Please check the examination details below before entering your candidate information

Candidate surname StemUp Model Solution | Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Thursday 9 October 2025

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 10 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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1. The curve C has equation

$$y = 6x^2 + 3\sqrt{x} + \frac{5}{8} \qquad x > 0$$

(a) Find $\frac{dy}{dx}$ writing the answer in simplest form.

(3)

The point $P\left(\frac{1}{4}, \frac{5}{2}\right)$ lies on C.

(b) Find the equation of the tangent to C at P, writing your answer in the form $y = mx + c$ where m and c are integers.

(3)

(a) $y = 6x^2 + 3x^{1/2} + \frac{5}{8}$

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

(b) At $x = \frac{1}{4}$: $\frac{dy}{dx} = 12 \times \frac{1}{4} + \frac{3}{2} \times \left(\frac{1}{4}\right)^{-1/2}$

$= 3 + \frac{3}{2} \times 2 = 6$

$y - \frac{5}{2} = 6\left(x - \frac{1}{4}\right)$

$y = 6x - \frac{3}{2} + \frac{5}{2}$

$y = 6x + 1$

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Question 1 continued

(Total for Question 1 is 6 marks)

2. Find

$$\int (x-3)^2(2x+5)\,dx$$

writing the answer in simplest form.

(5)

$(x-3)^2 = x^2 - 6x + 9$

$(x-3)^2(2x+5) = (x^2 - 6x + 9)(2x+5)$

$= 2x^3 + 5x^2 - 12x^2 - 30x + 18x + 45$

$= 2x^3 - 7x^2 - 12x + 45$

$\int (2x^3 - 7x^2 - 12x + 45)\,dx$

$= \frac{2x^4}{4} - \frac{7x^3}{3} - \frac{12x^2}{2} + 45x + c$

$= \frac{1}{2}x^4 - \frac{7}{3}x^3 - 6x^2 + 45x + c$

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Question 2 continued

(Total for Question 2 is 5 marks)

3. The sides of a triangle are in the ratio 2 : 4 : 5

(a) Find the size of the **largest** angle of the triangle, in degrees, to one decimal place.

(2)

Given that the area of the triangle is 140 cm^2

(b) find the length of the **shortest** side, in cm, to one decimal place.

(3)

(a) Sides 2x, 4x, 5x. Largest angle θ is opposite 5x.

$$\cos\theta = \frac{(2x)^2 + (4x)^2 - (5x)^2}{2 \times 2x \times 4x} = \frac{4 + 16 - 25}{16} = -\frac{5}{16}$$

$$\theta = \cos^{-1}\left(-\frac{5}{16}\right) = 108.2099...°$$

$$\theta = 108.2°$$

(b) Area $= \frac{1}{2}ab\sin C$: $140 = \frac{1}{2} \times 2x \times 4x \times \sin 108.2099...°$

$$140 = 4x^2 \sin 108.2099...°$$

$$x^2 = \frac{140}{4 \sin 108.2099...°} = 36.845...$$

$$x = \sqrt{36.845...} = 6.0700...$$

Shortest side = 2x = 12.140... = 12.1 cm

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Question 3 continued

(Total for Question 3 is 5 marks)

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

(i) Using the laws of indices, solve

$$3^{2p-5} = \frac{1}{9}\sqrt{27}$$

(3)

(ii) Find the real roots of the equation

$$x^2 + 1 = \frac{36}{x^2 - 4}$$

(4)

(i) $\frac{1}{9} = 3^{-2}$, $\sqrt{27} = (3^3)^{1/2} = 3^{3/2}$

$3^{2p-5} = 3^{-2} \times 3^{3/2} = 3^{-2+3/2} = 3^{-1/2}$

$2p - 5 = -\frac{1}{2} \Rightarrow 2p = \frac{9}{2}$

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

(ii) $(x^2 + 1)(x^2 - 4) = 36$

$x^4 - 4x^2 + x^2 - 4 = 36$

$x^4 - 3x^2 - 40 = 0$

$(x^2 - 8)(x^2 + 5) = 0$

$x^2 = 8$ or $x^2 = -5$ (no real roots)

$x = \pm\sqrt{8} = \pm 2\sqrt{2}$

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Question 4 continued

Question 4 continued

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Question 4 continued

(Total for Question 4 is 7 marks)

5.

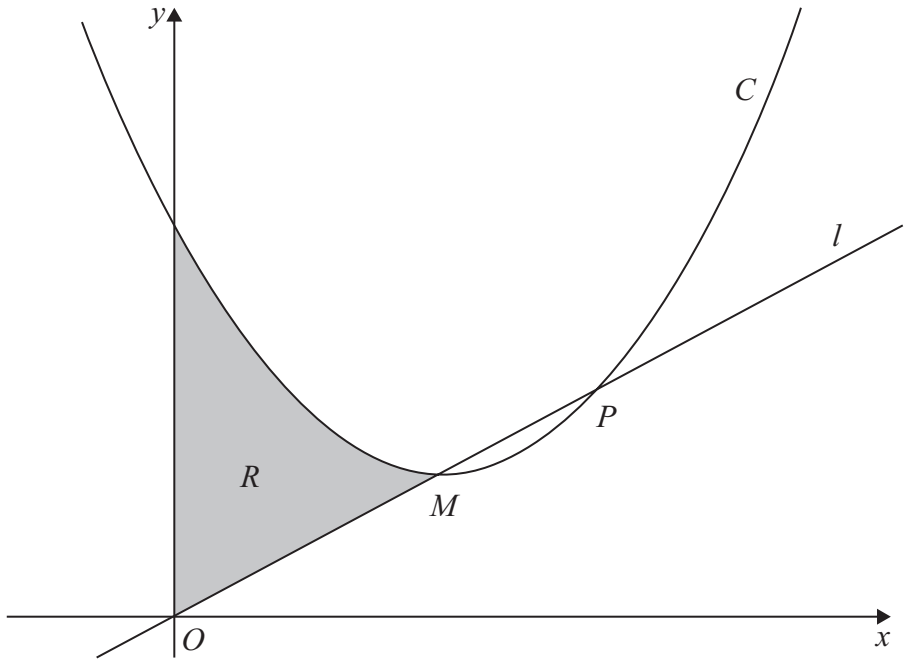


Figure 1

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

(a) Express $2x^2 - 16x + 50$ in the form

$$a(x + b)^2 + c$$

where a, b and c are constants to be found.

(3)

Figure 1 shows a sketch of the curve C with equation $y = 2x^2 - 16x + 50$

Given that in Figure 1

- M is the minimum point on C
- line l passes through the origin and intersects C at the points M and P

(b) find, using algebra and showing your working, the x coordinate of P.

(5)

The region R is shown shaded in Figure 1.

(c) Use inequalities to fully define R.

(2)

(a) $2x^2 - 16x + 50 = 2(x^2 - 8x + 25)$

$= 2[(x - 4)^2 - 16 + 25]$

$= 2(x - 4)^2 + 18$

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Question 5 continued

(b) Minimum point $M = (4, 18)$

l passes through O and M: gradient $= \frac{18}{4} = \frac{9}{2}$, $l: y = \frac{9}{2}x$

$2x^2 - 16x + 50 = \frac{9}{2}x$

$4x^2 - 32x + 100 = 9x$

$4x^2 - 41x + 100 = 0$

$(x - 4)(4x - 25) = 0$

$x = 4$ (at M) or $x = \frac{25}{4}$

x coordinate of P is $\frac{25}{4}$

(c) $\frac{9}{2}x \leqslant y \leqslant 2x^2 - 16x + 50, \quad 0 \leqslant x \leqslant 4$

Question 5 continued

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Question 5 continued

(Total for Question 5 is 10 marks)

6. (a) Sketch the graph of the curve C with equation

$$y = \frac{4k}{x - 2k}$$

where k is a positive constant.

On your sketch show

- the coordinates of any points where C cuts the coordinate axes
- the equation of the vertical asymptote to C

(4)

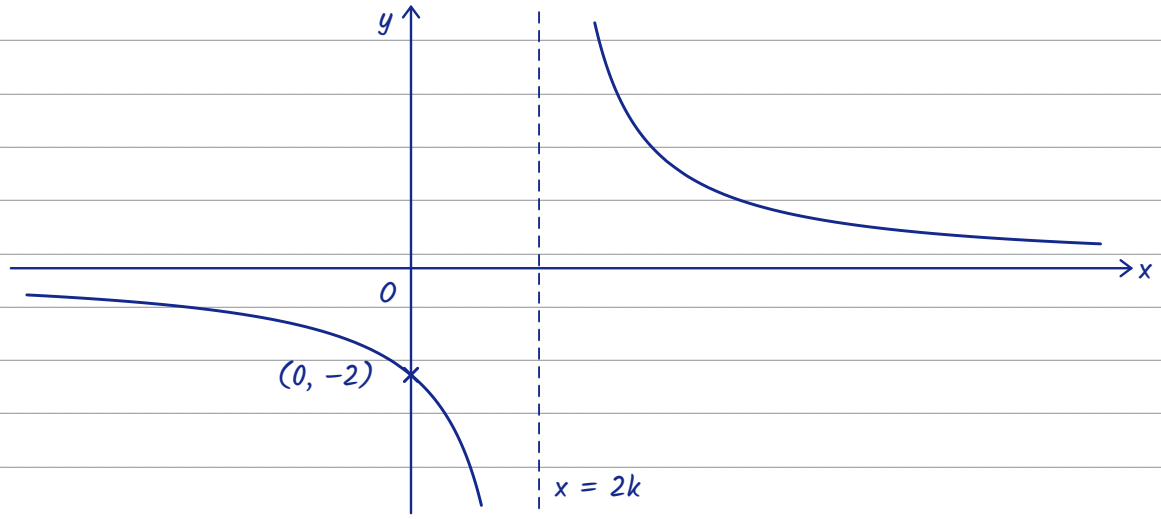
The straight line l has equation

$$y = 6 - 2x$$

Given that there is at least one point of intersection between l and C,

(b) find the range of possible values of k.

(5)



(a) Asymptote $x = 2k$; meets y-axis at $(0, -2)$; no x-axis crossing

(b) $\frac{4k}{x - 2k} = 6 - 2x$

$4k = (6 - 2x)(x - 2k) = 6x - 12k - 2x^2 + 4kx$

$2x^2 - (4k + 6)x + 16k = 0$

At least one intersection: $b^2 - 4ac \geq 0$

$(4k + 6)^2 - 4 \times 2 \times 16k \geq 0$

$16k^2 + 48k + 36 - 128k \geq 0$

$16k^2 - 80k + 36 \geq 0 \Rightarrow 4k^2 - 20k + 9 \geq 0$

$(2k - 1)(2k - 9) \geq 0$: critical values $k = \frac{1}{2}, \frac{9}{2}$

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Question 6 continued

Outside region: $k \leq \frac{1}{2}$ or $k \geq \frac{9}{2}$

$k > 0$, so $0 < k \leq \frac{1}{2}$ or $k \geq \frac{9}{2}$

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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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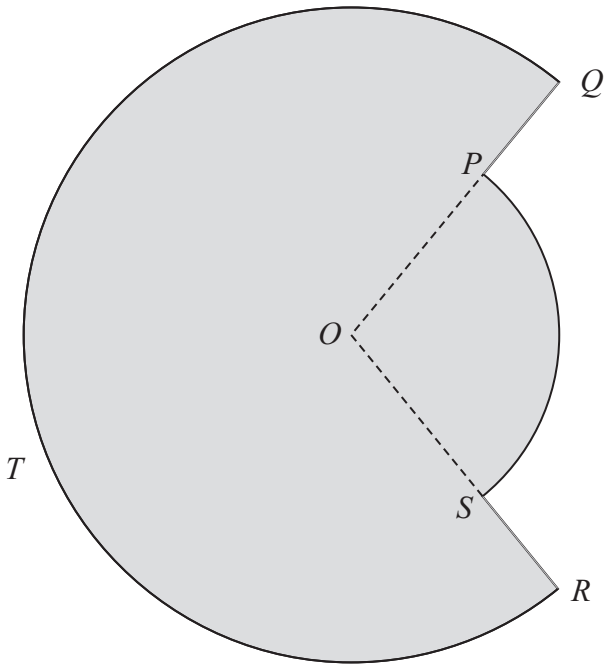


Figure 2

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

Figure 2 shows the plan view of a design for a swimming pool.

The design consists of a sector POS of a circle centre O joined to a major sector $QORTQ$ of a different circle, also with centre O.

Given that

- angle POS is 1.65 radians
- the area of sector POS is $30\,m^2$
- $PQ = 2.8\,m$

(a) show that, to 3 significant figures, $OQ = 8.83\,m$

(3)

(b) Find the total surface area of the swimming pool in m^2 to the nearest integer.

(3)

(c) Find the total perimeter of the swimming pool in metres to 2 significant figures.

(3)

(a) Sector POS: $\frac{1}{2} r^2 \times 1.65 = 30$

$r^2 = \frac{60}{1.65} = 36.3636\ldots \Rightarrow r = OP = 6.0302\ldots\ m$

$OQ = OP + PQ = 6.0302\ldots + 2.8 = 8.8302\ldots$

$OQ = 8.83\ m\ (3\ s.f.)$

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Question 7 continued

(b) Reflex angle QOR = $2\pi - 1.65 = 4.6331...$ rad

Major sector QORTQ = $\frac{1}{2} \times 8.83^2 \times 4.6331... = 180.62...$

Total area = $180.62... + 30 = 210.62...$

Total surface area = 211 m^2

(c) Arc PS = $6.0302... \times 1.65 = 9.9498...$

Arc QTR = $8.83 \times (2\pi - 1.65) = 8.83 \times 4.6331... = 40.911...$

Perimeter = $9.9498... + 40.911... + 2 \times 2.8 = 56.46...$

Perimeter = 56 m (2 s.f.)

Question 7 continued

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Question 7 continued

(Total for Question 7 is 9 marks)

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

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

Given that

- $f'(x) = 2x + \frac{8}{x^2} + k$, where k is a constant
- the equation of the tangent to the curve at $x = \sqrt{2}$ is $y = 5x - 3\sqrt{2}$

(a) find the exact value of k.

(2)

(b) Find an equation of the normal to the curve at $x = \sqrt{2}$

(2)

(c) Find $f(x)$, writing your answer in simplest form.

(4)

(a) Gradient of tangent at $x = \sqrt{2}$ is 5, so $f'(\sqrt{2}) = 5$

$2\sqrt{2} + \frac{8}{(\sqrt{2})^2} + k = 5 \Rightarrow 2\sqrt{2} + 4 + k = 5$

$k = 1 - 2\sqrt{2}$

(b) $x = \sqrt{2}$: $y = 5\sqrt{2} - 3\sqrt{2} = 2\sqrt{2}$

Gradient of normal $= -\frac{1}{5}$

$y - 2\sqrt{2} = -\frac{1}{5}(x - \sqrt{2})$

$y = -\frac{1}{5}x + \frac{11\sqrt{2}}{5}$

(c) $f(x) = \int (2x + 8x^{-2} + 1 - 2\sqrt{2})\,dx$

$= \frac{2x^2}{2} + \frac{8x^{-1}}{-1} + (1 - 2\sqrt{2})x + c$

$= x^2 - \frac{8}{x} + (1 - 2\sqrt{2})x + c$

At $(\sqrt{2}, 2\sqrt{2})$: $2\sqrt{2} = (\sqrt{2})^2 - \frac{8}{\sqrt{2}} + (1 - 2\sqrt{2})\sqrt{2} + c$

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

$c = 2 + 5\sqrt{2}$

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Question 8 continued

$f(x) = x^2 - \frac{8}{x} + (1 - 2\sqrt{2})x + 2 + 5\sqrt{2}$

Question 8 continued

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Question 8 continued

(Total for Question 8 is 8 marks)

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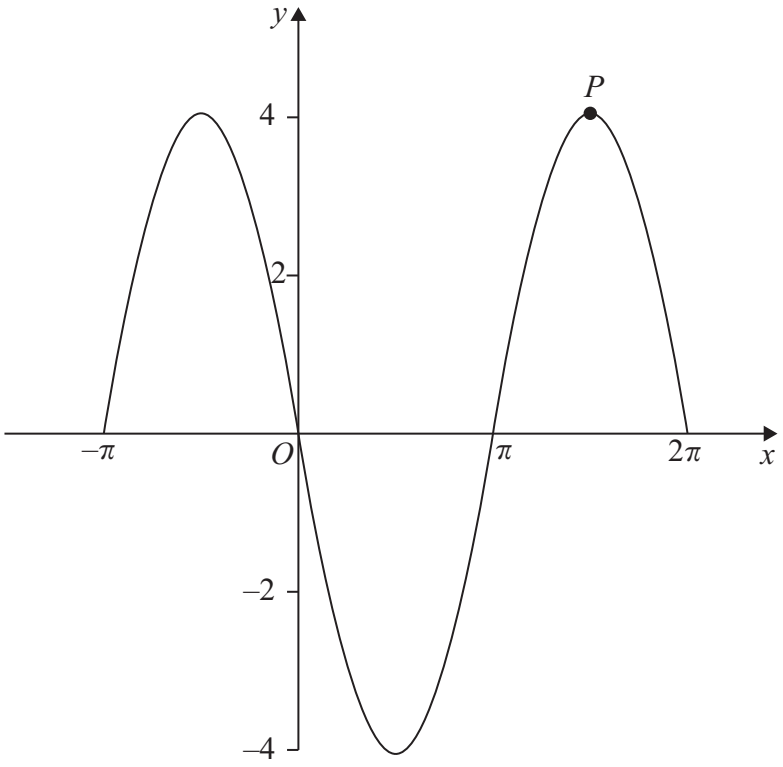


Figure 3

Figure 3 shows a sketch of part of the graph of the trigonometric function with equation $y = \mathrm{f}(x)$

(a) Write down an expression for $\mathrm{f}(x)$

(2)

The point P lies on $y = \mathrm{f}(x)$ and is shown in Figure 3.

(b) State the coordinates of the point to which P is transformed when the graph of $y = \mathrm{f}(x)$ is transformed to the graph with equation

(i) $y = \mathrm{f}\left(x - \frac{\pi}{6}\right)$

(2)

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

(2)

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Question 9 continued

(a) Amplitude 4, period 2π, decreasing through 0:

$f(x) = -4 \sin x$

(b) P is the maximum at $\left(\frac{3\pi}{2}, 4\right)$

(i) x: $\frac{3\pi}{2} + \frac{\pi}{6} = \frac{10\pi}{6} = \frac{5\pi}{3}$; y unchanged

$\left(\frac{5\pi}{3}, 4\right)$

(ii) x unchanged; y: $-\frac{1}{2} \times 4 = -2$

$\left(\frac{3\pi}{2}, -2\right)$

(Total for Question 9 is 6 marks)

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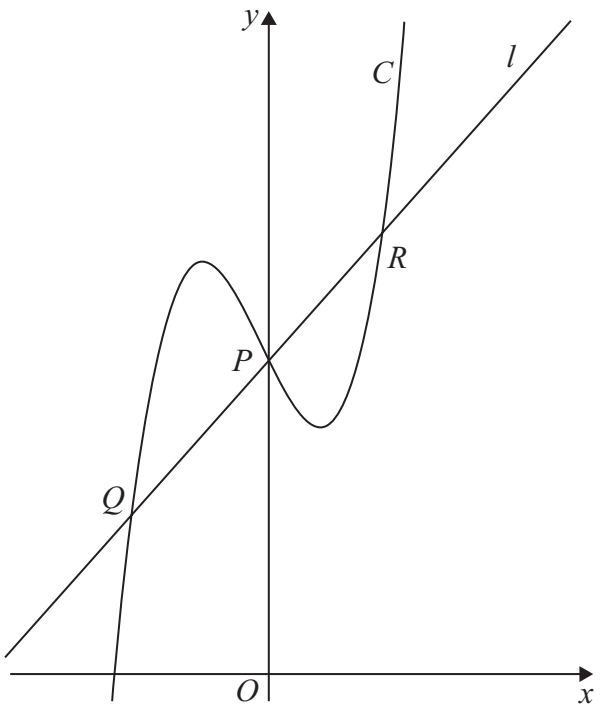


Figure 4

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

Figure 4 shows a sketch of the curve C with equation

$$y = 2x^3 + \frac{1}{2}x^2 - 2x + 5$$

The line l is the normal to C at the point P where $x = 0$

The line l also intersects C at points Q and R as shown in Figure 4.

(a) Find, using algebra, the x coordinate of point Q.

(6)

The point T lies on C.

Given that

- the tangent to C at T is parallel to l
- the x coordinate of T is positive

(b) find, using algebra, the exact x coordinate of T.

(4)

(a) $\frac{dy}{dx} = 6x^2 + x - 2$; at $x = 0$: $\frac{dy}{dx} = -2$

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Question 10 continued

$P = (0, 5)$. Gradient of normal $= \frac{1}{2}$

l: $y = \frac{1}{2}x + 5$

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

$4x^3 + x^2 - 4x = x \Rightarrow 4x^3 + x^2 - 5x = 0$

$x(4x^2 + x - 5) = 0$

$x(4x + 5)(x - 1) = 0$

$x = 0$ (P), $x = 1$ (R), $x = -\frac{5}{4}$

Q has negative x coordinate: $x = -\frac{5}{4}$

(b) Tangent parallel to l: $6x^2 + x - 2 = \frac{1}{2}$

$12x^2 + 2x - 4 = 1 \Rightarrow 12x^2 + 2x - 5 = 0$

$x = \frac{-2 \pm \sqrt{(2^2 - 4 \times 12 \times (-5))}}{2 \times 12} = \frac{-2 \pm \sqrt{244}}{24} = \frac{-2 \pm 2\sqrt{61}}{24}$

$x > 0$: $x = \frac{-1 + \sqrt{61}}{12}$

Question 10 continued

(Total for Question 10 is 10 marks)

TOTAL FOR PAPER IS 75 MARKS

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