21 Expand and simplify $(x+3)(x-5)(3x-1)$.

..... [3]

20 Expand and simplify.

$$(x-2)(2x+5)(x+3)$$

..... [3]

22 **(a)** Expand and simplify.

$$(2x-1)(x+4)(x-3)$$

..... [3]

(c) Expand and simplify.

$$(y+3)(y-4)(2y-1)$$

..... [3]

(e) Expand and simplify.

$$(2x-3)(x+6)(x-4)$$

..... [3]

19 Expand and simplify.

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

..... [3]

21 Expand and simplify.

$$(x-3)^2(2x+5)$$

..... [3]

20 $(x+a)(x+2)(2x+3)$ is equivalent to $2x^3+bx^2+cx-18$.

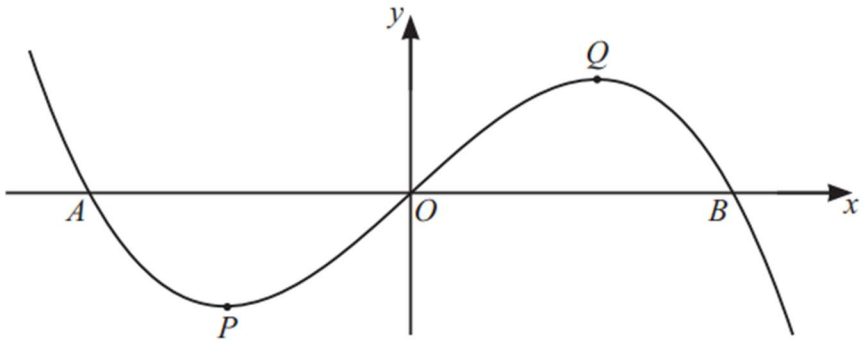
Find the value of each of a, b and c.

$a =$ .....

$b =$ .....

$c =$ ..... [3]

21



NOT TO SCALE

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.

(a) Find the x-coordinate of A and the x-coordinate of B.
Give your answers as exact values.

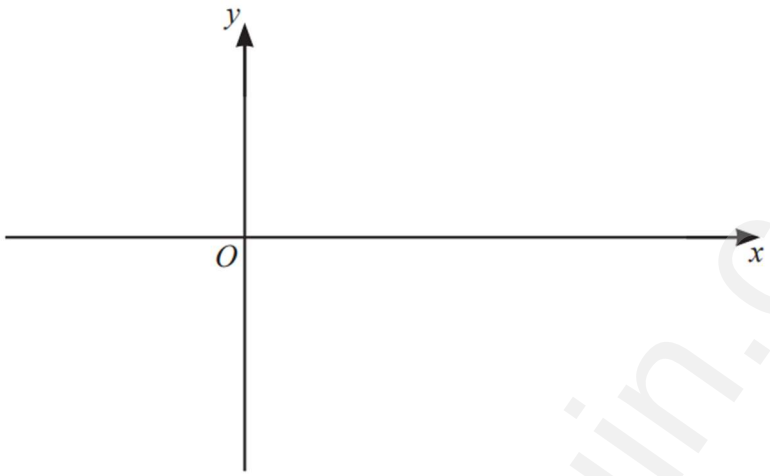
x-coordinate of A .....

x-coordinate of B .....

[3]

21 The graph of a cubic function has two turning points.
When $x < 0$ and when $x > 4$ the gradient of the graph is positive.
When $0 < x < 4$ the gradient of the graph is negative.
The graph passes through the origin.

Sketch the graph.



[2]

9 $f(x) = x(x-1)(x-2)$

(a) Find the coordinates of the points where the graph of $y = f(x)$ crosses the x-axis.

(..... , ...)

(..... , ...)

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

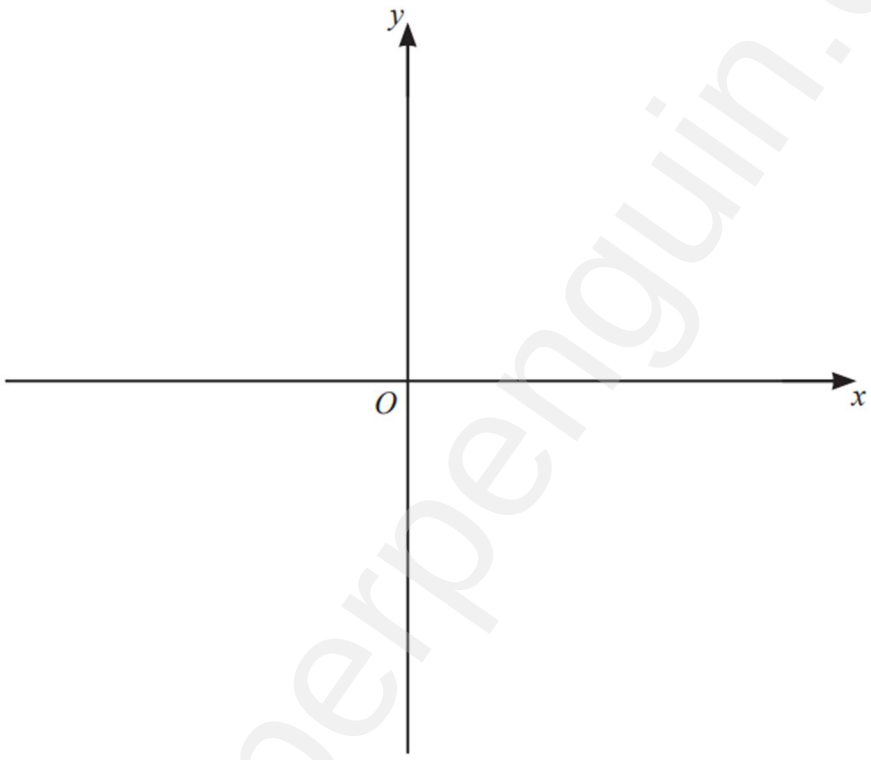
(b) Show that $f(x) = x^3 - 3x^2 + 2x$.

[2]

8 **(a)** **(i)** Show that the equation $y = (x-4)(x+1)(x-2)$ can be written as $y = x^3 - 5x^2 + 2x + 8$.

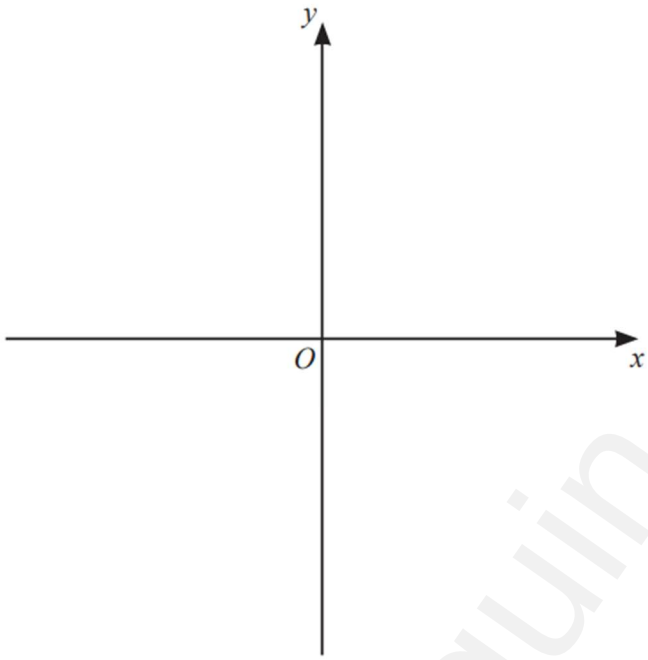
[2]

(ii) On the diagram, sketch the graph of $y = x^3 - 5x^2 + 2x + 8$, indicating the values where the graph crosses the axes.



[4]

9 **(a)** Sketch the graph of $y = (x+1)(3-x)(3+x)$, indicating the coordinates of the points where the graph crosses the x-axis and the y-axis.



(b) **(i)** Show that $y = (x+1)(3-x)(3+x)$ can be written as $y = 9+9x-x^2-x^3$.

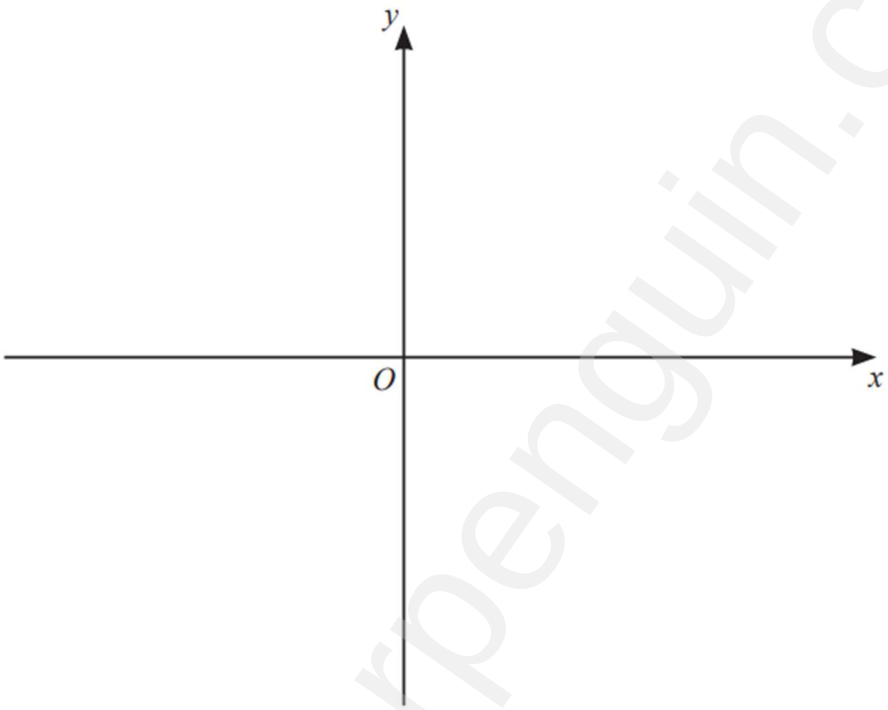
[2]

9 **(a)** **(i)** The equation $y = x^3 - 4x^2 + 4x$ can be written as $y = x(x-a)^2$.

Find the value of a.

$a =$ ..... [2]

(ii) On the axes, sketch the graph of $y = x^3 - 4x^2 + 4x$, indicating the values where the graph meets the axes.



[4]

11 The graph of $y = (x-3)(x+b)(x+2)$ intersects the y-axis at -30.

(a) Find the value of b.

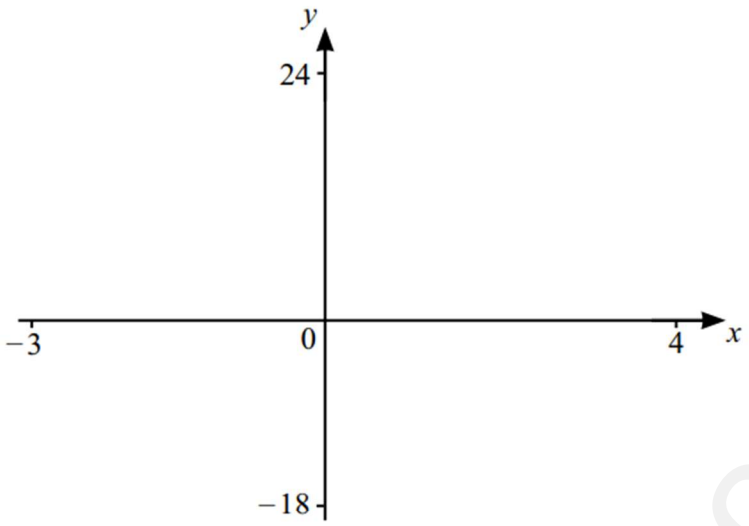
$b =$ ..... [2]

(b) When $x > 0$ the graph crosses the x-axis once.

Write down the coordinates of this point.

(..... , ...) [1]

26



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

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

(b) Expand and simplify.

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

..... [3]

(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]