Introduction to A-Level Maths

Transition Booklet

Introduction

Thank you for choosing to study Mathematics in the sixth form. In order that you make the best possible start to the course, we have prepared this booklet for you to complete. It is vital that you spend time working through this booklet as you must have a thorough and comprehensive knowledge of all these topics in order to be able to access the Maths A-level course. The tasks are designed to help you remember what you learnt at GCSE and give you exercise practice to develop these skills.

Each topic has two sections:

- **Introduce** questions allow you to practise key concepts.
- **Strengthen** questions build on your knowledge of the key concepts.

You must complete **both** of the sections for each topic. Unless otherwise indicated, you may use a calculator. The answers are at the back of the booklet. You are expected to mark your answers and keep track of your progress on the grid overleaf. If you struggle with a topic, you can use the Independent Learning section on Sparx maths with the relevant code to access videos. You can access this by using the link below. You will need to change the Curriculum to GCSE.

https://www.sparxmaths.uk/student/independentlearning

We expect this work to have been completed before you start the course in September.

In addition to the transition task, we have provided a reading list with suggestions of books that are useful for reading around the subject of Mathematics. We would very much encourage you to undertake some extra reading to allow you to develop a real interest in the subject.

We are really looking forward to starting your Mathematics A-level with you in September and hope that your gap task helps you to feel confident and positive about the course ahead.

- Please tick each section once you have completed it.
- Once you have marked it, please tick the relevant RAG box to indicate your understanding.

Topic	Completed		Sparx topic codes	Understanding		
	I	S		R	A	G
Surds			U499, U707, U281			
Expanding Brackets			U768, U606			
Factorising quadratics			U178, U858			
Simplifying expressions			U662, U437			
Operations with algebraic fractions			U685, U457, U824			
Solving quadratic equations			U228, U960, U665, U150			
Quadratic graphs			U589, U769, U601			
Linear simultaneous equations			U760, U757			
Straight-line graphs			U315, U477, U848			
Right-angled trigonometry			U283, U545, U170			
Further trigonometry			U952, U591			

Wider Reading List

Mathematics is a diverse subject with many strands available for further study. As you study Mathematics after GCSE it is worth investigating the many sides of Mathematics to see which areas interest you e.g. did you know that internet security relies on prime numbers, some of the greatest mathematics helped win WWII or zero did not exist for many centuries. Have you ever wondered what infinity looks like?

Below is a list of books which will help you discover some of the amazing influences of Mathematics. We hope that these books will inspire you to discover your own reading list.

Chaos

Does God Play Dice by *Ian Stewart*

Chaos by *James Gleick*

Cryptography

The Codebook by *Simon Singh*

The Mathematics of Ciphers by *S.C. Coutinho*

In Code by *Sara Flannery*

History of Mathematics

A History of Mathematics by *Carl B. Boyer*

Infinity: The Quest to Think the Unthinkable by *Brian Clegg*

E, the Story of a Number by *Eli Maor*

Biographies

The Man Who Loved Only Numbers by *Paul Hoffman*

My Brain is Open: The Mathematical Journeys of Paul Erdos by *Bruce Schecter*

The Man who knew Infinity by *Robert Kanigel*

Mathematical Physics

A Brief History of Time by *Stephen Hawking*

The Elegant Universe by *Brian Greene*

The Fabric of the Cosmos by *Brian Greene*

Mathematical Philosophy

Introduction to Mathematical Philosophy by *Bertrand Russell*

A Mathematician's Apology by *G. H. Hardy*

Thinking About Mathematics by *Stewart Shapiro*

Mathematical Problems

Fermat's Last Theorem by *Simon Singh*

The Millenium Problems by *Keith Devlin*

Journey Through Genius: The Great Theorems of Mathematics by *William Dunham*

The Equation That Couldn't Be Solved by *Mario Livio*

Kepler's Conjecture by *George Szpiro*

Poincaré's Prize by *George Szpiro*

The Music of the Primes by *Marcus du Sautoy*

Four Colors Suffice by *Robin Wilson*

Seventeen Equations that Changed the World by *Professor Ian Stewart*

Other

The Emperor's New Mind by *Roger Penrose*

The Mathematical Universe by *William Dunham*

The Wonders of Numbers by *Clifford Pickover*

From Here to Infinity by *Ian Stewart*

The Art of the Infinite: Our Lost Language of Numbers by *Robert Kaplan*

What is Mathematics? by *Richard Courant, Herbert Robbins and Ian Stewart*

Flatterland by *Ian Stewart*

The Number Devil: A Mathematical Adventure by *Hans Magnus Enzensberger*

Art of the Infinite by *Kaplan*

Imagining Numbers: Particularly the Square Root of Minus Fifteen by *Barry Mazur*

A Very Short Introduction to Mathematics by *Timothy Gowers*

Key facts and formulae:

The Quadratic formula:

The solution of $ax^2 + bx + c = 0$

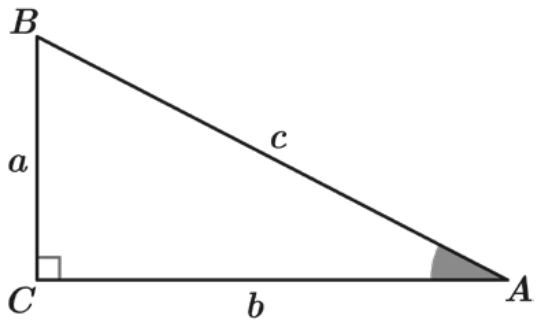
where $a \neq 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Trigonometry:

In any right-angled triangle ABC where a, b and c are the length of the sides and c is the hypotenuse:

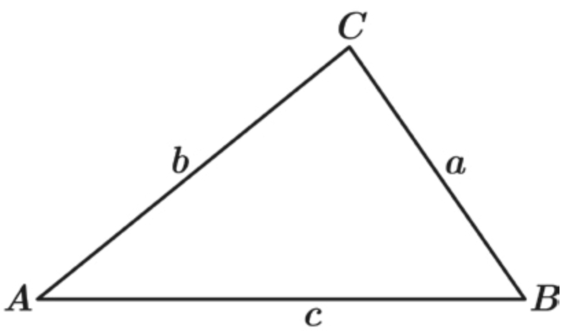
$\sin A = \frac{a}{c}$ $\cos A = \frac{b}{c}$ $\tan A = \frac{a}{b}$



In any triangle ABC where a, b and c are the length of the sides:

sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$



Q1 Expand and fully simplify $\sqrt{5}(\sqrt{5}+\sqrt{7})$

Answer: ....

Q2 Rationalise the denominator of $\dfrac{2\sqrt{5}}{\sqrt{6}}$

Give your answer in its simplest form.

Answer: ....

Q3 Expand and fully simplify $(6+\sqrt{5})(1+\sqrt{5})$

Answer: ....

Q4 Write $(5 + \sqrt{12})(11 + \sqrt{3})$ in the form $a + b\sqrt{3}$, where a and b are integers.

Answer: ....

Q5 Rationalise the denominator of $\frac{1 + \sqrt{2}}{\sqrt{2}}$

Give your answer as a fraction in its simplest form.

Answer: ....

Q1 Expand and fully simplify $(2\sqrt{6} - 5\sqrt{2})^2$

Answer: ....

Q2 Rationalise the denominator of $\dfrac{15 + \sqrt{3}}{10\sqrt{3}}$

Give your answer as a fraction in its simplest form.

Answer: ....

Q3

Rationalise the denominator of $\dfrac{2\sqrt{7}}{3+\sqrt{7}}$

Give your answer in its simplest form.

Answer: ....

Q4

Write $\sqrt{12} + \dfrac{33}{\sqrt{3}}$ in the form $r\sqrt{3}$, where r is an integer.

Answer: ....

Q1

Expand and fully simplify $(m + 9)(m + 2)$

Answer: ....

Q2

Expand and fully simplify $(2a + 3)(4a + 5)$

Answer: ....

Q3 Expand and fully simplify $(x - 3)(4x + 9)$

Answer: ....

Q4 Expand and fully simplify $(6n - 5)^2$

Answer: ....

Q1 Expand and fully simplify $2(4d + 5)(3d + 1)$

Answer: ....

Q2 Expand and fully simplify $(x + 1)(x^2 + 3x + 5)$

Answer: ....

Q3 Expand and fully simplify $(3n + 4)(5n + 2) + 5(n + 7)$

Answer: ....

Q4 Expand and fully simplify $(t - 2)(t + 5)(t - 4)$

Answer: ....

Q1 Fully factorise $y^2 + 9y + 20$

Answer: ....

Q2 Fully factorise $x^2 - x - 20$

Answer: ....

Q3 Fully factorise $w^2 - 15w + 54$

Answer: ....

Q1 Fully factorise x^2 - 16

Answer: ....

Q2 Fully factorise $2r^2 + 15r + 7$

Answer: ....

Q3 Fully factorise $5x^2 + 22x + 8$

Answer: ....

Q1 Fully simplify the expression $4y^5 \times 3y^2$

Answer: ....

Q2 Simplify $(h^{-5})^3$

Give your answer without any negative indices.

Answer: ....

Q3 Write $\dfrac{2t^6u}{8t^3}$ as a fraction in its simplest form.

Answer: ....

Q4 Fully simplify $\left(\frac{t^3}{u^5}\right)^2$

Answer: ....

Q5 Write $\frac{33xy + 9x}{18x}$ as a fraction in its simplest form.

Answer: ....

Q6 Fully simplify $\frac{6a + 42}{a^2 + 11a + 28}$

Answer: ....

Q1 Write $\dfrac{(3a)^2}{54ak}$ as a fraction in its simplest form.

Answer: ....

Q2 Fully simplify $(64g^8h^4)^{\frac{1}{2}}$

Answer: ....

Q3 Fully simplify $\dfrac{x+2}{2x^2-31x-70}$

Answer: ....

Q1

Fully simplify $\frac{14a}{b} \times \frac{b}{2}$

Answer: ....

Q2

Fully simplify $\frac{6a}{v} \div \frac{2a}{5}$

Give your answer as a fraction.

Answer: ....

Q3

Fully simplify the expression below to give a single fraction.

$$\frac{n+2}{5} + \frac{6n}{7}$$

Answer: ....

Q1

Fully simplify $\frac{2}{5a + 4} \times \frac{45a + 36}{a}$

Give your answer as a fraction.

Answer: ....

Q2

Fully simplify $\frac{6x}{(5x - 7)(x + 1)} - \frac{1}{5x - 7}$

Give your answer fully factorised.

Answer: ....

Q3 Write the following as a single fraction in its simplest form:

$$\frac{2x^2 - 11x + 12}{x + 5} \div (4x^2 - 6x)$$

Give your answer fully factorised.

Answer: ....

Q4 Fully simplify $\frac{4ab^2}{k} \times \frac{3ak}{12k} \times \frac{7}{5ab}$

Give your answer as a fraction.

Answer: ....

Q1 Find the two solutions to the equation

$(x - 9)(x + 5) = 0$

Answer: ....

Q2 Solve this equation by factorising:

$y^2 + 3y - 10 = 0$

Answer: ....

Q3 Solve this equation by factorising:

$12 - 8w + w^2 = 0$

Answer: ....

Q4

Using the quadratic formula, solve

$4x^2 + 16x + 15 = 0$

Answer: ....

Q5

Solve this equation by factorising:

$2m^2 - 11m + 5 = 0$

Answer: ....

Q1 Using the quadratic formula, solve $y^2 - 6y + 7 = 0$

Give your answer in the form $a \pm \sqrt{b}$

Answer: ....

Q2 Solve the equation below using factorising.

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

Answer: ....

Q3 Using the quadratic formula, solve $6x^2 - 35 = -11x$

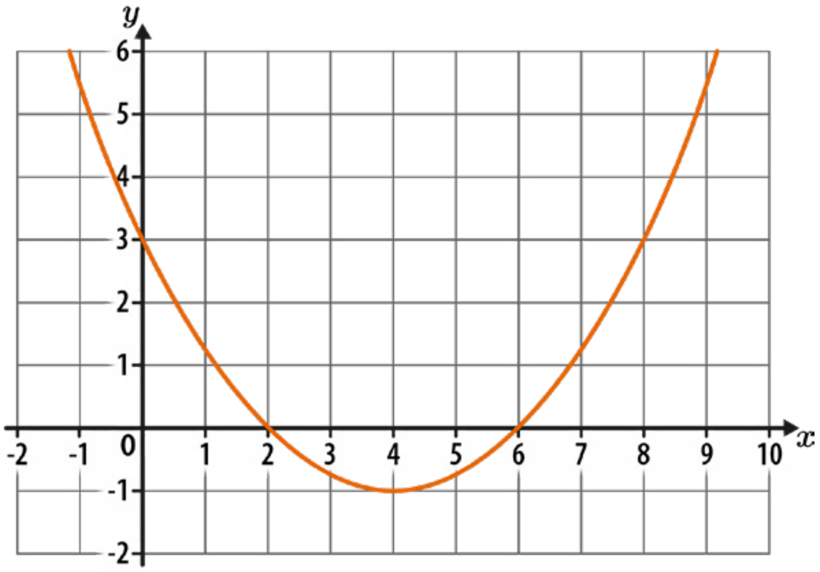
Answer: ....

Q4 Solve $3r(3r - 4) = 2$

Give your answers to 2 d.p.

Answer: ....

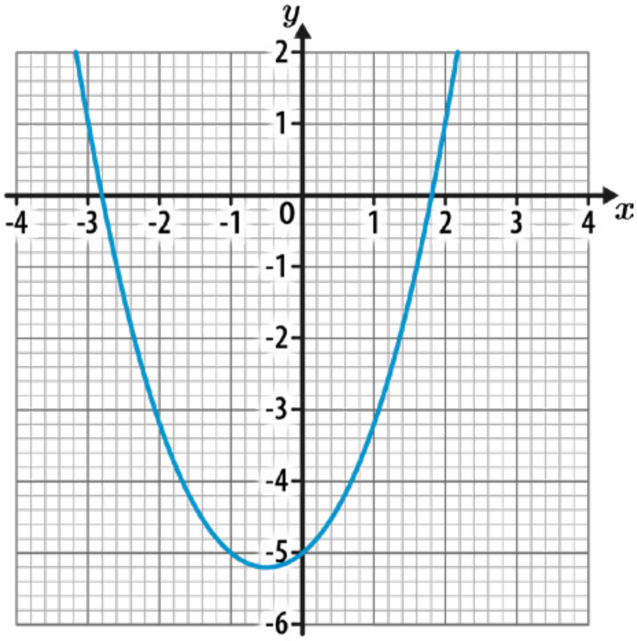
Q1 Write down the coordinates of the roots of the quadratic curve shown below.



Answer: (................ , ...) and (................ , ...)

Q2 Here is the graph of the function $y = x^2 + x - 5$

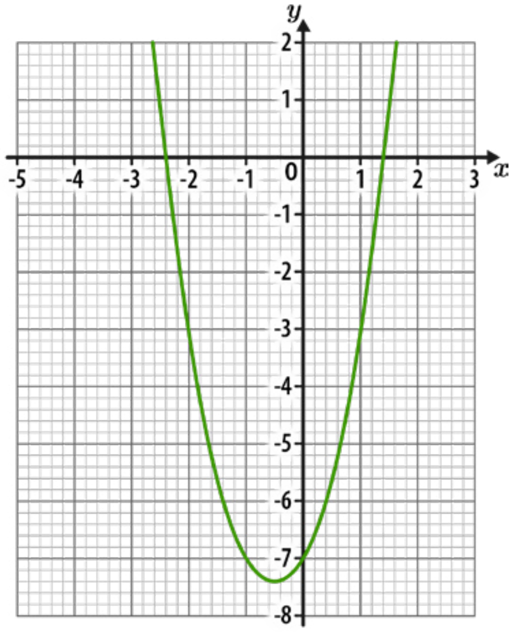
Estimate the solutions to $x^2 + x - 5 = 0$
Give your answers to 1 d.p.



Answer: ....

Q3 The diagram below shows the graph of the function $y = 2x^2 + 2x - 7$

Work out the solutions to $2x^2 + 2x - 7 = -3$



Answer: ....

Q4 a) Write $x^2 + 6x + 11$ in the form $(x + c)^2 + d$, where c and d are numbers.

Answer: a) ....

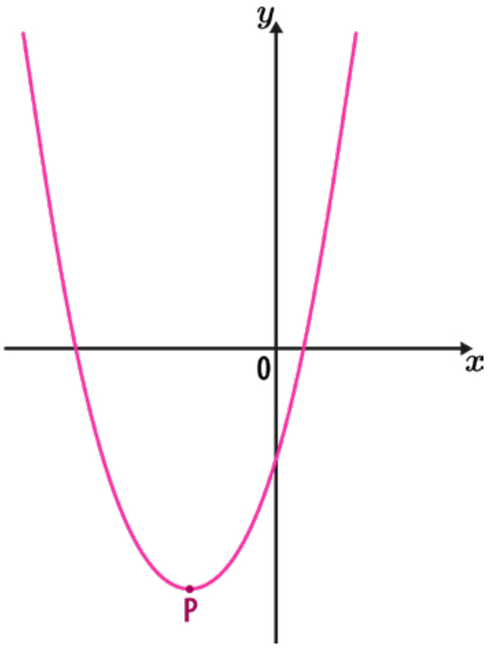
b) Hence, write down the coordinates of the turning point on the curve $y = x^2 + 6x + 11$

Answer: b) (.................... , ...)

Q1 The diagram below shows a sketch of the curve $y = x^2 + 8x - 10$

P is the turning point of the curve.

Work out the coordinates of P.



Answer: (.................... , ...)

Q2 Work out the coordinates of the turning point of the curve $y = x^2 - 5x + 1$

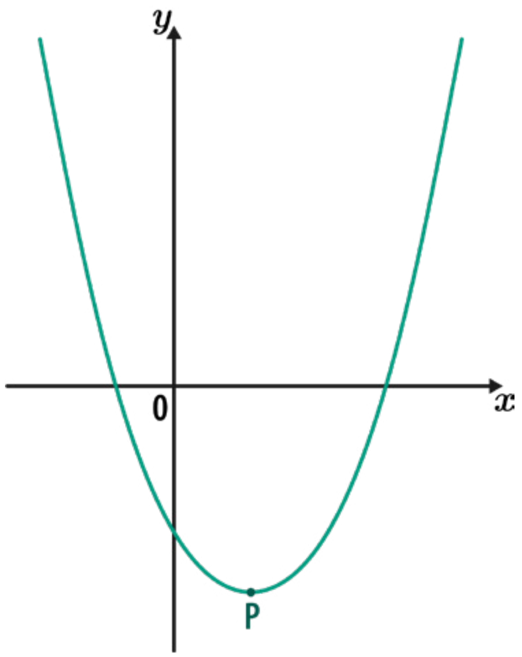
Answer: (.................... , ...)

Q3

The diagram below shows a sketch of the curve $y = 3x^2 - 6x - 10$

P is the turning point of the curve.

Work out the coordinates of P.

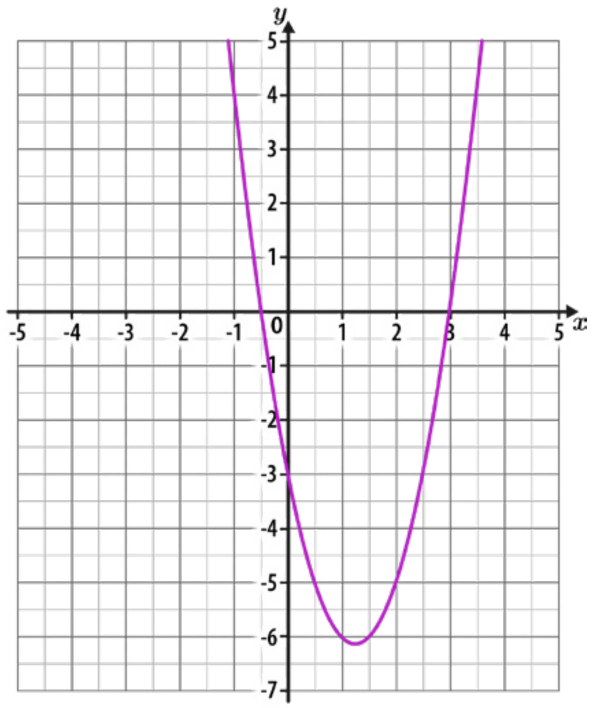


Answer: (.................... , ...)

Q4

The diagram below shows the graph of $y = 2x^2 - 5x - 3$

Use the diagram to estimate the solutions to $2x^2 - 5x - 3 = -2x + 2$
Give any decimal answers to 1 d.p.



Answer: ....

Q1

Solve the following simultaneous equations:

$6x + y = 22$

$2x + y = 10$

Answer: $x =$ .... $y =$ ....

Q2

Solve the following simultaneous equations:

$7x - 4y = 20$

$2x + 4y = 16$

Answer: $x =$ .... $y =$ ....

Q3 Solve the following simultaneous equations:

$15a - 4b = 25$

$5a + 2b = 25$

Answer: $a =$ .... $b =$ ....

Q4 Solve the following simultaneous equations:

$2x + 3y = 8$

$3x + 4y = 11$

Answer: $x =$ .... $y =$ ....

Q1

Solve the following simultaneous equations:

$7x + 5y = 8$

$3x - 2y = -9$

Answer: $x =$ .... $y =$ ....

Q2

Solve the following simultaneous equations:

$6x + 7y = 5$

$9x + 13y = -10$

Answer: $x =$ .... $y =$ ....

Q3

Solve the following simultaneous equations:

$$7y + 2x = \frac{23}{2}$$

$$5y + 3x = 9$$

Answer: $x =$ .... $y =$ ....

Q4

Solve the following simultaneous equations:

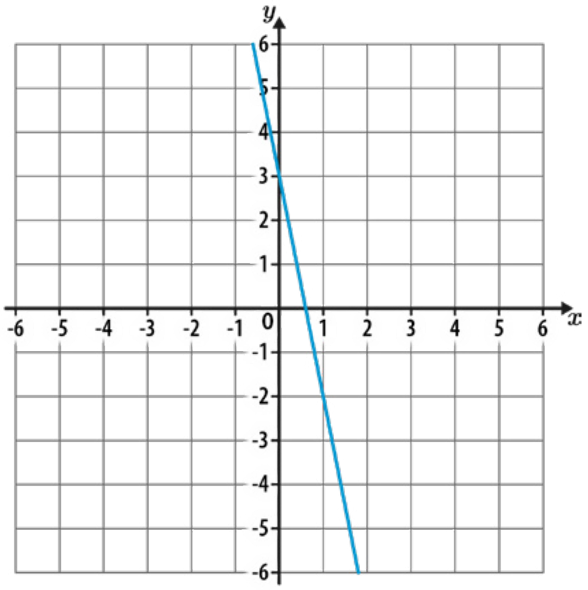
$$4.6t + 8.1u = 104$$

$$3.8t - 2.7u = -8$$

Answer: $t =$ .... $u =$ ....

Q1

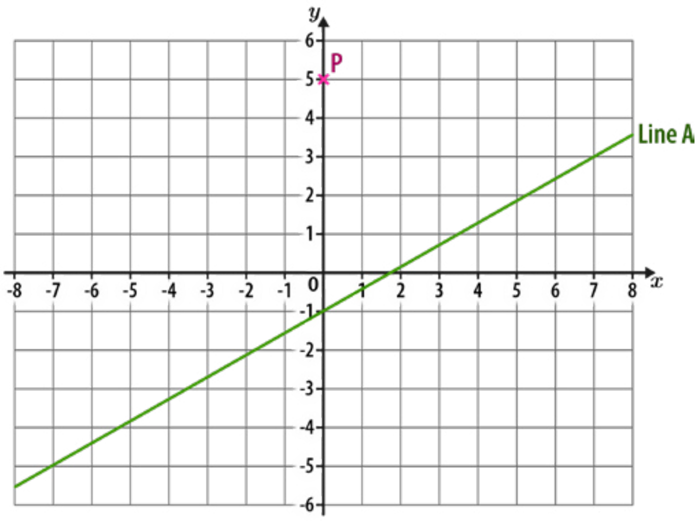
Work out the equation of the straight line shown below.



Answer: ....

Q2

Work out the equation of the straight line that is parallel to line A and passes through point P.



Answer: ....

Q3

Line A has the equation $2y - 10 = 16x$
Line B is perpendicular to Line A.

What is the gradient of Line B?

Answer: ....

Q4

A straight line has a gradient of 3 and passes through the point (2, 10)

Work out the equation of the line.

Answer: ....

Q5

Work out the equation of the straight line that passes through (2, 3) and (5, 18)

Answer: ....

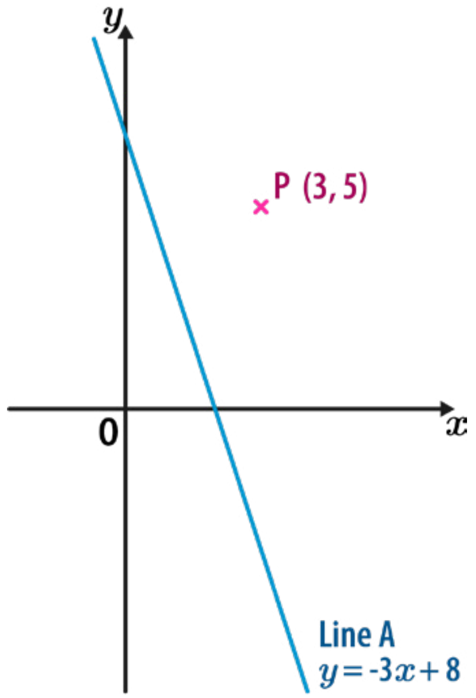
Q1 A straight line has a gradient of $-\frac{3}{4}$, and passes through the point (32, 12)

Work out the equation of the line.

Answer: ....

Q2 The diagram below shows point P and Line A.
Line B is **perpendicular** to line A and passes through point P.

What is the equation of line B?



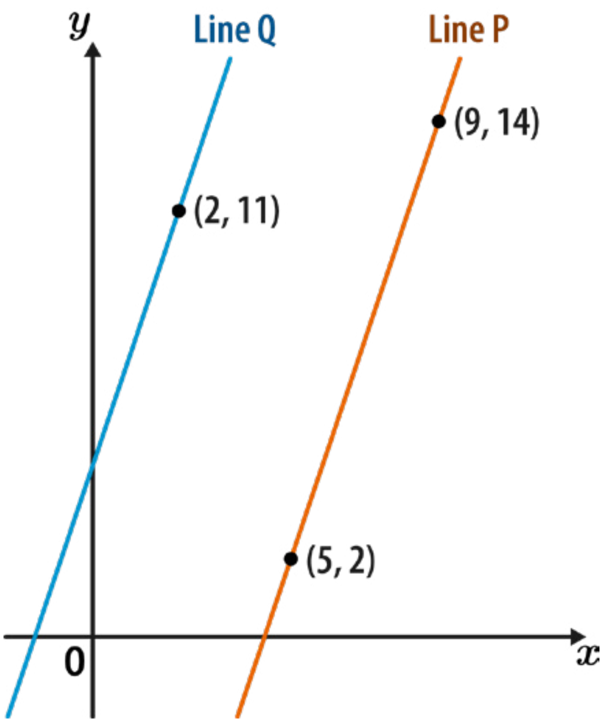
Answer: ....

Q3 Work out the equation of the straight line that passes through (1, -7) and (6, 8)

Answer: ....

Q4 The graph below shows line P and line Q.
Line Q is **parallel** to line P.

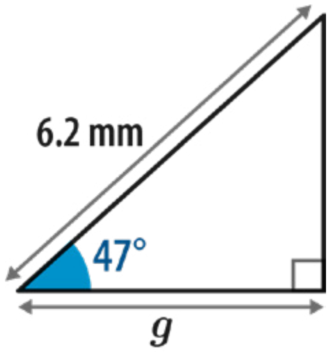
What is the equation of line Q?



Answer: ....

Q1

Work out the length g.
Give your answer to 1 d.p.

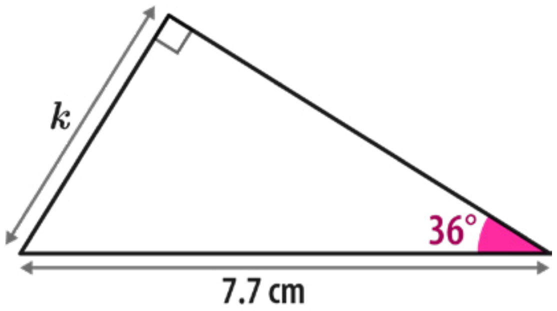


Not drawn accurately

Answer: .... mm

Q2

Work out the length k.
Give your answer to 1 d.p.

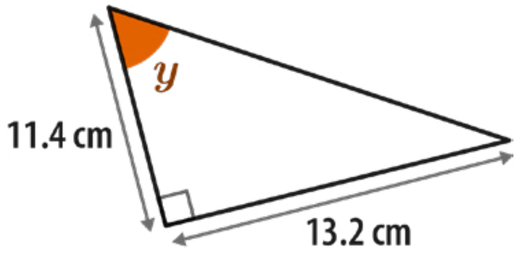


Not drawn accurately

Answer: .... cm

Q3

Calculate the size of angle y.
Give your answer to the nearest integer.

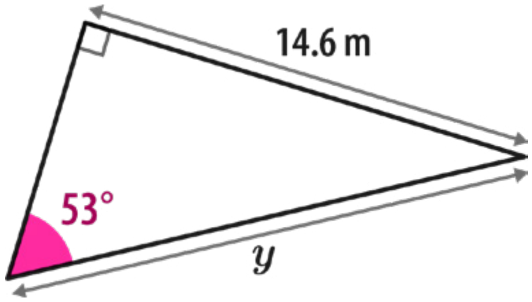


Not drawn accurately

Answer: .... °

Q1

Calculate the length y.
Give your answer to 2 d.p.

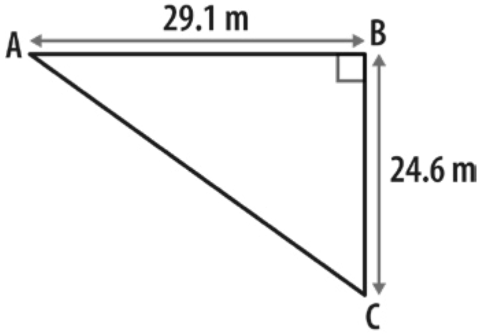


Not drawn accurately

Answer: .... m

Q2

Calculate the size of angle BAC.
Give your answer to 1 d.p.

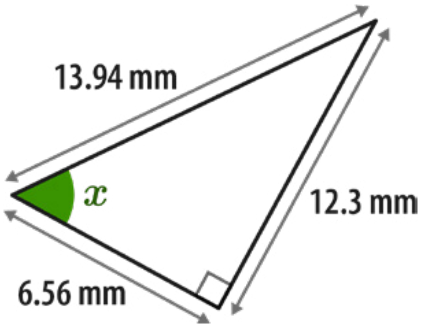


Not drawn accurately

Answer: .... °

Q3

What is the size of angle x?
Give your answer to 1 d.p.

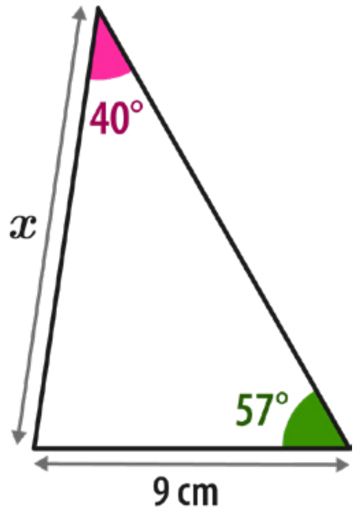


Not drawn accurately

Answer: .... °

Q1

Using the sine rule, calculate the length x.
Give your answer to 1 d.p.

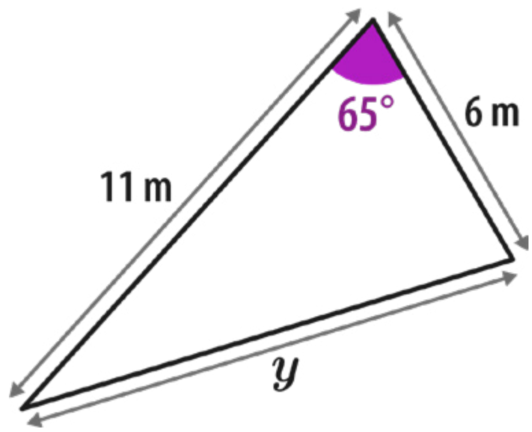


Not drawn accurately

Answer: .... cm

Q2

Using the cosine rule, work out the length y.
Give your answer to 1 d.p.

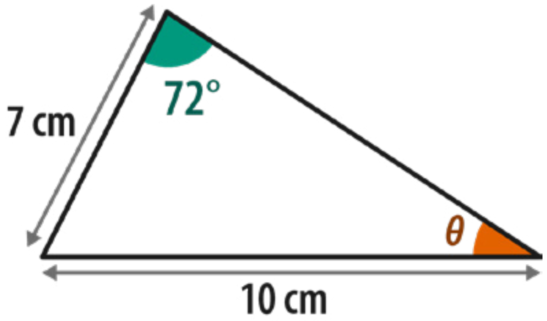


Not drawn accurately

Answer: .... m

Q3

Use the sine rule to calculate angle θ.
Give your answer to 1 d.p.

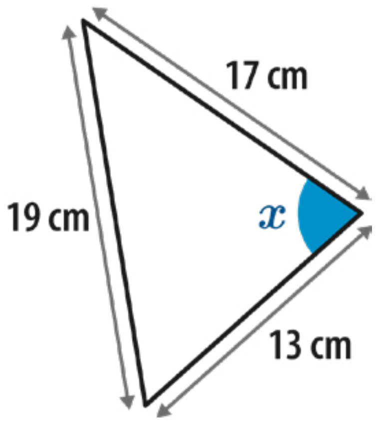


Not drawn accurately

Answer: .... °

Q4

Use the cosine rule to calculate the size of angle x.
Give your answer to the nearest degree.

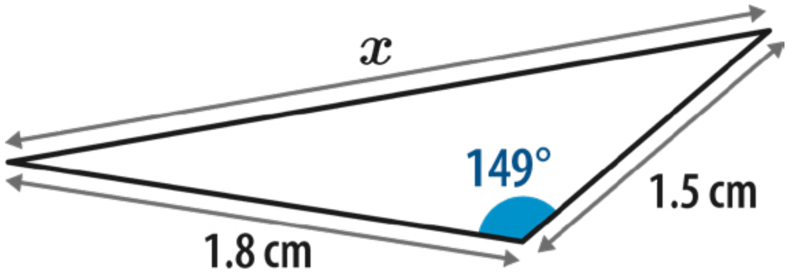


Not drawn accurately

Answer: .... °

Q1

Work out length x.
Give your answer to 1 d.p.

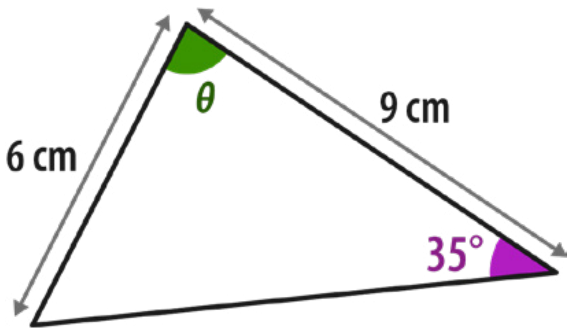


Not drawn accurately

Answer: .... cm

Q2

All the angles in the triangle below are acute.
Calculate the angle θ to 1 d.p.



Not drawn accurately

Answer: .... °

Answers

	Introduce		Strengthen	
Surds	**Q1**	$5 + \sqrt{35}$	**Q1**	$74 - 40\sqrt{3}$
	Q2	$\frac{\sqrt{30}}{3}$	**Q2**	$\frac{1 + 5\sqrt{3}}{10}$
	Q3	$11 + 7\sqrt{5}$	**Q3**	$3\sqrt{7} - 7$
	Q4	$61 + 27\sqrt{3}$	**Q4**	$13\sqrt{3}$
	Q5	$\frac{\sqrt{2} + 2}{2}$		
Expanding brackets	**Q1**	$m^2 + 11m + 18$	**Q1**	$24d^2 + 38d + 10$
	Q2	$8a^2 + 22a + 15$	**Q2**	$x^3 + 4x^2 + 8x + 5$
	Q3	$4x^2 - 3x - 27$	**Q3**	$15n^2 + 31n + 43$
	Q4	$36n^2 - 60n + 25$	**Q4**	$t^3 - t^2 - 22t + 40$
Factorising quadratics	**Q1**	$(y + 4)(y + 5)$	**Q1**	$(x + 4)(x - 4)$
	Q2	$(x + 4)(x - 5)$	**Q2**	$(2r + 1)(r + 7)$
	Q3	$(w - 6)(w - 9)$	**Q3**	$(5x + 2)(x + 4)$
Simplifying expressions	**Q1**	$12y^7$	**Q1**	$\frac{a}{6k}$
	Q2	$\frac{1}{h^{15}}$	**Q2**	$8g^4h^2$
	Q3	$\frac{t^3u}{4}$	**Q3**	$\frac{1}{2x - 35}$
	Q4	$\frac{t^6}{u^{10}}$		
	Q5	$\frac{11y + 3}{6}$		
	Q6	$\frac{6}{a + 4}$		

	Introduce	Strengthen
Operations with algebraic fractions	**Q1** $7a$ **Q2** $\frac{15}{v}$ **Q3** $\frac{37n + 14}{35}$	**Q1** $\frac{18}{a}$ **Q2** $\frac{5x - 1}{(5x - 7)(x + 1)}$ **Q3** $\frac{x - 4}{2x(x + 5)}$ **Q4** $\frac{7ab}{5k}$
Solving quadratic equations	**Q1** $x = 9$ and $x = -5$ **Q2** $y = 2$ and $y = -5$ **Q3** $w = 2$ and $w = 6$ **Q4** $x = \frac{-5}{2}$ and $x = \frac{-3}{2}$ **Q5** $m = \frac{1}{2}$ and $m = 5$	**Q1** $y = 3 \pm \sqrt{2}$ **Q2** $y = \frac{-2}{3}$ and $y = \frac{5}{2}$ **Q3** $y = \frac{-7}{2}$ and $y = \frac{5}{3}$ **Q4** $r = -0.15$ and $r = 1.48$
Quadratic graphs	**Q1** (2, 0) and (6, 0) **Q2** $x = -2.8$ and $x = 1.8$ **Q3** $x = -2$ and $x = 1$ **Q4** a) $(x + 3)^2 + 2$ b) (-3, 2)	**Q1** (-4, -26) **Q2** $\left(\frac{5}{2}, \frac{-21}{4}\right)$ **Q3** (1, -13) **Q4** $x = -1$ and $x = 2.5$
Linear simultaneous equations	**Q1** $x = 3,\ y = 4$ **Q2** $x = 4,\ y = 2$ **Q3** $a = 3,\ b = 5$ **Q4** $x = 1,\ y = 2$	**Q1** $x = -1,\ y = 3$ **Q2** $x = 9,\ y = -7$ **Q3** $x = \frac{1}{2},\ y = \frac{3}{2}$ **Q4** $t = 5,\ u = 10$
Straight-line graphs	**Q1** $y = -5x + 3$ **Q2** $y = \frac{4}{7}x + 5$ **Q3** $\frac{-1}{8}$ **Q4** $y = 3x + 4$ **Q5** $y = 5x - 7$	**Q1** $y = \frac{-3}{4}x + 36$ **Q2** $y = \frac{1}{3}x + 4$ **Q3** $y = 3x - 10$ **Q4** $y = 3x + 5$

	Introduce		Strengthen	
Right-angled trigonometry	**Q1**	4.2 mm	**Q1**	18.28 m
	Q2	4.5 cm	**Q2**	40.2°
	Q3	49°	**Q3**	61.9°
Further trigonometry	**Q1**	11.7 cm	**Q1**	3.2 cm
	Q2	10.1 m	**Q2**	85.6°
	Q3	41.7°		
	Q4	77°		