

Name:

Exam Style Questions

Turning Points using  
Completing the Square



Corbettmaths

Equipment needed: Pen

### Guidance

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

Video Tutorial

[www.corbettmaths.com/contents](http://www.corbettmaths.com/contents)

Video 265a



Answers and Video Solutions







3. The equation of a curve is  $y = (x - 3)^2 + 4$



Write down the coordinates of the turning point

(3, 4)  
(1)

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4. The equation of a curve is  $y = (x + 6)^2 - 8$



Write down the coordinates of the turning point

(-6, -8)  
(1)

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5. The equation of a curve is  $y = (x - 1)^2 + 13$



Write down the coordinates of the turning point

(1, 13)  
(1)

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6. The equation of a curve is  $y = (x + 7)^2$



Write down the coordinates of the turning point

(-7, 0)  
(1)

7. (a) Write  $x^2 + 8x + 18$  in the form  $(x + a)^2 + b$



$$(x + 4)^2 - 16 + 18$$

$$(x + 4)^2 + 2$$

$$\frac{(x + 4)^2 + 2}{\dots\dots\dots}$$

(2)

(b) Hence, write down the coordinates of the turning point of  $y = x^2 + 8x + 18$

$$\frac{(-4, 2)}{\dots\dots\dots}$$

(1)

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8. Given that  $x^2 - 10x + 3 \equiv (x - a)^2 - b$



(a) Find the values of a and b

$$(x - 5)^2 - 25 + 3$$

$$(x - 5)^2 - 22$$

a = ..... 5 .....

b = ..... 22 .....

(2)

(b) Hence, write down the coordinates of the turning point of  $y = x^2 - 10x + 3$

$$y = (x - 5)^2 - 22$$

$$\frac{(5, -22)}{\dots\dots\dots}$$

(1)

9. A curve has equation  $y = x^2 - 16x + 45$



Use completing the square to work out the coordinates of the turning point.

$$y = (x - 8)^2 - 64 + 45$$

$$y = (x - 8)^2 - 19$$

$$\underline{(8, -19)}$$

(3)

10. A curve has equation  $y = x^2 + 12x + 80$



Use completing the square to work out the coordinates of the turning point.

$$y = (x + 6)^2 - 36 + 80$$

$$y = (x + 6)^2 + 44$$

$$\underline{(-6, 44)}$$

(3)

11. A curve has equation  $y = x^2 - 6x - 17$



Work out the coordinates of the turning point.

$$y = (x - 3)^2 - 9 - 17$$

$$y = (x - 3)^2 - 26$$

$$\underline{(3, -26)}$$

(3)

12. A curve has equation  $y = x^2 + 4x + 1$



(a) Work out the coordinates of the turning point.

$$y = (x + 2)^2 - 4 + 1$$

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

$$\underline{(-2, -3)}$$

(3)

(b) Write down the equation of the line of symmetry of  $y = x^2 + 4x + 1$

$$\underline{x = -2}$$

(1)

The straight line  $y = 3x + 1$  intersects the curve  $y = x^2 + 4x + 1$  at the points A and B.

(c) Find the coordinates of the points A and B.

$$x^2 + 4x + 1 = 3x + 1$$

$$x^2 + x = 0$$

$$x(x + 1) = 0$$

$$x = 0$$

$$y = 1$$

$$\text{or } x = -1$$

$$y = -2$$

$$\underline{(-1, -2) \text{ and } (0, 1)}$$

(3)

13. (a) Sketch the graph of  $y = x^2 - 14x + 52$

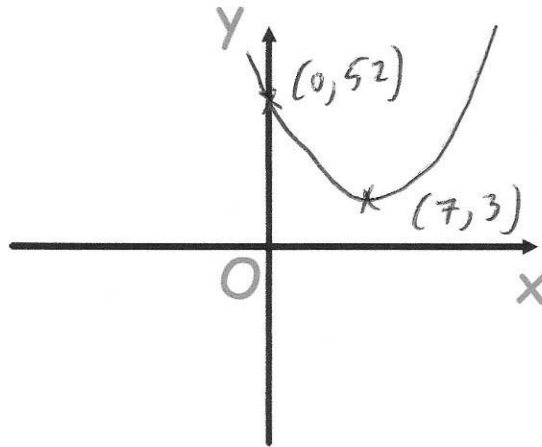


Show the coordinates of any turning points.

↓  
(7, 3)

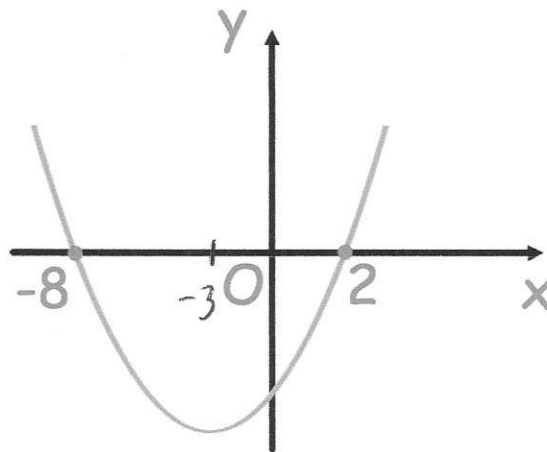
$$y = (x - 7)^2 - 49 + 52$$

$$y = (x - 7)^2 + 3$$



(3)

Here is a sketch of the curve with equation  $y = x^2 + ax + b$



(b) Find the coordinates of the turning point of the curve.

$$y = (x + 8)(x - 2)$$

$$y = x^2 + 6x - 16$$

Approach 2

$$y = (x + 3)^2 - 9 - 16$$

$$y = (x + 3)^2 - 25$$

.....  
(-3, -25)  
.....

(3)

Approach 1

$$x = -3$$

$$y = (5)(-5)$$

$$y = -25$$

14. The point  $(-3, 8)$  is the turning point of the graph of  $y = x^2 + ax + b$  where  $a$  and  $b$  are integers.



Find the values of  $a$  and  $b$ .

$$y = (x + 3)^2 + 8$$
$$y = (x + 3)(x + 3) + 8$$
$$y = x^2 + 6x + 9 + 8$$
$$y = x^2 + 6x + 17$$

$$a = \underline{\quad 6 \quad} \quad b = \underline{\quad 17 \quad}$$

(3)

15. The point  $(5, -1)$  is the turning point of the graph of  $y = x^2 + ax + b$  where  $a$  and  $b$  are integers.



Find the values of  $a$  and  $b$ .

$$y = (x - 5)^2 - 1$$
$$y = (x - 5)(x - 5) - 1$$
$$y = x^2 - 10x + 25 - 1$$
$$y = x^2 - 10x + 24$$

$$a = \underline{\quad -10 \quad} \quad b = \underline{\quad 24 \quad}$$

(3)

16. A curve has equation  $y = x^2 + 5x + 7$



Use completing the square to work out the coordinates of the turning point.

$$y = \left(x + \frac{5}{2}\right)^2 - \frac{25}{4} + 7$$

$$y = \left(x + \frac{5}{2}\right)^2 - \frac{25}{4} + \frac{28}{4}$$

$$y = \left(x + \frac{5}{2}\right)^2 + \frac{3}{4}$$

$$\left(-\frac{5}{2}, \frac{3}{4}\right)$$

(3)

17. A curve has equation  $y = -x^2 - 4x + 22$



Work out the coordinates of the turning point.

let  $f(x) = -x^2 - 4x + 22$

then  $-f(x) = x^2 + 4x - 22$

for  $y = -f(x)$

$$y = (x+2)^2 - 4 - 22$$

$$y = (x+2)^2 - 26$$

turning point of  $y = -f(x)$  is  $(-2, -26)$

$y = f(x)$  is a reflection in the  $x$ -axis

$$\left(-2, 26\right)$$

(3)

18. The turning point of the curve with equation  $y = x^2 - 8x + b$  has a y-coordinate of 14.



Work out the value of  $b$ .

$$y = (x^2 - 4)^2 - 16 + b$$

$$-16 + b = 14$$

$$b = 30$$

30

(3)

19. The curve with equation  $y = (x + a)^2 + b$  passes through the point (2, 4)



The turning of the curve has an x-coordinate of -1

Find the y-coordinate of the turning point.

$$y = (x + 1)^2 + c$$

$$4 = (2 + 1)^2 + c$$

$$4 = 9 + c$$

$$c = -5$$

$$y = (x + 1)^2 - 5$$

-5

(3)

20. Sketch the graph of  $y = 2x^2 - 12x + 1$



Show the coordinates of the turning point and the coordinates of any intercepts with the coordinate axes.

$$y = 2 \left[ x^2 - 6x + \frac{1}{2} \right]$$

$$y = 2 \left[ (x-3)^2 - 9 + \frac{1}{2} \right]$$

$$y = 2 \left[ (x-3)^2 - 8\frac{1}{2} \right]$$

$$y = 2(x-3)^2 - 17$$

$$0 = 2(x-3)^2 - 17$$

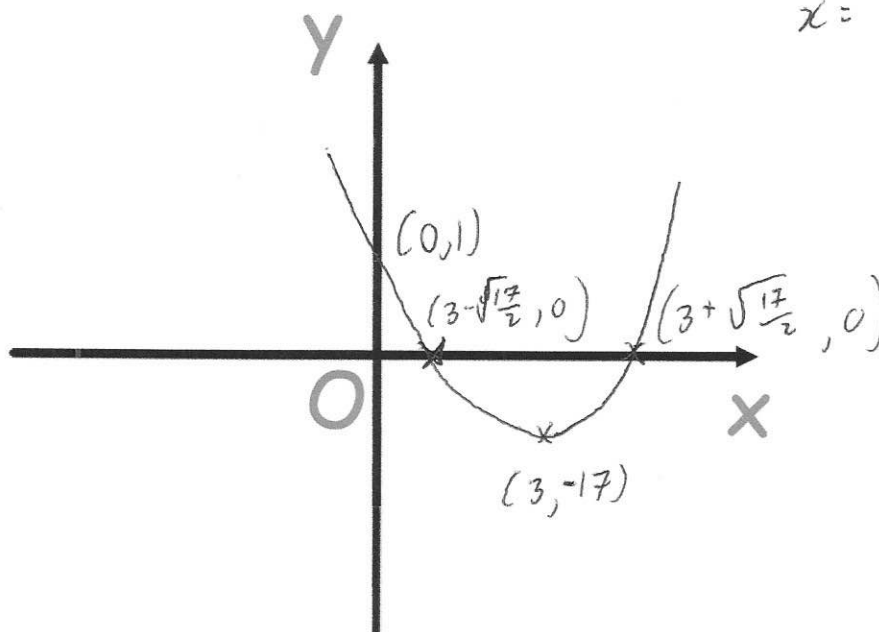
$$17 = 2(x-3)^2$$

$$\frac{17}{2} = (x-3)^2$$

$$\pm \sqrt{\frac{17}{2}} = (x-3)$$

$$x = 3 \pm \sqrt{\frac{17}{2}}$$

$\sqrt{8.5}$   
(less than 3)



(5)