1 A line has equation $y = 3x - 2k$ and a curve has equation $y = x^2 - kx + 2$, where k is a constant.

Show that the line and the curve meet for all values of k. [4]

2   A function f is defined by $f(x) = x^2 - 2x + 5$ for $x \in \mathbb{R}$. A sequence of transformations is applied in the following order to the graph of $y = f(x)$ to give the graph of $y = g(x)$.

Stretch parallel to the x-axis with scale factor $\frac{1}{2}$

Reflection in the y-axis

Stretch parallel to the y-axis with scale factor 3

Find $g(x)$, giving your answer in the form $ax^2 + bx + c$, where a, b and c are constants.   [4]

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3 A curve has equation $y = \frac{1}{60}(3x + 1)^2$ and a point is moving along the curve.

Find the x-coordinate of the point on the curve at which the x- and y-coordinates are increasing at the same rate. [4]
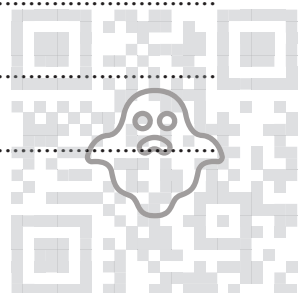
4   The circumference round the trunk of a large tree is measured and found to be 5.00 m. After one year the circumference is measured again and found to be 5.02 m.

   (a) Given that the circumferences at yearly intervals form an arithmetic progression, find the circumference 20 years after the first measurement.   [2]

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   (b) Given instead that the circumferences at yearly intervals form a geometric progression, find the circumference 20 years after the first measurement.   [3]

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5 Points A (7, 12) and B lie on a circle with centre $(-2, 5)$. The line AB has equation $y = -2x + 26$.

Find the coordinates of B. [6]

6 In the expansion of $\left(\dfrac{x}{a} + \dfrac{a}{x^2}\right)^7$, it is given that

$$\frac{\text{the coefficient of } x^4}{\text{the coefficient of } x} = 3.$$

Find the possible values of the constant a. [6]

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7 **(a)** By first obtaining a quadratic equation in $\cos\theta$, solve the equation

$$\tan\theta\sin\theta = 1$$

for $0° < \theta < 360°$. [5]

(b) Show that $\dfrac{\tan\theta}{\sin\theta} - \dfrac{\sin\theta}{\tan\theta} \equiv \tan\theta\sin\theta.$ [3]

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$\dfrac{\tan\theta}{\sin\theta} - \dfrac{\sin\theta}{\tan\theta} \equiv \tan\theta\sin\theta.$ ....
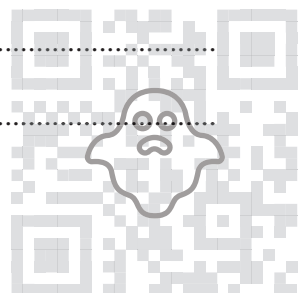
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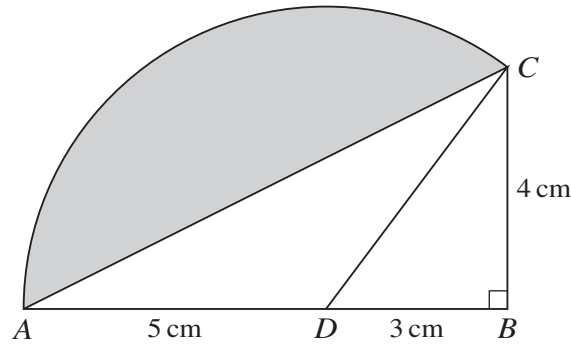
The diagram shows triangle ABC in which angle B is a right angle. The length of AB is $8\,\text{cm}$ and the length of BC is $4\,\text{cm}$. The point D on AB is such that $AD = 5\,\text{cm}$. The sector DAC is part of a circle with centre D.

(a) Find the perimeter of the shaded region. [5]

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(b) Find the area of the shaded region. [3]

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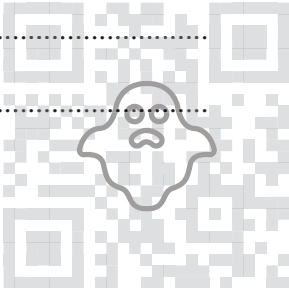..

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Find the area of the shaded region..

9 The function f is defined by $f(x) = -3x^2 + 2$ for $x \leqslant -1$.

(a) State the range of f. [1]

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(b) Find an expression for $f^{-1}(x)$. [3]

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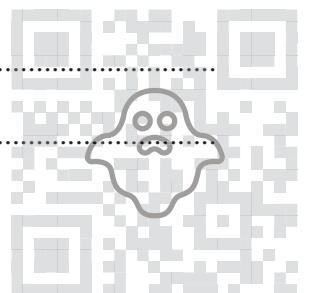
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The function g is defined by $g(x) = -x^2 - 1$ for $x \leqslant -1$.

(c) Solve the equation $fg(x) - gf(x) + 8 = 0$. [5]

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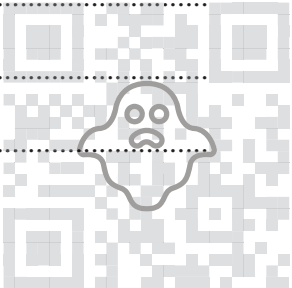
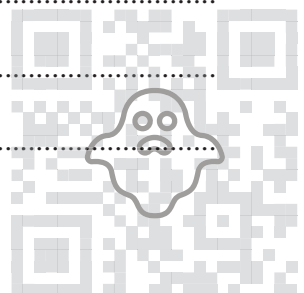The function g is defined by $g(x) = -x^2 - 1$ for $x \leqslant -1$.

10 At the point $(4, -1)$ on a curve, the gradient of the curve is $-\frac{3}{2}$. It is given that $\dfrac{dy}{dx} = x^{-\frac{1}{2}} + k$, where k is a constant.

(a) Show that $k = -2$. [1]

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

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(c) Find the coordinates of the stationary point. [3]

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(d) Determine the nature of the stationary point. [2]

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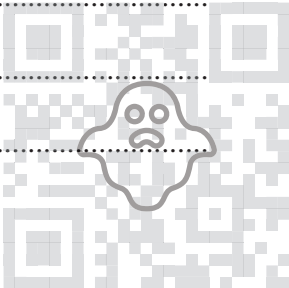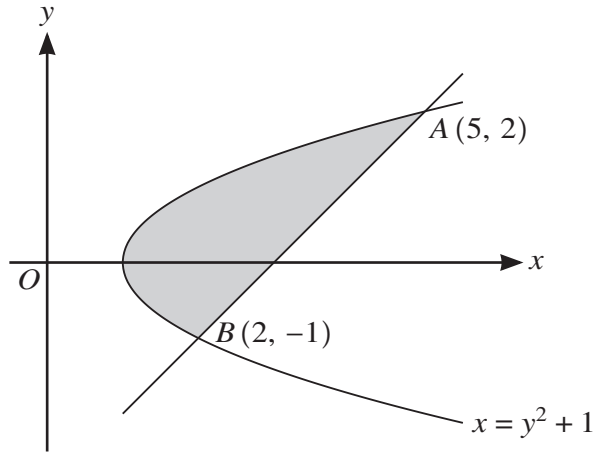
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The diagram shows the curve with equation $x = y^2 + 1$. The points $A(5, 2)$ and $B(2, -1)$ lie on the curve.

(a) Find an equation of the line AB. [2]

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(b) Find the volume of revolution when the region between the curve and the line AB is rotated through 360° about the **y-axis**. [9]

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