1 Points A and B have coordinates $(5, 2)$ and $(10, -1)$ respectively.

(a) Find the equation of the perpendicular bisector of AB. [3]

(b) Find the equation of the circle with centre A which passes through B. [3]

2 The first, second and third terms of an arithmetic progression are a, $2a$ and a^2 respectively, where a is a positive constant.

Find the sum of the first 50 terms of the progression. [5]

3 **(a)** Find the set of values of k for which the equation $8x^2 + kx + 2 = 0$ has no real roots. [2]

(b) Solve the equation $8\cos^2\theta - 10\cos\theta + 2 = 0$ for $0° \leqslant \theta \leqslant 180°$. [3]

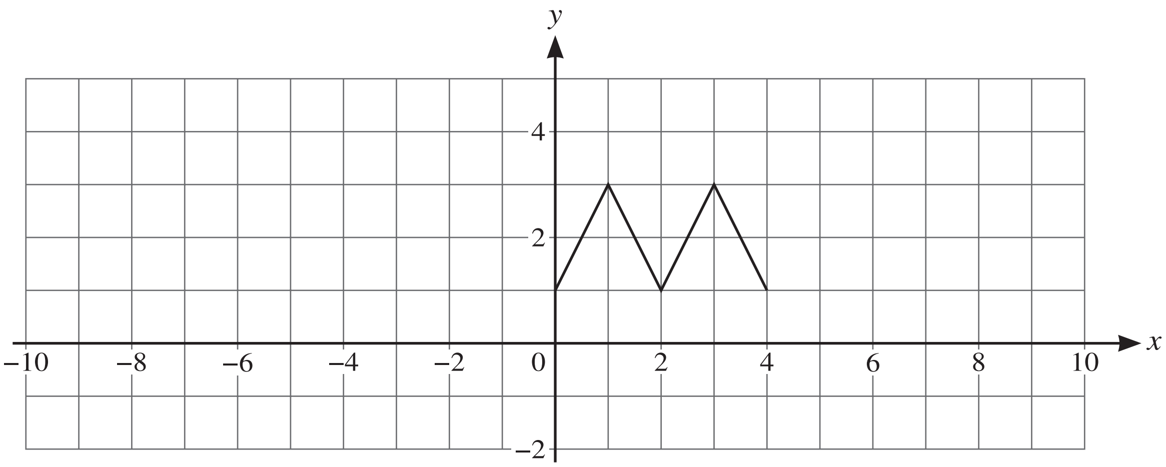
4 A geometric progression is such that the third term is 1764 and the sum of the second and third terms is 3444.

Find the 50th term. [4]

5 The graph with equation $y = \mathrm{f}(x)$ is transformed to the graph with equation $y = \mathrm{g}(x)$ by a stretch in the x-direction with factor 0.5, followed by a translation of $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$.

(a) The diagram below shows the graph of $y = \mathrm{f}(x)$.

On the diagram sketch the graph of $y = \mathrm{g}(x)$. [3]



(b) Find an expression for $\mathrm{g}(x)$ in terms of $\mathrm{f}(x)$. [2]

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6 The equation of a curve is $y = 4x^2 + 20x + 6$.

(a) Express the equation in the form $y = a(x + b)^2 + c$, where a, b and c are constants. [3]

(b) Hence solve the equation $4x^2 + 20x + 6 = 45$. [3]

(c) Sketch the graph of $y = 4x^2 + 20x + 6$ showing the coordinates of the stationary point. You are not required to indicate where the curve crosses the x- and y-axes. [3]

7 **(a)** Prove the identity $\frac{\sin\theta}{\sin\theta+\cos\theta}+\frac{\cos\theta}{\sin\theta-\cos\theta}\equiv\frac{\tan^2\theta+1}{\tan^2\theta-1}$. [3]

(b) Hence find the exact solutions of the equation $\dfrac{\sin\theta}{\sin\theta + \cos\theta} + \dfrac{\cos\theta}{\sin\theta - \cos\theta} = 2$ for $0 \leqslant \theta \leqslant \pi$. [4]

8 The equation of a curve is such that $\frac{dy}{dx} = 3x^{\frac{1}{2}} - 3x^{-\frac{1}{2}}$. The curve passes through the point (3, 5).

(a) Find the equation of the curve. [4]

(b) Find the x-coordinate of the stationary point. [2]

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(c) State the set of values of x for which y increases as x increases. [1]

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9 Functions f and g are defined by

$$\mathrm{f}(x) = x + \frac{1}{x} \quad \text{for } x > 0,$$
$$\mathrm{g}(x) = ax + 1 \quad \text{for } x \in \mathbb{R},$$

where a is a constant.

(a) Find an expression for $\mathrm{gf}(x)$. [1]

(b) Given that $\mathrm{gf}(2) = 11$, find the value of a. [2]

(c) Given that the graph of $y = \mathrm{f}(x)$ has a minimum point when $x = 1$, explain whether or not f has an inverse. [1]

It is given instead that $a = 5$.

(d) Find and simplify an expression for $g^{-1}f(x)$. [3]

(e) Explain why the composite function fg cannot be formed. [1]

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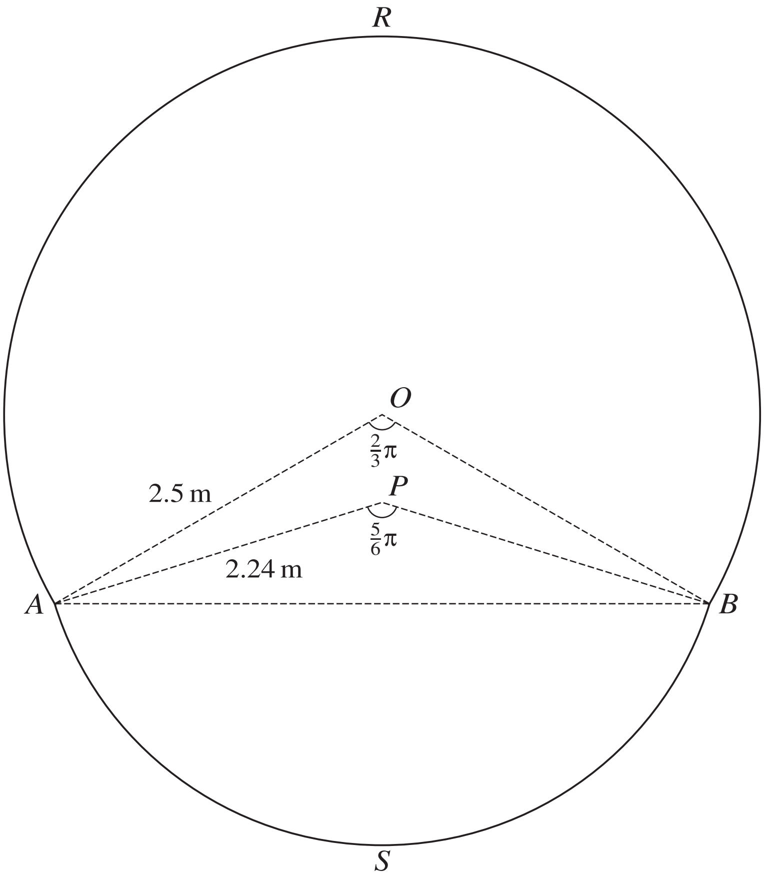

The diagram shows a cross-section *RASB* of the body of an aircraft. The cross-section consists of a sector *OARB* of a circle of radius 2.5 m, with centre *O*, a sector *PASB* of another circle of radius 2.24 m with centre *P* and a quadrilateral *OAPB*. Angle $AOB = \frac{2}{3}\pi$ and angle $APB = \frac{5}{6}\pi$.

(a) Find the perimeter of the cross-section *RASB*, giving your answer correct to 2 decimal places. [3]

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(b) Find the difference in area of the two triangles *AOB* and *APB*, giving your answer correct to 2 decimal places. [2]

(c) Find the area of the cross-section *RASB*, giving your answer correct to 1 decimal place. [3]

11 **(a)** Find the coordinates of the minimum point of the curve $y = \frac{9}{4}x^2 - 12x + 18$. [3]

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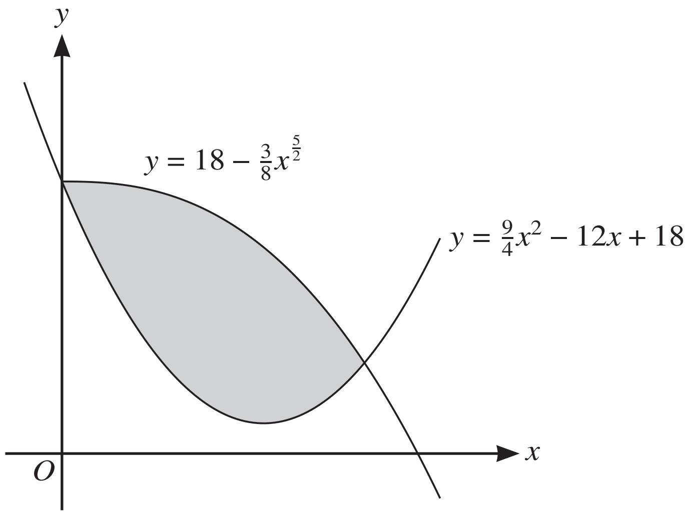

The diagram shows the curves with equations $y = \frac{9}{4}x^2 - 12x + 18$ and $y = 18 - \frac{3}{8}x^{\frac{5}{2}}$. The curves intersect at the points (0, 18) and (4, 6).

(b) Find the area of the shaded region. [5]

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(c) A point P is moving along the curve $y = 18 - \frac{3}{8}x^{\frac{5}{2}}$ in such a way that the x-coordinate of P is increasing at a constant rate of 2 units per second.

Find the rate at which the y-coordinate of P is changing when $x = 4$. [3]