

## Non-Calculator Questions

# Differentiation

Differentiation / Finding Stationary Points & Turning Points / Classifying Stationary Points / Problem Solving with Differentiation

|                         |            |
|-------------------------|------------|
| Medium (3 questions)    | /11        |
| Hard (4 questions)      | /31        |
| Very Hard (3 questions) | /15        |
| <b>Total Marks</b>      | <b>/57</b> |

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# Medium Questions

1 (a) Differentiate  $6 + 4x - x^2$ .

(2 marks)

(b) Find the coordinates of the turning point of the graph of  $y = 6 + 4x - x^2$ .

( ..... , ..... )

(2 marks)

**2 (a)** Use differentiation to find  $\frac{dy}{dx}$  for the following:

$$y = x^4$$

**(1 mark)**

**(b)**  $y = 2x^3$

**(1 mark)**

**(c)**  $y = 4.$

**(1 mark)**

**3 (a)** For the curve with equation  $y = 2x^2 - 6x - 11$ , find  $\frac{dy}{dx}$ .

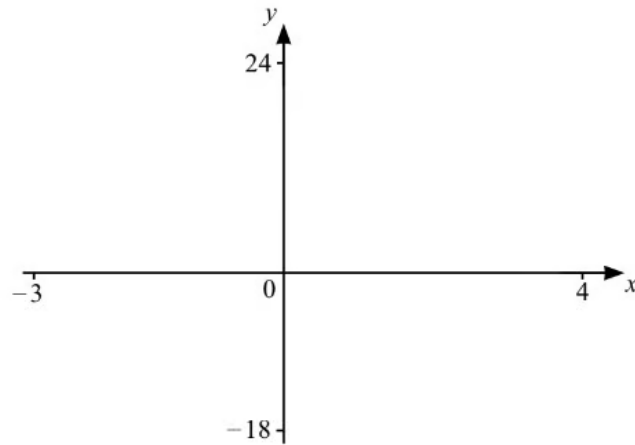
**(2 marks)**

**(b)** Find the coordinates of the point on the curve where the gradient is 2.

**(2 marks)**

# Hard Questions

1 (a)



$$f(x) = x(x + 2)(x - 3)$$

On the diagram, sketch the graph of  $y = f(x)$  for  $-3 \leq x \leq 4$ .  
Show the values of the intersections with the axes.

(3 marks)

(b) Expand and simplify.

$$x(x + 2)(x - 3)$$

(3 marks)

(c)  $A$  is the point  $(1, -6)$ .

The tangent to the graph of  $y = f(x)$  at  $A$  meets the  $y$ -axis at  $B$ .

Find the coordinates of  $B$ .

(5 marks)

2  $y = x^4 - 4x^3$

Find the two stationary points on the graph of  $y = x^4 - 4x^3$ .

( ..... , ..... )

( ..... , ..... )

(6 marks)

3 (a) A curve has equation  $y = x^3 - 3x + 4$ .

Work out the coordinates of the two stationary points.

( ..... , ..... )

( ..... , ..... )

(5 marks)

(b) Determine whether each stationary point is a maximum or a minimum. Give reasons for your answers.

(3 marks)

**4 (a)**  $y = x^3 - 6x^2 - 15x$ .

Find  $\frac{dy}{dx}$ .

$$\frac{dy}{dx} = \dots\dots\dots$$

**(2 marks)**

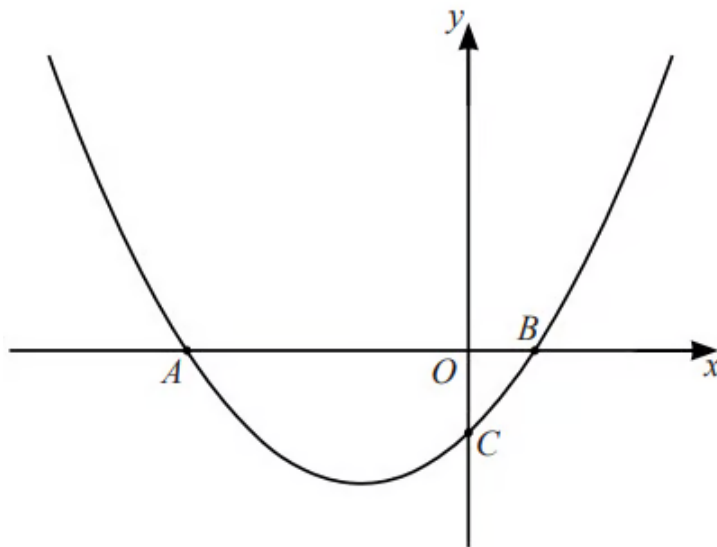
**(b)** The curve with equation  $y = x^3 - 6x^2 - 15x$  has two stationary points.

Work out the coordinates of these two stationary points.

**(4 marks)**

# Very Hard Questions

1



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The diagram shows a sketch of the curve  $y = x^2 + 3x - 4$ .

i) Differentiate  $y = x^2 + 3x - 4$

[2]

ii) Find the equation of the tangent to the curve at the point (2, 6).

[3]

(5 marks)

2

$$y = x^p + 2x^q$$

$$\frac{dy}{dx} = 11x^{10} + 10x^4, \text{ where } \frac{dy}{dx} \text{ is the derived function.}$$

Find the value of  $p$  and the value of  $q$ .

$$p = \dots\dots\dots$$

$$q = \dots\dots\dots$$

**(2 marks)**

**3 (a)** A curve,  $C$ , has equation  $y = 2x^2 + 8k^2x - 3$  where  $k$  is a constant.

Show that when  $k = 0$ , the turning point on  $C$  has coordinates  $(0, -3)$ .

**(2 marks)**

**(b)** Show that when  $k \neq 0$ , the turning point on  $C$  must have a negative  $x$ -coordinate.

**(4 marks)**

**(c)** When  $k \neq 0$  determine whether or not the  $y$ -coordinate of the turning point is negative.

**(2 marks)**