

Edexcel - Higher

Algebra

2022 GCSE Advance Information

Sparx Topics & Key Questions

We are always looking for ways to support maths teachers and students. In order to help you and your year 11s this year we've pulled together a list of key questions which may be useful to practise with your students based on the exam board topic lists.

These 113 key questions are all taken from our library of over 45,000 high-quality questions in Sparx Maths. If you are a Sparx Maths School then your students can use the Topic Codes provided to search the full content library directly within the independent learning section of Sparx Maths to help target their revision.

Please note this is not an exhaustive topic guide it is simply designed to help you pull together some key questions to use to check for understanding in lessons, starters, or as worksheets with your learners.



Algebra	Topics	Sparx Topic Codes
<u>Manipulation</u>	<u>Simplification</u>	U105, U662
	<u>Expansion of bracket</u>	U179
	<u>Factorisation</u>	U365, U178, U858
	<u>Laws of indices</u>	U235, U694, U662
	<u>Substitute values</u>	U585, U144
	<u>Change subject of a formula</u>	U556
	<u>Forming an expression</u>	U613
	<u>Expansion of brackets</u>	U768, U606
	<u>Algebraic fractions</u>	U437, U294, U685, U824
<u>Equations and inequalities</u>	<u>Linear equation</u>	U325, U870, U505
	<u>Form an equation</u>	U599
	<u>Set up and solve equation</u>	U599
	<u>Linear inequality.</u>	U738, U145, U337
	<u>Quadratic equation</u>	U960, U589, U665, U150, U601
	<u>Quadratic inequality.</u>	U133
	<u>Equation of a tangent to a circle</u>	U567

Algebra	Topics	Sparx Topic Codes
<u>Equations and inequalities</u>	<u>Simultaneous equations linear/quadratic</u>	U760, U757, U547, U836, U137
<u>Graphs</u>	<u>Coordinates</u>	U889
	<u>Quadratic graph</u>	U989, U667
	<u>Gradient of a straight line graph</u>	U315, U669, U477
	<u>Gradients of parallel and perpendicular lines</u>	U477, U848, U898
	<u>Speed-time graph</u>	U562, U611
	<u>Gradient of a curve</u>	U800
	<u>Transformations of functions</u>	U598, U487
	<u>Graphs of trigonometric functions</u>	U450
<u>Functions</u>	<u>Inverse and composite functions</u>	U996, U448

Manipulation - Simplification

Simplifying expressions by collecting like terms

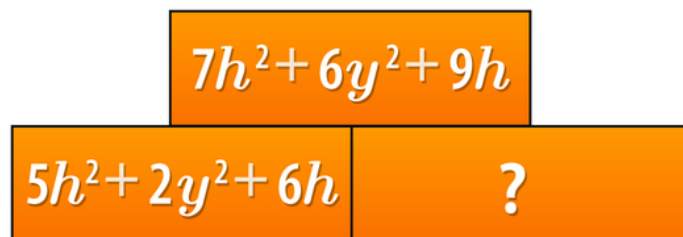
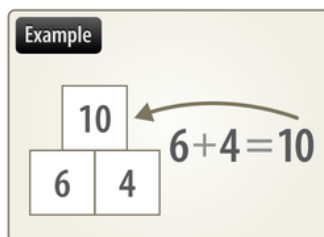
U105

Fully simplify the expression below.

$$5b^2 + 3r^2 + 7b^2 + 4r$$

In this pyramid, the expression in the top brick is found by adding together the expressions in the two bricks below it.

What expression should replace the question mark?
Give your answer as simply as possible.



Fully simplify the expression below.

$$7ch + 4hu + 3hc + 6cu + 5uh$$

Fully simplify $4x^2y + 2yx + 7xy + 2xy^2 + 3yx^2$

Simplifying expressions using index laws

U662

Simplify the following expression:

$$3q^5r^3 \times 4q^2r^5$$

Fully simplify the following expression:

$$(6f^9g^{-4})^2$$

Give your answer without any negative indices.

Fully simplify the expression below.

$$\frac{2xy^4z^7}{16y^{12}z}$$

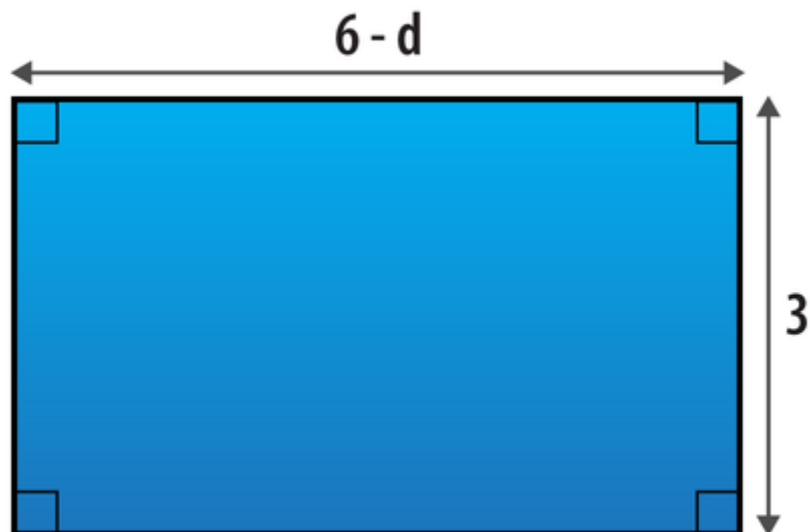
Give your answer as a fraction without any negative indices.

Manipulation - Expansion of bracket

Expanding single brackets

U179

Write an expression for the area of this rectangle. Expand your expression so that your answer does not contain brackets.

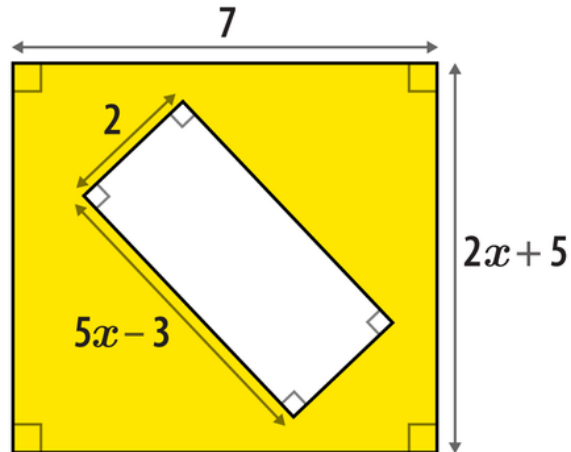


Not to scale

Expand the expression below.

$$-4a(3a - 7)$$

Write an expression for the **shaded area** of this shape.
Your expression should not contain any brackets and should be written as simply as possible.



Not drawn accurately

Manipulation - Factorisation

Factorising into one bracket**U365**

Fully factorise $7t^2 - 14tu$

Factorising quadratic expressions of the form $x^2 + bx + c$ **U178**

Fully factorise $w^2 - 15w + 54$

Work out the value of a in the equation below.

$$x^2 - 18x + 81 = (x - a)^2$$

Fully factorise $w^2 - 144$

Factorising quadratic expressions of the form $ax^2 + bx + c$ **U858**

Fully factorise $6h^2 - 19h + 15$

Fully factorise the expression $49w^2 - 36$

Manipulation - Laws of indices

Index rules with positive indices

U235

Work out the value of f in the equality below.

$$\frac{6^{10} \times 6^8}{6^2} = 6^f$$

What is the value of d in the equality below?

$$(7^4 \times 7^5)^3 = 7^d$$

Index rules with negative indices

U694

Write 5^{-3} as a fraction in its simplest form, without any indices.

What is the value of c in the equality below?

$$(16^3)^{-7} = 16^c$$

Simplifying expressions using index laws

U662

Simplify the following expression:

$$3q^5r^3 \times 4q^2r^5$$

Fully simplify the following expression:

$$(6f^9g^{-4})^2$$

Give your answer without any negative indices.

Fully simplify the expression below.

$$\frac{2xy^4z^7}{16y^{12}z}$$

Give your answer as a fraction without any negative indices.

Manipulation - Substitute values

Substituting into algebraic formulae

U585

Work out the value of x^n when $x = 5$ and $n = 3$

$$c = \frac{5n+9}{2p}$$

Work out the value of c when $n = 4$ and $p = 5$

Give your answer as a whole number or as a decimal.

$$k = \frac{a^2+t}{2-a}$$

Work out the value of t when $a = 4$ and $k = -11$.

Give your answer as an integer or as a decimal.

Which of the expressions below always have an **even** value when x is an **odd** number?
Select all of the correct answers.

$$6x$$

$$7 + x$$

$$2x + 3$$

$$x^2$$

Phoebe knows that w , x and y have the values 4, 5 and 8, but she does not know which is which.

What is the **largest** value that $3w + 7x - 2y$ could have?

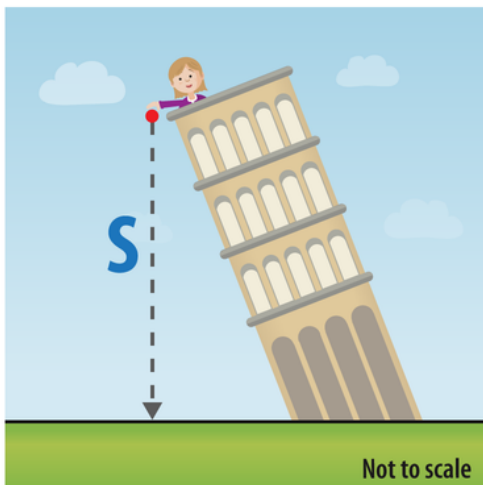
Substituting into real-life formulae

U144

Look at the information in the image below.

Francesca dropped an item from the top of the Leaning Tower of Pisa. Its initial speed was 0 m/s , its final speed was 33 m/s and it took 3.4 s to fall to the ground.

Giving your answer to 1 decimal place, work out s (the distance travelled), in metres (m).



$$s = \frac{1}{2} (u + v) t$$

where

s = distance travelled (m)

u = initial speed (m/s)

v = final speed (m/s)

t = time travelling (s)

The geometric mean of 10 and x is 20. Use the rule below to find the value of x .

To find the **geometric mean** of two numbers:

multiply the two numbers together, then
find the square root of the result.

Example

$$\begin{aligned} \text{geometric mean of 4 and 9} &= \sqrt{4 \times 9} \\ &= \sqrt{36} \\ &= 6 \end{aligned}$$

Manipulation - Change subject of a formula

Changing the subjects of formulae

U556

Make x the subject of

$$rt = \frac{(x+p)^2}{10}$$

Make x the subject of this formula:

$$n = 6x - yx$$

Manipulation - Forming an expression

Using algebraic notation

U613

Write the following expressions as simply as possible in correct algebraic notation:

a) $3c \times 2c$

b) $5 \div (r \times r \times r)$

Craig is x years old.

Lucia is twice as old as Craig.

Elena is 3 years **younger** than Lucia.

Write an expression in terms of x for Elena's age.

Manipulation - Expansion of brackets

Expanding double brackets

U768

Expand and simplify $(3w - 7)^2$

Expand and simplify $(5 - c)(7c + 3)$

Expanding triple brackets

U606

$(2x + 5)(4x - 3)(5x - 4)$ can be expanded and fully simplified to give an expression of the form $ax^3 + bx^2 + cx + d$.

Work out the values of a , b , c and d .

$2(3x + 10)^3$ can be expanded and fully simplified to give an expression of the form $ax^3 + bx^2 + cx + d$.

Work out the values of a , b , c and d .

Manipulation - Algebraic fractions

Simplifying algebraic fractions by factorising into one bracket

U437

Write the following fraction in its simplest form:

$$\frac{6m+30}{7m+35}$$

Simplifying algebraic fractions by factorising into two brackets

U294

Write the fraction below in its simplest form.

$$\frac{f^2 - 16}{f^2 - 10f + 24}$$

Fully simplify the fraction below.

$$\frac{6x^2 + 3x}{2x^2 + 7x + 3}$$

Adding and subtracting algebraic fractions

U685

Fully simplify

$$\frac{10}{5x-1} - \frac{2}{x+3}$$

Give your answer fully factorised.

Dividing algebraic fractions

U824

Write the following calculation as a fraction in its simplest form:

$$\frac{1}{2x^2 + x - 21} \div \frac{1}{5x^2 - 15x}$$

Equations and inequalities - Linear equation

Solving equations with two or more steps

U325

Solve $\frac{2h+17.2}{6} = 4$

Give your answer as a decimal.

Calculate the two possible values of x in the following equation:

$$4(7 + 5x^2) = 348$$

Solving equations with the variable on both sides

U870

Solve $\frac{7t+15}{2} = 6t$

$$t = \dots$$

Solving equations with the variable in the denominator

U505

Solve the equation below.

$$\frac{w+5}{10-3w} = 3$$

Give your answer as a decimal.

Equations and inequalities - Form an equation

Constructing and solving equations

U599

A regular hexagon and a regular pentagon have the same perimeter. All measurements are given in centimetres.

The hexagon has a side length given by $7m + 3$.

The pentagon has a side length given by $8m + 6$.

Work out the value of m .

Equations and inequalities - Set up and solve equation

Constructing and solving equations

U599

A regular hexagon and a regular pentagon have the same perimeter. All measurements are given in centimetres.

The hexagon has a side length given by $7m + 3$.

The pentagon has a side length given by $8m + 6$.

Work out the value of m .

Equations and inequalities - Linear inequality

Solving inequalities with the variable on both sides

U738

Work out the lowest **integer** value that p can take if

$$8p + 6 > 30 - 2p$$

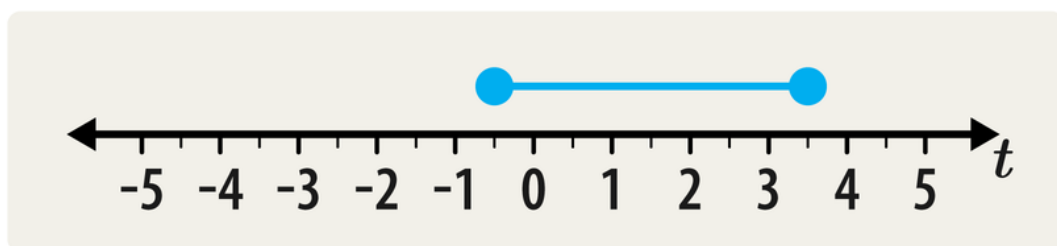
Solve the following inequality:

$$2(3d + 7) \leq 4d + 28$$

Solving double inequalities

U145

Write down the inequality shown on the number line below.



How many integer values are there that x could take to satisfy the following inequality?

$$5 < 2x + 3 \leq 9$$

Constructing and solving inequalities**U337**

Alfie has a collection of 528 trading cards, and Ellie has a collection of 609 trading cards. At the end of each month, Alfie buys a box of 50 trading cards and Ellie buys a box of 42 trading cards.

After how many months will Alfie have more trading cards than Ellie?

A rectangle has side lengths, in centimetres, of r and $r - 3$.

a) Write a sentence to explain why $r > 3$.

b) The perimeter of the rectangle is smaller than 26 cm.

Use this information and your answer to part a) to write a double inequality for r .

Equations and inequalities - Quadratic equation

Factorising to solve quadratic equations of the form $ax^2 + bx + c = 0$

U960

Solve the equation below using factorising.

$$6y^2 - 11y - 10 = 0$$

Give each answer as an integer or as a fraction in its simplest form.

Solving quadratic equations by completing the square

U589

By first completing the square, solve $x^2 + 12x + 4 = 0$.

Give your answers fully simplified in the form $x = a \pm b\sqrt{c}$, where a , b and c are integers.

By first completing the square, solve $x^2 - 3x + \frac{1}{4} = 0$.

Give your answers fully simplified in the form $x = a \pm \sqrt{b}$, where a and b are integers or fractions.

Solving quadratic equations using the quadratic formula

U665

Solve the quadratic equation

$$-5m^2 + 12m + 8 = 3 - 5m$$

Give each solution to 2 d.p.

$$\text{Solve } 2x(4 - 7x) = -9$$

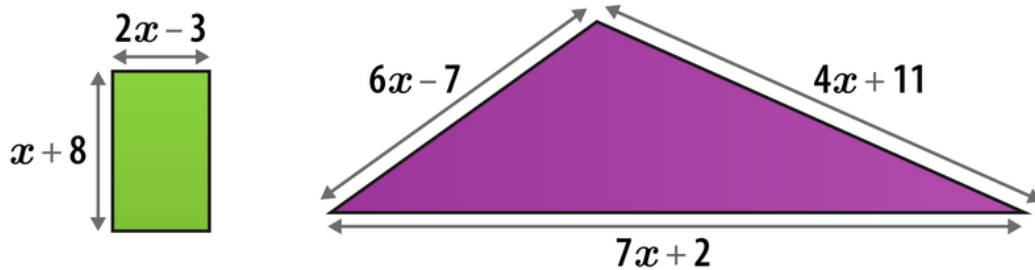
Give your answers to 2 d.p.

Constructing and solving quadratic equations**U150**

A rectangle and a triangle are shown below.

The area of the rectangle, measured in cm^2 , is numerically equal to the perimeter of the triangle, measured in cm .

Work out the value of x .
If your answer is a decimal, give it to 1 d.p.



Not drawn accurately

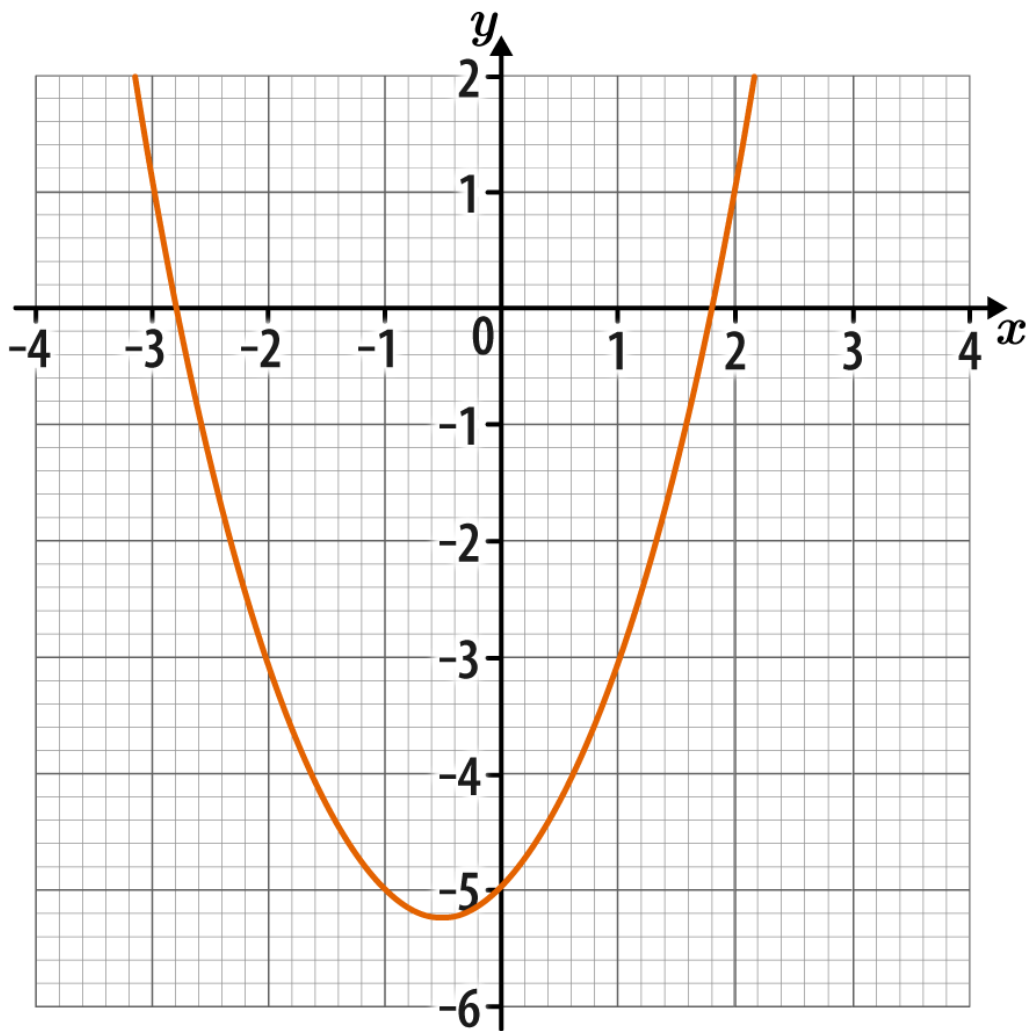
Solving quadratic equations graphically

U601

Here is the graph of the function $y = x^2 + x - 5$.

Estimate the solutions to $x^2 + x - 5 = 0$.

Give your answers to 1 decimal place.

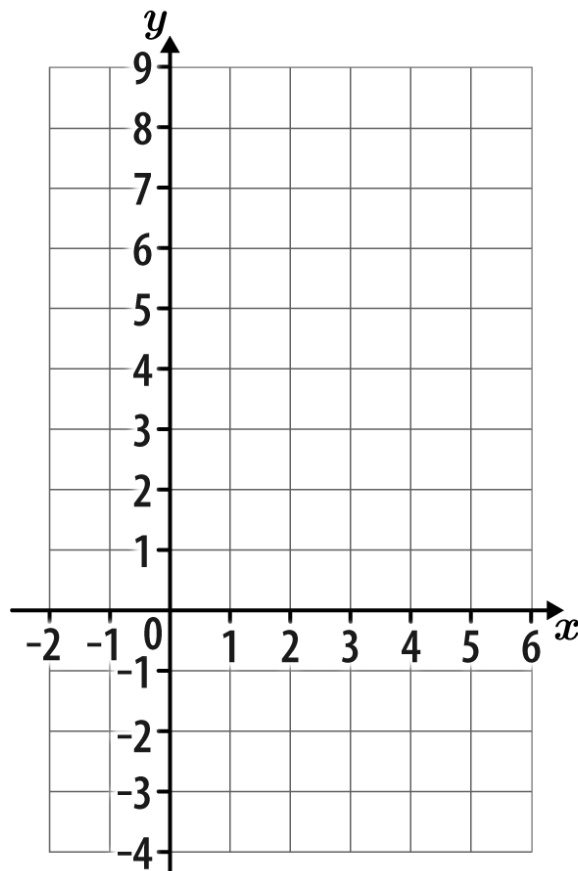


Copy and complete the table of values for $y = x^2 - 5x + 3$.

x	-1	0	1	2	3	4	5	6
y	9	3						

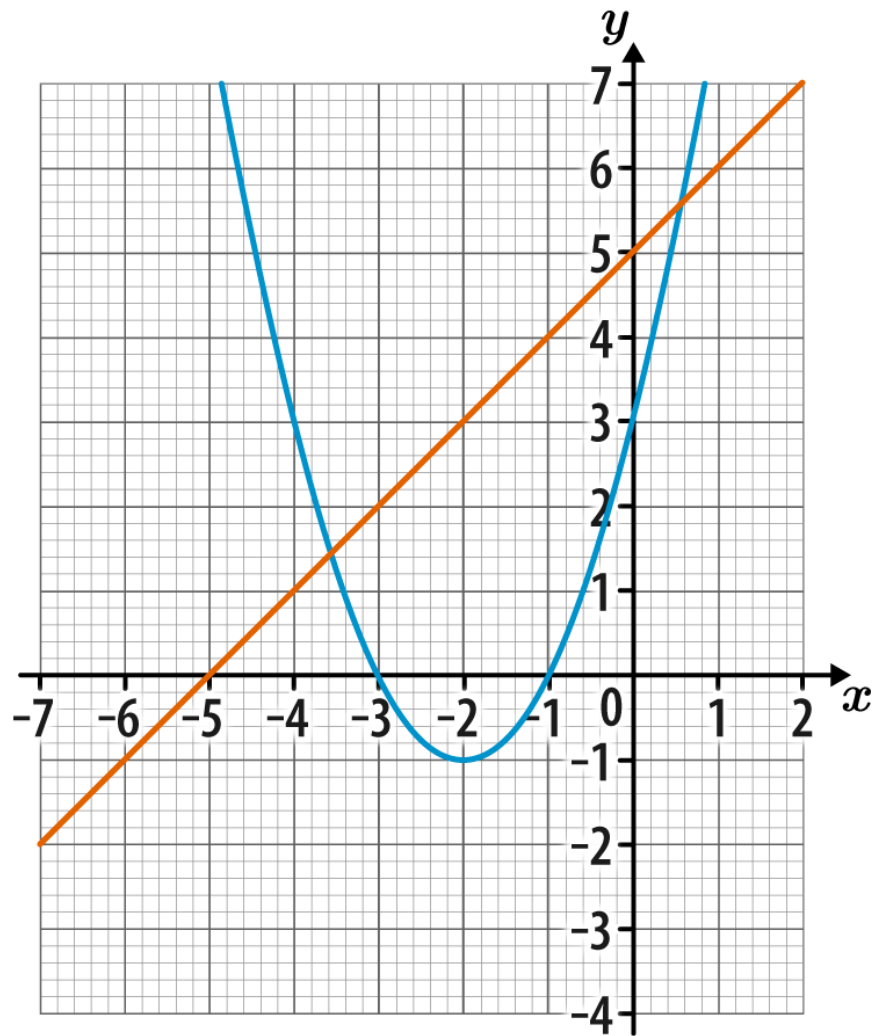
Copy these axes onto graph paper and use your completed table to help you plot the graph of $y = x^2 - 5x + 3$.

Then, by adding the line $y = 3$ to your diagram, solve the equation $x^2 - 5x + 3 = 3$.



The diagram shows the graph of $y = x^2 + 4x + 3$ and the line $y = x + 5$.

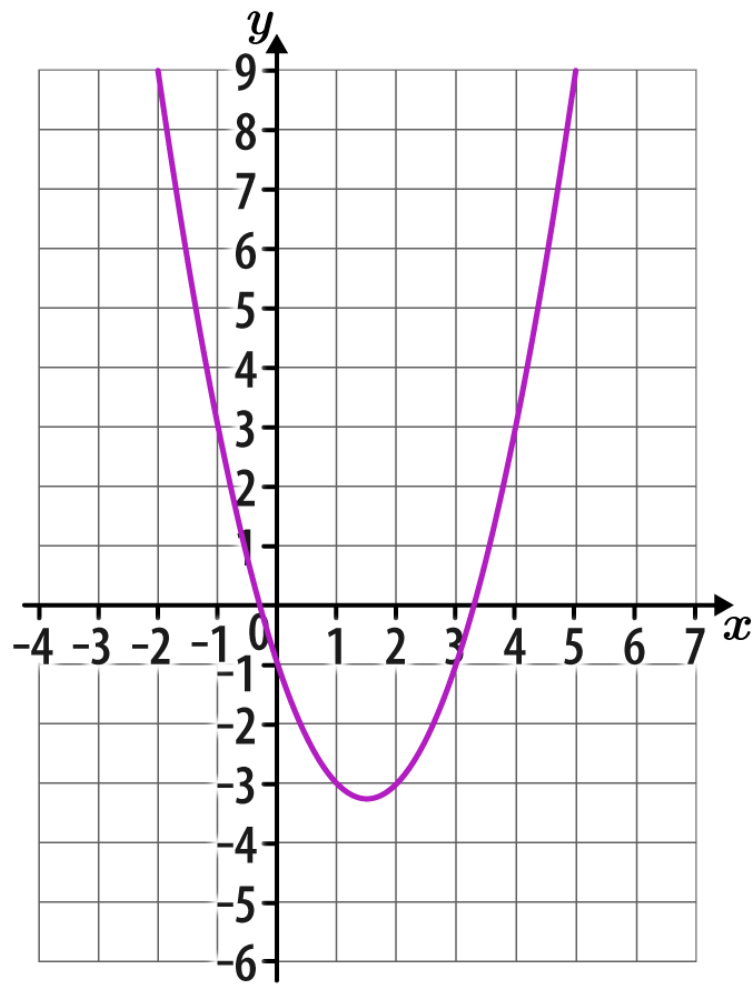
Use the graph to estimate the solutions to $x^2 + 4x + 3 = x + 5$ graphically.
Give your answers to 1 decimal place.



The diagram below shows the graph of $y = x^2 - 3x - 1$.

What line should you add to the graph in order to solve the equation $x^2 - 5x + 2 = 0$?

Give your answer in the form $y = mx + c$.



Equations and inequalities - Quadratic inequality

Solving quadratic inequalities

U133

Sketch a graph to solve $x^2 - 7x \leq 0$.

Solve $2x^2 - 17x + 8 > 0$

Fully simplify any fractions in your answer.

Equations and inequalities - Equation of a tangent to a circle

Equations of circles and tangents

U567

A circle is centred at the origin and has a radius of $\sqrt{130}$.

Work out the coordinates of the two points on the circle where $x = 7$.

A circle has the following equation:

$$x^2 + y^2 = 34$$

Work out the equation of the tangent to the circle at the point where $x = 3$ and y is negative.

Give your answer in the form $y = mx + c$, where m and c are integers or fractions in their simplest forms.

Equations and inequalities - Simultaneous equations linear/quadratic

Solving simultaneous equations using elimination

U760

Solve the following simultaneous equations algebraically:

$$7x + 5y = 3$$

$$3x - 2y = -7$$

Solve the following simultaneous equations:

$$6x + 7y = 10$$

$$9x + 13y = -5$$

Solving simultaneous equations using substitution

U757

Solve the simultaneous equations below using substitution.

$$7x - 2y = 15$$

$$y + 6 = 2x$$

Solve the simultaneous equations below using substitution.

$$2y + 5x = 42$$

$$4x = 8y + 24$$

Solving simultaneous equations involving quadratics

U547

Look at the simultaneous equations below.

$$x - 9y = 10$$

$$3y^2 = 4x + 7$$

a) Show that $3y^2 - 36y - 47 = 0$

b) Use part a) to solve the simultaneous equations.
If any of your answers are decimals, give them to 1 d.p.

Solve these simultaneous equations:

$$x^2 + y^2 = 26$$

$$2x + y = 7$$

If any of your answers are decimals, give them to 1 d.p.

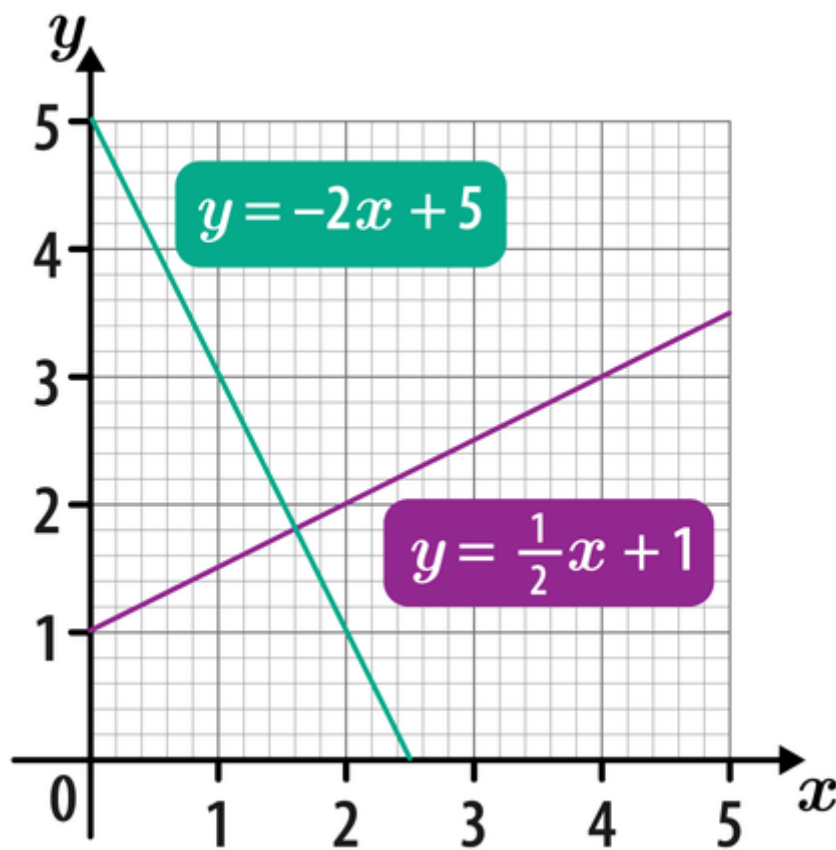
Solving simultaneous equations graphically

U836

Use the diagram to work out the solution to these simultaneous equations:

$$y = -2x + 5$$

$$y = \frac{1}{2}x + 1$$



Copy the axes below.

a) By completing the tables of values to help you, plot the lines $y = \frac{1}{4}x + 5$ and $y = -2x + \frac{1}{2}$ on your axes.

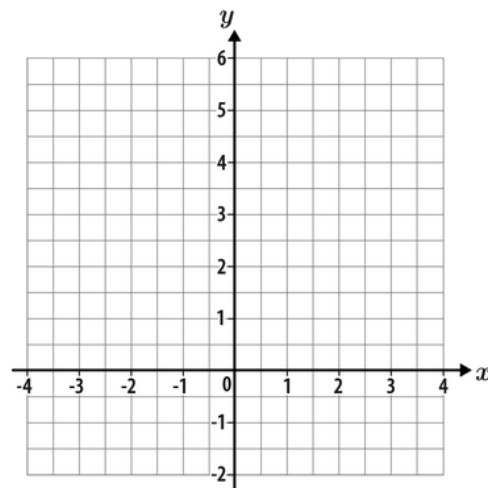
b) Use your diagram to find the solution to the simultaneous equations $y = \frac{1}{4}x + 5$ and $y = -2x + \frac{1}{2}$.

$$y = \frac{1}{4}x + 5$$

x	-4	0	4
y	<input type="text"/>	<input type="text"/>	<input type="text"/>

$$y = -2x + \frac{1}{2}$$

x	-1	0	1
y	<input type="text"/>	<input type="text"/>	<input type="text"/>



Constructing and solving simultaneous equations

U137

Charlie sold 100 tickets for his show.

An adult ticket costs £6.50 and a child ticket costs £2.50.

Charlie's ticket sales totalled £410.

a) How many adult tickets did he sell?

b) How many child tickets did he sell?

A rectangle has side lengths of x cm and $(x + y)$ cm, where x and y are both positive.

The rectangle has an area of 57 cm^2 and a perimeter of 44 cm.

Work out the values of x and y .

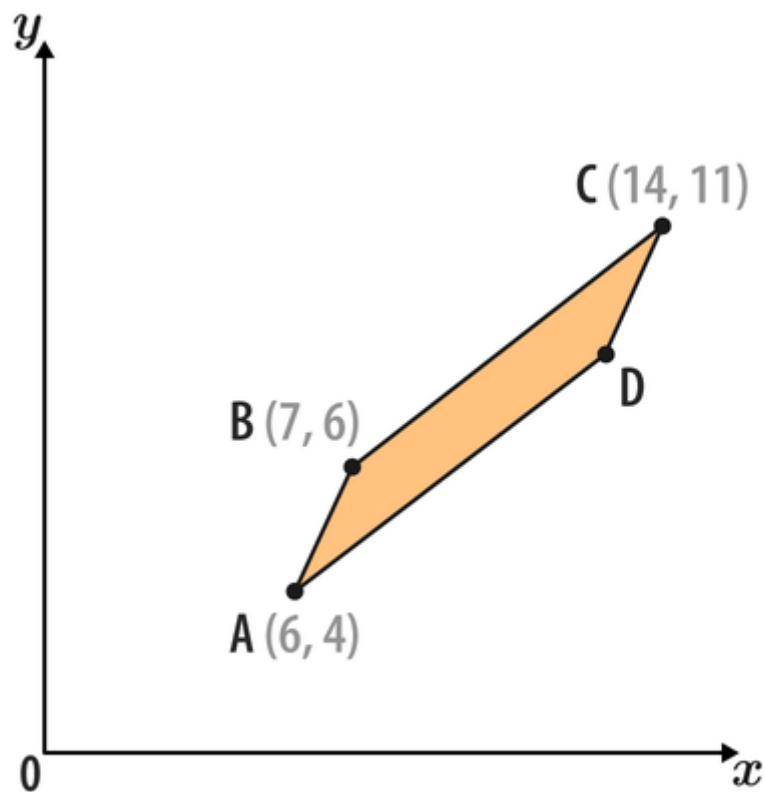
Graphs - Coordinates

Solving shape problems involving coordinates

U889

Shape $ABCD$ below is a parallelogram.

What are the coordinates of point D ?



Not drawn accurately

Vertex A of rectangle $ABCD$ has the coordinates $(4, 5)$.

$M (1, 5)$ is the midpoint of AB .

$N (-2, -1)$ is the midpoint of BC .

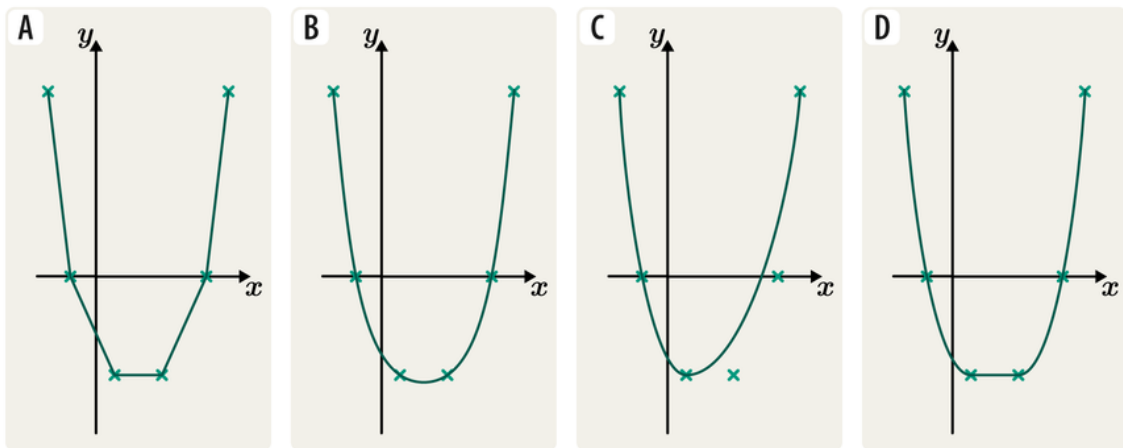
What are the coordinates of point D ?

Graphs - Quadratic graph

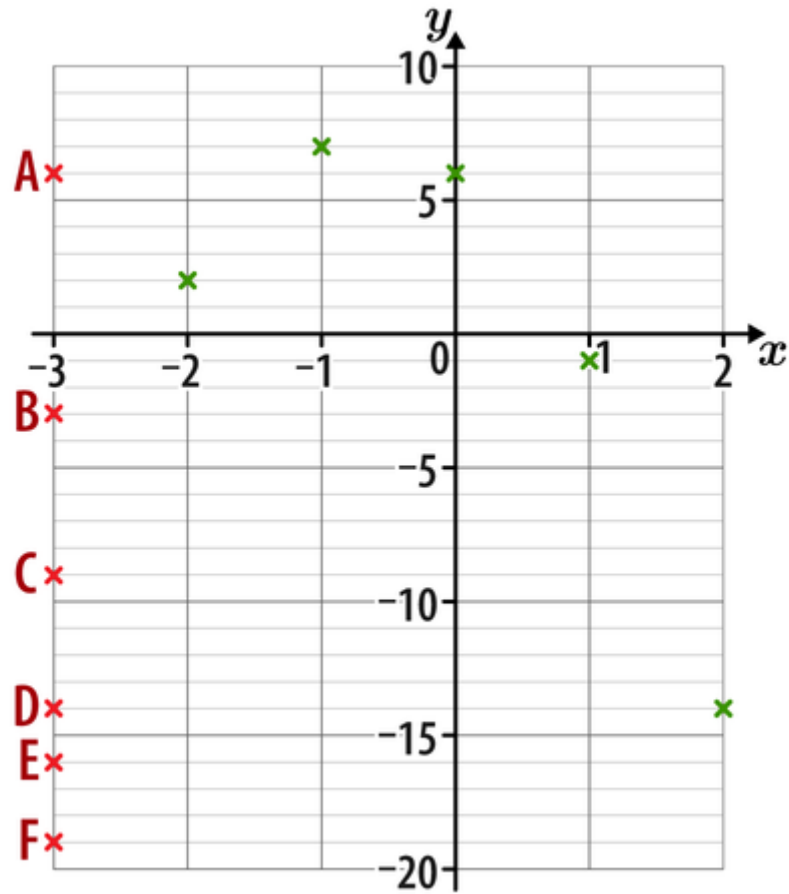
Plotting graphs of quadratic functions

U989

Which of these options shows a correctly drawn quadratic graph?



Which of the points A-F is on the curve $y = -3x^2 - 4x + 6$?

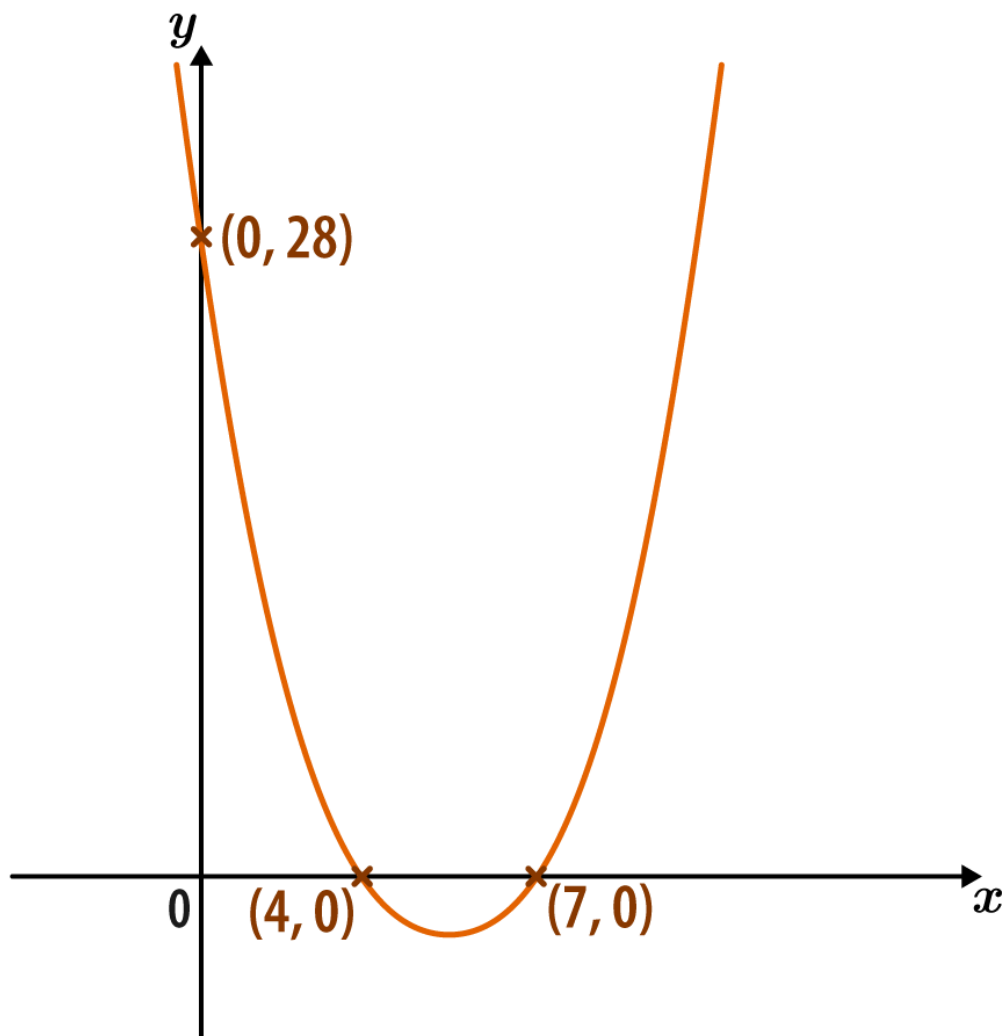


Interpreting graphs of quadratic functions

U667

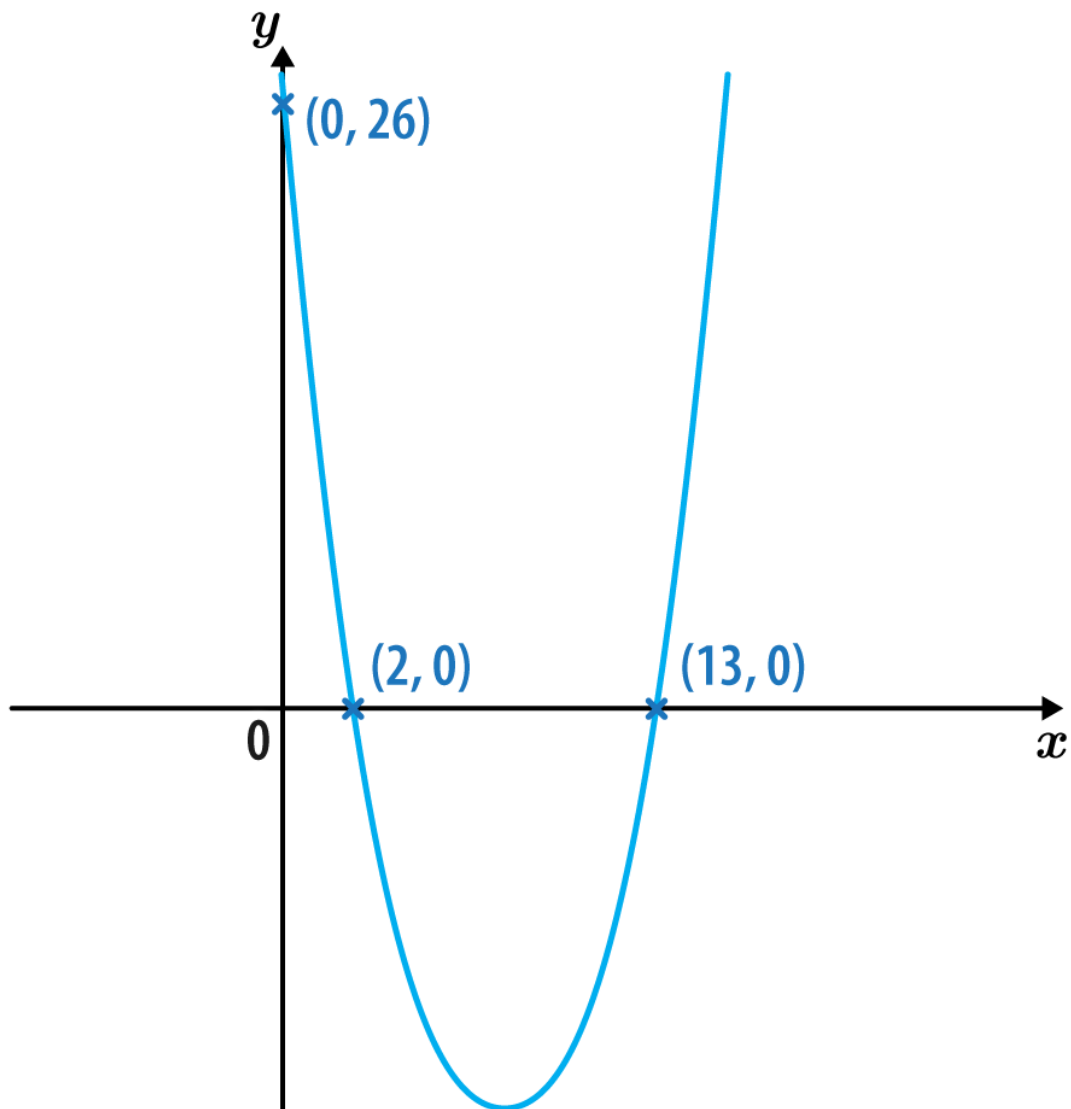
The quadratic function $y = x^2 - 11x + 28$ is drawn here.

Use the symmetry of the quadratic curve to find the x -coordinate of the **turning point** (the minimum).



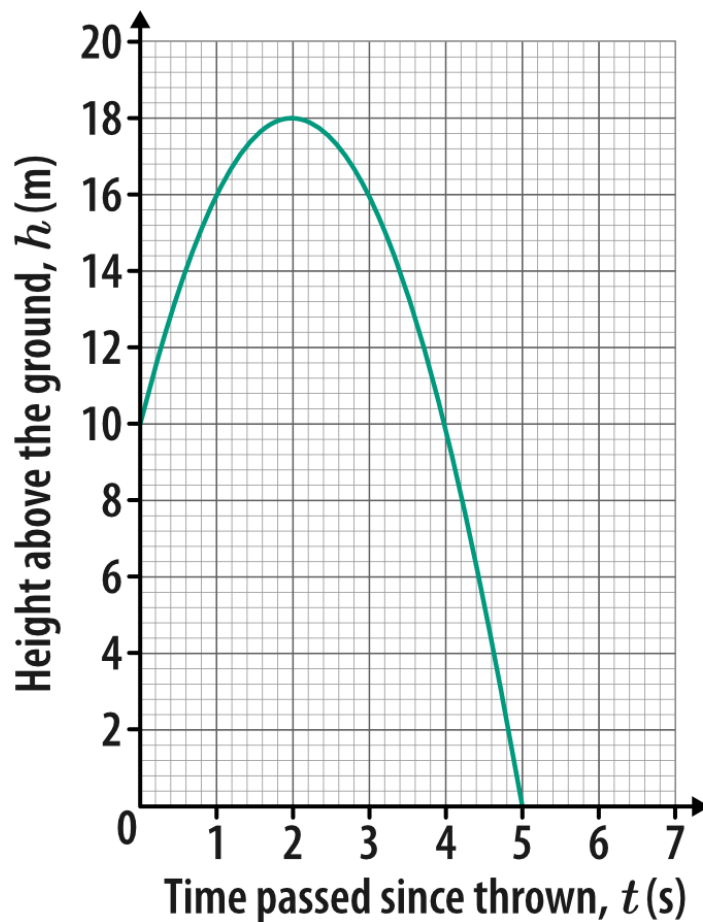
The quadratic function $y = x^2 - 15x + 26$ is drawn below.

Use the symmetry of the quadratic curve to find the **coordinates** of the minimum.



The graph of the quadratic function $h = -2t^2 + 8t + 10$ is shown below and models the height of a ball over time.

- a) After how many seconds does the ball return to the same height from which it was thrown?
- b) What height was the ball thrown from?
- c) After how many seconds does the ball hit the ground?



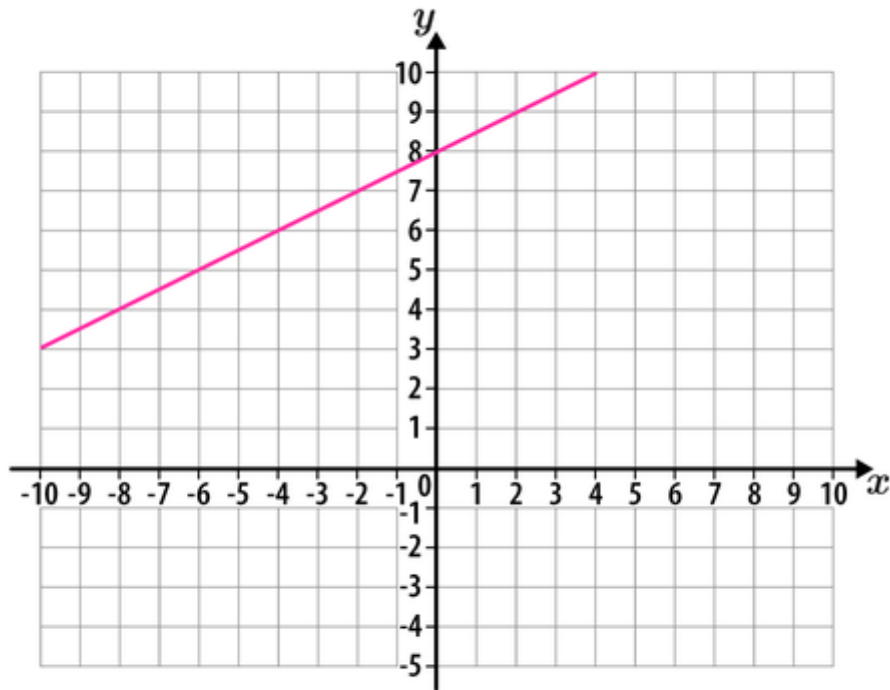
Graphs - Gradient of a straight line graph

Finding equations of straight line graphs

U315

What is the equation of the straight line shown below?

Give your answer in the form $y = mx + c$, where m and c are integers or fractions in their simplest forms.

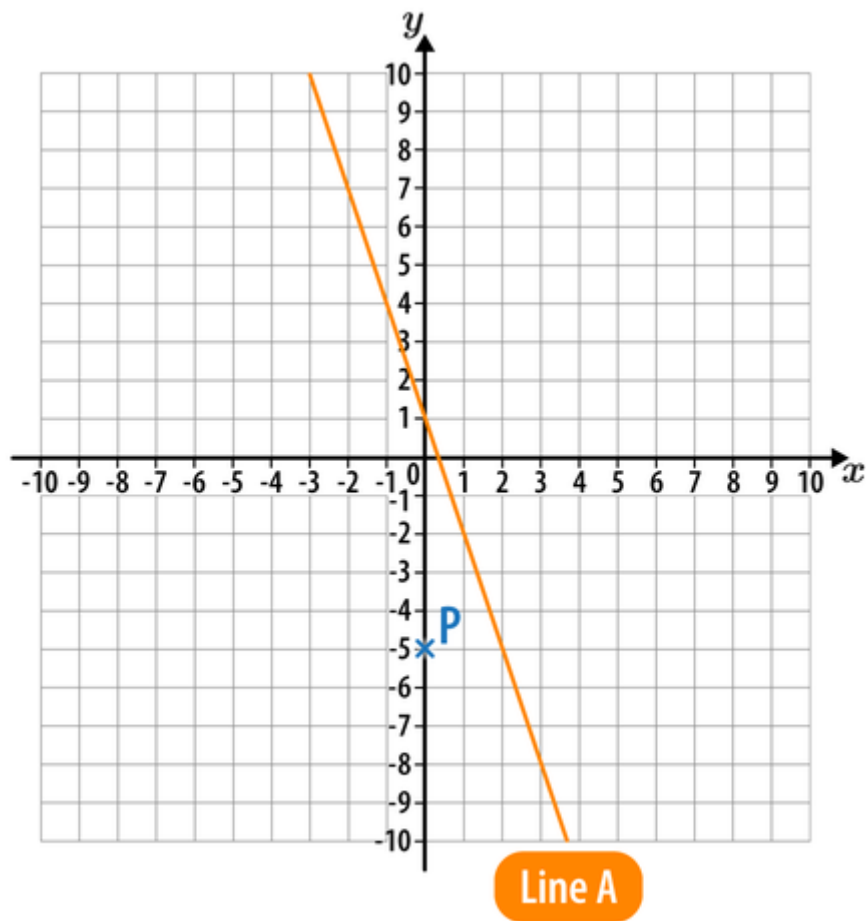


The graph below shows line **A** and point **P**.

Line **B** is the straight line that is parallel to line **A** and passes through point **P**.

Work out the equation of line **B**.

Give your answer in the form $y = mx + c$, where m and c are integers or fractions in their simplest forms.



Interpreting equations of straight line graphs

U669

Which one of the equations below gives a line that is parallel to the line given by $y - 4x = 12$?

$$y = 4x - 9$$

$$y = 12x + 4$$

$$y = 12 - 4x$$

$$y = \frac{1}{4}x + 12$$

$$y = 9 - \frac{1}{4}x$$

Line **P** is straight and has a gradient of 6.

Line **Q** is perpendicular to line **P**.

What is the gradient of line **Q**?

Give your answer as an integer or as a fraction in its simplest form.

Finding the equation of a straight line from its gradient and a point

U477

Line **A** has a y -intercept of 6 and is **perpendicular** to the line given by $y = 5x + 1$.

What is the equation of line **A**?

Give your answer in the form $y = mx + c$, where m and c are integers or fractions in their simplest forms.

Graphs - Gradients of parallel and perpendicular lines

Finding the equation of a straight line from its gradient and a point

U477

Line **A** has a y -intercept of 6 and is **perpendicular** to the line given by $y = 5x + 1$.

What is the equation of line **A**?

Give your answer in the form $y = mx + c$, where m and c are integers or fractions in their simplest forms.

Finding the equation of a straight line from two points on the line

U848

The straight line that passes through the points $(4, w)$ and $(8, 1)$ has gradient $\frac{3}{5}$.

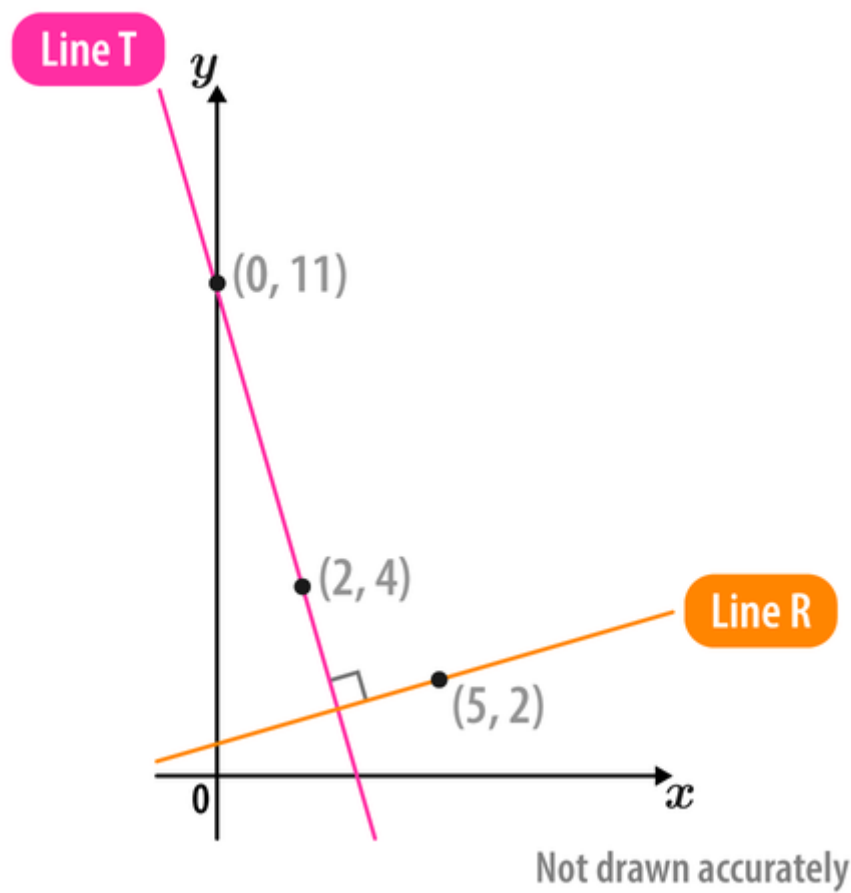
What is the value of w ?

Give your answer as an integer or as a fraction in its simplest form.

Line **R** is **perpendicular** to line **T**, as shown below.

What is the equation of line **R**?

Give your answer in the form $y = mx + c$, where m and c are integers or fractions in their simplest forms.



Equations of parallel and perpendicular lines

U898

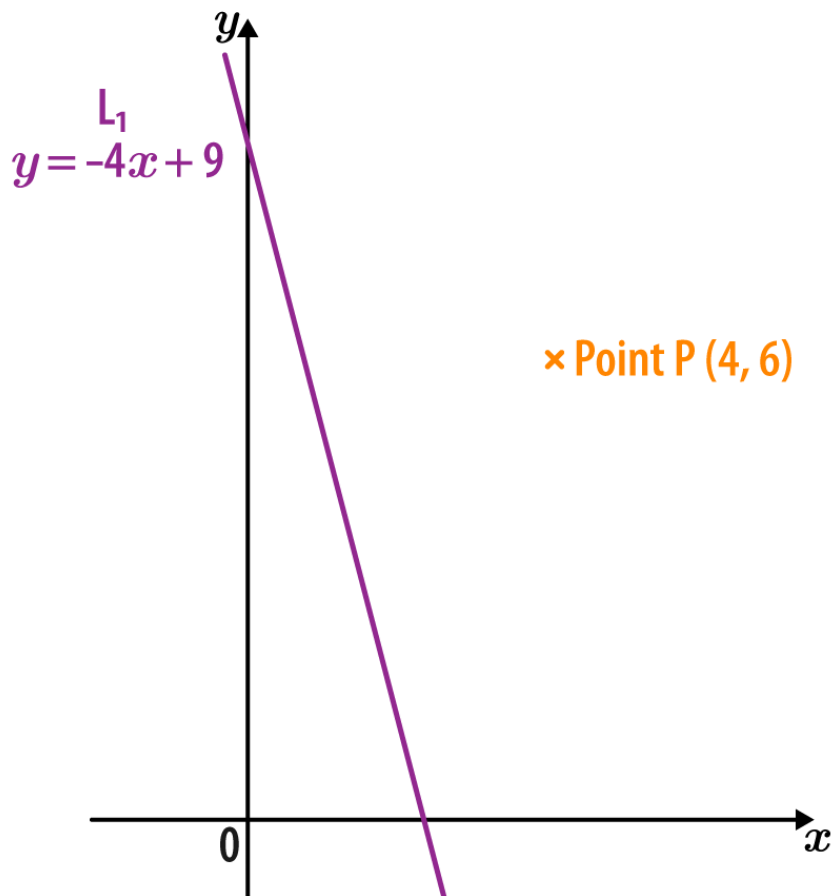
The diagram below shows point P and line L_1 .

Line L_2 is **perpendicular** to line L_1 and passes through point P.

What is the equation of line L_2 ?

Give your answer in the form $y = mx + c$,

where m and c are integers or fractions in their simplest form.



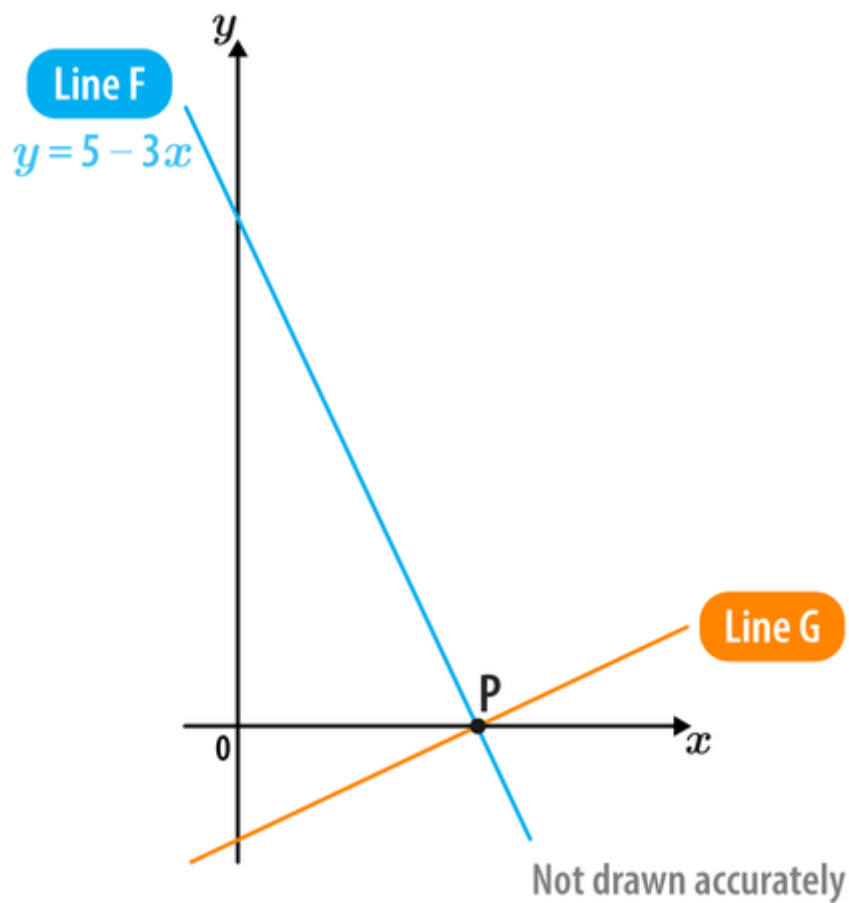
Line **F** has equation $y = 5 - 3x$, as shown below.

Line **G** is perpendicular to line **F**.

The lines intersect at point **P**, which is on the x -axis.

What is the equation of line **G**?

Give your answer in the form $y = mx + c$, where m and c are integers or fractions in their simplest forms.



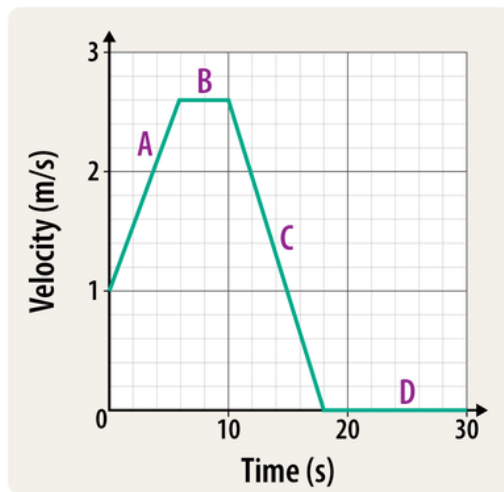
Graphs - Speed-time graph

Calculating acceleration from velocity-time graphs

U562

The graph below shows the velocity of a cat over time.

For each section of the graph, choose the option that best describes the movement of the cat.



Stationary

Accelerating

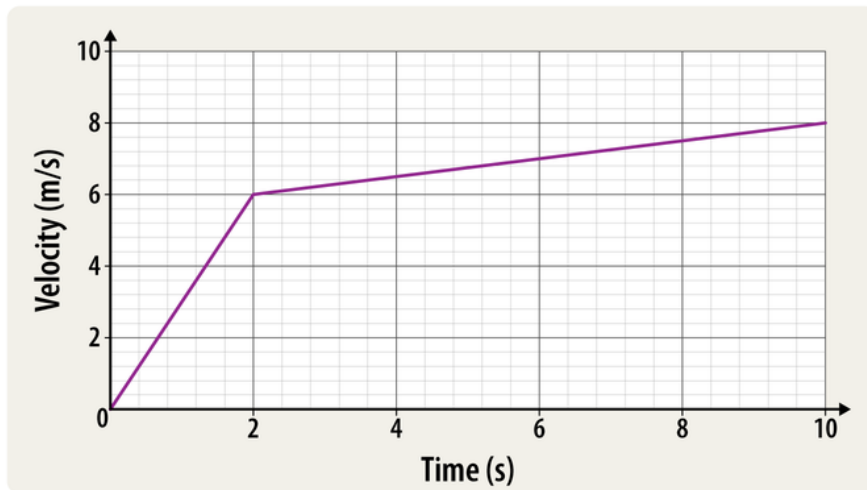
Decelerating

Moving backwards

Moving at a steady speed

The graph below shows the velocity of a marble as it rolls down a ramp.

What was the average acceleration of the marble during this time?
If your answer is a decimal, give it to 1 d.p.

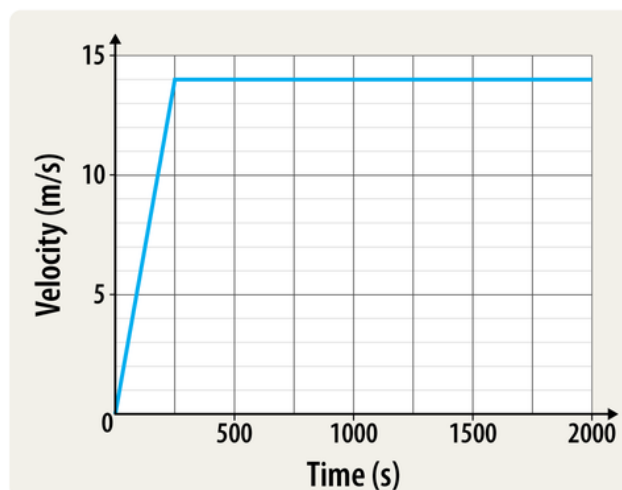


Calculating distances from velocity-time graphs

U611

The motion of a research submarine is described by the graph below.

How many seconds did it take the submarine to travel the first 9800 m of the journey?
If your answer is a decimal, give it to 1 d.p.



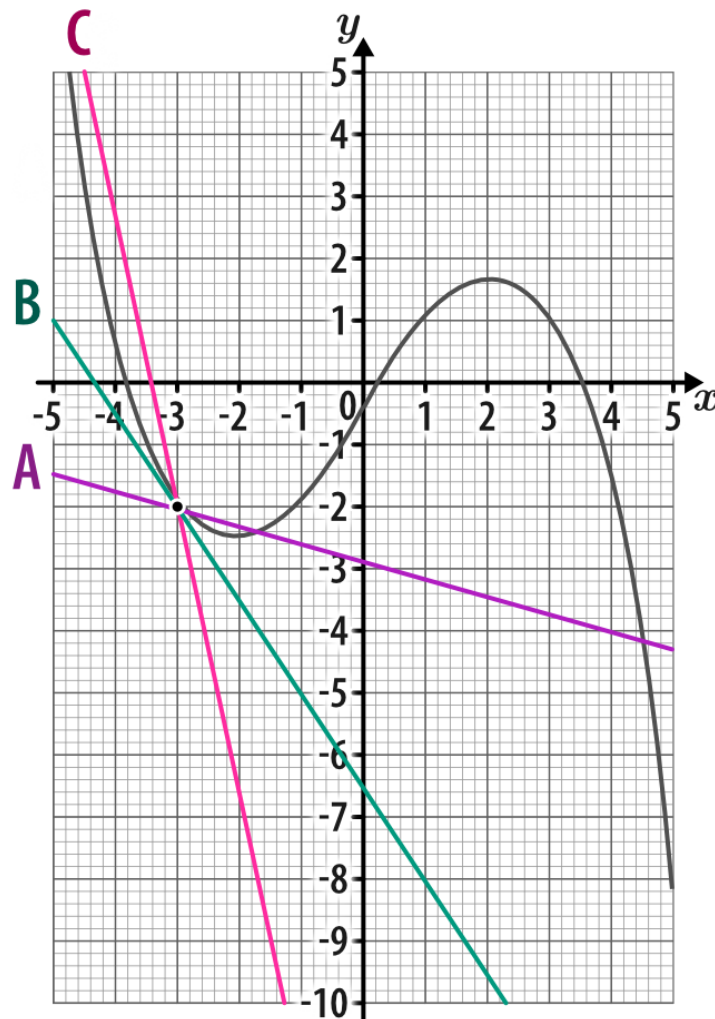
Graphs - Gradient of a curve

Estimating gradients of non-linear graphs using tangents

U800

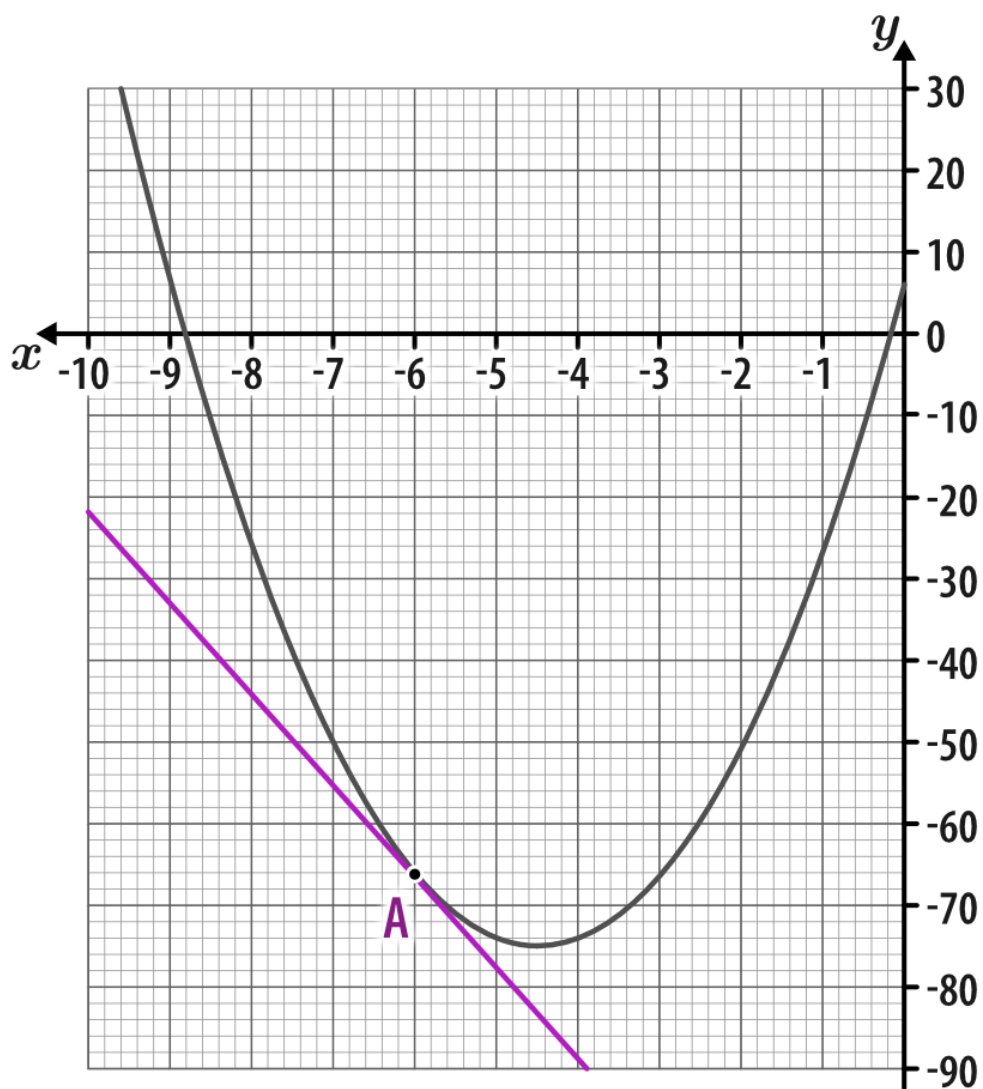
The diagram shows the graph of $y = f(x)$.

- a) Which of the lines A, B or C gives the best estimate for the tangent at $x = -3$?
- b) Using this line, estimate the gradient of the curve at $x = -3$.



The diagram shows the graph of $y = f(x)$ and the tangent to the graph drawn at $x = -5$.

Use the tangent to work out an estimate for the gradient of the curve at $x = -5$.

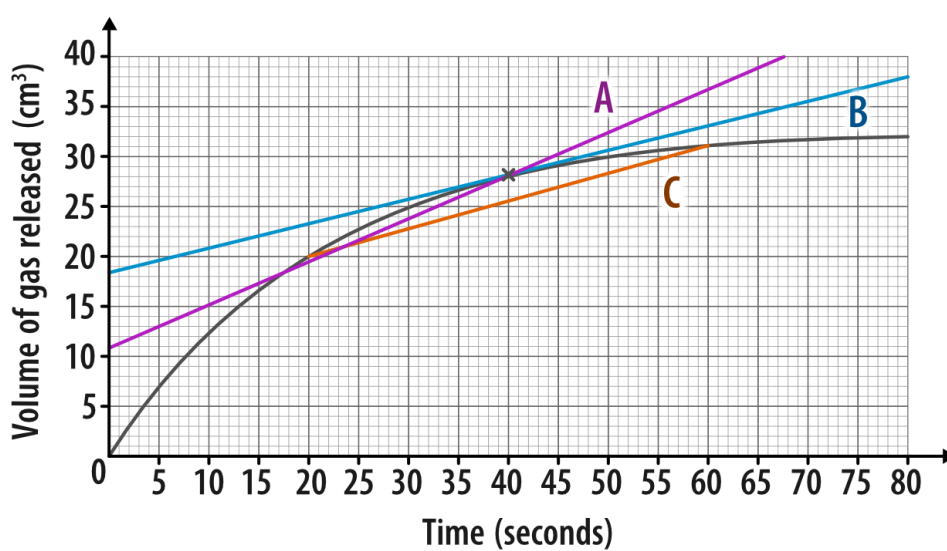


This graph shows the volume of gas released during a chemical reaction.

a) Which of the lines A, B or C shows the best estimate for the tangent to the curve at 40 seconds?

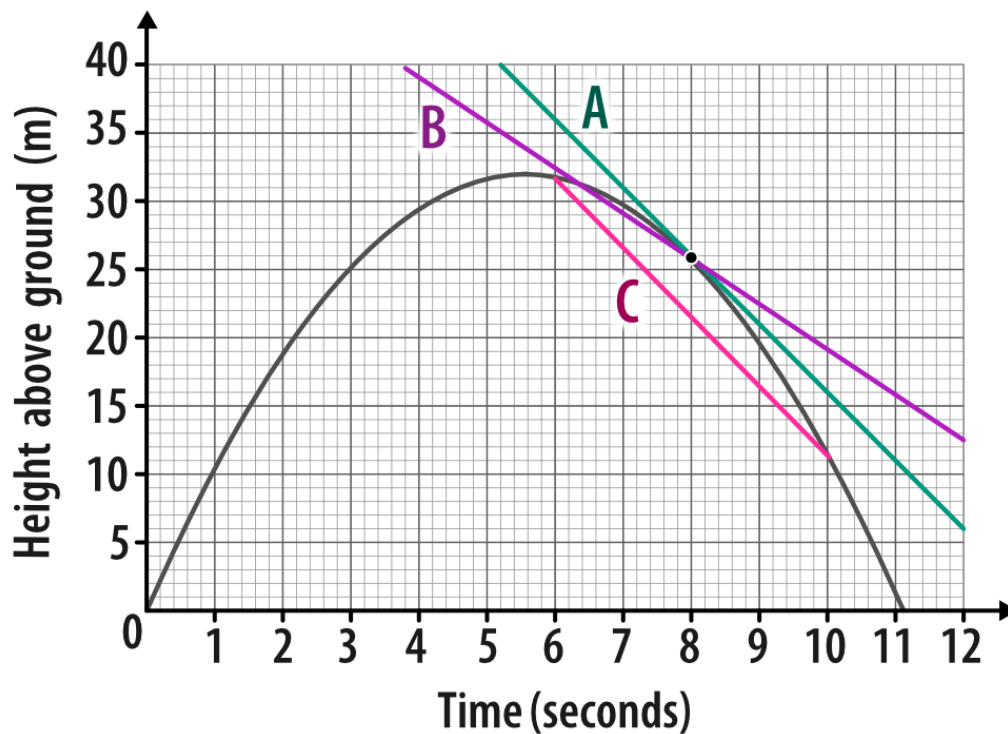
b) Use your answer to part a) to work out an estimate for the rate of the reaction at 40 seconds.

Give your answer to 1 d.p. and with appropriate units.



The graph below shows height of an object that is thrown in the air.

- a) Which of the lines A, B or C shows the best estimate for the tangent to the curve at 8 seconds?
- b) Work out the velocity of the object at 8 seconds.



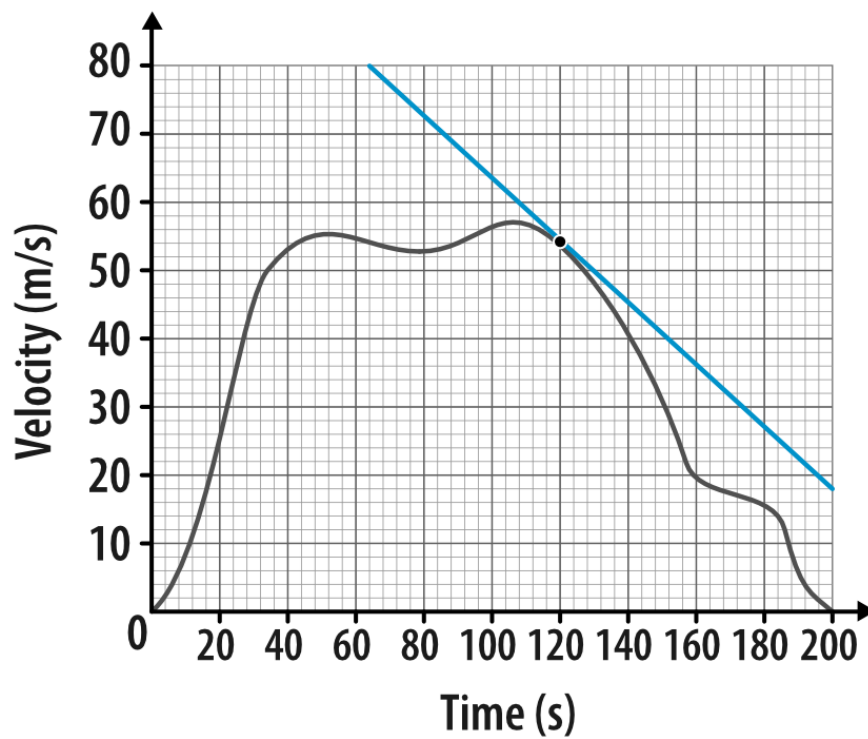
The velocity-time graph shows the journey of a train.

A tangent is drawn to the graph at 120 seconds.

- a) Use the tangent to work out an estimate for the acceleration of the train at 120 seconds to 2 d.p.

Give suitable units with your answer.

- b) Use your answer to part a) to work out whether the train is speeding up or slowing down at this point.



Graphs - Transformations of functions

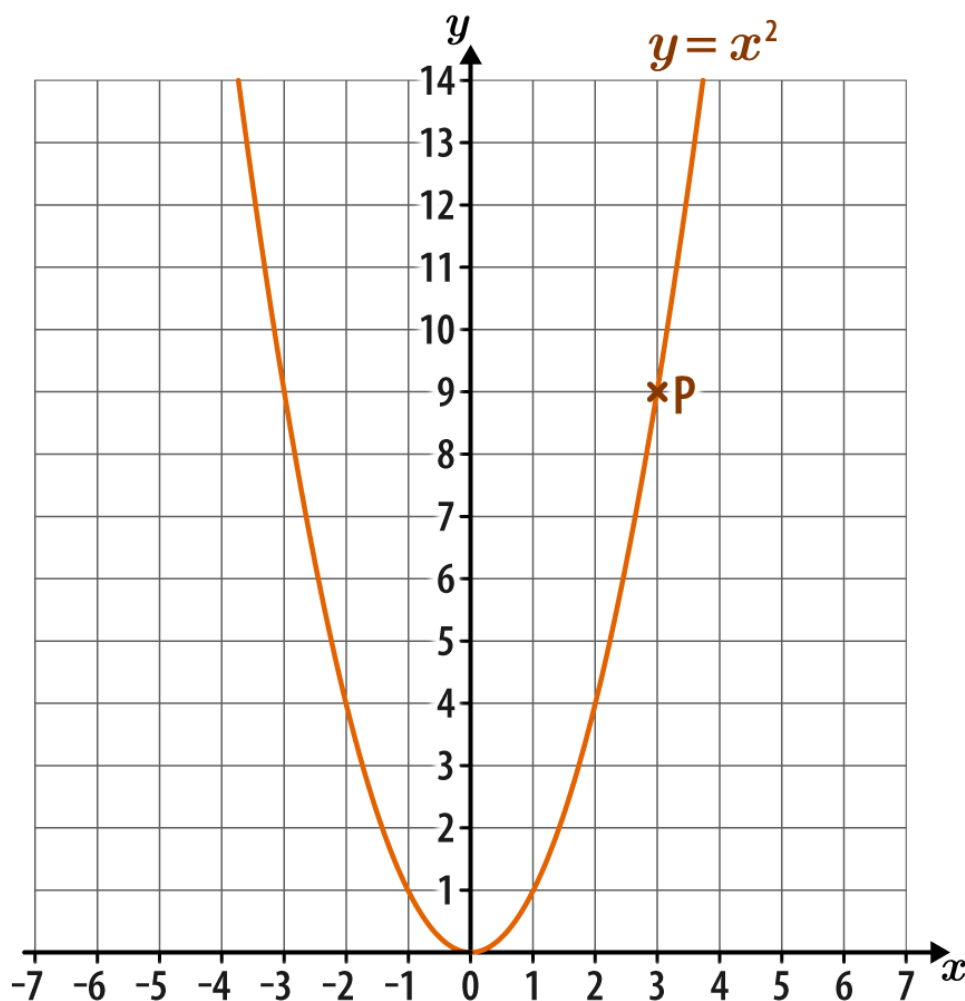
Translating graphs

U598

The diagram shows the graph of $y = x^2$ and point P, which is on the curve.

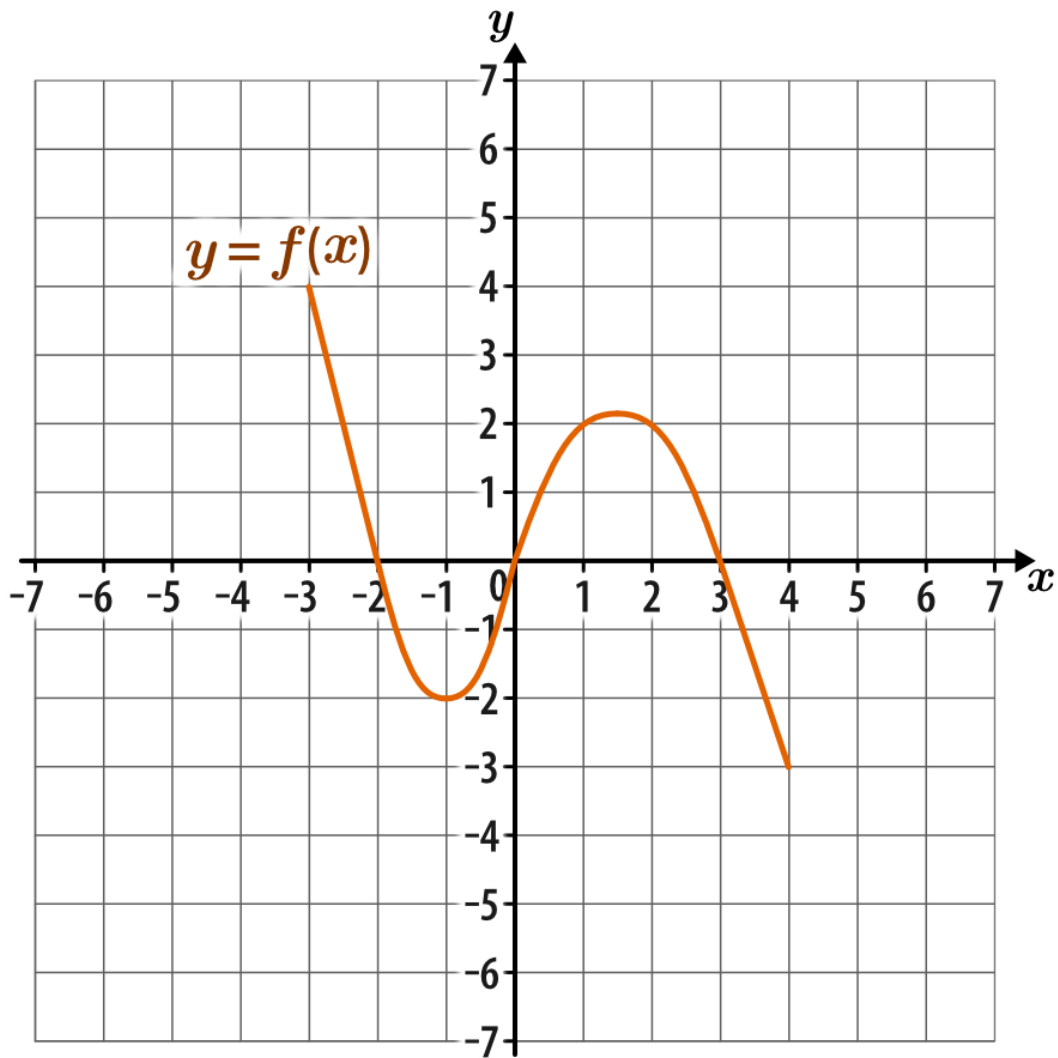
The graph is translated to become $y = x^2 + 2$.

Write down the new coordinates of point P.



Copy the axes shown below, and sketch the graph of $y = f(x)$ onto your axes.

Then sketch the graph of $y = f(x - 2)$ onto the same axes.

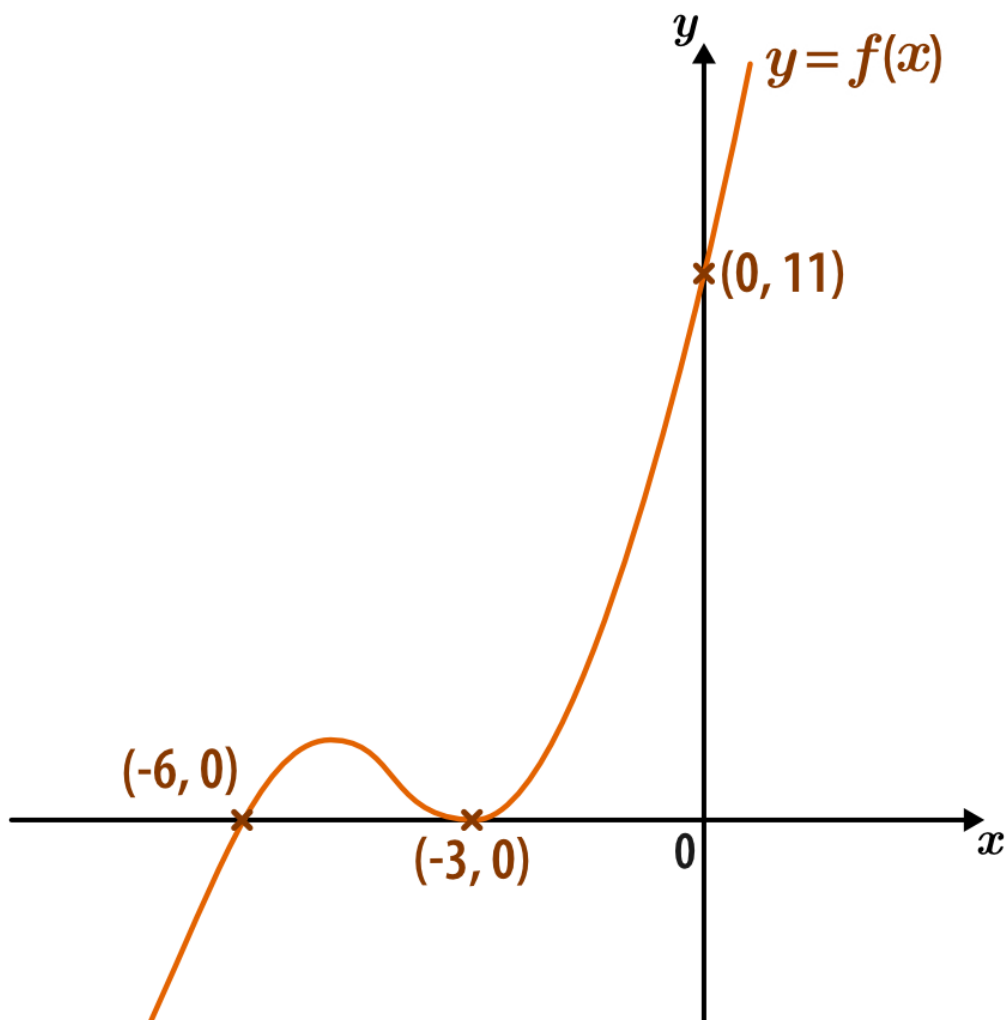


Reflecting graphs

U487

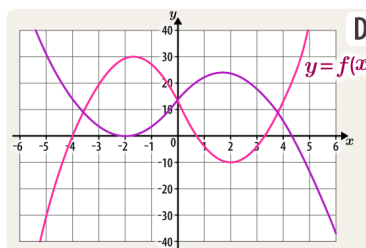
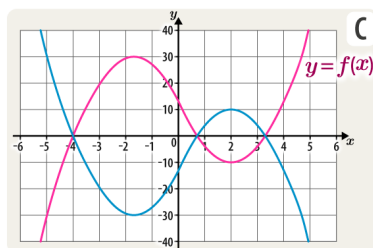
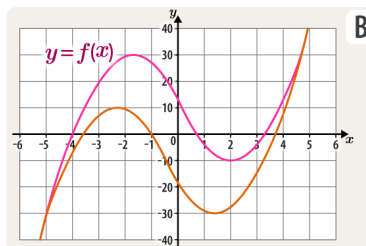
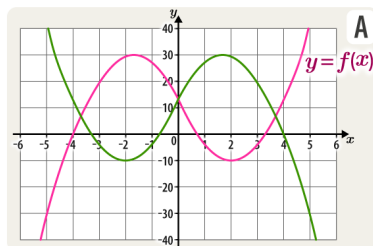
The function of $y = f(x)$ is shown below.

Write down the coordinates of any points where $y = -f(x)$ intersects the axes.



a) Which diagram shows both $y = f(x)$ and $y = -f(x)$?

b) Which diagram shows both $y = f(x)$ and $y = f(-x)$?



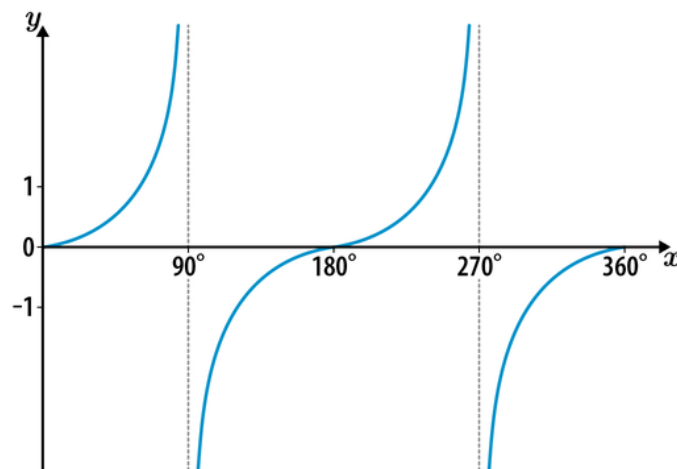
Graphs - Graphs of trigonometric functions

Graphs of trigonometric functions

U450

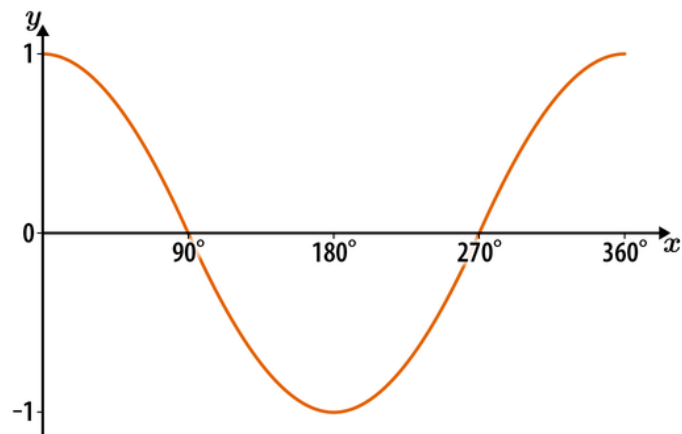
The graph of $y = \tan x$ for $0^\circ \leq x \leq 360^\circ$ is shown below.

Solve $\tan x = \tan 42^\circ$ when $90^\circ \leq x \leq 360^\circ$.



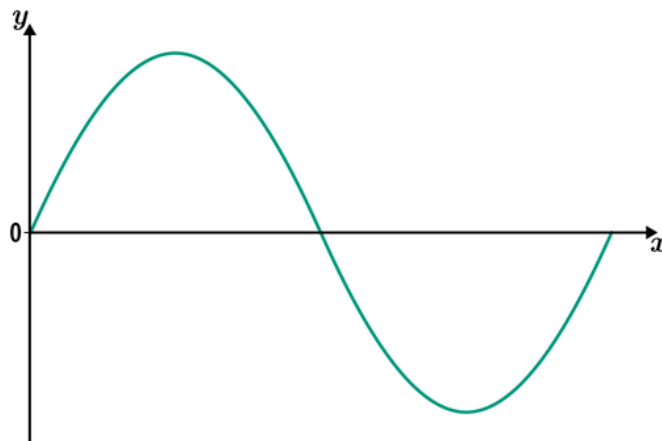
The graph $y = \cos x$ for $0^\circ \leq x \leq 360^\circ$ is shown below.

Work out the two solutions to $\cos x = \frac{\sqrt{3}}{2}$ for $0^\circ \leq x \leq 360^\circ$.



The graph of $y = \sin x$ for $0^\circ \leq x \leq 360^\circ$ is shown below.

What are the coordinates of the minimum point of $y = \sin x$ for $0^\circ \leq x \leq 360^\circ$?



Functions - Inverse and composite functions

Finding inverse functions

U996

The function g is shown below.

$$g(x) = \frac{x-10}{3}$$

Work out an expression for $g^{-1}(x)$.
Expand any brackets in your answer.

Finding composite functions

U448

The functions g and h are shown below.

$$g(x) = 2x + 7$$

$$h(x) = x^2 - 10$$

Work out $hg(x)$.
Give your answer in its simplest form and expand any brackets.