Elite Mathematics
Edexcel International A Level

IAL PURE 1 · WMA11

WMA11/01 May/June 2025 Worked Solutions

May/June 2025 paper rebuilt with the worked solution after each question.

10	2019–2026	Single-paper solutions
paper questions	19 exam sessions	checked by Dr Eslam



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PAST PAPER

WMA11/01 May/June 2025

May/June 2025

10	75	1 h 30
questions	marks	exam time

Each question is followed by its worked solution and final answer.

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Question 1

5 marks | Indices & Surds

1. Given that

$$p = \frac{1}{16}x^4 \qquad q = \frac{40}{x^3}$$

express each of the following in the form kx^n where k and n are fully simplified constants.

(a) $p^{\frac{1}{2}}$

(1)

(b) $(pq)^{-1}$

(2)

(c) pq^2

(2)

(Total for Question 1 is 5 marks)

WORKED SOLUTION

Question 1 · WMA11/01 May/June 2025

1 Simplify p

$p = \frac{1}{16}x^4$.

2 Simplify part (a)

$p^{1/2} = \left(\frac{1}{16}x^4\right)^{1/2} = \frac{1}{4}x^2$.

3 Simplify pq

$pq = \frac{1}{16}x^4 \cdot \frac{40}{x^3} = \frac{5}{2}x$.

4 Simplify part (b)

$(pq)^{-1} = \left(\frac{5}{2}x\right)^{-1} = \frac{2}{5}x^{-1}$.

5 Simplify part (c)

$pq^2 = \frac{1}{16}x^4\left(\frac{40}{x^3}\right)^2 = \frac{1600}{16}x^{-2} = 100x^{-2}$.

FINAL ANSWER

$(a)\ \frac{1}{4}x^2.\quad (b)\ \frac{2}{5}x^{-1}.\quad (c)\ 100x^{-2}.$

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Question 2

5 marks | Differentiation

2. The curve C has equation

$$y = 2x^{\frac{5}{2}} - 4x + 3$$

(a) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ writing your answer in simplest form.

(2)

The point P lies on C.

Given that

- the x coordinate of P is 2^k where k is a constant
- the gradient of C at the point P is 16

(b) find the value of k.

(3)

(Total for Question 2 is 5 marks)

WORKED SOLUTION

Question 2 · WMA11/01 May/June 2025

1 Differentiate

$y = 2x^{5/2} - 4x + 3$, so $\dfrac{dy}{dx} = 2 \cdot \dfrac{5}{2}x^{3/2} - 4 = 5x^{3/2} - 4$.

2 Use the gradient at P

At P, the gradient is 16, so $5x^{3/2} - 4 = 16$.

3 Find x

$5x^{3/2} = 20$, hence $x^{3/2} = 4$.

4 Use x equals 2 to the k

Since the x-coordinate of P is 2^k, we have $(2^k)^{3/2} = 4 = 2^2$.

5 Solve for k

$2^{3k/2} = 2^2$, so $\dfrac{3k}{2} = 2$ and $k = \dfrac{4}{3}$.

FINAL ANSWER

$(a)\ \dfrac{dy}{dx} = 5x^{3/2} - 4.$ $(b)\ k = \dfrac{4}{3}.$

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Question 3

5 marks | Integration

3. Find

$$\int \frac{(x+3)^2}{3\sqrt{x}}\,\mathrm{d}x$$

writing your answer in simplest form.

(5)

(Total for Question 3 is 5 marks)

WORKED SOLUTION

Question 3 · WMA11/01 May/June 2025

1 Expand the numerator

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

2 Divide by the denominator

$$\frac{(x+3)^2}{3\sqrt{x}} = \frac{x^2+6x+9}{3x^{1/2}} = \frac{1}{3}x^{3/2} + 2x^{1/2} + 3x^{-1/2}.$$

3 Integrate term by term

$$\int \left(\frac{1}{3}x^{3/2} + 2x^{1/2} + 3x^{-1/2}\right)dx = \frac{1}{3}\cdot\frac{2}{5}x^{5/2} + 2\cdot\frac{2}{3}x^{3/2} + 3\cdot 2x^{1/2} + c.$$

4 Simplify

$$\frac{2}{15}x^{5/2} + \frac{4}{3}x^{3/2} + 6x^{1/2} + c.$$

✓ **FINAL ANSWER**

$$\frac{2}{15}x^{5/2} + \frac{4}{3}x^{3/2} + 6x^{1/2} + c.$$

Question 4

6 marks | Trigonometric Functions

4.

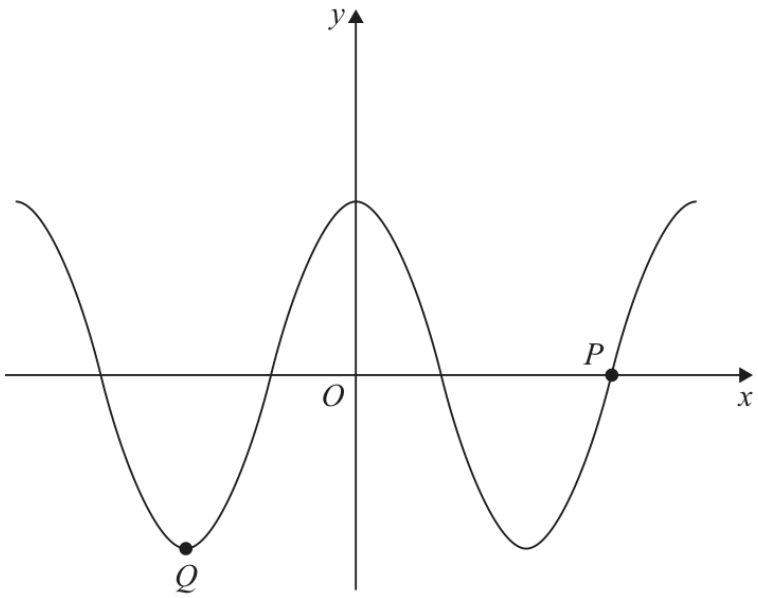


Figure 1

Figure 1 shows a sketch of part of the curve with equation

$$y = 4\cos x$$

where x is measured in degrees.

The points P and Q lie on the curve and are shown in Figure 1.

(a) State the coordinates of P.

(1)

(b) State the coordinates of Q.

(2)

(c) State the **number** of solutions of the equation

(i) $4\cos x = 3$ in the interval $0 < x \leqslant 18\,000°$

(ii) $5 + 4\cos x = 1$ in the interval $-720° < x \leqslant 720°$

(iii) $4\cos x - 3 = 1$ in the interval $-1080° \leqslant x \leqslant 1080°$

(3)

(Total for Question 4 is 6 marks)

1 **Point P**

For $y = 4\cos x$, the x-intercepts occur at $x = 90° + 180°n$. The labelled point P is the right-hand intercept after $180°$, so $P = (270°, 0)$.

2 **Point Q**

The minimum value is -4, reached at $x = 180° + 360°n$. The labelled point on the left is $Q = (-180°, -4)$.

3 **Count part c(i)**

$4\cos x = 3$ has two solutions every $360°$. The interval $0 < x \leq 18000°$ contains 50 full periods, so there are 100 solutions.

4 **Count part c(ii)**

$5 + 4\cos x = 1$ gives $\cos x = -1$. This occurs once every $360°$. In $-720° < x \leq 720°$, the solutions are $-540°, -180°, 180°, 540°$, so there are 4.

5 **Count part c(iii)**

$4\cos x - 3 = 1$ gives $\cos x = 1$. In $-1080° \leq x \leq 1080°$, the multiples of $360°$ are $-1080, -720, -360, 0, 360, 720, 1080$, so there are 7.

✓ **FINAL ANSWER**

$(a)\ P = (270°, 0).\quad (b)\ Q = (-180°, -4).\quad (c)(i)\ 100,\ (ii)\ 4,\ (iii)\ 7.$

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Question 5

7 marks | Straight Line

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

The line l_1 has equation

$$x - 2y + 25 = 0$$

The line l_2 passes through the origin and is perpendicular to l_1

(a) Find an equation for l_2

(2)

The lines l_1 and l_2 intersect at the point P.

(b) Use algebra to find the coordinates of P.

(3)

(c) Hence find the shortest distance from l_1 to the origin.

Write your answer as a fully simplified surd.

(2)

(Total for Question 5 is 7 marks)

WORKED SOLUTION

Question 5 · WMA11/01 May/June 2025

1 Find the gradient of l1

$l_1 : x - 2y + 25 = 0$ gives $y = \frac{1}{2}x + \frac{25}{2}$, so its gradient is $\frac{1}{2}$.

2 Use perpendicular gradient

A line perpendicular to l_1 has gradient -2.

3 Use the origin

Since l_2 passes through the origin, its equation is $y = -2x$.

4 Find the intersection

Substitute $y = -2x$ into $x - 2y + 25 = 0$ to get $x + 4x + 25 = 0$.

5 Coordinates of I

$5x + 25 = 0$, so $x = -5$ and $y = 10$. Hence $I = (-5, 10)$.

6 Shortest distance from I to origin

The distance is $\sqrt{(-5)^2+10^2}=\sqrt{125}=5\sqrt{5}$.

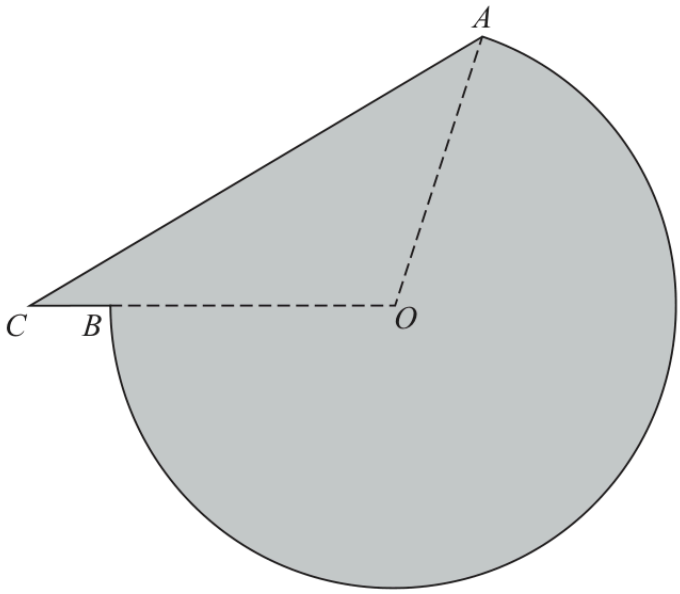
FINAL ANSWER

$(a)\ y=-2x.\quad (b)\ I=(-5,10).\quad (c)\ 5\sqrt{5}.$

Question 6

9 marks | Radians

6.



Not to scale

Figure 2

The shaded area in Figure 2 shows the plan view of a helicopter landing pad.

The area consists of the major sector AOB of a circle centre O joined to a triangle AOC.

Given that

- $AO = OB = 15\,\text{m}$
- $BC = 2\,\text{m}$
- CBO is a straight line
- angle $ACO = 0.6$ radians

(a) show that angle COA is 1.847 radians to 3 decimal places.

(3)

(b) Find the total area of the helicopter landing pad.
Give your answer in m^2 to 3 significant figures.

(3)

(c) Find the perimeter of the helicopter landing pad.
Give your answer in metres to 3 significant figures.

(3)

(Total for Question 6 is 9 marks)

1 Set up triangle AOC

$AO = 15$, $OC = OB + BC = 17$, and $\angle ACO = 0.6$.

2 Use the sine rule

$\dfrac{\sin \angle CAO}{17} = \dfrac{\sin 0.6}{15}$, so $\angle CAO \approx 0.6944$ radians.

3 Show angle COA

$\angle COA = \pi - 0.6 - 0.6944\ldots = 1.847\ldots$, so $\angle COA = 1.847$ radians to 3 decimal places.

4 Major sector angle

The shaded sector is the major sector AOB, so its angle is $2\pi - 1.847\ldots$.

5 Sector area

$\text{Sector area} = \dfrac{1}{2}(15)^2(2\pi - 1.847\ldots) = 499.15\ldots$.

6 Triangle area

$\text{Area } AOC = \dfrac{1}{2}(15)(17)\sin(1.847\ldots) = 122.73\ldots$.

7 Total area

$499.15\ldots + 122.73\ldots = 621.88\ldots$, so the total area is $622\ \text{m}^2$ to 3 significant figures.

8 Find AC

By the cosine rule, $AC^2 = 15^2 + 17^2 - 2(15)(17)\cos(1.847\ldots)$, so $AC \approx 27.57$ m.

9 Major arc length

$\text{arc } AB = 15(2\pi - 1.847\ldots) = 66.54\ldots$ m.

10 Perimeter

$66.54\ldots + 27.57\ldots = 94.11\ldots$, so the perimeter is $94.1\ \text{m}$.

FINAL ANSWER

$(a)\ \angle COA = 1.847\ \text{rad}.$ $(b)\ 622\ \text{m}^2.$ $(c)\ 94.1\ \text{m}.$

Question 7

10 marks | Graphs of Functions

7.

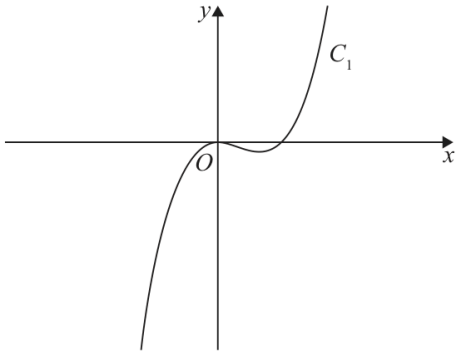


Figure 3

Figure 3 shows a sketch of part of the curve C_1

Given that C_1

- has equation $y = \mathrm{f}(x)$ where $\mathrm{f}(x)$ is a cubic function
- touches the x-axis at the origin and cuts the x-axis at $x = 4$
- passes through the point $(10, 120)$

(a) find $\mathrm{f}(x)$

(3)

The curve C_2 has equation $y = 1.2x(8 - x)$

On the following page there is a copy of Figure 3 called Diagram 1.

(b) On Diagram 1 sketch a graph of the curve C_2

(2)

(c) Use algebra to find the coordinates of the points where C_1 and C_2 intersect. Show each stage of your working.

(5)

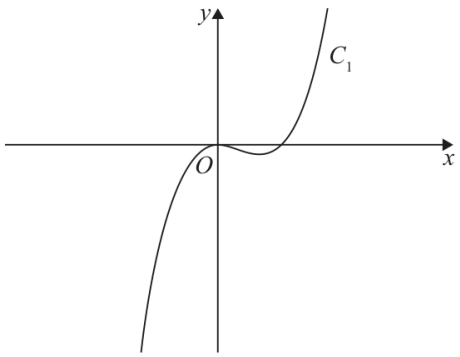


Diagram 1

(Total for Question 7 is 10 marks)

1 **Use the repeated root at the origin**

Since the cubic touches the x-axis at the origin and cuts it at $x = 4$, write $f(x) = \lambda x^2(x - 4)$.

2 **Use the point (10,120)**

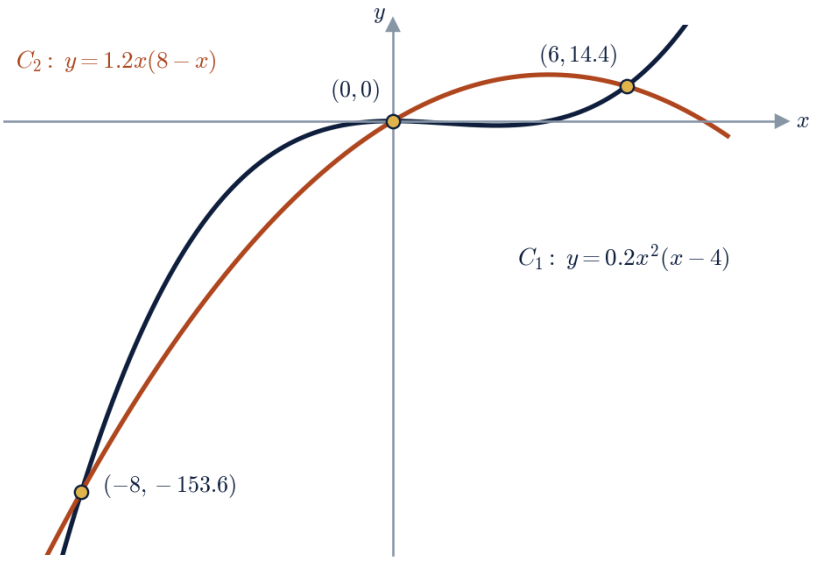
$120 = \lambda(10)^2(10 - 4) = 600\lambda$, so $\lambda = 0.2$.

3 **State f(x)**

$f(x) = 0.2x^2(x - 4)$.

4 **Sketch C2**

$C_2 : y = 1.2x(8 - x)$ is a downward-opening parabola through $x = 0$ and $x = 8$, with its maximum between them.



5 **Set intersections equal**

$1.2x(8 - x) = 0.2x^2(x - 4)$.

6 **Clear decimals**

Divide by 0.2 to get $6x(8 - x) = x^2(x - 4)$.

7 **Factor**

$48x - 6x^2 = x^3 - 4x^2$, so $x^3 + 2x^2 - 48x = 0$ and $x(x^2 + 2x - 48) = 0$.

8 **Solve for x**

$x = 0$, or $x^2 + 2x - 48 = 0 = (x + 8)(x - 6)$, so $x = -8$ or $x = 6$.

9 **Find y-values**

Using $y = 1.2x(8 - x)$ gives $(-8, -153.6)$, $(0, 0)$ and $(6, 14.4)$.

FINAL ANSWER

$(a)\ f(x) = 0.2x^2(x-4).$ $(c)\ (-8, -153.6),\ (0, 0),\ (6, 14.4).$

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Question 8

11 marks | Integration

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

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

The point $P(4, 12)$ lies on the curve.

Given that

- $f'(x) = 3\sqrt{x} + kx^2$ where k is a constant
- the equation of the tangent to the curve at P has equation $y = 10x + c$ where c is a constant

(a) (i) show that $k = \frac{1}{4}$

(ii) find the value of c

(4)

(b) Hence find the value of $f''(x)$ at P.

(3)

(c) Find $f(x)$.

(4)

(Total for Question 8 is 11 marks)

WORKED SOLUTION

Question 8 · WMA11/01 May/June 2025

1 Use the tangent gradient

The tangent at P has equation $y = 10x + c$, so the gradient at P is 10.

2 Show k

$f'(4) = 3\sqrt{4} + k(4)^2 = 6 + 16k = 10$, so $16k = 4$ and $k = \frac{1}{4}$.

3 Find c

Substitute $P(4, 12)$ into $y = 10x + c$: $12 = 40 + c$, so $c = -28$.

4 Differentiate f prime

With $k = \frac{1}{4}$, $f'(x) = 3x^{1/2} + \frac{1}{4}x^2$.

5 **Find f double prime**

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

6 **Evaluate at P**

$$f''(4) = \frac{3}{2}\cdot\frac{1}{2} + 2 = \frac{3}{4} + 2 = \frac{11}{4}.$$

7 **Integrate f prime**

$$f(x) = \int \left(3x^{1/2} + \frac{1}{4}x^2\right)dx = 2x^{3/2} + \frac{1}{12}x^3 + d.$$

8 **Use P to find d**

$$12 = 2(4^{3/2}) + \frac{1}{12}(4^3) + d = 16 + \frac{16}{3} + d.$$

9 **State f(x)**

$d = -\dfrac{28}{3}$, so $f(x) = 2x^{3/2} + \dfrac{1}{12}x^3 - \dfrac{28}{3}$.

✓ **FINAL ANSWER**

$(a)(i)\ k = \dfrac{1}{4}.$ $(a)(ii)\ c = -28.$ $(b)\ f''(P) = \dfrac{11}{4}.$ $(c)\ f(x) = 2x^{3/2} + \dfrac{1}{12}x^3 - \dfrac{28}{3}.$

Question 9

10 marks | Transformations

9.

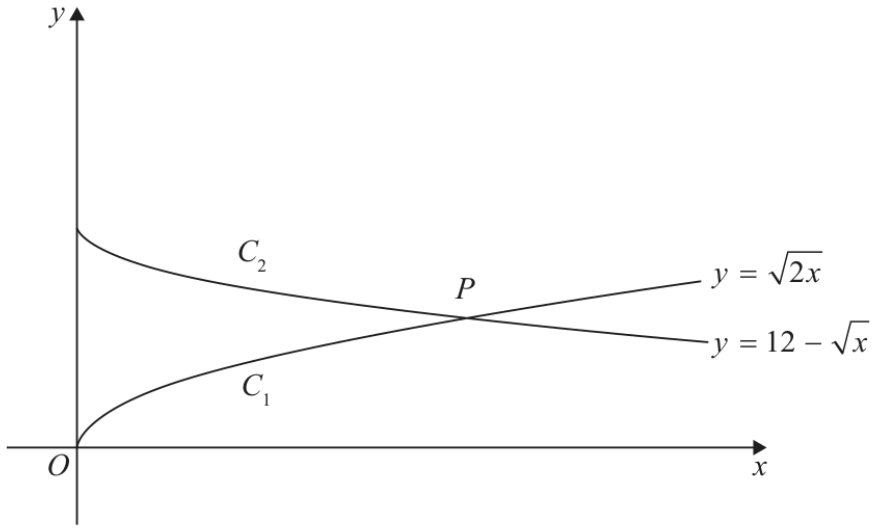


Figure 4

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

Figure 4 shows a sketch of

- the graph C_1 with equation $y = \sqrt{2x}$
- the graph C_2 with equation $y = 12 - \sqrt{x}$

(a) Describe fully the single transformation that would transform

(i) the graph with equation $y = \sqrt{x}$ onto C_1

(ii) the graph with equation $y = -\sqrt{x}$ onto C_2

(4)

The graphs C_1 and C_2 meet at the point P, as shown in Figure 4.

(b) (i) Show that the x coordinate of P is a solution of

$$\sqrt{x} = 12\left(\sqrt{2} - 1\right)$$

(ii) Hence find, in simplest form, the exact coordinates of P.

(6)

(Total for Question 9 is 10 marks)

1 **Transform y equals root x to C1**

C_1 has equation $y = \sqrt{2x}$. This is obtained from $y = \sqrt{x}$ by a stretch parallel to the x-axis with scale factor $\frac{1}{2}$.

2 **Equivalent description**

Equivalently, $y = \sqrt{2x} = \sqrt{2}\sqrt{x}$ is a stretch parallel to the y-axis with scale factor $\sqrt{2}$. The mark scheme also accepts the horizontal stretch description.

3 **Translate the reflected curve**

C_2 has equation $y = 12 - \sqrt{x} = -\sqrt{x} + 12$, so it is a translation of $y = -\sqrt{x}$ by $\begin{pmatrix} 0 \\ 12 \end{pmatrix}$.

4 **Set the curves equal**

At P, $\sqrt{2x} = 12 - \sqrt{x}$.

5 **Factor out root x**

$\sqrt{2}\sqrt{x} + \sqrt{x} = 12$, so $(\sqrt{2}+1)\sqrt{x} = 12$.

6 **Rationalise**

$$\sqrt{x} = \frac{12}{\sqrt{2}+1} = \frac{12(\sqrt{2}-1)}{(\sqrt{2}+1)(\sqrt{2}-1)} = 12(\sqrt{2}-1).$$

7 **Find x**

$x = [12(\sqrt{2}-1)]^2 = 144(3-2\sqrt{2})$.

8 **Find y**

$y = \sqrt{2x} = \sqrt{2}\sqrt{x} = \sqrt{2}\cdot 12(\sqrt{2}-1) = 24 - 12\sqrt{2}$.

FINAL ANSWER

$(a)(i)$ stretch parallel to the x-axis scale factor $\frac{1}{2}$ (equivalently vertical stretch scale factor $\sqrt{2}$).

$(a)(ii)$ translation by $\begin{pmatrix} 0 \\ 12 \end{pmatrix}$.

(b) $P = (144(3-2\sqrt{2}),\ 24 - 12\sqrt{2})$.

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Question 10

7 marks | Quadratics

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

$(k-1)x^6 + 4x^3 + (k-4) = 0$ where k is a constant

(a) Find the exact solutions to the given equation for $k = 4.5$

(3)

(b) Find the set of possible values of k for which the given equation has no real roots.

(4)

(Total for Question 10 is 7 marks)

WORKED SOLUTION

Question 10 · WMA11/01 May/June 2025

1 Substitute k equals 4.5

The equation becomes $3.5x^6 + 4x^3 + 0.5 = 0$.

2 Clear decimals

Multiplying by 2 gives $7x^6 + 8x^3 + 1 = 0$.

3 Use a quadratic in x cubed

$7x^6 + 8x^3 + 1 = (x^3 + 1)(7x^3 + 1) = 0$.

4 Solve for x

$x^3 = -1$ or $x^3 = -\frac{1}{7}$, so $x = -1$ or $x = -\sqrt[3]{\frac{1}{7}}$.

5 View the equation as a quadratic

Let $u = x^3$. Then the equation is $(k-1)u^2 + 4u + (k-4) = 0$.

6 Use no real roots

Since every real value of u gives a real x, the original equation has no real roots exactly when this quadratic in u has no real roots.

7 Use the discriminant

Require $b^2 - 4ac < 0$: $16 - 4(k-1)(k-4) < 0$.

8 **Simplify**

$16 - 4(k^2 - 5k + 4) < 0$ gives $20k - 4k^2 < 0$, so $4k(5 - k) < 0$.

9 **Solve the inequality**

$4k(5 - k) < 0$ for $k < 0$ or $k > 5$.

FINAL ANSWER

$(a)\ x = -1,\ -\sqrt[3]{\frac{1}{7}}.$ $(b)\ k < 0$ or $k > 5$.