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Non-linear simultaneous equations on graphs

A LEVEL LINKS
Scheme of work: 1c. Equations – quadratic/linear simultaneous

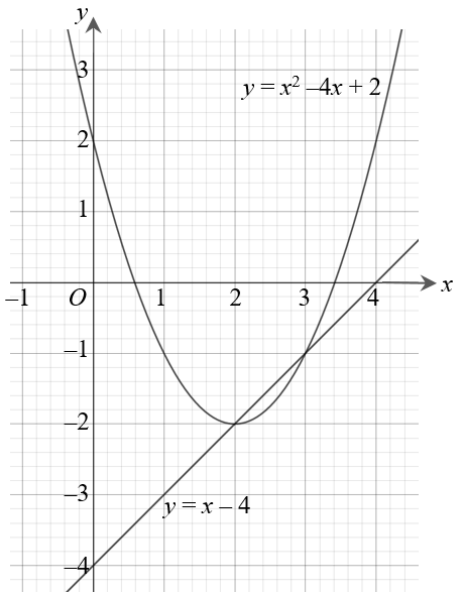
Key points

- You can solve any pair of simultaneous equations by drawing the graph of both equations and finding the point/points of intersection.

Example 1

Solve the simultaneous equations $y = x - 4$ and $y = x^2 - 4x + 2$ graphically.

x	0	1	2	3	4
y	2	–1	–2	–1	2



The line and curve intersect at
$x = 3, y = -1$ and $x = 2, y = -2$

Check:
First equation $y = x - 4$:
$-1 = 3 - 4$ YES
$-2 = 2 - 4$ YES
Second equation $y = x^2 - 4x + 2$:
$-1 = 3^2 - 4 \times 3 + 2$ YES
$-2 = 2^2 - 4 \times 2 + 2$ YES

1 Construct a table of values and calculate the points for the quadratic equation.

2 Plot the graph.

3 Plot the linear graph on the same grid using the gradient and y-intercept.
$y = x - 4$ has gradient 1 and y-intercept –4.

4 The solutions of the simultaneous equations are the points of intersection.

5 Check your solutions by substituting the values into both equations.

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Practice questions

1 Solve these pairs of simultaneous equations graphically.

a $y = x - 1$ and $y = x^2 - 4x + 3$

b $y = 1 - 3x$ and $y = x^2 - 3x - 3$

c $y = 3 - x$ and $y = x^2 + 2x + 5$

2 Solve the simultaneous equations $x + y = 1$ and $x^2 + y^2 = 25$ graphically.

3 **a** Solve the simultaneous equations $2x + y = 3$ and $x^2 + y = 4$

i graphically

ii algebraically to 2 decimal places.

b Which method gives the more accurate solutions? Explain your answer.

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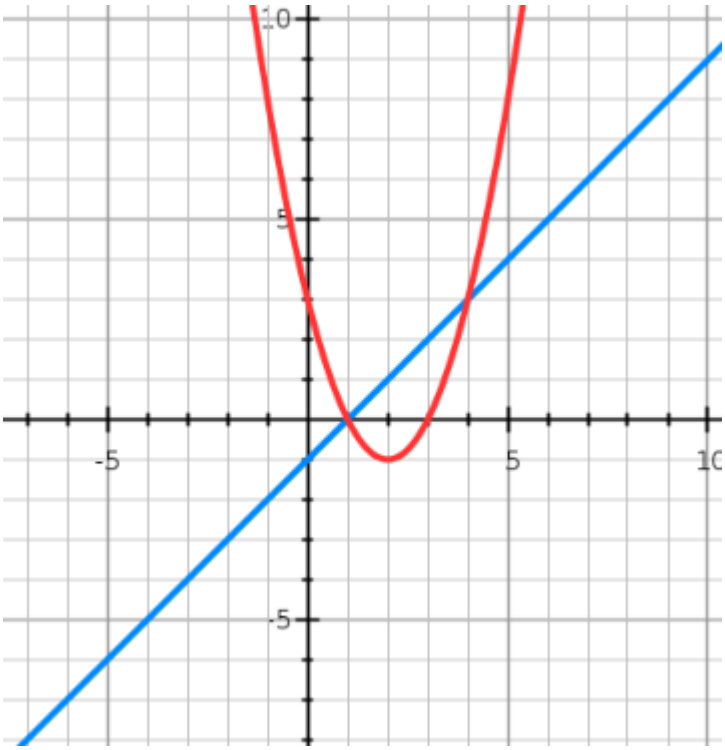
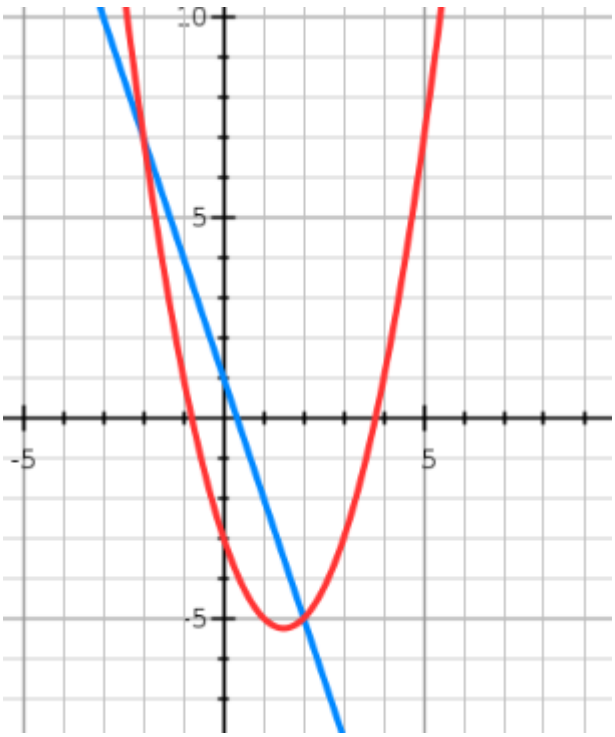
Answers

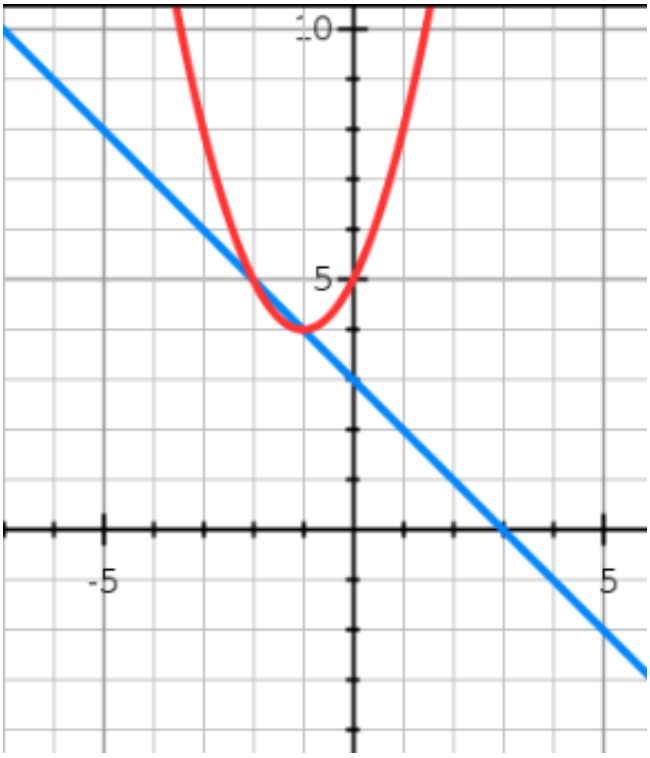
1 **a** $x = 1, y = 0$ and $x = 4, y = 3$



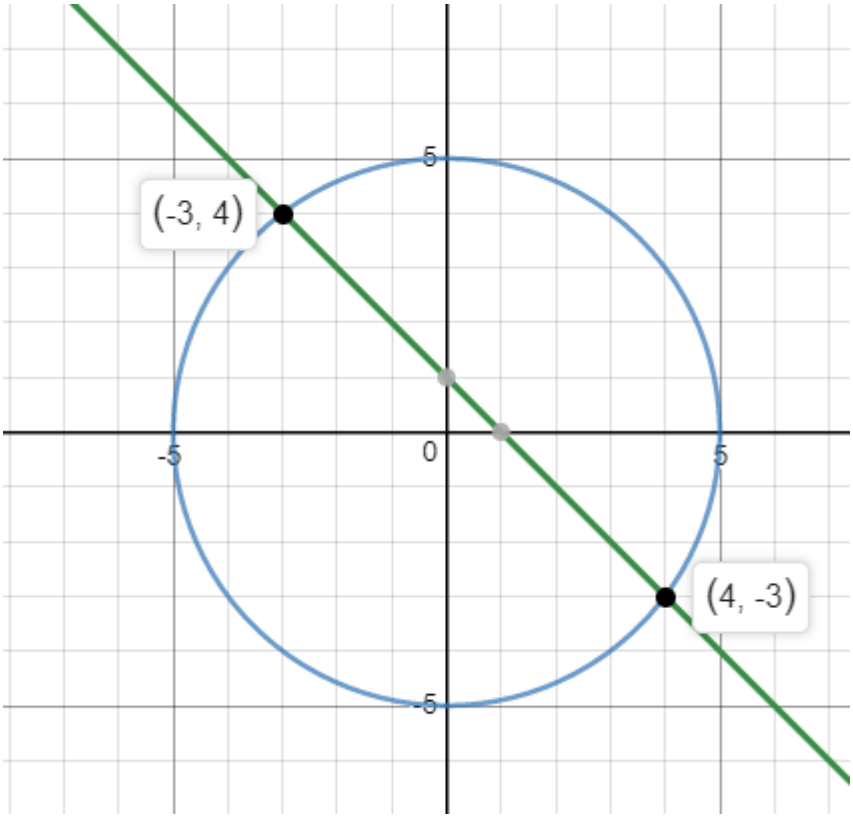
b $x = -2, y = 7$ and $x = 2, y = -5$



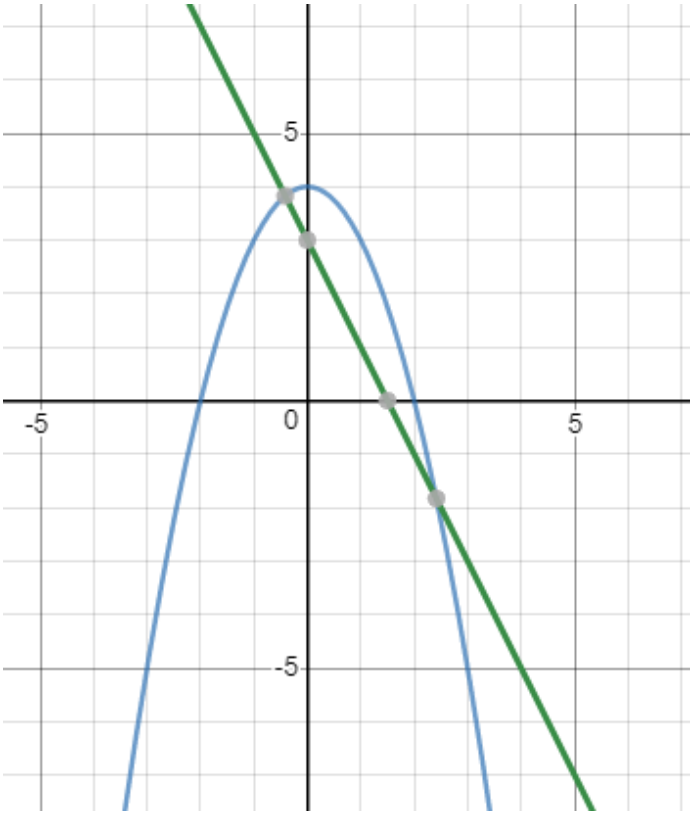
c $x = -2, y = 5$ and $x = -1, y = 4$



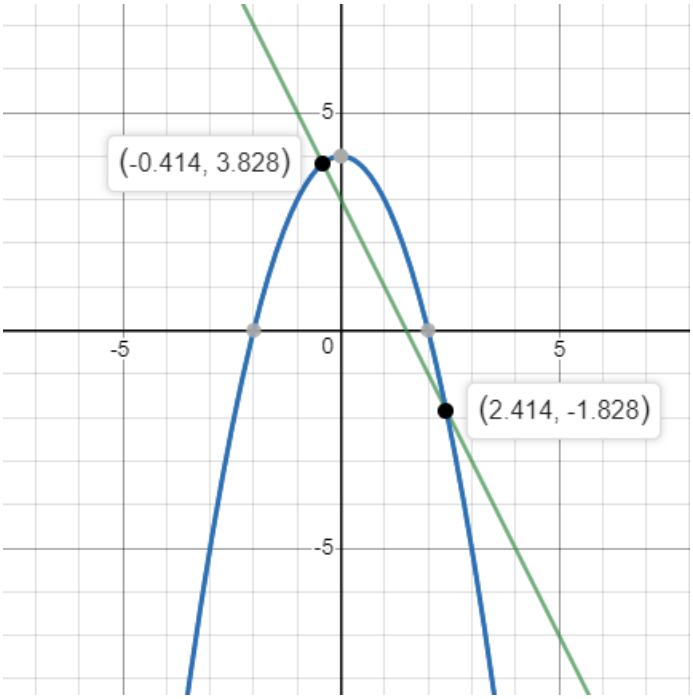
2 $x = -3, y = 4$ and $x = 4, y = -3$



3 a i $x = 2.5, y = -2$ and $x = -0.5, y = 4$



ii $x = 2.41, y = -1.83$ and $x = -0.41, y = 3.83$



b Solving algebraically gives the more accurate solutions as the solutions from the graph are only estimates, based on the accuracy of your graph.