

**Q Differentiation**

(b) Differentiate  $18 + 5x - 2x^2$ .

..... [2]

(c) Find the coordinates of the point on  $y = 18 + 5x - 2x^2$  where the gradient is 17.

( ..... , ..... ) [3]

12 (a) Find the gradient of the curve  $y = 2x^3 - 7x + 4$  when  $x = -2$ .

..... [3]

(c) When  $y = 2x^p + qx^2$ ,  $\frac{dy}{dx} = 14x^6 + 6x$ .

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

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

$$q = \dots\dots\dots [2]$$

20  $y = 2x^k + ux^7$  and  $\frac{dy}{dx} = 18x^{k-1} + 21x^6$

Find the value of  $k$  and the value of  $u$ .

$$k = \dots\dots\dots$$

$$u = \dots\dots\dots [2]$$

25 The derivative of  $2ax^7 + 3x^k$  is  $42x^6 + 15x^{k-1}$ .

Find the value of  $a$  and the value of  $k$ .

$a = \dots\dots\dots$

$k = \dots\dots\dots$  [2]

25 Find the  $x$ -coordinates of the points on the graph of  $y = x^5 - 5x^4$  where the gradient is 0.

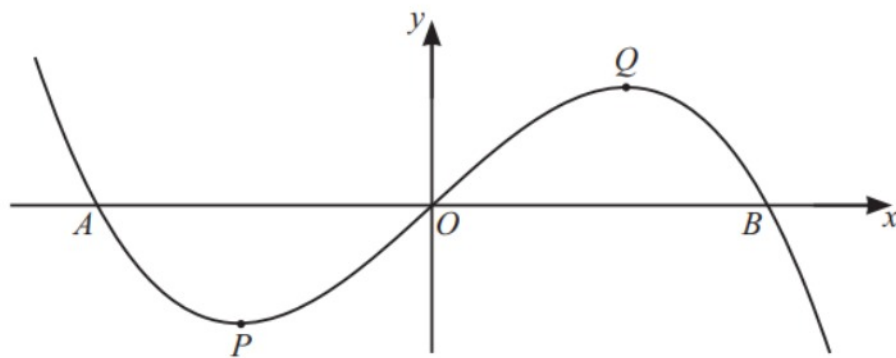
$\dots\dots\dots$  [4]

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

..... [2]

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

(....., ..... ) [2]



The diagram shows the graph of  $y = 3x - x^3$ .  
 The graph crosses the  $x$ -axis at  $A$ , at  $O$  and at  $B$ .  
 The turning points of the graph are at  $P$  and at  $Q$ .

(b) (i) Differentiate  $3x - x^3$ .

..... [2]

(ii) Find the coordinates of  $P$  and  $Q$ .

$P$  ( ..... , ..... )

$Q$  ( ..... , ..... )

[4]

**22** A curve has equation  $y = x^n + qx^2 + 9x$ .

$$\frac{dy}{dx} = 3x^2 - 12x + 9$$

**(a)** Find the value of  $n$ , and the value of  $q$ .

$$n = \dots\dots\dots q = \dots\dots\dots [2]$$

**(b)** Work out the coordinates of the turning points of the curve.

$$(\dots\dots\dots, \dots\dots\dots) \text{ and } (\dots\dots\dots, \dots\dots\dots) [4]$$

**21** A curve has equation  $y = x^3 - 12x$ .

**(a)** Find the gradient of the curve at the point  $(1, -11)$ .

..... [3]

**(b)** Find the coordinates of the turning points of the curve.

(....., ..... ) and (....., ..... ) [3]

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

Find the coordinates of its two stationary points.

(....., ..... ) and (....., ..... ) [5]

$$f(x) = x^3 - 3x^2 - 4$$

- (a) Find the gradient of the graph of  $y = f(x)$  where  $x = 1$ .

..... [3]

- (b) Find the coordinates of the turning points of the graph of  $y = f(x)$ .

( ..... , ..... ) , ( ..... , ..... ) [4]

- (c) A curve has equation  $y = x^3 + ax + b$ .  
The stationary points of the curve have coordinates  $(2, k)$  and  $(-2, 10 - k)$ .

Work out the value of  $a$ , the value of  $b$  and the value of  $k$ .

$a = \dots\dots\dots$ ,  $b = \dots\dots\dots$ ,  $k = \dots\dots\dots$  [6]

- (c) (i) Find the coordinates of the turning points of the graph of  $y = 10 + 9x^2 - 2x^3$ .  
You must show all your working.

( ..... , ..... ) and ( ..... , ..... ) [5]

- (ii) Determine whether each turning point is a maximum or a minimum.  
Show how you decide.

[3]

**11** A curve has equation  $y = x^3 - 3x + 4$ .

**(a)** Work out the coordinates of the two stationary points.

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

(..... , .....) [5]

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

[3]

(c) A curve has equation  $y = 2x^3 - 4x^2 + 6$ .

(i) Find  $\frac{dy}{dx}$ , the derived function of  $y$ .

..... [2]

(ii) Calculate the gradient of the curve  $y = 2x^3 - 4x^2 + 6$  at  $x = 4$ .

..... [2]

(iii) Find the coordinates of the two stationary points on the curve.

(....., ..... ) and (....., ..... ) [4]

(b) A curve has the equation  $y = x^3 + 8x^2 + 5x$ .

(i) Work out the coordinates of the two turning points.

(....., ..... ) and (....., ..... ) [6]

(ii) Determine whether each of the turning points is a maximum or a minimum.  
Give reasons for your answers.

[3]

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

(i) Find the coordinates of the two stationary points.

( ..... , ..... ) and ( ..... , ..... ) [5]

(ii) Determine whether each of the stationary points is a maximum or a minimum.  
Give reasons for your answers.

[3]

10 (a)  $y = x^4 - 4x^3$

(i) Find the value of  $y$  when  $x = -1$ .

$y = \dots\dots\dots$  [2]

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

$(\dots\dots\dots, \dots\dots\dots)$

$(\dots\dots\dots, \dots\dots\dots)$  [6]

(b)  $y = x^p + 2x^q$

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

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

$p = \dots\dots\dots$

$q = \dots\dots\dots$  [2]

- 12** A curve has equation  $y = x^3 - kx^2 + 1$ .  
When  $x = 2$ , the gradient of the curve is 6.

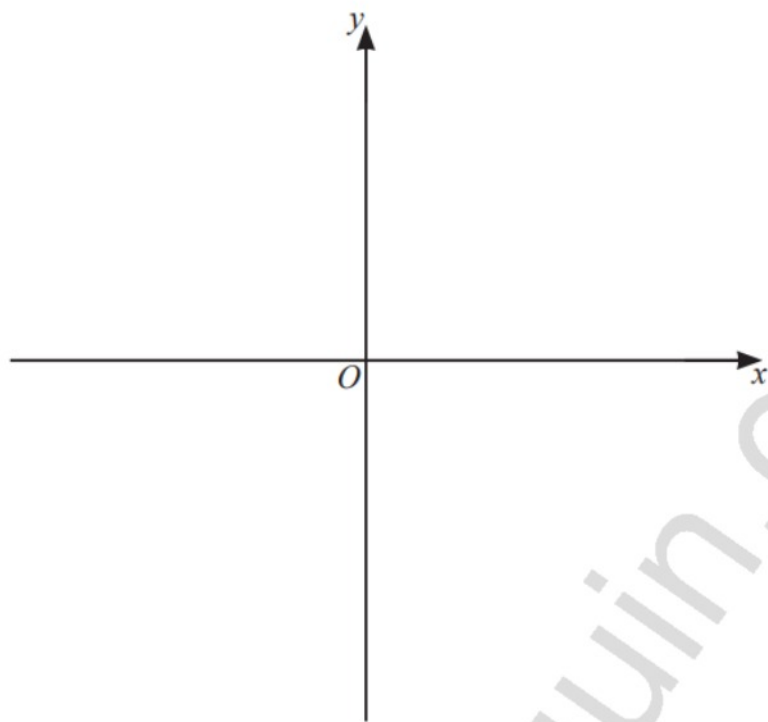
**(a)** Show that  $k = 1.5$ .

[5]

- (b)** Find the coordinates of the two stationary points of  $y = x^3 - 1.5x^2 + 1$ .  
You must show all your working.

(....., ..... ) and (....., ..... ) [4]

(c) Sketch the curve  $y = x^3 - 1.5x^2 + 1$ .



[2]

**12** The equation of a curve is  $y = x^4 - 8x^2 + 5$ .

**(a)** Find the derivative,  $\left(\frac{dy}{dx}\right)$ , of  $y = x^4 - 8x^2 + 5$ .

..... [2]

**(b)** Find the coordinates of the three turning points.  
You must show all your working.

(..... , ..... ) and (..... , ..... ) and (..... , ..... ) [4]

**(c)** Determine which one of these turning points is a maximum.  
Justify your answer.

[2]

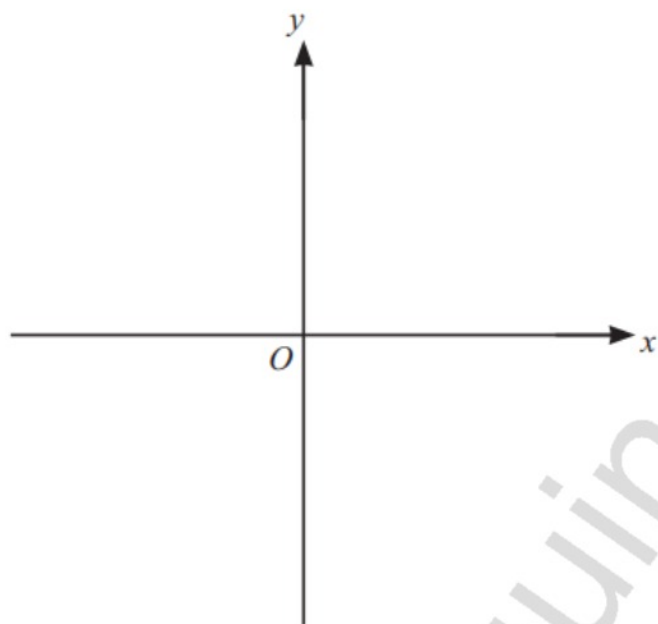
**22** A curve has equation  $y = x^3 + x^2 - x$ .

The curve has a stationary point at  $\left(\frac{1}{3}, -\frac{5}{27}\right)$ .

**(a)** Find the coordinates of the other stationary point.

(....., .....) [5]

- (b) By sketching the graph of  $y = x^3 + x^2 - x$ , determine whether the stationary point  $\left(\frac{1}{3}, -\frac{5}{27}\right)$  is a maximum or a minimum.



$\left(\frac{1}{3}, -\frac{5}{27}\right)$  is a ..... [2]

- (c) The equation  $x^3 + x^2 - x = k$  has fewer than 3 solutions.

Find the range of possible values for  $k$ .

..... [2]

(b) (i) Find the derivative,  $\frac{dy}{dx}$ , of  $y = 5 + 8x - \frac{4}{3}x^3$ .

..... [2]

(ii) Find the gradient of  $y = 5 + 8x - \frac{4}{3}x^3$  at  $x = -1$ .

..... [2]

(iii) A tangent is drawn to the graph of  $y = 5 + 8x - \frac{4}{3}x^3$ .

The gradient of the tangent is  $-28$ .

Find the coordinates of the two possible points where this tangent meets the graph.

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

( ..... , ..... ) [5]

- (iii) Find the equation of the tangent to the graph of  $y = 18 - 3x - x^2$  at  $x = 4$ .  
Give your answer in the form  $y = mx + c$ .

$y = \dots\dots\dots$  [6]

- (b) Find the equation of the tangent to the graph of  $y = x^3 - 4x^2 + 4x$  at  $x = 4$ .  
Give your answer in the form  $y = mx + c$ .

$y = \dots\dots\dots$  [7]

- (b) The graph of  $y = x^3 - 5x^2 + 2x + 8$  has two tangents with a gradient of 10.

Find the equations of these two tangents.

You must show all your working and give your answers in the form  $y = mx + c$ .

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