

A curve has equation $y = 5x^3 - 12x$.

What is the gradient of the tangent at the point $(1, -7)$?

- A -7
- B -5
- C 3
- D 5

What is the derivative of $\frac{1}{4x^3}$, $x \neq 0$?

- A $\frac{1}{12x^2}$
- B $-\frac{1}{12x^2}$
- C $\frac{4}{x^4}$
- D $-\frac{3}{4x^4}$

$$A = 2\pi r^2 + 6\pi r.$$

What is the rate of change of A with respect to r when $r = 2$?

- A 10π
- B 12π
- C 14π
- D 20π

Find the coordinates of the turning points of the curve with equation $y = x^3 - 3x^2 - 9x + 12$ and determine their nature. 8

Functions f and g are given by $f(x) = 3x + 1$ and $g(x) = x^2 - 2$.

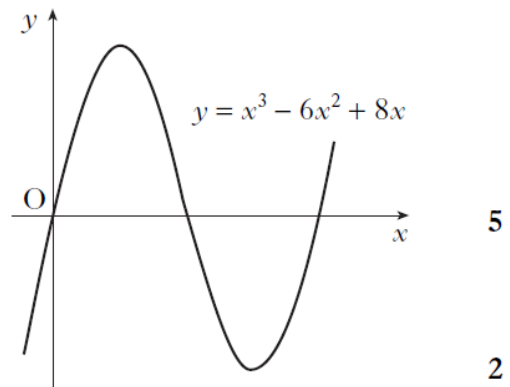
- (a) (i) Find $p(x)$ where $p(x) = f(g(x))$. 3
(ii) Find $q(x)$ where $q(x) = g(f(x))$. 3
(b) Solve $p'(x) = q'(x)$. 3

A function f is defined on the set of real numbers by $f(x) = x^3 - 3x + 2$.

- (a) Find the coordinates of the stationary points on the curve $y = f(x)$ and determine their nature. 6
(b) (i) Show that $(x - 1)$ is a factor of $x^3 - 3x + 2$.
(ii) Hence or otherwise factorise $x^3 - 3x + 2$ fully. 5
(c) State the coordinates of the points where the curve with equation $y = f(x)$ meets both the axes and hence sketch the curve. 4

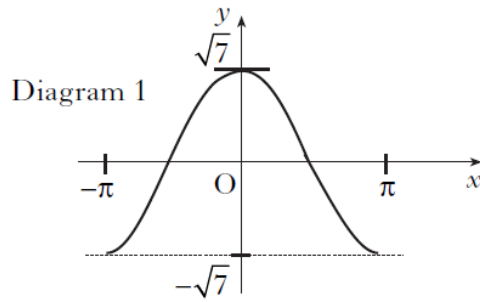
The diagram shows a sketch of the curve with equation $y = x^3 - 6x^2 + 8x$.

- (a) Find the coordinates of the points on the curve where the gradient of the tangent is -1 .
(b) The line $y = 4 - x$ is a tangent to this curve at a point A. Find the coordinates of A.



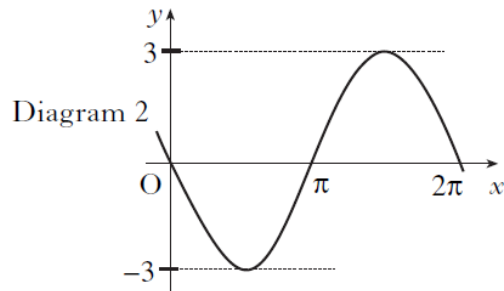
- (a) (i) Diagram 1 shows part of the graph of $y = f(x)$, where $f(x) = p \cos x$.

Write down the value of p .



- (ii) Diagram 2 shows part of the graph of $y = g(x)$, where $g(x) = q \sin x$.

Write down the value of q .



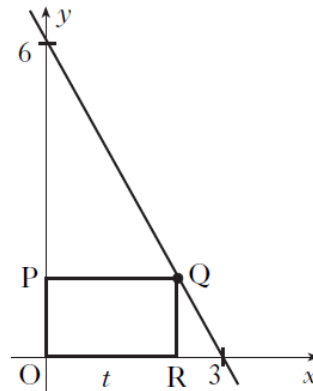
- (b) Write $f(x) + g(x)$ in the form $k \cos(x + a)$ where $k > 0$ and $0 < a < \frac{\pi}{2}$.

- (c) Hence find $f'(x) + g'(x)$ as a single trigonometric expression.

In the diagram, Q lies on the line joining $(0, 6)$ and $(3, 0)$.

OPQR is a rectangle, where P and R lie on the axes and $OR = t$.

- (a) Show that $QR = 6 - 2t$.
- (b) Find the coordinates of Q for which the rectangle has a maximum area.

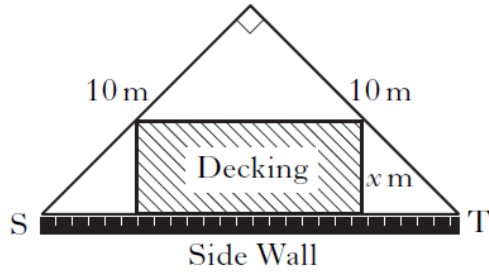


A function f is defined by the formula $f(x) = 3x - x^3$.

- (a) Find the exact values where the graph of $y = f(x)$ meets the x - and y -axes.
- (b) Find the coordinates of the stationary points of the function and determine their nature.
- (c) Sketch the graph of $y = f(x)$.

A householder has a garden in the shape of a right-angled isosceles triangle.

It is intended to put down a section of rectangular wooden decking at the side of the house, as shown in the diagram.



- (a) (i) Find the exact value of ST.
(ii) Given that the breadth of the decking is x metres, show that the area of the decking, A square metres, is given by

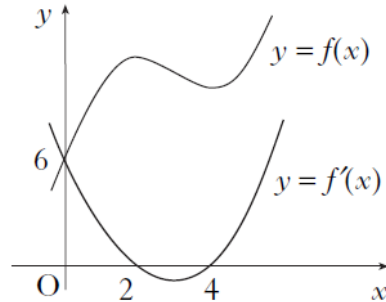
$$A = (10\sqrt{2})x - 2x^2. \quad 3$$

- (b) Find the dimensions of the decking which maximises its area. 5

The diagram shows the graphs of a cubic function $y = f(x)$ and its derived function $y = f'(x)$.

Both graphs pass through the point $(0, 6)$.

The graph of $y = f'(x)$ also passes through the points $(2, 0)$ and $(4, 0)$.



- (a) Given that $f'(x)$ is of the form $k(x - a)(x - b)$:
(i) write down the values of a and b ;
(ii) find the value of k . 3
- (b) Find the equation of the graph of the cubic function $y = f(x)$. 4