Level 2 Further Maths

Stationary Points

Ensure you have: Pencil or pen

Guidance

1. Read each question carefully before you begin answering it.
2. Check your answers seem right.
3. Always show your workings

Revision for this topic

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1. A curve has equation \( y = x^2 - 4x + 21 \)

(a) Find \( \frac{dy}{dx} \)

(b) Hence, find the coordinates of the minimum point.

2. A curve has equation \( y = 1 + x - x^2 \)

(a) Find \( \frac{dy}{dx} \)

(b) Hence, find the coordinates of the maximum point.
3. A curve has equation \( y = x^3 - 3x^2 + 1 \)

Work out the coordinates of the stationary points, A and B.

A = ……………………………

B = ……………………………

(5)
4. \( y = 2x^3 - 9x^2 + 12x - 9 \)

(a) Work out \( \frac{dy}{dx} \)

\[ \frac{dy}{dx} = \frac{d}{dx} (2x^3 - 9x^2 + 12x - 9) \]

\[ \frac{dy}{dx} = 6x^2 - 18x + 12 \]

(b) Hence, work out the coordinates of the stationary points of \( y = 2x^3 - 9x^2 + 12x - 9 \)

\[ \text{Critical points:} \quad \frac{dy}{dx} = 0 \]

\[ 6x^2 - 18x + 12 = 0 \]

\[ 6(x^2 - 3x + 2) = 0 \]

\[ x^2 - 3x + 2 = 0 \]

\[ (x - 1)(x - 2) = 0 \]

\[ x = 1, \quad x = 2 \]

\[ y(1) = 2(1)^3 - 9(1)^2 + 12(1) - 9 = 4 \]

\[ y(2) = 2(2)^3 - 9(2)^2 + 12(2) - 9 = -1 \]

\[ \text{Stationary points:} \quad (1, 4), \quad (2, -1) \]
5. (a) Work out the stationary points on the curve \( y = x^3 - 3x \)

\[ \text{............... and ...............} \]

(4)

(b) Sketch \( y = x^3 - 3x \)
6. The curve C has equation \( y = 3x^4 - 12x^3 + 2 \)

(a) Find \( \frac{dy}{dx} \) 

(b) Find \( \frac{d^2y}{dx^2} \) 

(c) Show that C has a stationary point when \( x = 3 \) 

(d) Determine the nature of this stationary point, giving a reason for your answer
7. The curve C has equation \( y = -x^3 + 12x^2 - 36x \)

Work out the coordinates of any stationary point on this curve and determine their nature
8. The equation of a curve is \( y = x^3 - \frac{1}{2}x^2 + ax + 1 \) where \( a \) is a constant.

The curve has a maximum point at \( \left( -\frac{2}{3}, \frac{49}{27} \right) \).

The curve has a minimum point at \( (1, -0.5) \).

Work out the value of \( a \).
9. \( y = f(x) \) has exactly two stationary points.

The stationary points are

a minimum at \( D (3, -2) \)

a maximum at \( E (b, c) \) where \( 0 < b < 3 \) and \( -2 < c < 0 \)

Sketch the curve and label \( D \) and \( E \).