

Gradients, Tangents & Normals

Question Paper 1

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Differentiation
Sub Topic	Gradients, Tangents & Normals
Booklet	Question Paper 1

Time Allowed: 56 minutes

Score: /46

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 The function f is defined by $f(x) = \frac{1}{x+1} + \frac{1}{(x+1)^2}$ for $x > -1$.

(i) Find $f'(x)$. [3]

(ii) State, with a reason, whether f is an increasing function, a decreasing function or neither. [1]

The function g is defined by $g(x) = \frac{1}{x+1} + \frac{1}{(x+1)^2}$ for $x < -1$.

(iii) Find the coordinates of the stationary point on the curve $y = g(x)$. [4]

2 The equation of a curve is $y = x^3 + ax^2 + bx$, where a and b are constants.

(i) In the case where the curve has no stationary point, show that $a^2 < 3b$. [3]

(ii) In the case where $a = -6$ and $b = 9$, find the set of values of x for which y is a decreasing function of x . [3]

3 **(i)** Express $9x^2 - 12x + 5$ in the form $(ax + b)^2 + c$. [3]

(ii) Determine whether $3x^3 - 6x^2 + 5x - 12$ is an increasing function, a decreasing function or neither. [3]

4 A curve has equation $y = \frac{4}{(3x+1)^2}$. Find the equation of the tangent to the curve at the point where the line $x = -1$ intersects the curve. [5]

- 5 A curve has equation $y = 2x^2 - 3x$.
- (i) Find the set of values of x for which $y > 9$. [3]
- (ii) Express $2x^2 - 3x$ in the form $a(x + b)^2 + c$, where a , b and c are constants, and state the coordinates of the vertex of the curve. [4]

The functions f and g are defined for all real values of x by

$$f(x) = 2x^2 - 3x \quad \text{and} \quad g(x) = 3x + k,$$

where k is a constant.

- (iii) Find the value of k for which the equation [3]
- 6 It is given that $f(x) = (2x - 5)^3 + x$, for $x \in \mathbb{R}$. Show that f is an increasing function. [3]

- 7 A function f is defined by $f(x) = \frac{5}{1 - 3x}$, for $x \geq 1$.
- (i) Find an expression for $f'(x)$. [2]
- (ii) Determine, with a reason, whether f is an increasing function, a decreasing function or neither. [1]
- (iii) Find an expression for $f^{-1}(x)$, and state the domain and range of f^{-1} . [5]

- 8 It is given that $f(x) = \frac{1}{x^3} - x^3$, for $x > 0$. Show that f is a decreasing function. [3]