Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Core Mathematics C12

Advanced Subsidiary

Monday 19 May 2014 – 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.

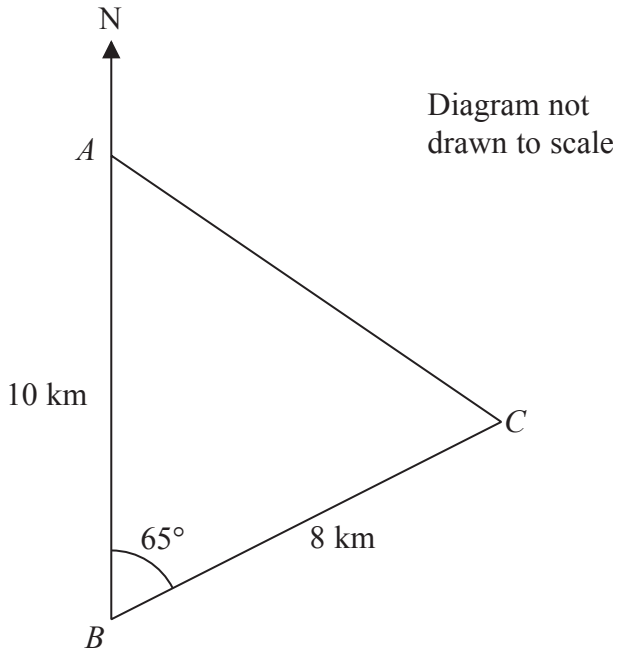

Figure 1

Figure 1 shows the position of three stationary fishing boats *A*, *B* and *C*, which are assumed to be in the same horizontal plane.

Boat *A* is 10 km due north of boat *B*.

Boat *C* is 8 km on a bearing of 065° from boat *B*.

(a) Find the distance of boat *C* from boat *A*, giving your answer to the nearest 10 metres.

(3)

(b) Find the bearing of boat *C* from boat *A*, giving your answer to one decimal place.

(3)

Leave blank

Question 1 continued

Q1

(Total 6 marks)

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2. Without using your calculator, solve

$$x\sqrt{27} + 21 = \frac{6x}{\sqrt{3}}$$

Write your answer in the form $a\sqrt{b}$ where a and b are integers.

You must show all stages of your working.

(4)

Leave blank

Question 2 continued

Q2

(Total 4 marks)

Leave blank

3. Solve, giving each answer to 3 significant figures, the equations

(a) $4^a = 20$

(2)

(b) $3 + 2\log_2 b = \log_2(30b)$

(5)

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

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Question 3 continued

Q3

(Total 7 marks)

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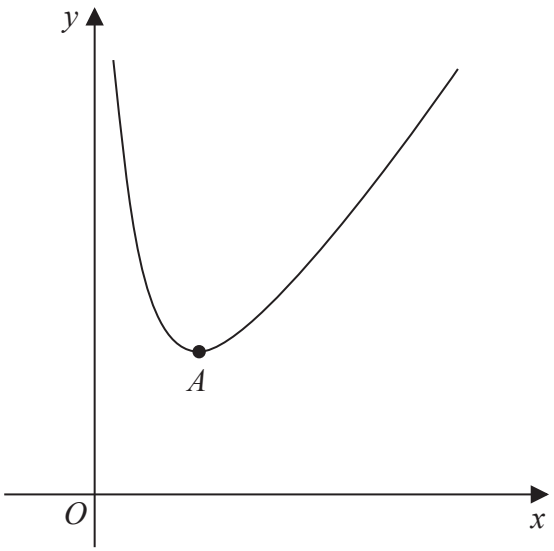

Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = f(x)$ where

$$f(x) = x^2 + \frac{16}{x}, \quad x > 0$$

The curve has a minimum turning point at A.

(a) Find $f'(x)$.

(2)

(b) Hence find the coordinates of A.

(4)

(c) Use your answer to part (b) to write down the turning point of the curve with equation

(i) $y = f(x + 1)$,

(ii) $y = \frac{1}{2} f(x)$.

(2)

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Question 4 continued

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Question 4 continued

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Question 4 continued

Q4

(Total 8 marks)

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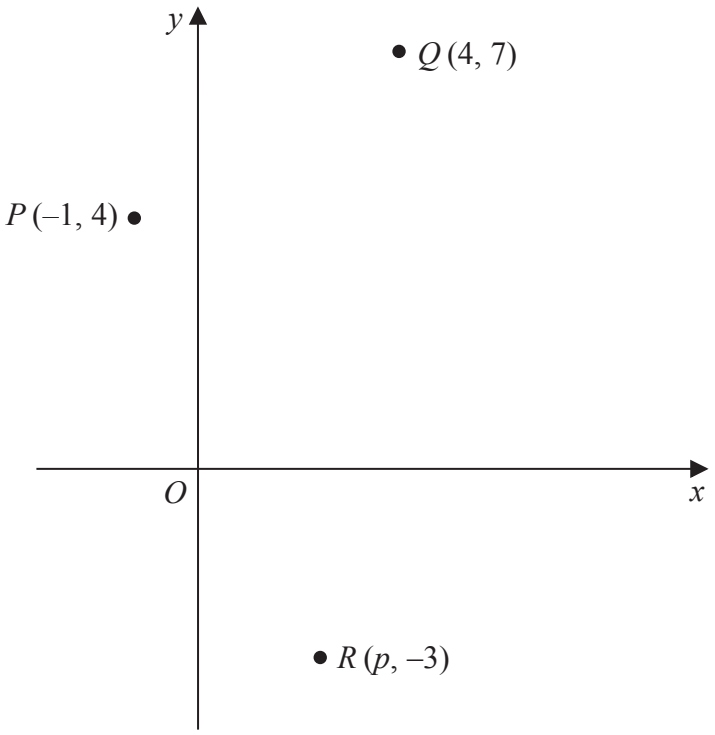

Figure 3

Figure 3 shows the points P, Q and R.

Points P and Q have coordinates $(-1, 4)$ and $(4, 7)$ respectively.

(a) Find an equation for the straight line passing through points P and Q.

Give your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(4)

The point R has coordinates $(p, -3)$, where p is a positive constant.

Given that angle $QPR = 90°$,

(b) find the value of p.

(3)

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Q5

(Total 7 marks)

Leave blank

6. (a) Show that

$$\frac{\cos^2 x - \sin^2 x}{1 - \sin^2 x} \equiv 1 - \tan^2 x, \qquad x \neq (2n+1)\frac{\pi}{2},\ n \in \mathbb{Z}$$

(2)

(b) Hence solve, for $0 \leqslant x < 2\pi$,

$$\frac{\cos^2 x - \sin^2 x}{1 - \sin^2 x} + 2 = 0$$

Give your answers in terms of π.

(5)

Leave blank

Question 6 continued

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Question 6 continued

Leave blank

Question 6 continued

Q6

(Total 7 marks)

Leave blank

7. (i) A curve with equation $y = f(x)$ passes through the point (2, 3).

Given that

$$f'(x) = \frac{4}{x^3} + 2x - 1$$

find the value of f(1).

(5)

(ii) Given that

$$\int_1^4 (3\sqrt{x} + A)\,dx = 21$$

find the exact value of the constant A.

(5)

Leave blank

Question 7 continued

Leave blank

Question 7 continued

Leave blank

Question 7 continued

Q7

(Total 10 marks)

Leave blank

8. Given that

$$1 + 12x + 70x^2 + \ldots$$

is the binomial expansion, in ascending powers of x of $(1 + bx)^n$, where $n \in \mathbb{N}$ and b is a constant,

(a) show that $nb = 12$

(1)

(b) find the values of the constants b and n.

(6)

Leave blank

Question 8 continued

Leave blank

Question 8 continued

Leave blank

Question 8 continued

Q8

(Total 7 marks)

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9. (i) Find the value of $\sum_{r=1}^{20}(3+5r)$

(3)

(ii) Given that $\sum_{r=0}^{\infty}\frac{a}{4^r}=16$, find the value of the constant a.

(4)

Leave blank

Question 9 continued

Q9

(Total 7 marks)

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10. The equation

$$kx^2 + 4x + k = 2, \text{ where } k \text{ is a constant,}$$

has two distinct real solutions for x.

(a) Show that k satisfies

$$k^2 - 2k - 4 < 0$$

(4)

(b) Hence find the set of all possible values of k.

(3)

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Question 10 continued

Q10

(Total 7 marks)

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11.

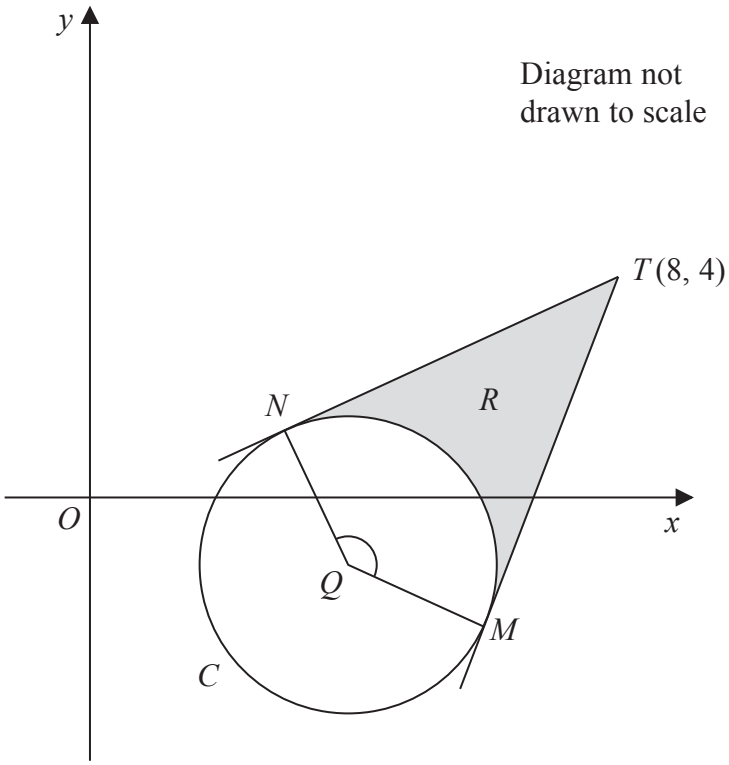

Figure 4

Figure 4 shows a sketch of the circle C with centre Q and equation

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

(a) Find

(i) the coordinates of Q,

(ii) the exact value of the radius of C.

(5)

The tangents to C from the point T (8, 4) meet C at the points M and N, as shown in Figure 4.

(b) Show that the obtuse angle MQN is 2.498 radians to 3 decimal places.

(5)

The region R, shown shaded in Figure 4, is bounded by the tangent TN, the minor arc NM, and the tangent MT.

(c) Find the area of region R.

(5)

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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.

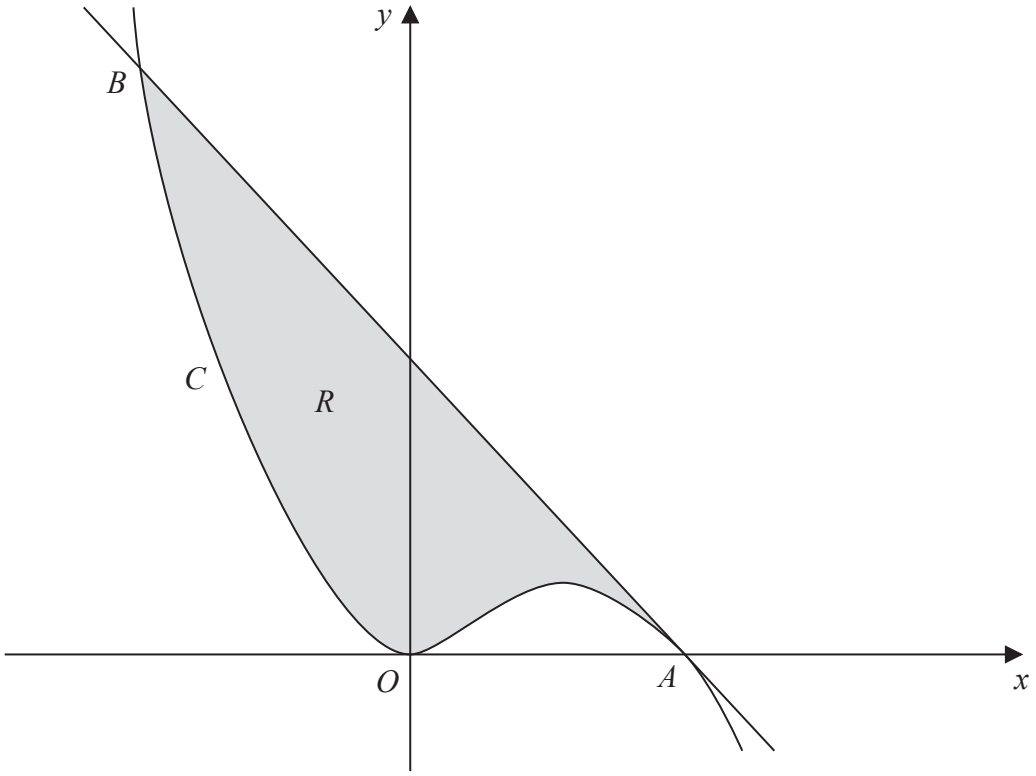

Figure 5

Figure 5 shows a sketch of part of the curve C with equation $y = x^2 - \frac{1}{3}x^3$

C touches the x-axis at the origin and cuts the x-axis at the point A.

(a) Show that the coordinates of A are (3, 0).

(1)

(b) Show that the equation of the tangent to C at the point A is $y = -3x + 9$

(5)

The tangent to C at A meets C again at the point B, as shown in Figure 5.

(c) Use algebra to find the x coordinate of B.

(4)

The region R, shown shaded in Figure 5, is bounded by the curve C and the tangent to C at A.

(d) Find, by using calculus, the area of region R.

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

(5)

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Question 12 continued

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Question 12 continued

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Question 12 continued

Q12

(Total 15 marks)

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13. The height of sea water, h metres, on a harbour wall at time t hours after midnight is given by

$$h = 3.7 + 2.5\cos(30t - 40)°, \qquad 0 \leqslant t < 24$$

(a) Calculate the maximum value of h and the exact time of day when this maximum first occurs.

(4)

Fishing boats cannot enter the harbour if h is less than 3

(b) Find the times during the morning between which fishing boats cannot enter the harbour.
Give these times to the nearest minute.

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

(6)

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Question 13 continued

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Question 13 continued

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Question 13 continued

Q13

(Total 10 marks)

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14.

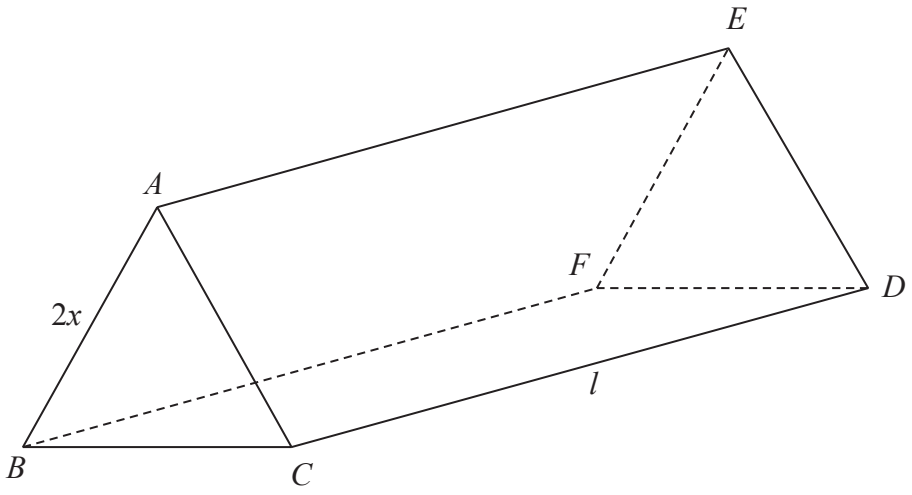

Figure 6

Figure 6 shows a solid triangular prism $ABCDEF$ in which $AB = 2x$ cm and $CD = l$ cm.

The cross section ABC is an equilateral triangle.

The rectangle $BCDF$ is horizontal and the triangles ABC and DEF are vertical.

The total surface area of the prism is S cm^2 and the volume of the prism is V cm^3.

(a) Show that $S = 2x^2\sqrt{3} + 6xl$

(3)

Given that $S = 960$,

(b) show that $V = 160x\sqrt{3} - x^3$

(5)

(c) Use calculus to find the maximum value of V, giving your answer to the nearest integer.

(5)

(d) Justify that the value of V found in part (c) is a maximum.

(2)

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Question 14 continued

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Question 14 continued

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Question 14 continued

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Question 14 continued

Q14

(Total 15 marks)

TOTAL FOR PAPER: 125 MARKS

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