Please check the examination details below before entering your candidate information

Candidate surname	Other names
Solved by Mr. Pabitra	

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Thursday 8 January 2026

Morning (Time: 1 hour 30 minutes)

Paper reference **WMA11/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Pure Mathematics P1

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

Total Marks

Candidates may use any calculator permitted 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 9 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

Solved by Mr. Pabitra | Math Tonic

- 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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1. $y = 4x^3 + \dfrac{3}{2\sqrt{x}} - 8 \qquad x > 0$

Find, in simplest form,

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

(3)

(b) $\int y\,dx$

(3)

Write $y = 4x^3 + \frac{3}{2}x^{-1/2} - 8$

(a) $\frac{dy}{dx} = 12x^2 + \frac{3}{2} \times (-\frac{1}{2})x^{-3/2}$

$$\boxed{\frac{dy}{dx} = 12x^2 - \frac{3}{4}x^{-3/2}}$$

(b) $\int y\,dx = \frac{4x^4}{4} + \frac{3}{2} \times \frac{x^{1/2}}{\frac{1}{2}} - 8x + c$

$$\boxed{\int y\,dx = x^4 + 3x^{1/2} - 8x + c}$$

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Question 1 continued

(Total for Question 1 is 6 marks)

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2. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

(a) Given

$$y - x = 4$$

and

$$2x^2 - xy = 8$$

show that

$$x^2 - 4x - 8 = 0$$

(2)

(b) Hence solve the simultaneous equations

$$y - x = 4$$

$$2x^2 - xy = 8$$

writing the answers in the form $p + q\sqrt{3}$, where p and q are integers to be found.

(4)

(a) $y - x = 4$, so $y = x + 4$

Substitute into $2x^2 - xy = 8$: $2x^2 - x(x + 4) = 8$

$2x^2 - x^2 - 4x = 8$

$x^2 - 4x - 8 = 0$ as required

(b) $x = \frac{4 \pm \sqrt{16 + 32}}{2} = \frac{4 \pm \sqrt{48}}{2} = \frac{4 \pm 4\sqrt{3}}{2} = 2 \pm 2\sqrt{3}$

$y = x + 4 = 6 \pm 2\sqrt{3}$

$x = 2 + 2\sqrt{3}, y = 6 + 2\sqrt{3}$ and $x = 2 - 2\sqrt{3}, y = 6 - 2\sqrt{3}$

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Question 2 continued

(Total for Question 2 is 6 marks)

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3. (i) Find the range of values of z for which

$$\frac{4}{z} < 8$$

giving the answer in simplest form.

(2)

(ii)

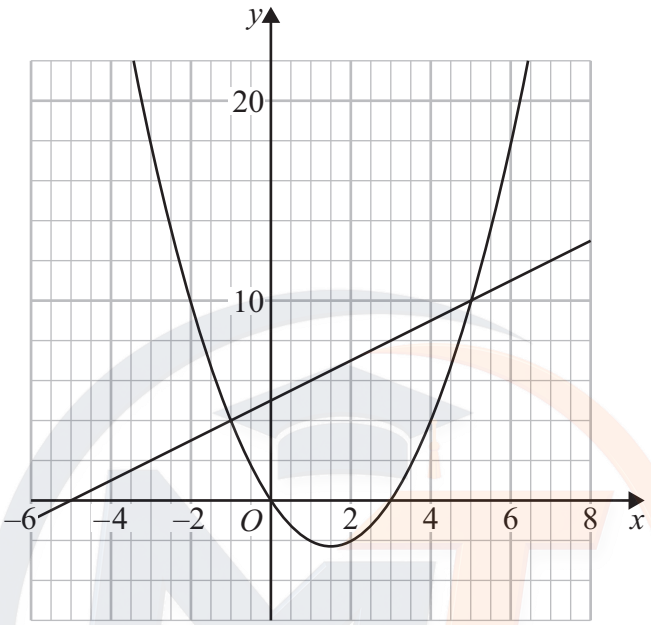


Figure 1

Figure 1 shows a plot of

- the line with equation $y = x + 5$
- the curve with equation $y = x(x - 3)$

On the opposite page there is a copy of Figure 1 labelled Diagram 1.
On Diagram 1 represent the following inequality graphically.

$$x + 5 \leqslant y \leqslant x(x - 3) \quad \text{for} \quad x \geqslant -2$$

(3)

(i) Critical values: $z = 0$ and $\frac{4}{z} = 8$ gives $z = \frac{1}{2}$

Multiply by z^2 (positive): $4z < 8z^2$ $\quad 8z^2 - 4z > 0$ $\quad 4z(2z - 1) > 0$

$$z < 0 \quad \text{or} \quad z > \frac{1}{2}$$

(ii) Line and curve meet: $x^2 - 3x = x + 5$, $\quad x^2 - 4x - 5 = 0$, $\quad x = -1, 5$

Region: above the line, below the curve, $x \geq -2$ (shaded on Diagram 1)

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Question 3 continued

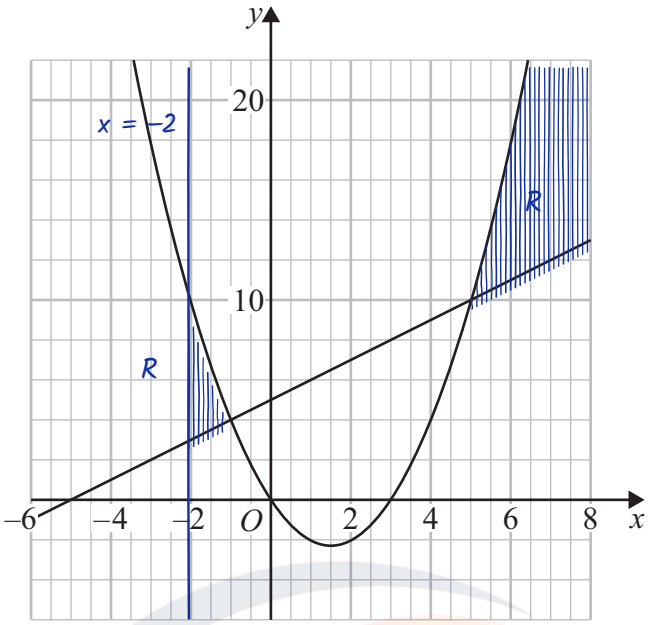


Diagram 1

(Total for Question 3 is 5 marks)

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4. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

The point $A(-1, 8)$ and the point $B(7, 2)$ lie on the line L_1

(a) Find an equation for L_1 in the form $ax + by + c = 0$, where a, b and c are integers.

(3)

The line L_2

- passes through A and is perpendicular to L_1
- cuts the x-axis at the point C

(b) Find the coordinates of C.

(3)

(c) Hence find the area of triangle ABC.

(3)

(a) Gradient of $L_1 = \frac{2-8}{7-(-1)} = \frac{-6}{8} = -\frac{3}{4}$

$y - 8 = -\frac{3}{4}(x + 1)$ $\quad 4y - 32 = -3x - 3$

$\boxed{3x + 4y - 29 = 0}$

(b) Gradient of $L_2 = \frac{4}{3}$ (perpendicular). L_2: $y - 8 = \frac{4}{3}(x + 1)$

At C, $y = 0$: $-8 = \frac{4}{3}(x + 1)$, $\quad x + 1 = -6$, $\quad x = -7$

$\boxed{C = (-7, 0)}$

(c) L_1 and L_2 are perpendicular at A, so angle $BAC = 90°$

$AB = \sqrt{(7+1)^2 + (2-8)^2} = \sqrt{64 + 36} = 10$

$AC = \sqrt{(-7+1)^2 + (0-8)^2} = \sqrt{36 + 64} = 10$

Area $= \frac{1}{2} \times AB \times AC = \frac{1}{2} \times 10 \times 10$

$\boxed{\text{Area of } ABC = 50}$

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Question 4 continued

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Question 4 continued

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Question 4 continued

(Total for Question 4 is 9 marks)

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5. **In this question you must show all stages of your working.**
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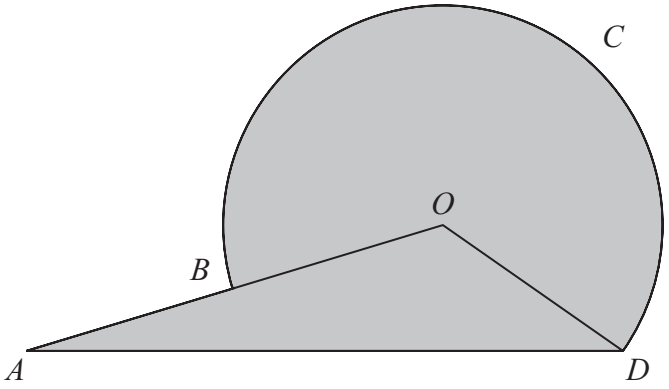


Diagram NOT to scale

Figure 2

Figure 2 shows the logo for the tourist board of an island.

The logo consists of a sector $BODCB$ of a circle centre O joined to a triangle AOD.

Given that

- ABO is a straight line
- $OD = 3$ cm
- $AD = 8$ cm
- angle $AOD = 2.5$ radians

(a) show that angle ODA is 0.415 radians to 3 significant figures.

(3)

(b) Find the total area of the logo, in cm^2, to one decimal place.

(3)

(c) Find the perimeter of the logo, $ABCDA$, in cm, to one decimal place.

(3)

(a) Sine rule in triangle AOD: $\frac{\sin OAD}{3} = \frac{\sin 2.5}{8}$

$\sin OAD = \frac{3 \sin 2.5}{8} = 0.22442...$, angle $OAD = 0.22635...$

angle $ODA = \pi - 2.5 - 0.22635... = 0.41523... = 0.415$ (3 s.f.) as required

(b) ABO is straight, so the sector BODCB has reflex angle $2\pi - 2.5 = 3.7831...$

Sector area $= \frac{1}{2} \times 3^2 \times (2\pi - 2.5) = 17.024...$

Triangle AOD $= \frac{1}{2} \times 3 \times 8 \times \sin(0.41523...) = 4.8408...$

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Question 5 continued

Total = 17.024... + 4.8408... = 21.865...

Area = 21.9 cm^2

(c) $OA^2 = 3^2 + 8^2 - 2 \times 3 \times 8 \cos(0.41523...) = 29.079...$, $OA = 5.3924...$

$AB = OA - OB = 5.3924... - 3 = 2.3924...$

Arc $BCD = 3 \times (2\pi - 2.5) = 11.349...$

Perimeter = AB + arc BCD + DA = 2.3924... + 11.349... + 8 = 21.742...

Perimeter = 21.7 cm

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Question 5 continued

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Question 5 continued

(Total for Question 5 is 9 marks)

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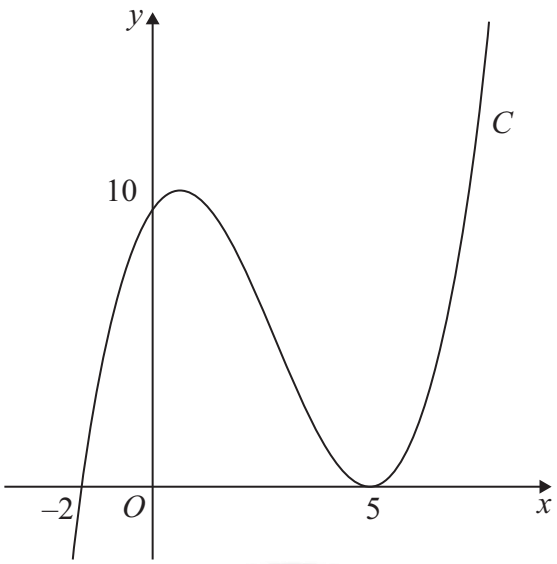


Figure 3

Figure 3 shows a sketch of the curve C with equation $y = f(x)$ where $f(x)$ is a cubic function in x.

The curve C

- cuts the x-axis at $(-2, 0)$ and cuts the y-axis at $(0, 10)$
- touches the x-axis at $(5, 0)$

as shown in Figure 3.

(a) Deduce the roots of the equation

(i) $f\left(\frac{1}{3}x\right) = 0$

(ii) $f(x - 3) = 0$

(2)

(b) Find an expression for $f(x)$. You should leave your answer in factorised form.

(3)

The curve C intersects the straight line $y = 10(x + 2)$ at exactly three points.

(c) Use algebra to find the exact x coordinates of the three points of intersection.

(*Solutions based entirely on calculator technology are not acceptable.*)

(4)

Roots of $f(x) = 0$: $x = -2$ and $x = 5$ (repeated)

(a)(i) $\frac{1}{3}x = -2$ or 5: $x = -6$, $x = 15$

(a)(ii) $x - 3 = -2$ or 5: $x = 1$, $x = 8$

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Question 6 continued

(b) $f(x) = k(x + 2)(x - 5)^2$. $f(0) = 10$: $k \times 2 \times 25 = 10$, $k = \frac{1}{5}$

$$\boxed{f(x) = \frac{1}{5}(x + 2)(x - 5)^2}$$

(c) $\frac{1}{5}(x + 2)(x - 5)^2 = 10(x + 2)$

$(x + 2)(x - 5)^2 - 50(x + 2) = 0$

$(x + 2)[(x - 5)^2 - 50] = 0$

$x = -2$ or $(x - 5)^2 = 50$, $x - 5 = \pm\sqrt{50} = \pm 5\sqrt{2}$

$$\boxed{x = -2, \quad x = 5 + 5\sqrt{2}, \quad x = 5 - 5\sqrt{2}}$$

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 9 marks)

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7. The curve C has equation

$$y = \frac{2}{3}x^3 - 8x^2 + 43x - \frac{20}{3}$$

(a) Show that $\frac{dy}{dx}$ can be written in the form

$$p(x+q)^2 + r$$

where p, q and r are constants to be found.

(5)

(b) Hence state

(i) the minimum value of $\frac{dy}{dx}$

(ii) the value of x at which this minimum value occurs.

(2)

Given that S is the point on C at which the gradient is a minimum,

(c) find the equation of the tangent to C at S, giving your answer in the form $y = mx + c$, where m and c are constants.

(3)

(a) $\frac{dy}{dx} = 2x^2 - 16x + 43$

$= 2(x^2 - 8x) + 43 = 2[(x-4)^2 - 16] + 43 = 2(x-4)^2 - 32 + 43$

$\boxed{\frac{dy}{dx} = 2(x-4)^2 + 11 \quad (p = 2, q = -4, r = 11)}$

(b)(i) $(x-4)^2 \geq 0$, so the minimum value of $\frac{dy}{dx}$ is 11

(b)(ii) it occurs when $x = 4$

(c) At $x = 4$: $y = \frac{2}{3} \times 64 - 8 \times 16 + 43 \times 4 - \frac{20}{3} = \frac{128}{3} - 128 + 172 - \frac{20}{3} = 80$

$S = (4, 80)$, gradient 11: $y - 80 = 11(x - 4)$

$\boxed{y = 11x + 36}$

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Question 7 continued

(Total for Question 7 is 10 marks)

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8. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

A curve C has equation $y = f(x), \quad x > 0$

A point P lies on C.

Given that

- $f'(x) = 4x^2 + \frac{6}{x^2} - 4$
- the equation of the tangent to C at P is $y = 10x - 6\sqrt{3}$

(a) (i) verify that $\sqrt{3}$ is a possible x coordinate of P,

(ii) find, using algebra, the other possible x coordinate of P.

(6)

Given that the x coordinate of P is $\sqrt{3}$

(b) find an equation of the normal to C at P.

(2)

(c) Find $f(x)$, writing your answer in simplest form.
You must show each stage of your working.

(4)

(a)(i) $f'(\sqrt{3}) = 4 \times 3 + \frac{6}{3} - 4 = 12 + 2 - 4 = 10$

This equals the gradient of the tangent $y = 10x - 6\sqrt{3}$, so $\sqrt{3}$ is possible.

(a)(ii) $4x^2 + \frac{6}{x^2} - 4 = 10$

Multiply by x^2: $4x^4 + 6 - 4x^2 = 10x^2$

$4x^4 - 14x^2 + 6 = 0 \qquad 2x^4 - 7x^2 + 3 = 0$

$(2x^2 - 1)(x^2 - 3) = 0 \qquad x^2 = \frac{1}{2}$ or $x^2 = 3$

$x > 0$: $x = \sqrt{3}$ (given) or

$$x = \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$$

(b) $y = 10\sqrt{3} - 6\sqrt{3} = 4\sqrt{3}, \qquad P = (\sqrt{3}, 4\sqrt{3}).$ Normal gradient $= -\frac{1}{10}$

$y - 4\sqrt{3} = -\frac{1}{10}(x - \sqrt{3})$

$$y = -\frac{1}{10}x + \frac{41\sqrt{3}}{10}$$

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Question 8 continued

(c) $f(x) = \int (4x^2 + 6x^{-2} - 4)\,dx = \frac{4}{3}x^3 - 6x^{-1} - 4x + c$

$f(\sqrt{3}) = 4\sqrt{3}$: $\frac{4}{3} \times 3\sqrt{3} - \frac{6}{\sqrt{3}} - 4\sqrt{3} + c = 4\sqrt{3}$

$4\sqrt{3} - 2\sqrt{3} - 4\sqrt{3} + c = 4\sqrt{3}$, $c = 6\sqrt{3}$

$$\boxed{f(x) = \frac{4}{3}x^3 - \frac{6}{x} - 4x + 6\sqrt{3}}$$

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Question 8 continued

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Question 8 continued

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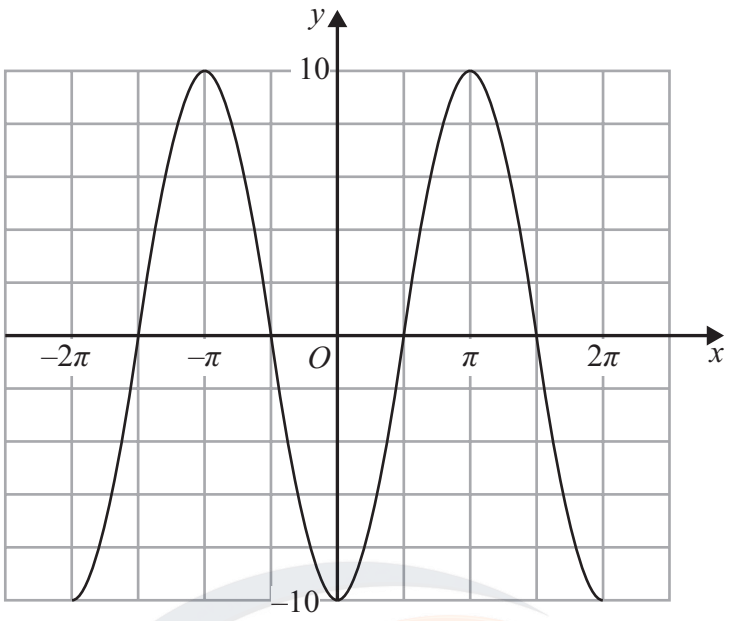


Figure 4

Figure 4 shows a sketch of part of the graph of the trigonometric function with equation $y = f(x)$.

(a) Write down an expression for $f(x)$.

(2)

Copies of Figure 4 (labelled Diagram 1 and Diagram 2) can be found on the following pages.

(b) (i) On Diagram 1 sketch a graph of the curve with equation

$$y = 10 - x^2$$

(ii) Hence find the **number** of solutions of the equation

$$f(x) = 10 - x^2 \quad \text{in the interval} \quad -100\pi \leqslant x \leqslant 100\pi$$

(3)

(c) (i) On Diagram 2 sketch a graph of the curve with equation

$$y = \tan x \qquad -2\pi \leqslant x \leqslant 2\pi$$

(ii) Hence find the **number** of solutions of the equation

$$f(x) = \tan x \quad \text{in the interval} \quad -100\pi \leqslant x \leqslant 100\pi$$

giving a reason for your answer.

(4)

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Question 9 continued

(a)

(a) $f(x) = -10\cos x$

(b)(i)

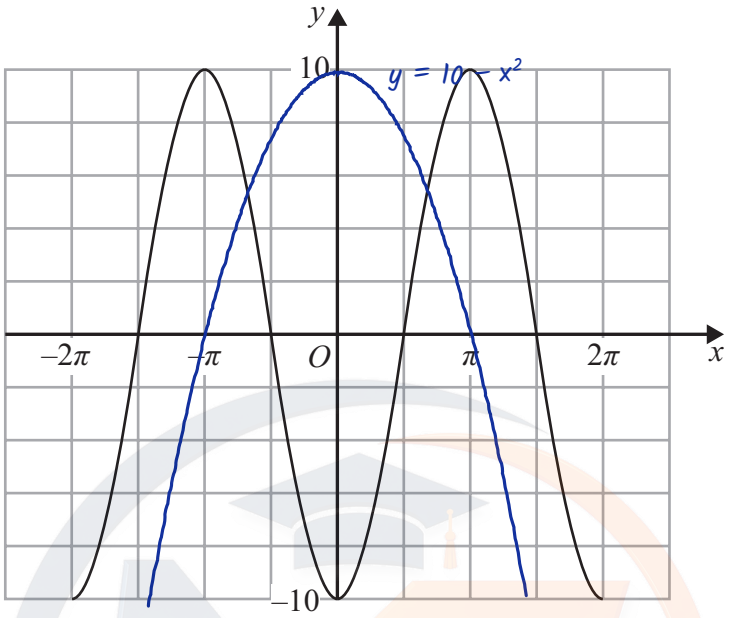
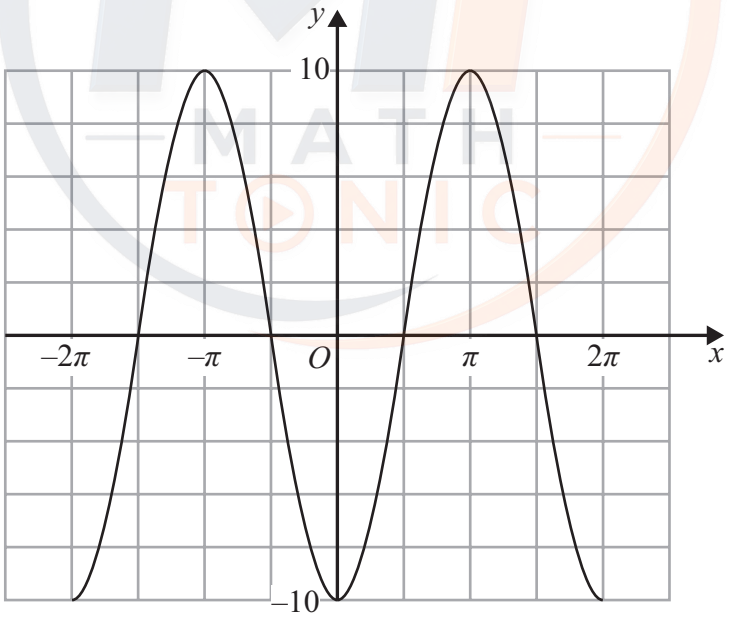


Diagram 1



Copy of Diagram 1

Only use this copy if you need to redraw your graph.

(b)(ii)

(b)(ii) The curves meet at 2 points (near $x = \pm\pi$) and $y = 10 - x^2$ is below -10 for $|x| > \sqrt{20}$, so there are 2 solutions.

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Question 9 continued

(c)(i)

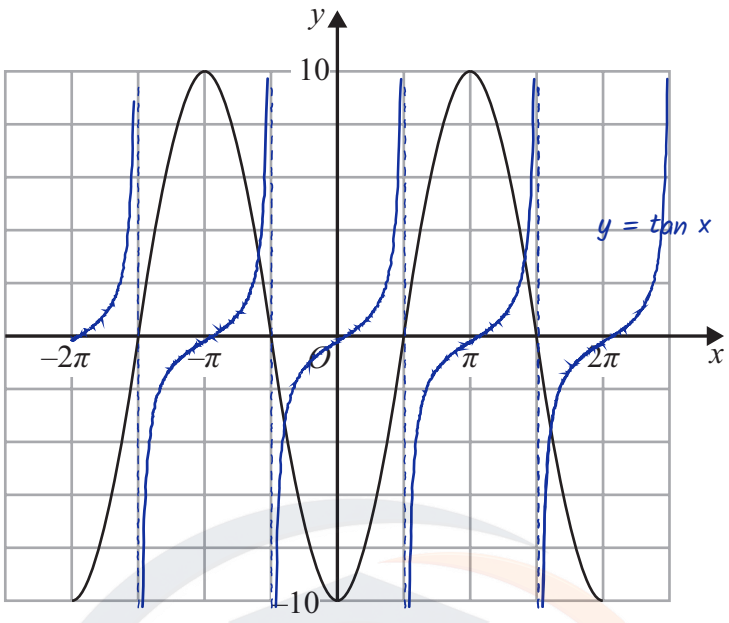
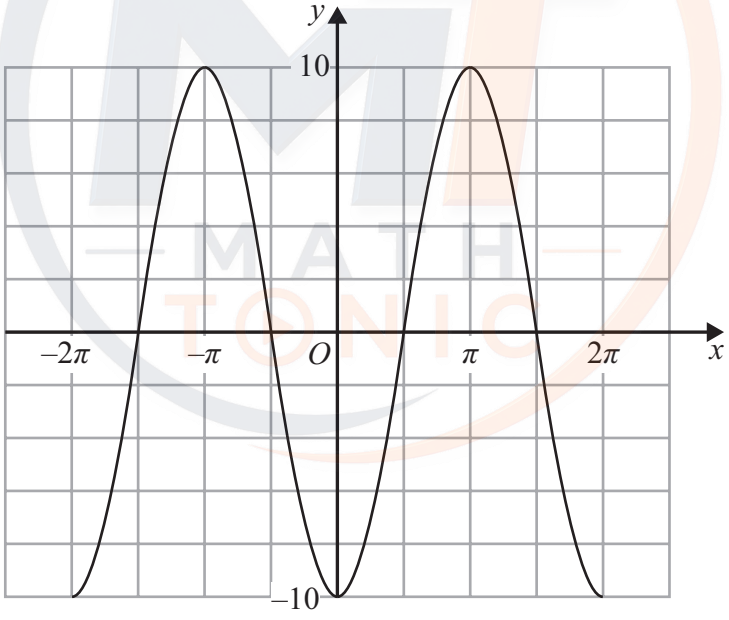


Diagram 2



Copy of Diagram 2

Only use this copy if you need to redraw your graph.

(c)(ii)

(c)(ii) 4 roots in $-2\pi \leq x \leq 2\pi$, and the pattern repeats every 4π, so there are $50 \times 4 = 200$ solutions.

(Total for Question 9 is 9 marks)

TOTAL FOR PAPER IS 75 MARKS

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