Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Wednesday 9 October 2019

Morning (Time: 2 hours 30 minutes) | Paper Reference **WMA01/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Core Mathematics C12

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

Total Marks

Candidates may use any calculator allowed by Pearson regulations. 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).
- **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.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet □Mathematical Formulae and Statistical Tables□is provided.
- There are 15 questions in this question paper. 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ▶

P58509A

1/1/1/1/1/

P 5 8 5 0 9 A 0 1 4 8

Pearson

Leave blank

1. Find

$$\int\left(\frac{1}{2x^3}+3x^{\frac{1}{2}}-6\right)\mathrm{d}x \qquad x>0$$

writing each term as simply as possible.

(4)

Leave blank

Question 1 continued

Q1

(Total 4 marks)

Leave blank

2. (a) Write 4^{2x+1} in the form 2^{a}, where a is an expression in x.

(1)

(b) Hence solve, without using a calculator, the equation

$$2^{x} \times 4^{2x+1} = 16^{3x}$$

(4)

Leave blank

Question 2 continued

Q2

(Total 5 marks)

Leave blank

3. Given $f(x) = 4x^3 - kx^2 + 2kx + 8$, where k is a constant,

(a) show that $(x - 2)$ is not a factor of $f(x)$.

(2)

Given that when $f(x)$ is divided by $(2x - 1)$ the remainder is $\frac{25}{4}$

(b) find the value of k.

(3)

Using this value of k,

(c) show that $(x + 2)$ is a factor of $f(x)$.

(2)

Leave blank

Question 3 continued

Q3

(Total 7 marks)

Leave blank

4. A curve has equation

$$y = 16x\sqrt{x} - 3x^2 - 78 \qquad x > 0$$

(a) Find, in simplest form, $\frac{dy}{dx}$

(3)

(b) Hence find the equation of the normal to the curve at the point where $x = 4$, writing your answer in the form $ax + by + c = 0$, where a, b and c are integers to be found.

(5)

Leave blank

Question 4 continued

Q4

(Total 8 marks)

Leave blank

5.

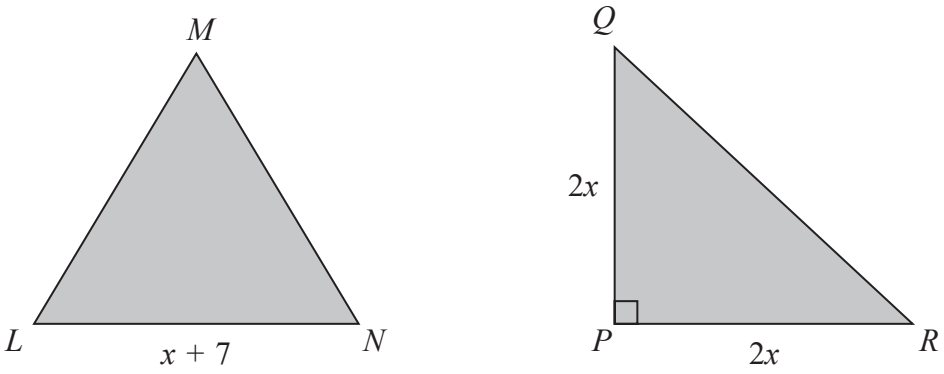

Figure 1

In this question you must show detailed reasoning.

Solutions relying on calculator technology are not acceptable.

Figure 1 shows a sketch of a triangle LMN and a sketch of a triangle PQR.

Triangle LMN is an equilateral triangle with sides $(x + 7)$ cm.

Triangle PQR is a right-angled isosceles triangle with $PQ = PR = 2x$ cm and angle $QPR = 90°$

(a) Find, in its simplest form in terms of x, the length QR.

(2)

Given that the perimeter of triangle LMN is equal to the perimeter of triangle PQR,

(b) find the value of x, writing your answer in the form $a\sqrt{2} + b$, where a and b are integers to be found.

(5)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 5 continued

Leave blank

Question 5 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 5 continued

Q5

(Total 7 marks)

Leave blank

6. (a) Find, in ascending powers of x, the first four terms in the binomial expansion of

$$\left(1-\frac{1}{4}x\right)^{12}$$

Write each coefficient as a fully simplified fraction.

(4)

Using the answer to part (a), find the coefficient of x^2 in the expansion of

(b) (i) $(2+x)\left(1-\frac{1}{4}x\right)^{12}$

(ii) $\frac{(2+x)}{2x}\left(1-\frac{1}{4}x\right)^{12}$

(4)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 6 continued

Q6

(Total 8 marks)

Leave blank

7.

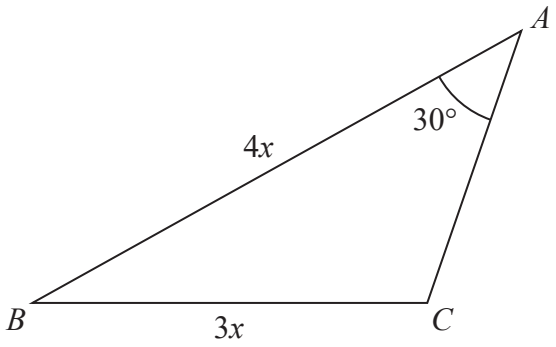

Figure 2

Figure 2 shows a sketch of a triangle ABC.

Given that $AB = 4x$, $BC = 3x$ and angle $BAC = 30°$

(a) show that $\sin ACB = \frac{2}{3}$

(2)

Given that angle ACB is obtuse,

(b) find the size of angle ABC, giving your answer in degrees, to 2 decimal places.

(2)

Given further that the area of triangle ABC is 20

(c) find the value of x to 2 decimal places,

(3)

(d) find the length of side AC to 2 decimal places.

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 7 continued

Leave blank

Question 7 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 7 continued

Q7

(Total 9 marks)

Leave blank

8. A circle C has equation $x^2 + y^2 - 6x - 14y + k = 0$, where k is constant.

(a) Find the coordinates of the centre of C.

(2)

(b) Find the radius of C when $k = -32$

(2)

(c) Find the range of values of k for which C lies completely within the first quadrant.

(4)

Leave blank

Question 8 continued

Q8

(Total 8 marks)

Leave blank

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

$$u_n = p - qn, \qquad n \in \mathbb{N},\ n \geqslant 1$$

where p and q are positive constants.

Given that $u_2 = 21$ and $u_8 = -9$

(a) find the value of p and the value of q.

(4)

Hence find

(b) the value of u_{100}

(2)

(c) the value of $\sum_{n=6}^{30} u_n$

(3)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 9 continued

Leave blank

Question 9 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 9 continued

Q9

(Total 9 marks)

Leave blank

10.

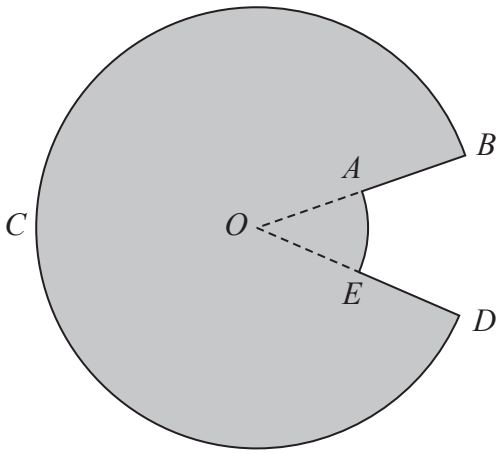

Figure 3

The design for a logo, *ABCDEA*, is shown shaded in Figure 3.

The logo consists of a sector *OBCDO* of a circle with centre *O*, joined to a sector *OAEO* of a smaller circle, also with centre *O*.

Given that the size of the acute angle *AOE* is $\frac{\pi}{6}$ radians, the length of arc *AE* is π cm and $OB = 2 \times OA$, find the exact value of

(a) the length *OA*,

(2)

(b) the area of the logo,

(4)

(c) the perimeter of the logo.

(3)

Leave blank

Question 10 continued

Leave blank

Question 10 continued

Leave blank

Question 10 continued

Q10

(Total 9 marks)

Leave blank

11. The curve C_1 has equation $y = f(x)$ where

$$f(x) = (x^2 - 4)(x - 3)$$

(a) Sketch a graph of C_1 showing clearly the coordinates of each point where the curve crosses the coordinate axes.

(3)

The finite region R is bounded by C_1 and the x-axis.

Given that R lies above the x-axis,

(b) find the area of R.

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

(5)

A second curve C_2 has equation $y = f(2x)$.

(c) (i) Write down an equation of C_2
(You may leave your equation in a factorised form.)

(ii) Describe geometrically the transformation that maps C_1 onto C_2

(3)

Leave blank

Question 11 continued

Leave blank

Question 11 continued

Leave blank

Question 11 continued

Q11

(Total 11 marks)

Leave blank

12. (i) Given that p is a positive constant and

$$\log_p 2x - \log_p 5 = 3 + \log_p 8$$

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

(4)

(ii) Solve the equation

$$2(\log_2 y)^2 + 7\log_2 y - 15 = 0$$

Show each step in your working and write your answers as simplified surds where appropriate.

(5)

Leave blank

Question 12 continued

Q12

(Total 9 marks)

Leave blank

13. (i) Solve, for $0 \leqslant \theta < 180°$, the equation

$$7\sin 2\theta = 5\cos 2\theta$$

giving your answers, in degrees, to one decimal place.

(4)

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

$$24\tan x = 5\cos x$$

giving your answers, in radians, to 3 decimal places.

(5)

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

Leave blank

Question 13 continued

Leave blank

Question 13 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 13 continued

Q13

(Total 9 marks)

Leave blank

14. A colony of ants is being studied.

The number of ants in the colony at the start of the study was 140 000

Two years after the start of the study the number of ants in the colony is 150 000

A model predicts that the number of ants in the colony will increase by p% each year. Hence the number of ants in the colony at the end of each year of study form a geometric sequence.

Assuming the model,

(a) find the value of p, giving your answer to 2 decimal places.

(3)

According to the model, at the end of N years of study the number of ants in the colony exceeds 500 000

(b) Find, showing all steps in your working, the smallest integer value of N.

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

(5)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 14 continued

Leave blank

Question 14 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 14 continued

Q14

(Total 8 marks)

Leave blank

15.

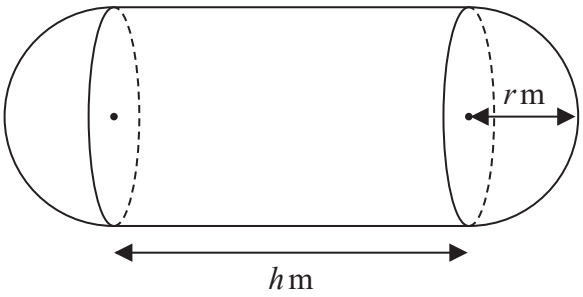

Figure 4

[A sphere of radius r has volume $\frac{4}{3}\pi r^3$ and surface area $4\pi r^2$]

A manufacturer wishes to produce a storage tank.

The tank is modelled in the shape of a hollow circular cylinder with a hemispherical shell at each end, as shown in Figure 4.

The walls of the tank are assumed to have negligible thickness.

The cylinder has radius r metres and length h metres and each hemisphere has radius r metres.

The volume of the tank will be $5\,\text{m}^3$.

(a) Show that, according to the model, the surface area of the tank $A\,\text{m}^2$ is given by

$$A = \frac{10}{r} + \frac{4}{3}\pi r^2$$

(4)

The manufacturer wishes to find the minimum value of A.

(b) Find the value of A when $\frac{\mathrm{d}A}{\mathrm{d}r} = 0$

(6)

(c) Justify, by further differentiation, that the value of A found in part (b) is a minimum.

(2)

For the minimum value of A,

(d) find the value of h.

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave blank

Question 15 continued

Leave blank

Question 15 continued

Leave blank

Question 15 continued

Leave blank

Question 15 continued

Q15

(Total 14 marks)

TOTAL FOR PAPER: 125 MARKS

END

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA