

## Solving Equations Graphically

### Starter

1. (Review of Y10 material)
- (a) Draw the graphs of  $x + y = 3$  and  $y = 2x - 1$  on the same axes.
- (b) Hence estimate the solution to the simultaneous equations  $x + y = 3$  and  $y = 2x - 1$ .

### Notes

In the same way that graphs can be drawn to solve linear equations we can also draw graphs to solve equations involving non-linear equations.

Normally another line, either horizontal or diagonal, needs to be drawn on the graph. The key is to know which line to draw.

Remember,

### Finding the equation of the line to draw

1. If necessary, separate the curve within the equation.
2. Replace the equation of the curve by  $y$ .
3. If necessary, rearrange to make  $y$  the subject.

**Remember:**

$y = \text{"a number"} \Rightarrow$	horizontal line
$y = mx + c \Rightarrow$	diagonal line

Here are a couple of examples to help you understand:

**E.g.** State the equation of the line needed to solve the following equations using the graph of  $y = x^2 - 7x + 4$ .

(a)  $x^2 - 7x + 5 = 8$     (b)  $x^2 - 4x + 2 = 10$

**Working:**

<p>(a) <math>x^2 - 7x + 5 = 8</math>  <math>x^2 - 7x + 4 + 1 = 8</math>  <math>y + 1 = 8</math>  <math>y = 7</math></p> <p>Draw <math>y = 7</math></p>	<p><i>separate curve within equation</i>  <i>replace <math>x^2 - 7x + 4</math> by <math>y</math></i>  <i>rearrange</i></p>
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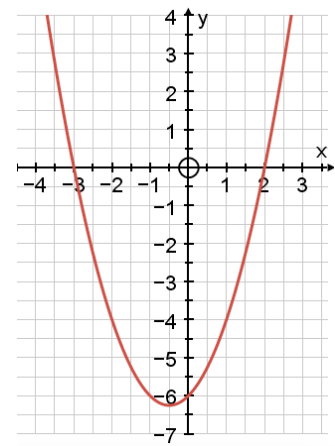
<p>(b) <math>x^2 - 4x + 2 = 10</math>  <math>x^2 - 7x + 4 + 3x - 2 = 10</math>  <math>y + 3x - 2 = 10</math>  <math>y = 12 - 3x</math></p> <p>Draw <math>y = 12 - 3x</math></p>	<p><i>separate curve within equation</i>  <i>replace <math>x^2 - 7x + 4</math> by <math>y</math></i>  <i>rearrange</i></p>
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**E.g. 1** State the equation of the line needed to solve the following equations using the graph of  $y = x^2 + 3x - 2$ .

<p>(a) <math>x^2 + 3x - 2 = 7</math></p> <p>(c) <math>x^2 + 3x - 5 = 1</math></p> <p>(e) <math>x^2 + 3x = 0</math></p> <p>(g) <math>x^2 + 5x - 6 = 0</math></p>	<p>(b) <math>x^2 + 3x - 2 = -1</math></p> <p>(d) <math>x^2 + 3x + 8 = 25</math></p> <p>(f) <math>x^2 + 3x - 2 = x - 4</math></p> <p>(h) <math>x^2 - 2x + 4 = 6</math></p>
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**E.g. 2** Using the graph of  $y = x^2 + x - 6$ :

- (a) find the equation of the line needed to be drawn
- (b) state the solution to the equation for
- $x^2 + x - 6 = 0$
  - $x^2 + x - 6 = 2$
  - $x^2 + x - 6 = -7$
  - $x^2 + x - 5 = 0$
  - $x^2 + x - 2 = 0$
  - $x^2 + x - 6 = x$



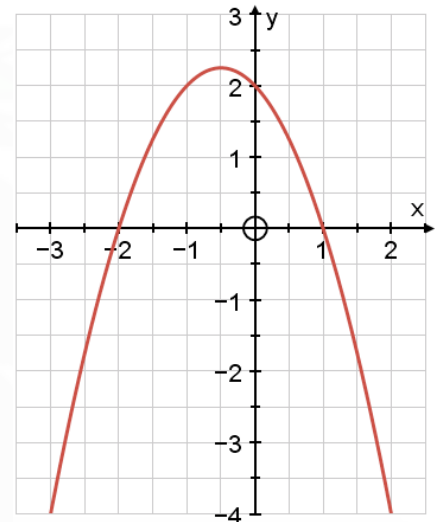
**Working:**

(i)	(a)	Draw $y = 0$	(b)	$x = -3$ or $x = 2$
(ii)	(a)	Draw $y = 2$	(b)	$x = -3.4$ or $x = 2.4$

**N.B.** Where a curve intersects the  $x$ -axis is called the **roots** of the equation.  
If the line drawn does not intersect the curve, there is **no solution**.

**E.g. 3** Using the graph of  $y = 2 - x - x^2$ :

- (a) find the equation of the line needed to be drawn
- (b) state the solution to the equation for
- $2 - x - x^2 = 0$
  - $2 - x - x^2 = 3$
  - $2 - x - x^2 = 1$
  - $1 - x - x^2 = 0$
  - $5 - x - x^2 = 0$
  - $1 - 2x - x^2 = 0$



**Video:** [Solving quadratics graphically/](#)

[Solutions to Starter and E.g.s](#)

**Exercise**

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|----------------------|---|
| 9-1 class textbook:  | p413 M12.9 Qu 3-6 (without drawing the graphs)<br>p413 M12.9 Qu 1-2, 7-10 (needing graph to be drawn) |
| A*-G class textbook: | p369 E12.7 Qu 3-6 (without drawing the graphs)<br>p369 E12.7 Qu 1-2, 7-10 (needing graph to be drawn) |
| 9-1 homework book:   | p142 M12.9 Qu 1-4   |
| A*-G homework book:  | p104 E12.7 Qu 1-4   |

**Summary**

Finding the equation of the line to draw

- If necessary, separate the curve within the equation.
- Replace the equation of the curve by  $y$ .
- If necessary, rearrange to make  $y$  the subject.

