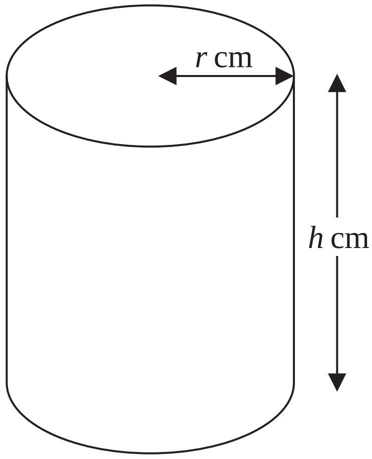

Figure 5

Figure 5 shows a design for a water barrel.

It is in the shape of a right circular cylinder with height h cm and radius r cm.

The barrel has a base but has no lid, is open at the top and is made of material of negligible thickness.

The barrel is designed to hold 60 000 cm^3 of water when full.

(a) Show that the total external surface area, S cm^2, of the barrel is given by the formula

$$S = \pi r^2 + \frac{120\,000}{r}$$

(3)

(b) Use calculus to find the minimum value of S, giving your answer to 3 significant figures.

(6)

(c) Justify that the value of S you found in part (b) is a minimum.

(2)

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Question 15 continued

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16.

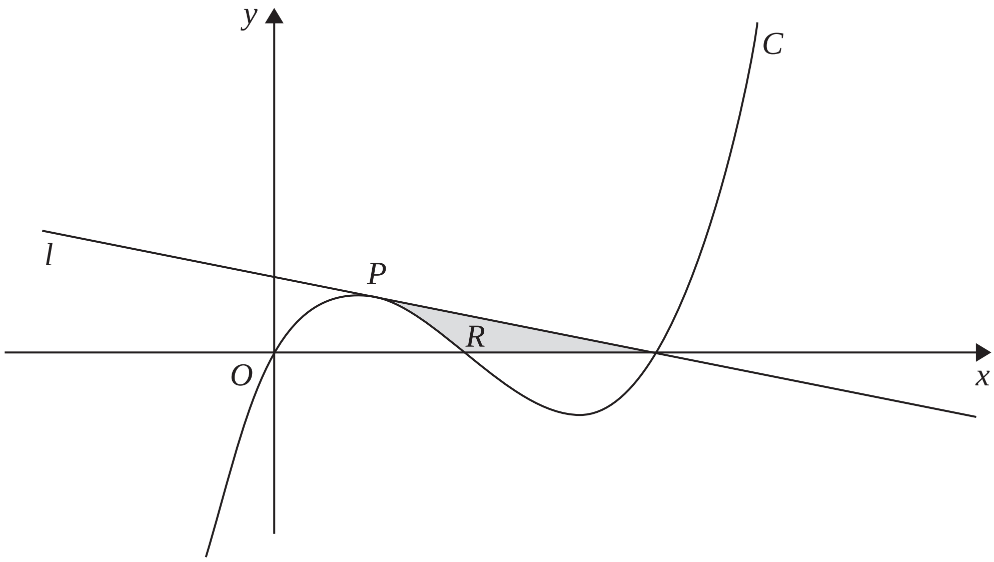

Figure 6

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

$$y = x(x - 1)(x - 2)$$

The point P lies on C and has x coordinate $\frac{1}{2}$

The line l, as shown on Figure 6, is the tangent to C at P.

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

(2)

(b) Use part (a) to find an equation for l in the form $ax + by = c$, where a, b and c are integers.

(4)

The finite region R, shown shaded in Figure 6, is bounded by the line l, the curve C and the x-axis.

The line l meets the curve again at the point (2, 0)

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

(6)

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Question 16 continued

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