

## 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  $y = 2x - 1$ .

**Working:**  $x + y = 3$  passes through the points  $(0, 3)$  and  $(3, 0)$

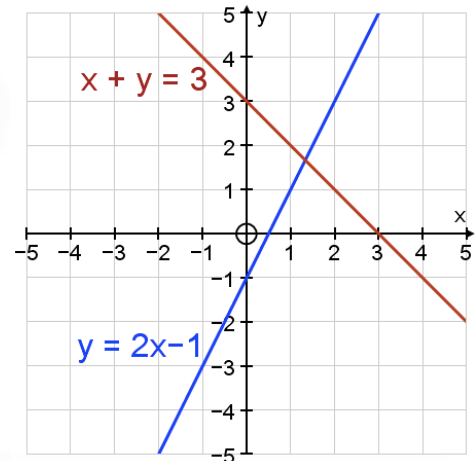
$$y = 2x - 1$$

Let  $x = 3$ ,  $y = 6 - 1 = 5$  plot  $(3, 5)$

Let  $x = 1$ ,  $y = 2 - 1 = 1$  plot  $(1, 1)$

Draw the two lines — where they intersect is the solution to the equation

$$x \approx 1.3, y \approx 1.7$$



**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:** (a)  $x^2 - 7x + 5 = 8$

$$x^2 - 7x + 4 + 1 = 8$$

$$y + 1 = 8$$

$$y = 7$$

Draw  $y = 7$

*separate curve within equation*

*replace  $x^2 - 7x + 4$  by  $y$*

*rearrange*

(b)  $x^2 - 4x + 2 = 10$

$$x^2 - 7x + 4 + 3x - 2 = 10$$

$$y + 3x - 2 = 10$$

$$y = 12 - 3x$$

Draw  $y = 12 - 3x$

*separate curve within equation*

*replace  $x^2 - 7x + 4$  by  $y$*

*rearrange*

**E.g. 1** State the equation of the line needed to solve the following equations using the graph of

$$y = x^2 + 3x - 2.$$

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

(b)  $x^2 + 3x - 2 = -1$

(c)  $x^2 + 3x - 5 = 1$

(d)  $x^2 + 3x + 8 = 25$

(e)  $x^2 + 3x = 0$

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

(g)  $x^2 + 5x - 6 = 0$

(h)  $x^2 - 2x + 4 = 6$

**Working:**

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

*separate curve within equation  
 replace  $x^2 + 3x - 2$  by  $y$*

Draw  $y = 7$

(b)  $x^2 + 3x - 2 = -1$   
 $y = -1$

*separate curve within equation  
 replace  $x^2 + 3x - 2$  by  $y$*

Draw  $y = -1$

(c)  $x^2 + 3x - 5 = 1$   
 $x^2 + 3x - 2 - 3 = 1$   
 $y - 3 = 1$   
 $y = 4$

*separate curve within equation  
 replace  $x^2 + 3x - 2$  by  $y$   
 rearrange*

Draw  $y = 4$

(d)  $x^2 + 3x + 8 = 25$   
 $x^2 + 3x - 2 + 10 = 25$   
 $y + 10 = 25$   
 $y = 15$

*separate curve within equation  
 replace  $x^2 + 3x - 2$  by  $y$   
 rearrange*

Draw  $y = 15$

(e)  $x^2 + 3x = 0$   
 $x^2 + 3x - 2 + 2 = 0$   
 $y + 2 = 0$   
 $y = -2$

*separate curve within equation  
 replace  $x^2 + 3x - 2$  by  $y$   
 rearrange*

Draw  $y = -2$

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

*separate curve within equation  
 replace  $x^2 + 3x - 2$  by  $y$*

Draw  $y = x - 4$

(g)  $x^2 + 5x - 6 = 0$   
 $x^2 + 3x - 2 + 2x - 4 = 0$   
 $y + 2x - 4 = 0$   
 $y = 4 - 2x$

*separate curve within equation  
 replace  $x^2 + 3x - 2$  by  $y$   
 rearrange*

Draw  $y = 4 - 2x$

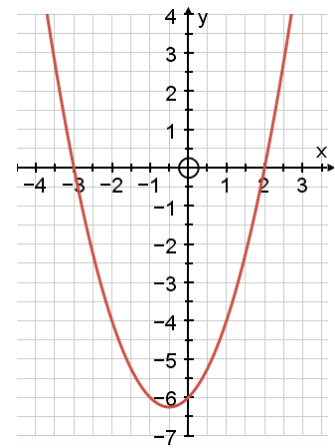
(h)  $x^2 - 2x + 4 = 6$   
 $x^2 + 3x - 2 - 5x + 6 = 6$   
 $y - 5x + 6 = 6$   
 $y = 5x$

*separate curve within equation  
 replace  $x^2 + 3x - 2$  by  $y$   
 rearrange*

Draw  $y = 5x$

**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
- $x^2 + x - 6 = 0$
  - $x^2 + x - 6 = 2$
  - $x^2 + x - 6 = -7$
  - $x^2 + x - 5 = 0$
  - $x^2 + x - 2 = 0$
  - $x^2 + x - 6 = x$

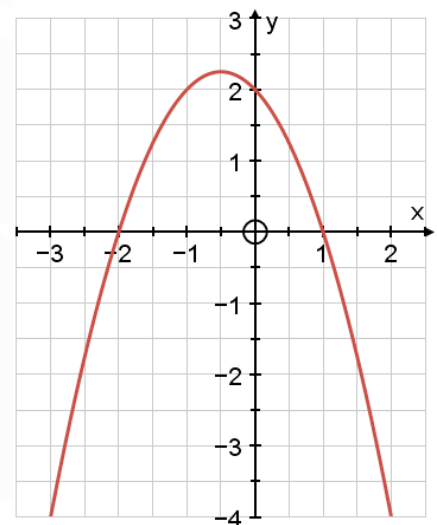


<b>Working:</b>	(i)	(a)	Draw $y = 0$	(b)	$x = -3$ or $x = 2$
	(ii)	(a)	Draw $y = 2$	(b)	$x = -3.4$ or $x = 2.4$
	(iii)	(a)	Draw $y = -7$	(b)	No solution
	(iv)	(a)	Draw $y = -1$	(b)	$x = -2.8$ or $x = 1.8$
	(v)	(a)	Draw $y = -4$	(b)	$x = -2$ or $x = 1$
	(vi)	(a)	Draw $y = x$	(b)	$x = -2.4$ or $x = 2.3$

**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
- $2 - x - x^2 = 0$
  - $2 - x - x^2 = 3$
  - $2 - x - x^2 = 1$
  - $1 - x - x^2 = 0$
  - $5 - x - x^2 = 0$
  - $1 - 2x - x^2 = 0$



<b>Working:</b>	(i)	(a)	Draw $y = 0$	(b)	$x = -2$ or $x = 1$
	(ii)	(a)	Draw $y = 3$	(b)	No solution
	(iii)	(a)	Draw $y = 1$	(b)	$x = -1.6$ or $x = 0.6$
	(iv)	(a)	Draw $y = 1$	(b)	$x = -1.6$ or $x = 0.6$
	(v)	(a)	Draw $y = -3$	(b)	$x = -2.8$ or $x = 1.8$
	(vi)	(a)	Draw $y = x + 1$	(b)	$x = -2.4$ or $x = 0.4$

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

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

**Exercise**

9-1 class textbook: p413 M12.9 Qu 3-6 (without drawing the graphs)  
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)  
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

[Homework book answers \(only available during a lockdown\)](#)

