Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number	Candidate Number

Tuesday 8 January 2019

Morning (Time: 1 hour 30 minutes)	Paper Reference **WMA11/01**

Mathematics
Advanced Subsidiary
Pure Mathematics P1

You must have: Mathematical Formulae and Statistical Tables (Lilac), calculator	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).
- **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 12 questions in this question paper. The total mark for this paper is 75.
- 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

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P 6 0 7 9 1 A 0 1 2 8

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Answer ALL questions. Write your answers in the spaces provided.

1. Find

$$\int\left(\frac{2}{3}x^3 - \frac{1}{2x^3} + 5\right)\mathrm{d}x$$

simplifying your answer.

(4)

(a) $\int \frac{2}{3}x^3 - \frac{1}{2}x^{-3} + 5.$

$= \frac{2x^4}{3\times 4} - \frac{1}{2\times -2}x^{-2} + 5x + C$

$= \frac{1}{6}x^4 + \frac{1}{4}x^{-2} + 5x + C.$

DO NOT WRITE IN THIS AREA

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2. Given

$$\frac{3^x}{3^{4y}} = 27\sqrt{3}$$

find y as a simplified function of x.

(3)

$$\frac{3^x}{(3^y)^4} = 3^3 . 3^{1/2} .$$

$$3^x = 3^{4y} . 3^3 . 3^{1/2} .$$

$$3^x = 3^{4y + 7/2}$$

setting the powers equal;

$$x = 4y + \frac{7}{2} .$$

$$\frac{x - \frac{7}{2}}{4} = y .$$

$$y = \frac{x}{4} - \frac{7}{8}$$

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3. The line l_1 has equation $3x + 5y - 7 = 0$

(a) Find the gradient of l_1

(2)

The line l_2 is perpendicular to l_1 and passes through the point (6, −2).

(b) Find the equation of l_2 in the form $y = mx + c$, where m and c are constants.

(3)

$5y = -3x + 7$

$y = -\frac{3}{5}x + \frac{7}{5}$

$m = -\frac{3}{5}$

(b) ~~f~~ m

$= -\frac{3}{5} \times m = -1$

$m = \frac{5}{3}$

$y = \frac{5}{3}x + c \quad (6, -2)$

$-2 = \frac{5}{3}(6) + c$

$c = -2 - 10$

$c = -12$

$y = \frac{5}{3}x - 12$

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4.

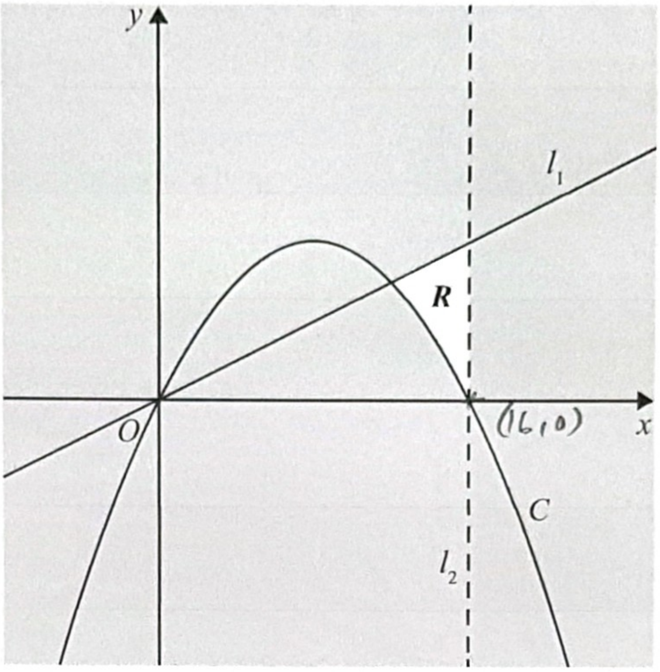

Figure 1

Figure 1 shows a line l_1 with equation $2y = x$ and a curve C with equation $y = 2x - \frac{1}{8}x^2$

The region R, shown unshaded in Figure 1, is bounded by the line l_1, the curve C and a line l_2

Given that l_2 is parallel to the y-axis and passes through the intercept of C with the positive x-axis, identify the inequalities that define R.

(3)

$x < 16$.

$y \geq 2x - \frac{1}{8}x^2$.

$y \leq \frac{x}{2}$.

$x\left(2 - \frac{1}{8}x\right) = 0$

$x = 0$ or 16.

$\therefore$ x int for curve $= (16, 0)$.

$\therefore$ from the diagram we can see the dotted

Line is the equation $\underline{x = 16}$

→ Since it's dotted $\underline{x < 16}$

→ Since ~~its~~ R is below the line l_1 but the line isn't dotted

$2y \leq x$

$y \leq \frac{x}{2}$

→ Since R is above the curve and the curve is not dotted

$y \geq 2x - \frac{1}{8}x^2$

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5.

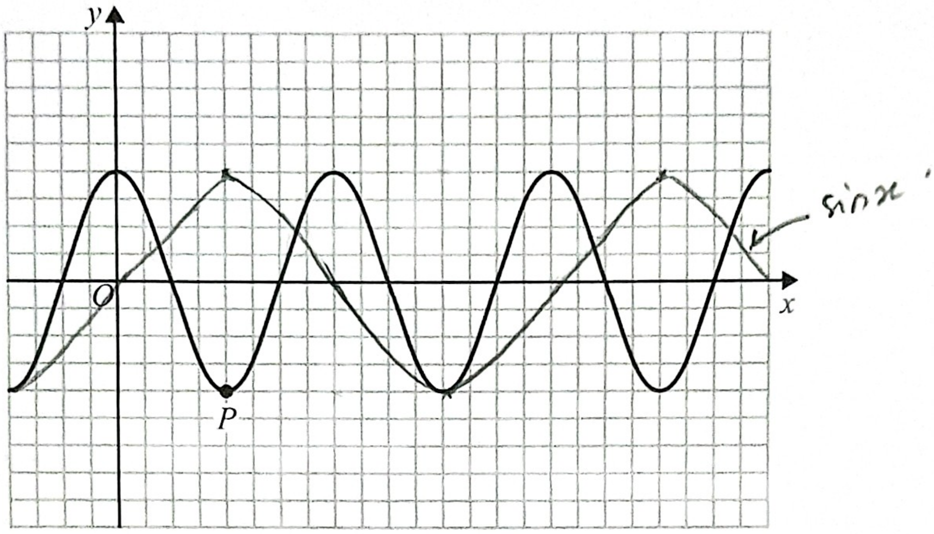

Figure 2

Figure 2 shows a plot of part of the curve with equation $y = \cos 2x$ with x being measured in radians.

The point P, shown on Figure 2, is a minimum point on the curve.

(a) State the coordinates of P.

(2)

A copy of Figure 2, called Diagram 1, is shown at the top of the next page.

(b) Sketch, on Diagram 1, the curve with equation $y = \sin x$

(2)

(c) Hence, or otherwise, deduce the number of solutions of the equation

(i) $\cos 2x = \sin x$ that lie in the region $0 \leqslant x \leqslant 20\pi$

(ii) $\cos 2x = \sin x$ that lie in the region $0 \leqslant x \leqslant 21\pi$

(2)

(a) $\left(\frac{\pi}{2}, -1\right)$.

(ci) Until 2π there are 3 solns.

$\therefore$ $20\pi \rightarrow$ 30 solns

(ii) $21\pi \rightarrow$ 32 solns because in π extra there are 2 extra solns.

Leave blank

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

Given

$$f(x) = 2x^{\frac{5}{2}} - 40x + 8 \qquad x > 0$$

(a) solve the equation $f'(x) = 0$

(4)

(b) solve the equation $f''(x) = 5$

(3)

(a) $\frac{dy}{dx} = 0.$

differentiating f(x) results to;

$2 \cdot \frac{5}{2} x^{3/2} - 40$

$= 5x^{3/2} - 40 = 0.$ as $f'(x) = 0$

$x^{3/2} = 8.$

$x = 8^{2/3}$

$\underline{\underline{x = 4}}$

(b) $\frac{d^2y}{dx^2} = 5.$

$\frac{3}{2} \cdot 5x^{1/2} = \cancel{0}\,5.$

$x^{1/2} = \cancel{\frac{2}{3}}\ \frac{2}{3}$

$x = \frac{4}{9}$

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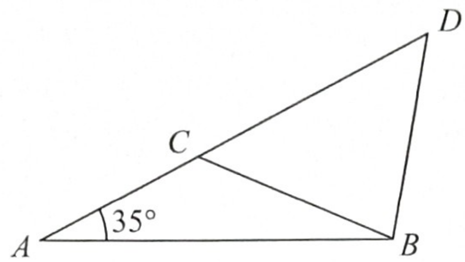
7.



Not to scale

Figure 3

Figure 3 shows the design for a structure used to support a roof.

The structure consists of four wooden beams, AB, BD, BC and AD.

Given $AB = 6.5$ m, $BC = BD = 4.7$ m and angle $BAC = 35°$

(a) find, to one decimal place, the size of angle ACB,

(3)

(b) find, to the nearest metre, the total length of wood required to make this structure.

(3)

a) $\frac{\sin\theta}{6.5} = \frac{\sin 35}{4.7}$

$\sin\theta = \frac{6.5 \times \sin 35}{4.7}$

$\theta = 52.5$

since obtuse

$\theta = 180 - 52.5$

$= \underline{127.5°}$

(b) Angle ABC

$180 - (35 + 127.5)$

$= \underline{17.5}$

$\frac{\sin 17.5}{x} = \frac{\sin 35}{4.7}$

$x = \underline{2.46m} \rightarrow$ length AC

length CD

$\frac{\sin(52.5)}{4.7} = \frac{\sin 75}{x}$

$x = 5.72$

$2.46 + 5.72 + 4.7 + 4.7 + 6.5$

$= 24.08$

$= \underline{24m}$ (nearest metre)

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8.

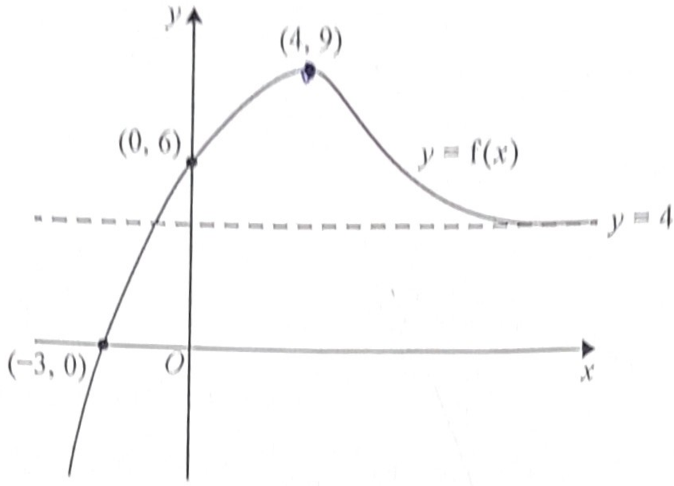

Figure 4

The curve C with equation $y = \mathrm{f}(x)$ is shown in Figure 4.

The curve C

- has a single turning point, a maximum at (4, 9)
- crosses the coordinate axes at only two places, (−3, 0) and (0, 6)
- has a single asymptote with equation $y = 4$

as shown in Figure 4.

(a) State the equation of the asymptote to the curve with equation $y = \mathrm{f}(-x)$.

(1)

(b) State the coordinates of the turning point on the curve with equation $y = \mathrm{f}\left(\frac{1}{4}x\right)$.

(1)

Given that the line with equation $y = k$, where k is a constant, intersects C at exactly one point,

(c) state the possible values for k.

(2)

The curve C is transformed to a new curve that passes through the origin.

(d) (i) Given that the new curve has equation $y = \mathrm{f}(x) - a$, state the value of the constant a.

(ii) Write down an equation for another single transformation of C that also passes through the origin.

(2)

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Question 8 continued

(a) $y=4$. as the reflections is in the y-axis results in no change of the asymptote.

b) $y=f\left(\frac{1}{4}x\right)$

All x-co-ordinates by 4.

$=(16,9)$

(c) $k \leq 4$
$k=9 \rightarrow$ due to tangent

(d) i) $a=6$.

ii) $f(x-3)$

i) Because the transformation means we need to translate all y-co-ordinates down by 'a' such that the y int is $(0,0)$ $\therefore$ 'a' can only be $=6$.

ii) We need to find a way to make ~~the~~ / translate the original curve such that now the xintercept is $(0,0)$ and that's done by moving all x-coordinates towards the right by 3 units.

Q8

(Total for Question 8 is 11 marks)

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9. The equation

$$\frac{3}{x} + 5 = -2x + c$$

where c is a constant, has no real roots.

Find the range of possible values of c.

(7)

$\frac{3}{x} + 5 = -2x + c$.

$\times x \quad \frac{3}{x} + 5x + 2x - c = 0. \quad \times x$

Multiply by x on both sides to get rid of x from the denominator

$3 + x(5-c) + 2x^2 = 0$.

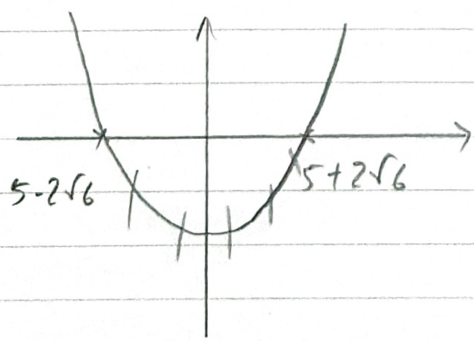
$b^2 - 4ac < 0$.

$2x^2 + x(5-c) + 3 = 0$.

$(5-c)^2 - 4(2 \times 3) < 0$.

$25 - 10c + c^2 - 24 < 0$.

$c^2 - 10c + 1 < 0$.



$5 - 2\sqrt{6} < c < 5 + 2\sqrt{6}$.

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10. A sector AOB, of a circle centre O, has radius r cm and angle θ radians.

Given that the area of the sector is 6 cm^2 and that the perimeter of the sector is 10 cm,

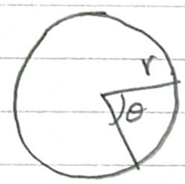
(a) show that

$$3\theta^2 - 13\theta + 12 = 0$$

(4)

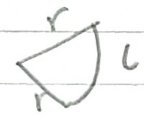
(b) Hence find possible values of r and θ.

(3)



$\frac{1}{2}r^2\theta = 6.$

(Perimeter) $= 2r + l = 10$



($l = r\theta$ (where l is arc length)

$2r + r\theta = 10$

$r(2+\theta) = 10.$

$r = \frac{10}{2+\theta}.$

$\frac{1}{2}\left(\frac{10}{2+\theta}\right)^2 \times \theta = 6.$

$12 = \frac{100}{4+4\theta+\theta^2} \times \theta.$

$48 + 48\theta + 12\theta^2 = 100\theta$

$\frac{12\theta^2 - 52\theta + 48}{4} = \frac{0}{4}$

$3\theta^2 - 13\theta + 12 = 0$ as req.

(b) $\frac{13 \pm \sqrt{13^2 - 4(3 \times 12)}}{2 \times 3}.$

$\theta = \frac{4}{3}$ or $3.$

r when $\theta = 4/3$

$r = \frac{10}{2+4/3} = \underline{\underline{r = 3}}$

when $\theta = 3.$

$r = \frac{10}{2+3} = \underline{\underline{2}}$

Leave blank

11. (a) On Diagram 1 sketch the graphs of

(i) $y = x(3 - x)$

(ii) $y = x(x - 2)(5 - x)$

showing clearly the coordinates of the points where the curves cross the coordinate axes.

(4)

(b) Show that the x coordinates of the points of intersection of

$$y = x(3 - x) \text{ and } y = x(x - 2)(5 - x)$$

are given by the solutions to the equation $x(x^2 - 8x + 13) = 0$

(3)

The point P lies on both curves. Given that P lies in the first quadrant,

(c) find, using algebra and showing your working, the exact coordinates of P.

(5)

(b) $x(3-x) = x(x-2)(5-x)$

$-x^2+3x = (x^2-2x)(5-x)$

$= 5x^2 - x^3 - 10x + 2x^2$

$-x^2+3x = -x^3+7x^2-10x$

$x^3-8x^2+13x = 0$

$x(x^2-8x+13)=0$ as req

(c) $\dfrac{8 \pm \sqrt{8^2-4(13)}}{2}$

$x = 4 \pm \sqrt{3}$

when $x = 4-\sqrt{3}$

$y = -7+5\sqrt{3}$

$P: (4-\sqrt{3}, -7+5\sqrt{3})$

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Question 11 continued

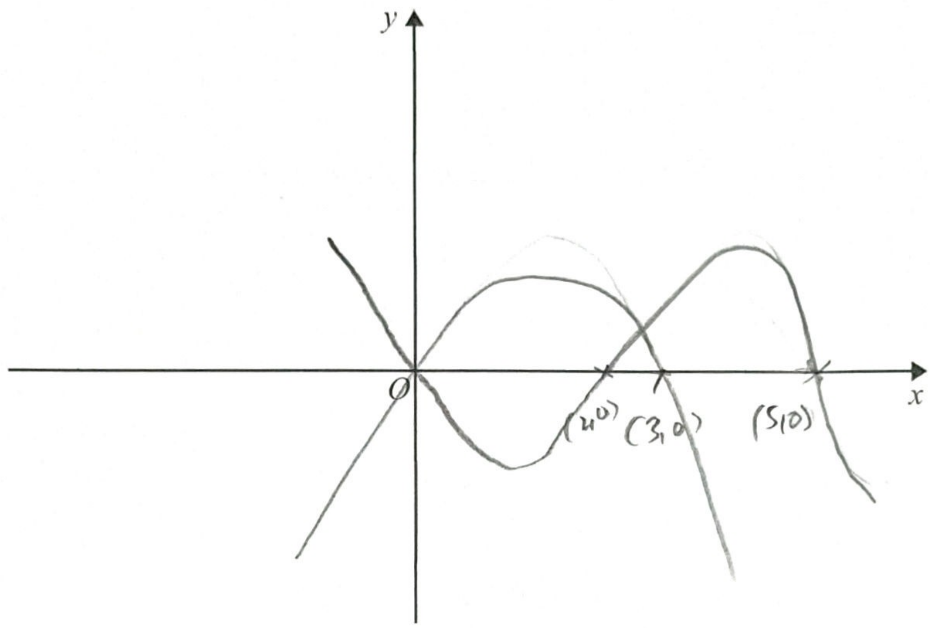

Diagram 1

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12. The curve with equation $y = f(x), x > 0$, passes through the point $P(4, -2)$.

Given that

$$\frac{dy}{dx} = 3x\sqrt{x} - 10x^{-\frac{1}{2}}$$

(a) find the equation of the tangent to the curve at P, writing your answer in the form $y = mx + c$, where m and c are integers to be found.

(4)

(b) Find $f(x)$.

(5)

(a) $3(4)(\sqrt{4}) - 10(4)^{-1/2}$

Grad $= \underline{19}$

$y - y_0 = m(x - x_0)$.

$y + 2 = 19(x - 4)$

$y = 19x - 76 - 2$

$y = 19x - 78$

$m = 19$

$\underline{\underline{c = -78}}$

(b) $\int 3x^{3/2} - 10x^{-1/2}\, dx$.

$f(x) = \frac{3x^{5/2}}{5/2} - \frac{10x^{1/2}}{1/2}$

$f(x) = \frac{6}{5}x^{5/2} - 20x^{1/2} + c$.

$-2 = \frac{6}{5}(4)^{5/2} - 20(4)^{1/2} + c$

$c = -\frac{2}{5}$.

$y = \frac{6}{5}x^{5/2} - 20x^{1/2} - \frac{2}{5}$.

$f(x) = \frac{6}{5}x^{5/2} - 20x^{1/2} - \frac{2}{5}$