

Edexcel AS Mathematics Differentiation

Section 1: Introduction to differentiation

Solutions to Exercise level 1

1. (i) $f(x) = 2x + 1$
 $f'(x) = 2$

(ii) $f(x) = x^3 - 5x$
 $f'(x) = 3x^2 - 5$

(iii) $f(x) = x(x+2) = x^2 + 2x$
 $f'(x) = 2x + 2$

2. (i) $y = 2x^3 - 3x^2 + x$
 $\frac{dy}{dx} = 6x^2 - 6x + 1$

(ii) When $x = -2$, gradient $= 6(-2)^2 - 6(-2) + 1$
 $= 24 + 12 + 1$
 $= 37$

3. (i) $y = 12x - x^3$
 $\frac{dy}{dx} = 12 - 3x^2$

When $x = 0$, $\frac{dy}{dx} = 12$

The gradient of the curve at the origin is 12.

(ii) When gradient is zero, $12 - 3x^2 = 0$

$$4 - x^2 = 0$$

$$(2 + x)(2 - x) = 0$$

$$x = -2 \text{ or } x = 2$$

When $x = -2$, $y = 12 \times -2 - (-2)^3 = -24 + 8 = -16$

When $x = 2$, $y = 12 \times 2 - 2^3 = 24 - 8 = 16$

The gradient is zero at $(-2, -16)$ and $(2, 16)$.

4. $y = x^4 - x + 1$
 $\frac{dy}{dx} = 4x^3 - 1$

AQA AS Maths Differentiation 1 Exercise solutions

$$\text{When } x = 1, \frac{dy}{dx} = 4 \times 1^3 - 1 = 4 - 1 = 3$$

$$\text{When } x = 1, y = 1^4 - 1 + 1 = 1$$

The tangent is the straight line with gradient 3 passing through (1, 1).

Equation of tangent is $y - 1 = 3(x - 1)$

$$y - 1 = 3x - 3$$

$$y = 3x - 2$$

5. $y = x^2 - x$

$$\frac{dy}{dx} = 2x - 1$$

$$\text{When } x = 3, \frac{dy}{dx} = 2 \times 3 - 1 = 5$$

Gradient of tangent = 5, so gradient of normal = $-\frac{1}{5}$.

The normal is the straight line with gradient $-\frac{1}{5}$ passing through (3, 6).

Equation of normal is $y - 6 = -\frac{1}{5}(x - 3)$

$$5(y - 6) = -(x - 3)$$

$$5y - 30 = -x + 3$$

$$5y + x = 33$$

Where the normal meets the x-axis, $y = 0$ so $x = 33$.

The normal meets the x-axis at (33, 0).