Write your name here

| Surname | Other names |
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**Pearson Edexcel**
**International**
**Advanced Level**

Centre Number | | | | | |

Candidate Number | | | | |

# Core Mathematics C12

## Advanced Subsidiary

Tuesday 9 January 2018 – 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.** Given that

$$y = \frac{2x^{\frac{2}{3}} + 3}{6}, \quad x > 0$$

find, in the simplest form,

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

**(2)**

(b) $\int y \, dx$

**(3)**

Leave blank

**Question 1 continued**

**Q1**

**(Total 5 marks)**

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**2.** A sequence is defined by

$$u_1 = 1$$
$$u_{n+1} = 2 - 3u_n \quad n \geqslant 1$$

(a) Find the value of $u_2$ and the value of $u_3$

**(2)**

(b) Calculate the value of $\sum_{r=1}^{4}(r - u_r)$

**(3)**

Leave blank

**Question 2 continued**

**Q2**

**(Total 5 marks)**

Leave blank

**3.** Simplify fully

(a) $\left(3x^{\frac{1}{2}}\right)^4$

**(2)**

(b) $\dfrac{2y^7 \times (4y)^{-2}}{3y}$

**(2)**

Leave blank

**Question 3 continued**

**Q3**

**(Total 4 marks)**

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**4.** The equation

$$(p - 2)x^2 + 8x + (p + 4) = 0, \quad \text{where } p \text{ is a constant}$$

has no real roots.

(a) Show that $p$ satisfies $p^2 + 2p - 24 > 0$

**(3)**

(b) Hence find the set of possible values of $p$.

**(4)**

Leave blank

**Question 4 continued**

**Q4**

**(Total 7 marks)**

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

(i) Solve, for $0 < \theta < \frac{\pi}{2}$

$$5\sin 3\theta - 7\cos 3\theta = 0$$

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

**(5)**

(ii) Solve, for $0 < x < 360°$

$$9\cos^2 x + 5\cos x = 3\sin^2 x$$

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

**(6)**

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**Question 5 continued**

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**Question 5 continued**

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**Question 5 continued**

**Q5**

**(Total 11 marks)**

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**6.**

$$f(x) = ax^3 - 8x^2 + bx + 6$$

where $a$ and $b$ are constants.

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

When $f(x)$ is divided by $(x - 2)$ the remainder is $-12$

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

**(5)**

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

**(4)**

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**Question 6 continued**

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**Question 6 continued**

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**Question 6 continued**

**Q6**

**(Total 9 marks)**

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**7.**

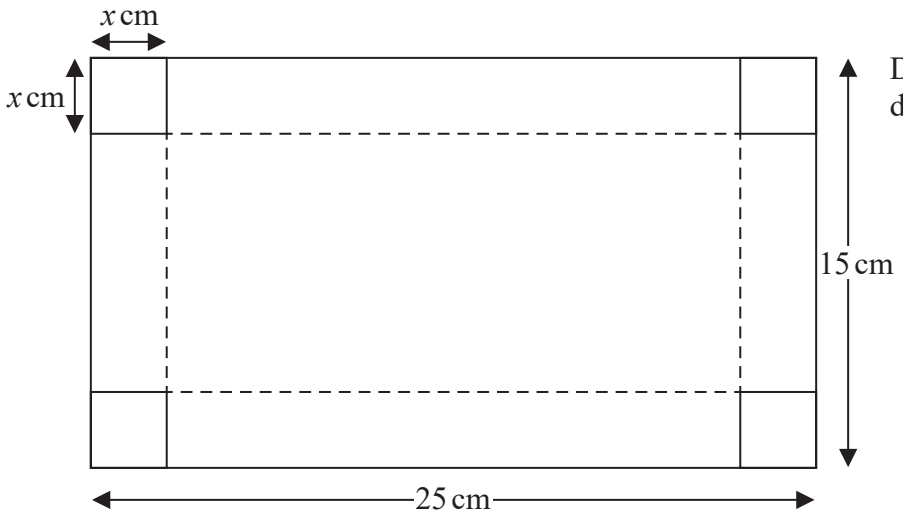


**Figure 1**

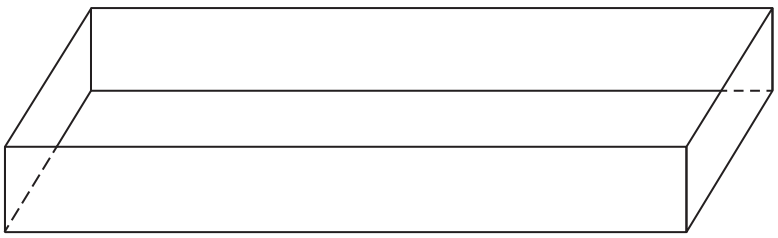

**Figure 2**

Figure 1 shows a rectangular sheet of metal of negligible thickness, which measures 25 cm by 15 cm. Squares of side $x$ cm are cut from each corner of the sheet and the remainder is folded along the dotted lines to make an open cuboid box, as shown in Figure 2.

(a) Show that the volume, $V$ cm$^3$, of the box is given by

$$V = 4x^3 - 80x^2 + 375x$$

**(2)**

(b) Use calculus to find the value of $x$, to 3 significant figures, for which the volume of the box is a maximum.

**(4)**

(c) Justify that this value of $x$ gives a maximum value for $V$.

**(2)**

(d) Find, to 3 significant figures, the maximum volume of the box.

**(2)**

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**Question 7 continued**

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**Question 7 continued**

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**Question 7 continued**

**(Total 10 marks)**

**Q7**

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**8.**

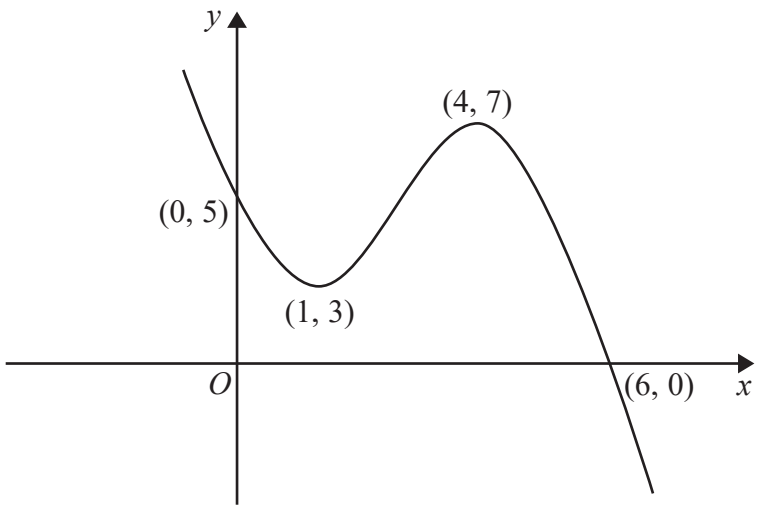


**Figure 3**

Figure 3 shows a sketch of the curve with equation $y = f(x), \ x \in \mathbb{R}$.

The curve crosses the $y$-axis at the point (0, 5) and crosses the $x$-axis at the point (6, 0).

The curve has a minimum point at (1, 3) and a maximum point at (4, 7).

On separate diagrams, sketch the curve with equation

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

**(3)**

(b) $y = f(2x)$

**(3)**

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

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**Question 8 continued**

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**Question 8 continued**

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**Question 8 continued**

**Q8**

**(Total 6 marks)**

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**9.** The first term of a geometric series is 20 and the common ratio is 0.9

(a) Find the value of the fifth term.

**(2)**

(b) Find the sum of the first 8 terms, giving your answer to one decimal place.

**(2)**

Given that $S_\infty - S_N < 0.04$, where $S_N$ is the sum of the first $N$ terms of this series,

(c) show that $0.9^N < 0.0002$

**(4)**

(d) Hence find the smallest possible value of $N$.

**(2)**

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**Question 9 continued**

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**Question 9 continued**

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**Question 9 continued**

**(Total 10 marks)**

**Q9**

Leave blank

**10.** (i) Use the laws of logarithms to solve the equation

$$3\log_8 2 + \log_8(7 - x) = 2 + \log_8 x$$

**(5)**

(ii) Using algebra, find, in terms of logarithms, the exact value of $y$ for which

$$3^{2y} + 3^{y+1} = 10$$

**(5)**

Leave blank

**Question 10 continued**

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**Question 10 continued**

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**Question 10 continued**

**Q10**

**(Total 10 marks)**

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**11.** The circle $C$ has equation

$$x^2 + y^2 - 8x - 10y + 16 = 0$$

The centre of $C$ is at the point $T$.

(a) Find

(i) the coordinates of the point $T$,

(ii) the radius of the circle $C$.

**(4)**

The point $M$ has coordinates (20, 12).

(b) Find the exact length of the line $MT$.

**(2)**

Point $P$ lies on the circle $C$ such that the tangent at $P$ passes through the point $M$.

(c) Find the exact area of triangle $MTP$, giving your answer as a simplified surd.

**(3)**

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**Question 11 continued**

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**Question 11 continued**

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**Question 11 continued**

**Q11**

**(Total 9 marks)**

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**12.** The line $l_1$ has equation $x + 3y - 11 = 0$

The point $A$ and the point $B$ lie on $l_1$

Given that $A$ has coordinates $(-1, p)$ and $B$ has coordinates $(q, 2)$, where $p$ and $q$ are integers,

(a) find the value of $p$ and the value of $q$,

**(2)**

(b) find the length of $AB$, giving your answer as a simplified surd.

**(2)**

The line $l_2$ is perpendicular to $l_1$ and passes through the midpoint of $AB$.

(c) Find an equation for $l_2$ giving your answer in the form $y = mx + c$, where $m$ and $c$ are constants to be found.

**(5)**

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**Question 12 continued**

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**Question 12 continued**

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**Question 12 continued**

**Q12**

**(Total 9 marks)**

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**13.**

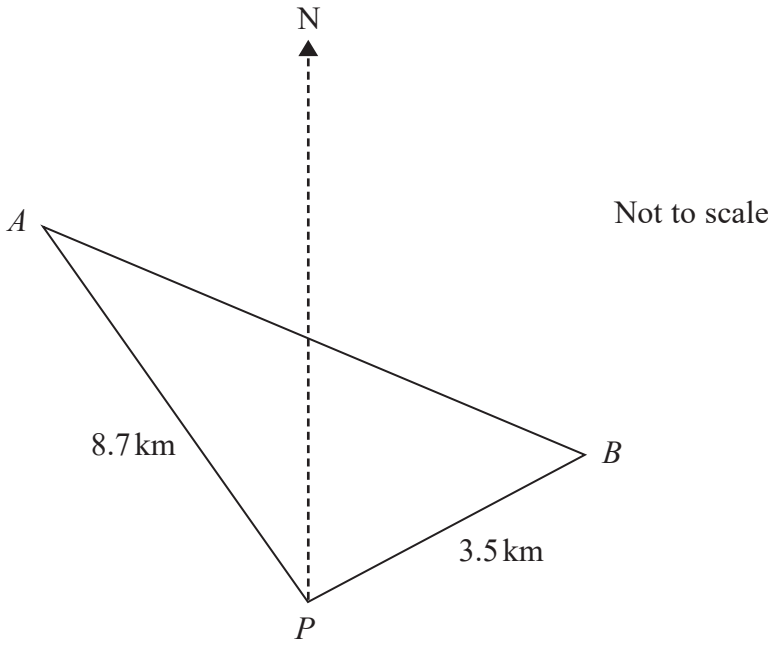


**Figure 4**

Figure 4 shows the position of two stationary boats, $A$ and $B$, and a port $P$ which are assumed to be in the same horizontal plane.

Boat $A$ is 8.7 km on a bearing of 314° from port $P$.

Boat $B$ is 3.5 km on a bearing of 052° from port $P$.

(a) Show that angle $APB$ is 98°

**(1)**

(b) Find the distance of boat $B$ from boat $A$, giving your answer to one decimal place.

**(2)**

(c) Find the bearing of boat $B$ from boat $A$, giving your answer to the nearest degree.

**(4)**

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**Question 13 continued**

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**Question 13 continued**

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**Question 13 continued**

**Q13**

**(Total 7 marks)**

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**14.**

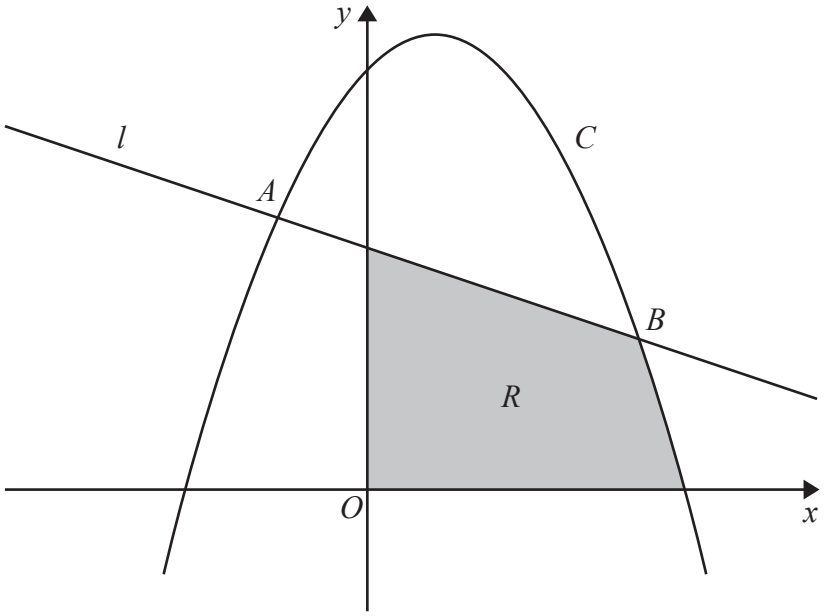


**Figure 5**

Figure 5 shows a sketch of part of the line $l$ with equation $y = 8 - x$ and part of the curve $C$ with equation $y = 14 + 3x - 2x^2$

The line $l$ and the curve $C$ intersect at the point $A$ and the point $B$ as shown.

(a) Use algebra to find the coordinates of $A$ and the coordinates of $B$.

**(5)**

The region $R$, shown shaded in Figure 5, is bounded by the coordinate axes, the line $l$, and the curve $C$.

(b) Use algebraic integration to calculate the exact area of $R$.

**(8)**

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**Question 14 continued**

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**Question 14 continued**

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**Question 14 continued**

**Q14**

**(Total 13 marks)**

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**15.** The binomial expansion, in ascending powers of $x$, of $(1 + kx)^n$ is

$$1 + 36x + 126kx^2 + ...$$

where $k$ is a non-zero constant and $n$ is a positive integer.

(a) Show that $nk(n - 1) = 252$

**(2)**

(b) Find the value of $k$ and the value of $n$.

**(5)**

(c) Using the values of $k$ and $n$, find the coefficient of $x^3$ in the binomial expansion of $(1 + kx)^n$

**(3)**

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**Question 15 continued**

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**Question 15 continued**

**Q15**

**(Total 10 marks)**

**TOTAL FOR PAPER: 125 MARKS**

**END**