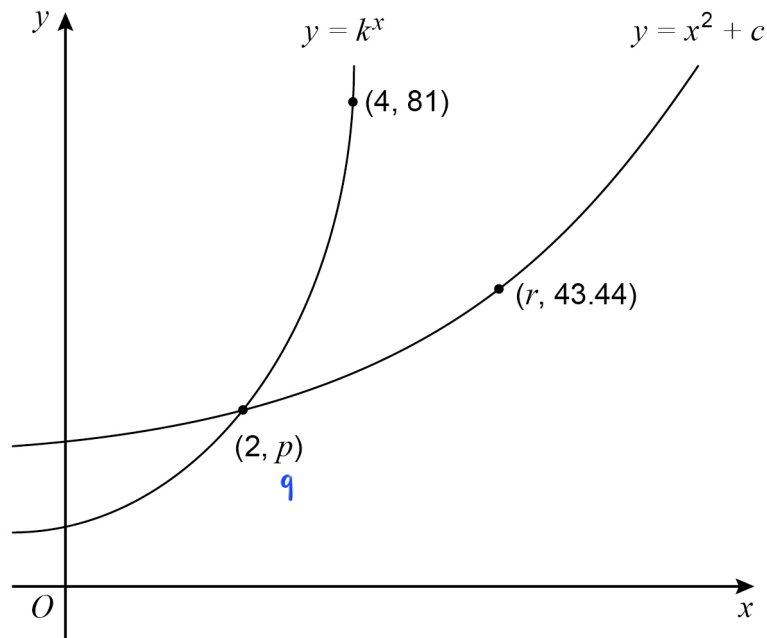**1**    Here is a sketch of the graphs of    $y = k^x$    and    $y = x^2 + c$

$k$ and $c$ are positive constants.



Work out the value of $r$.

**[4 marks]**

Using point $(4, 81)$ :   $81 = k^4$

$k = 3$ ①

$y = 3^x$

When $x = 2$, $y = 3^2 = 9$   $(p = 9)$

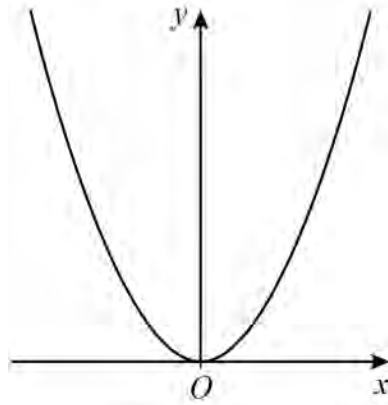Using point $(2, 9)$ :  $9 = 2^2 + c$

$c = 5$ ①  ,  $y = x^2 + 5$

When $y = 43.44$ ,  $43.44 = x^2 + 5$ ①

$x^2 = 38.44$

$x = 6.2$  ∴  $r = 6.2$

$r =$ _____ $6.2$ ① _____

**2** Here is a sketch of $y = x^2$



**2 (a)** The minimum point of $y = x^2$ is at (0, 0)

Write down the coordinates of the minimum point of $y = x^2 + 2$

**[1 mark]**

Answer ( _____ **0** _____ , _____ **2** _____ )

**2 (b)** The graph $y = x^2$ is reflected in the $x$ axis.

Write down the equation of the graph after this transformation.

**[1 mark]**

Answer _____ $y = -x^2$ _____

**2 (c)** $y = x^2$ is now transformed to give $y = (x + 3)^2$

Describe fully this single transformation.

**[2 marks]**

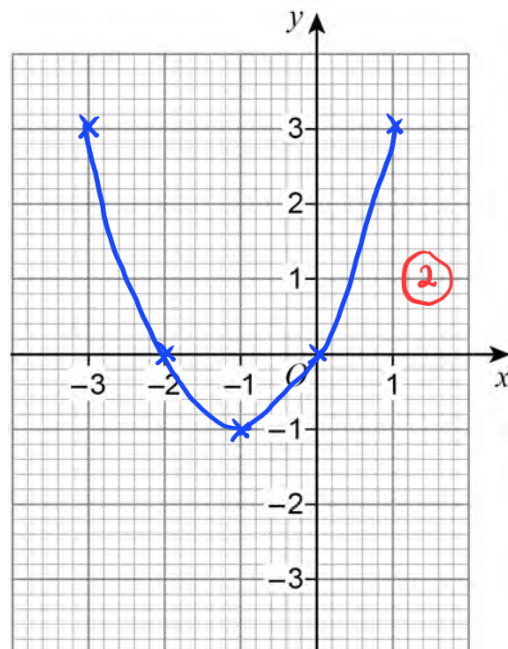_____ Translation with vector $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ _____

**3 (a)** Complete the table of values for $y = x^2 + 2x$

**[2 marks]**

| $x$ | −3 | −2 | −1 | 0 | 1 |
|-----|-----|-----|-----|-----|-----|
| $y$ | 3 | 0 | −1 | 0 | 3 |

**3 (b)** Draw the graph of $y = x^2 + 2x$ for values of $x$ from −3 to 1

**[2 marks]**

**4**     A graph has the equation     $y = x^2 + px + r$     where $p$ and $r$ are constants.

The graph passes through the points (0, 4), (1, 3) and (8, $w$)

Work out the value of $w$.

**[4 marks]**

at point $(0,4)$ : $4 = (0)^2 + p(0) + r$ , $r = 4$ ①

point $(1,3)$ = $3 = (1)^2 + p(1) + 4$

$3 = 5 + p$

$p = -2$ ①

$\therefore$ $y = x^2 - 2x + 4$

at point $(8,w)$ : $w = (8)^2 - 2(8) + 4$

$= 64 - 16 + 4$ ①

$= 52$ ①

$w = \underline{\qquad 52 \qquad}$

**5**      A graph passes through the points (3, 15) and (7, $w$)

**5 (a)**      Assume that the equation of the graph has the form      $y = x^2 + c$

Work out the value of $w$ that this would give.

**[3 marks]**

At point $(3,15)$ :   $15 = (3)^2 + c$

$c = 15 - 9 = 6$   ✓ ①

At point $(7, w)$ :   $w = (7)^2 + 6$   ✓ ①

$w = 49 + 6$

$= 55$   ✓ ①

$w = $ _____ **55** _____

**5 (b)**      In fact, the graph is a straight line.

What does this mean about the actual value of $w$?

Tick **one** box.

**[1 mark]**

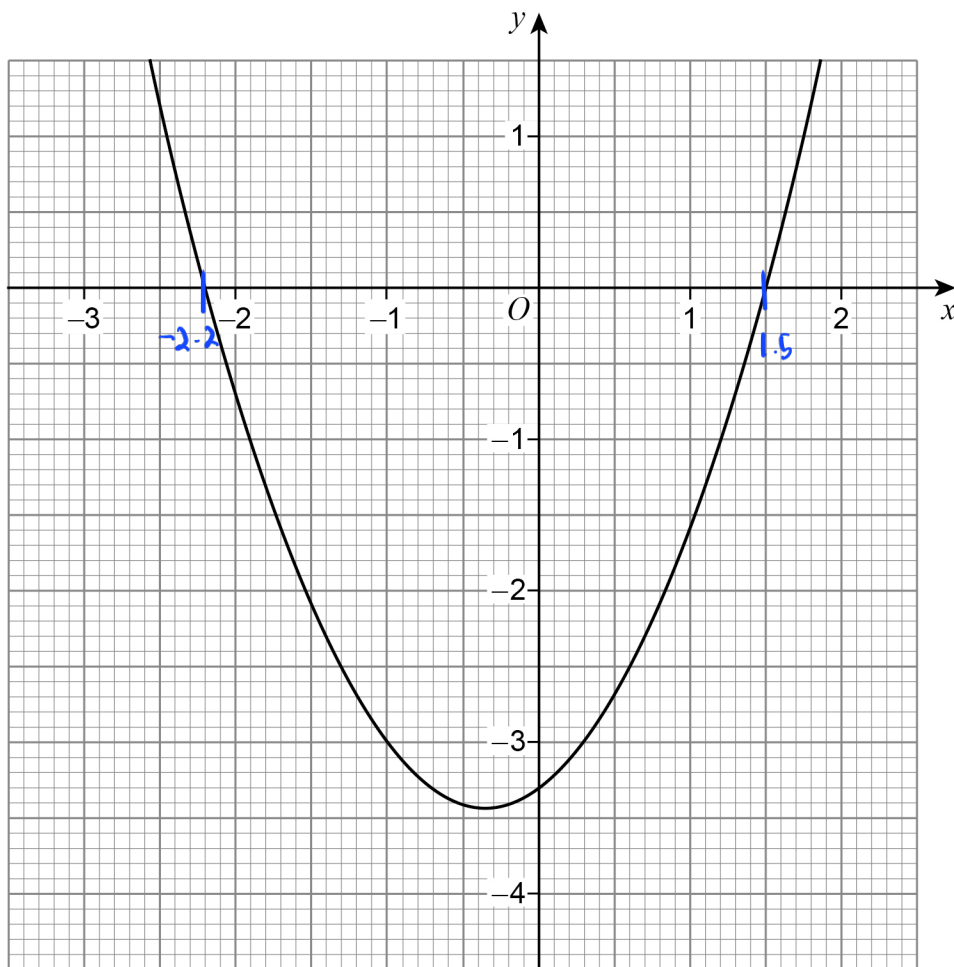☐      It must be the same as the value in part (a)

☐      It must be different to the value in part (a)

☑      It is impossible to tell   ✓ ①

**6**     Here is a quadratic graph with equation    $y = f(x)$



Write down the roots of the equation    $f(x) = 0$

**[2 marks]**

Answer     $-2 \cdot 2$  ,  $1 \cdot 5$