



Higher Mathematics

Differentiation - Questions

Marks are indicated in brackets after each question number

2013 Paper 1 Question 2, (2)

The point P (5, 12) lies on the curve with equation $y = x^2 - 4x + 7$.

What is the gradient of the tangent to this curve at P?

2013 Paper 1 Question 18, (2)

Given that $y = \sin(x^2 - 3)$, find $\frac{dy}{dx}$.

2014 Paper 1 Question 8, (2)

What is the derivative of $(4 - 9x^4)^{\frac{1}{2}}$?

2014 Paper 1 Question 9, (2)

$\sin x + \sqrt{3} \cos x$ can be written as $2 \cos\left(x - \frac{\pi}{6}\right)$.

The maximum value of $\sin x + \sqrt{3} \cos x$ is 2.

What is the maximum value of $5 \sin 2x + 5\sqrt{3} \cos 2x$?

2014 Paper 2 Question 2, (4)

A curve has equation $y = x^4 - 2x^3 + 5$.

Find the equation of the tangent to this curve at the point where $x = 2$.

2015 Paper 1 Question 2, (4)

Find the equation of the tangent to the curve $y = 2x^3 + 3$ at the point where $x = -2$.



2015 Paper 1 Question 7, (4)

A function f is defined on a suitable domain by $f(x) = \sqrt{x} \left(3x - \frac{2}{x\sqrt{x}} \right)$.

Find $f'(4)$.

2016 Paper 1 Question 2, (3)

Given that $y = 12x^3 + 8\sqrt{x}$, where $x > 0$, find $\frac{dy}{dx}$.

2016 Paper 2 Question 10, (2) (1)

(a) Given that $y = (x^2 + 7)^{\frac{1}{2}}$, find $\frac{dy}{dx}$.

(b) Hence find $\int \frac{4x}{\sqrt{x^2 + 7}} dx$.

2017 Paper 1 Question 3, (2)

Given $y = (4x - 1)^{12}$, find $\frac{dy}{dx}$.

2017 Paper 1 Question 8, (3)

Calculate the rate of change of $d(t) = \frac{1}{2t}$, $t \neq 0$, when $t = 5$.

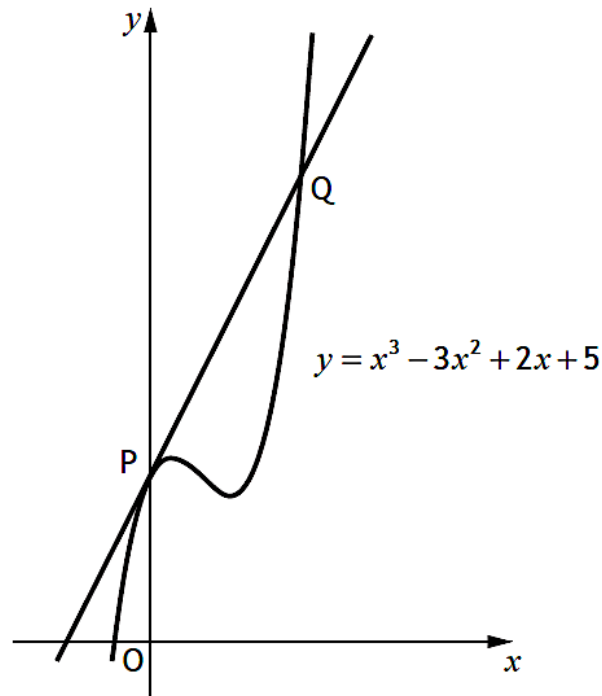
2018 Paper 1 Question 3, (3)

Given $h(x) = 3\cos 2x$, find the value of $h'\left(\frac{\pi}{6}\right)$.



2018 Paper 1 Question 7, (1) (3) (4)

The curve with equation $y = x^3 - 3x^2 + 2x + 5$ is shown on the diagram.



- (a) Write down the coordinates of P, the point where the curve crosses the y -axis .
- (b) Determine the equation of the tangent to the curve at P.
- (c) Find the coordinates of Q, the point where this tangent meets the curve again.

2018 Paper 1 Question 15, (5)

A cubic function, f , is defined on the set of real numbers.

- $(x + 4)$ is a factor of $f(x)$
- $x = 2$ is a repeated root of $f(x)$
- $f'(-2) = 0$
- $f'(x) > 0$ where the graph with equation $y = f(x)$ crosses the y -axis

Sketch a possible graph of $y = f(x)$ on the diagram in your answer booklet.



2018 Paper 2 Question 3, (3)

A function, f , is defined on the set of real numbers by $f(x) = x^3 - 7x - 6$.

Determine whether f is increasing or decreasing when $x = 2$.

2018 Paper 2 Question 9, (6)

A sector with a particular fixed area has radius x cm.

The perimeter, P cm, of the sector is given by

$$P = 2x + \frac{128}{x}.$$

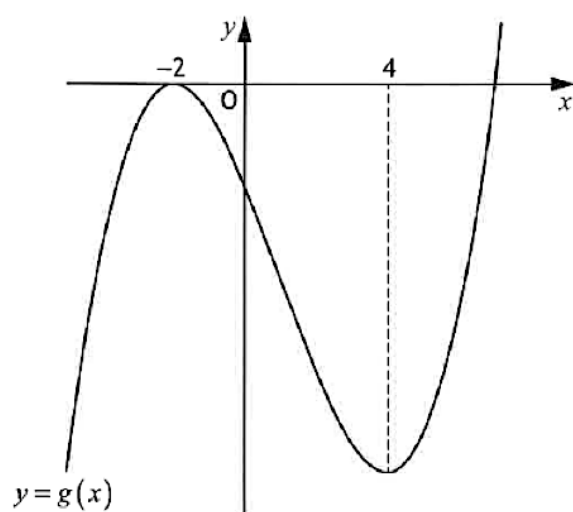
Find the minimum value of P .

2019 Paper 1 Question 6, (3)

Given that $y = \frac{1}{(1-3x)^5}$, $x \neq \frac{1}{3}$, find $\frac{dy}{dx}$.

2019 Paper 2 Question 5, (2)

The diagram below shows the graph of a cubic function $y = g(x)$, with stationary points at $x = -2$ and $x = 4$.



On the diagram in your answer booklet, sketch the graph of $y = g'(x)$.



2019 Paper 2 Question 7, (3) (3)

- (a) Express $-6x^2 + 24x - 25$ in the form $p(x+q)^2 + r$.
- (b) Given that $f(x) = -2x^3 + 12x^2 - 25x + 9$,
show that $f(x)$ is strictly decreasing for all $x \in \mathbb{R}$.

2022 Paper 1 Question 4, (3)

Differentiate $y = \sqrt{x^3} - 2x^{-1}$, where $x > 0$.

2022 Paper 1 Question 12, (3)

Given that $f(x) = 4\sin\left(3x - \frac{\pi}{3}\right)$, evaluate $f'\left(\frac{\pi}{6}\right)$.

2023 Paper 1 Question 1, (3)

Given that $y = x^{\frac{5}{3}} - \frac{10}{x^4}$, where $x \neq 0$, find $\frac{dy}{dx}$.

2023 Paper 2 Question 2, (4)

Find the equation of the tangent to the curve with equation $y = 2x^5 - 3x$ at the point where $x = 1$.

2023 Paper 2 Question 5, (3)

A function, f , is defined by $f(x) = (3 - 2x)^4$, where $x \in \mathbb{R}$.

Calculate the rate of change of f when $x = 4$.

2023 Paper 2 Question 10, (4)

Determine the range of values of x for which the function $f(x) = 2x^3 + 9x^2 - 24x + 6$ is strictly decreasing.



2024 Paper 1 Question 3, (2)

Given that $y = (5x^2 + 3)^7$, find $\frac{dy}{dx}$.

2024 Paper 1 Question 12, (4)

The function f is given by $f(x) = 12\sqrt[3]{x}$, $x > 0$.

When $x = a$ the rate of change of f with respect to x is 1.

Determine the value of a .

2024 Paper 2 Question 2, (5)

A curve has equation $y = \frac{8}{x^3}$, $x > 0$.

Find the equation of the tangent to this curve at the point where $x = 2$.

2025 Paper 1 Question 1, (4)

A curve has equation $y = x^3 - 2x^2 + 5$.

Find the equation of the tangent to this curve at the point where $x = 2$.

2026 Paper 1 Question 7, (4)

Determine the gradient of the tangent to the curve with equation $y = 2x + 4\sqrt{x}$, $x > 0$, at the point where $x = 9$.

2026 Paper 2 Question 9, (4)

Determine the range of values of x for which the function $f(x) = 4x^3 - 12x^2 + 7$ is strictly decreasing.

Justify your answer.