



# Year 11 - 12 Bridging the Gap

## GCSE → A Level

### A Level Mathematics

&

### A Level Further Mathematics





## USF & Maths FAQs

### 1. What equipment will I need for A-Level Maths and Further Maths?

- a. To start with, just bring your usual pencil case contents and GCSE calculator. You will need to get an A-Level calculator, but there is a choice between two models, and we can explain the difference between these models during a lesson in September.

### 2. Do I need to buy any text books?

- a. No. Text books will be provided in exchange for a returnable deposit. We use a lot of online resources too.

### 3. What happens if I don't get the GCSE grades I was hoping for?

- a. Please talk to us! We can discuss your specific situation with you and will collaboratively establish whether maths / further maths are still appropriate options for you.

### 4. Will I have a lot of homework?

- a. It depends! Successful mathematicians practise maths until they understand new skills and relevant knowledge thoroughly. Your homework will be reasonably consistent each week, but you will also be expected to do additional independent practice to ensure that you are really confident with each new topic. You might need to do more practice with certain topics compared to others.

### 5. How can I get help between lessons?

- a. There are several specialist A-Level maths teachers who will be happy to help you, even if they don't teach you, and we will give you their details in September. We will also give you a list of resources that you can use to help revisit topics independently.

### 6. I am unsure about something to do with A-Level maths or further maths at USF. How can I ask a question before September?

- a. Mrs Taylor can be contacted via email anytime: [mandy.taylor@avonbourneacademy.org.uk](mailto:mandy.taylor@avonbourneacademy.org.uk)



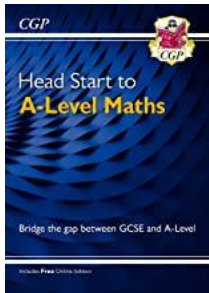
## Course Breakdown for Mathematics

Area of Maths	Exams	Total Marks
Pure Maths: <ul style="list-style-type: none"><li>• Proof</li><li>• Algebra and functions</li><li>• Coordinate geometry</li><li>• Sequences and Series</li><li>• Trigonometry</li><li>• Exponentials and Logarithms</li><li>• Differentiation</li><li>• Integration</li><li>• Numerical Methods</li><li>• Vectors</li></ul>	<b>Paper 1: 2 hours</b> <b>Paper 2: 2 hours</b>	<b>100 marks for each paper</b>
Statistics: <ul style="list-style-type: none"><li>• Statistical Sampling</li><li>• Data presentation and Interpretation</li><li>• Probability</li><li>• Statistical Distributions</li><li>• Statistical Hypothesis Testing</li></ul>	<b>Paper 3: 2 hours</b>	<b>100 marks</b>
Mechanics: <ul style="list-style-type: none"><li>• Quantities and units</li><li>• Kinematics</li><li>• Forces and Newtons Laws</li><li>• Moments</li></ul>		

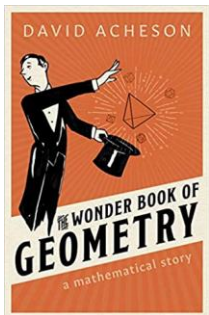
## Course Breakdown for Further Mathematics

Area of Maths	Exams	Total Marks
Core Pure Maths: <ul style="list-style-type: none"><li>• Complex Numbers</li><li>• Matrices</li><li>• Polar coordinates</li><li>• Hyperbolic functions</li><li>• Differential equations</li><li>• Extensions to A-Level pure content.</li></ul>	<b>Paper 1: 1 hour 30 minutes</b> <b>Paper 2: 1 hour 30 minutes</b>	<b>75 marks for each paper</b>
One or two options are chosen from: <ul style="list-style-type: none"><li>• Decision Maths – involving optimisation algorithms</li><li>• Mechanics – including circular motion</li><li>• Pure – including number theory and groups</li><li>• Statistics – including Poisson and geometrical distributions</li></ul>	<b>Paper 3: 1 hour 30 minutes</b> <b>Paper 4: 1 hour 30 minutes</b>	<b>75 marks for each paper</b>

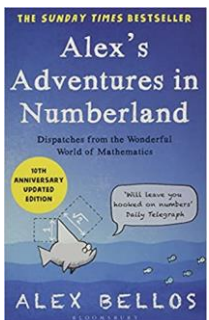
## Recommended Reading



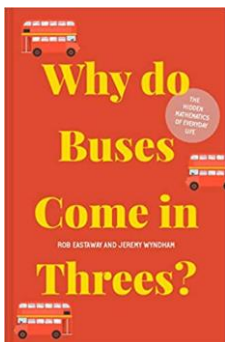
Head Start to A-Level Maths: Bridging the gap between GCSE and A-Level



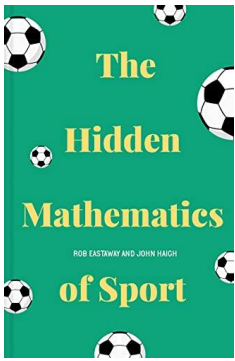
Acheson, D. 2020. *The Wonder Book of Geometry. A Mathematical Story*. OUP Oxford.



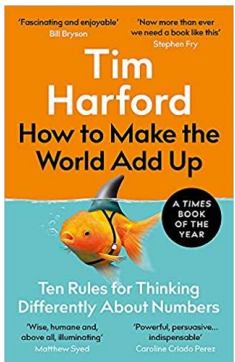
Bellos, A. 2020. *Alex's Adventures in Numberland. Dispatches from the Wonderful World of Mathematics*. Bloomsbury Publishing.



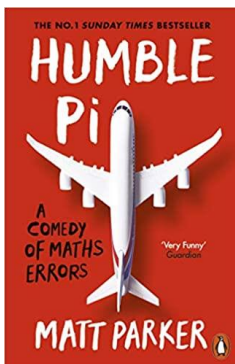
Eastaway, R. 2020. *Why do buses come in threes? The hidden maths of everyday life*. Harper Collins



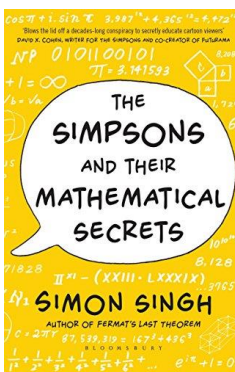
Eastaway, R. & Haigh, J. 2021 *The Hidden Mathematics of Sport*. Portico



Harford, T. 2021 *How to Make the World Add up. Ten rules for thinking differently about numbers*. The Bridge Street Press



Parker, M. 2020 *Humble Pi. A comedy of maths errors*. Penguin.



Singh, S. 2013 *The Simpsons and their mathematical secrets*. Bloomsbury Publishing.



## Youtube Clips

### Pure

Dividing by zero? <https://youtu.be/J2z5uzqxJNU>

The Magic of Fibonacci numbers <https://youtu.be/SjSHVDfXHQ4>

### Mechanics

Galileo's gravity experiment <https://youtu.be/QyeF-QPSbk>

The mighty mathematics of the lever <https://youtu.be/YIYEiOPgG1g>

### Statistics

Types of sampling methods <https://youtu.be/pTuj57uXWlk>

Standard deviation explained and visualised <https://youtu.be/MRqtXL2WX2M>

### Further Maths (core)

Imaginary numbers are just regular numbers <https://youtu.be/sZrOxm5Gszk>

Sounds of the Mandelbrot Set <https://youtu.be/GiAj9WW1OfQ>

### Further Maths (decision)

Quick sort with Hungarian Folk Dance <https://youtu.be/ywWBy6J5gz8>

Visualisation and comparison of sorting algorithms <https://youtu.be/ZZuD6iUe3Pc>

## Channels

Numberphile <https://www.youtube.com/user/numberphile>

Maths Explained <https://www.youtube.com/channel/UCf89Gd0FuNUdWv8FISS7lqQ>

TLMaths <https://www.youtube.com/channel/UCCgGyPD6MYQcHuMIc-Kv-Uw>

Vihart <https://www.youtube.com/user/Vihart>

### TASK 1: Seneca Short tasks

Join the Bridging the Gap maths class with code cl6hdh450g on <http://Senecalearning.com>

There are two assignments to complete. Each one should take less than half an hour.

The first is a refresher of GCSE topics that are relevant for the A-Level course.

The second assignment involves some taster activities for the topics you will learn at A-Level.

### TASK 2: Desmos Activities

We will sometimes use Desmos in lessons or for homework. It is helpful for you to familiarise yourself with the system, as well as learn some new maths.

Firstly, complete the Desmos activity on infinite series: <https://student.desmos.com/join/mcdwwz> You do not need to sign in so use the 'continue without signing in' option.

Secondly, complete the Desmos activity on logarithms: <https://student.desmos.com/join/4wteps> You do not need to sign in so use the 'continue without signing in' option.

**Further Mathematicians (and mathematicians who would like to),** there are two more activities for you to do.

The Desmos activity on complex numbers is here: <https://student.desmos.com/join/cthedg> You do not need to sign in so use the 'continue without signing in' option.

The Desmos activity on matrices is here: <https://student.desmos.com/join/vitgu3> You do not need to sign in so use the 'continue without signing in' option.



### TASK 3: UL A-Level Ready Questions

Have a go at these questions to make sure you are completely ready for the A-Level content. The answers are available through the video links and QR codes, but if you need help, do get in touch.

## Manipulating Algebraic Expressions

1	Expand and Simplify: $(2x - 1)(x + 2)(x - 3)$
2	Write $\frac{x^2 + 7x - 18}{2x^2 - x - 6}$ in the form $\frac{x + a}{bx + c}$ where $a$ , $b$ , and $c$ are integers.
3	Simplify fully $\frac{3x + 6}{x - 4} \div \frac{2x^2 + 9x + 10}{x^2 - 4x}$

Scan the QR code to watch the solution or use the link

<https://www.youtube.com/watch?v=jlGJpsgc0KM&feature=youtu.be>



## Surds

1	Simplify (a) $(3\sqrt{7})^2$ (b) $(8 + \sqrt{5})(2 - \sqrt{5})$
2	Expand and simplify $(\sqrt{7} + 2)(\sqrt{7} - 2)$ .
3	Simplify $\frac{5 - \sqrt{3}}{2 + \sqrt{3}}$ giving your answer in the form $a + b\sqrt{3}$ , where $a$ and $b$ are integers.

Scan the QR code to watch the solution or use the link


<https://www.youtube.com/watch?v=oacsMZvJLUc&feature=youtu.be>








## Indices


1	Simplify $\left(\frac{125x^6}{64}\right)^{\frac{1}{3}}$	Simplify $\left(\frac{216x^6}{27y^3}\right)^{-\frac{2}{3}}$
2	Express $9^{3x+2}$ in the form $3^y$ , giving $y$ in the form $ax + b$ , where $a$ and $b$ are constants.	
3	Given $y = 2^x$ (a) Express $4^x$ in terms of $y$ . (b) Hence, or otherwise, solve $4^x - 6(2^x) - 16 = 0$	
Scan the QR code to watch the solution or use the link <a href="https://www.youtube.com/watch?v=mazi0qxX1wU&amp;feature=youtu.be">https://www.youtube.com/watch?v=mazi0qxX1wU&amp;feature=youtu.be</a>		
 SCAN ME		

## Factorising Expressions


1	Factorise completely $x^3 - 9x$ .
2	Factorise completely $x^3 - 6x^2 + 9x$
3	Factorise completely: $75x - 12x^3$
Scan the QR code to watch the solution or use the link <a href="https://www.youtube.com/watch?v=l3t1o_aWws4">https://www.youtube.com/watch?v=l3t1o_aWws4</a>	
 SCAN ME	



## Completing the Square


1	(a) Express $x^2 + 9x + 3$ in the form $(x + a)^2 + b$  (b) State the coordinates of the minimum point of the curve $y = x^2 + 9x + 3$
2	$f(x) = 2x^2 + 8x + 1$  Find the values of the constants $a$ , $b$ and $c$ such that  $f(x) = a(x + b)^2 + c$
3	The curve C has the equation $x^2 + ax + b = 0$  Where $a$ and $b$ are constants  Given that the minimum point of C has coordinates $(4, -3)$ find the values of $a$ and $b$ .
Scan the QR code to watch the solution or use the link <a href="https://www.youtube.com/watch?v=EeyUb2mSfX8">https://www.youtube.com/watch?v=EeyUb2mSfX8</a>	
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## Solve Linear & Quadratic Equations


1	Solve $4x^2 - 19x - 5 = 0$
2	Solve $5x^2 = 6x + 3$  Give your solutions correct to 3 significant figures.
3	Solve $\frac{7}{x + 1} - \frac{4}{3x - 2} = 1$
Scan the QR code to watch the solution or use the link <a href="https://www.youtube.com/watch?v=jpch-tFae1M&amp;feature=youtu.be">https://www.youtube.com/watch?v=jpch-tFae1M&amp;feature=youtu.be</a>	
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## Solve Simultaneous Equations


1	Solve the simultaneous equations $y = x - 2,$ $y^2 + x^2 = 10.$
2	Solve the simultaneous equations $x - 2y = 1,$ $x^2 + y^2 = 29.$
Scan the QR code to watch the solution or use the link <a href="https://www.youtube.com/watch?v=FhiNkpRmlUg&amp;feature=youtu.be">https://www.youtube.com/watch?v=FhiNkpRmlUg&amp;feature=youtu.be</a>	
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## Inequalities


1	Find the set of values of $x$ for which $x^2 - 7x - 18 > 0.$
2	Find the set of values of $x$ for which (a) $4x - 3 > 7 - x$ (b) $2x^2 - 5x - 12 < 0$ (c) <b>both</b> $4x - 3 > 7 - x$ <b>and</b> $2x^2 - 5x - 12 < 0$
Scan the QR code to watch the solution or use the link <a href="https://www.youtube.com/watch?v=MHWQzBU7BDM&amp;feature=youtu.be">https://www.youtube.com/watch?v=MHWQzBU7BDM&amp;feature=youtu.be</a>	
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## The Equation of a Straight Line


1	<p>The line <math>l</math> passes through the coordinates <math>(2, 1)</math> and <math>(4, -5)</math>.</p> <p>Find an equation for <math>l</math>.</p>
2	<p>(a) Find an equation of the straight line passing through the points <math>(-2, 5)</math> and <math>(5, -1)</math>. Give your answer in the form <math>ax + by + c = 0</math>, where <math>a</math>, <math>b</math> and <math>c</math> are integers.</p> <p>The line crosses the <math>x</math> axis at point <math>A</math>, the <math>y</math> axis at point <math>B</math> and <math>O</math> is the origin.</p> <p>(b) Find the area of triangle <math>AOB</math>.</p>
<p>Scan the QR code to watch the solution or use the link <a href="https://www.youtube.com/watch?v=6_3M2mS567k">https://www.youtube.com/watch?v=6_3M2mS567k</a></p>	
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## Parallel and Perpendicular Lines

1	<p>The line <math>l_1</math> has the equation <math>2x + 3y + 5 = 0</math></p> <p>The line <math>l_2</math> passes through the coordinates <math>(1, 7)</math> and <math>(5, 1)</math>.</p> <p>Determine, giving full reasons for your answer, whether <math>l_1</math> and <math>l_2</math> are parallel, perpendicular or neither.</p>
2	<p>The points <math>A</math> and <math>B</math> have coordinates <math>(-1, k + 2)</math> and <math>(2k - 3, 8)</math> where <math>k</math> is a constant.</p> <p>Given the gradient of <math>AB</math> is <math>\frac{1}{3}</math></p> <p>(a) Show that <math>k = 4</math></p> <p>(b) Find the equation of the line the passes through <math>A</math> and <math>B</math>.</p> <p>(c) Find the equation of the perpendicular bisector of <math>A</math> and <math>B</math>. Give your answer in the form <math>ax + by + c = 0</math></p>
<p>Scan the QR code to watch the solution or use the link <a href="https://www.youtube.com/watch?v=owtikgpa14Q">https://www.youtube.com/watch?v=owtikgpa14Q</a></p>	
 SCAN ME	



## Sine & Cosine Rules

<b>1</b>	<p>In triangle <math>ABC</math>, side <math>AB</math> has length 15cm, side <math>AC</math> has length 12cm and <math>\angle BAC = 60^\circ</math></p> <p>(a) Find the length of side <math>BC</math>.</p> <p>(b) Find the area of triangle <math>ABC</math>.</p>
<b>2</b>	<p>In triangle <math>PQR</math>, side <math>PQ</math> has length 9cm and side <math>PR</math> has length 10cm.</p> <p>Given the area of <math>PQR</math> is <math>30\text{cm}^2</math></p> <p>(a) Find the length of side <math>QR</math>.</p> <p>(b) Find <math>\angle PQR</math></p>
<b>3</b>	<p>In the triangle <math>ABC</math>, <math>AB = (x + 3)\text{cm}</math>, <math>BC = (x + 2)\text{cm}</math>, <math>AC = x\text{cm}</math> and angle <math>BAC = 60^\circ</math></p> <p>Find the value of <math>x</math>.</p>
<p><b>Scan the QR code to watch the solution or use the link</b> <a href="https://www.youtube.com/watch?v=9aWNyX_vPs8&amp;feature=youtu.be">https://www.youtube.com/watch?v=9aWNyX_vPs8&amp;feature=youtu.be</a></p>	
	

### TASK 4: Large Data Set

The large data set is used throughout the statistics module of the A-Level mathematics course. It is really helpful if you can familiarise yourself with what it is and what information it contains, before September.

This video is a comprehensive introduction: <https://youtu.be/dcF9eKbqRH8>

Basic information that you need to know is included on the next page too. As a minimum, try to learn where the different locations are. Can you label a map with their locations?



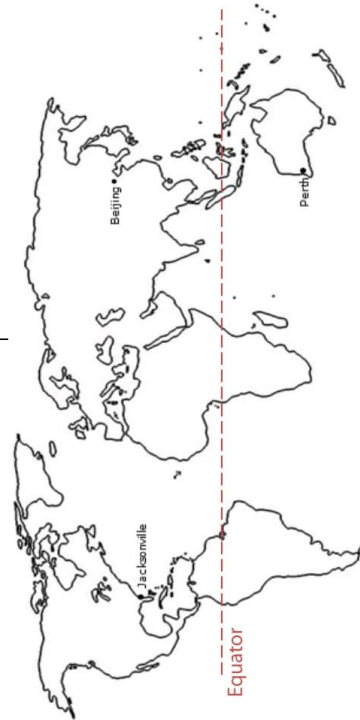
## The Large Data Set

### Locations

5 UK weather stations



3 overseas



@sxpmaths

### Time Periods

May – October 1987 (6 months)  
May – October 2015 (6 months)

### Seasons

May/June are the end of spring  
July-Sept is summer  
October is autumn

Perth (Australia) is in the southern hemisphere, so July-Sept is winter

### UK Great Storm

The night of 15-16<sup>th</sup> October 1987  
Gusts up to 100 knots recorded

### Florida hurricanes

12 October 1987 Hurricane Floyd  
1-2 October 2015 Hurricane Joaquin

### Variables Recorded

**Daily Maximum Temperature**  
°C

**Daily Total Rainfall**  
mm

**Daily Total Sunshine**  
hours

**Daily Maximum Relative Humidity**  
%; mist and fog if > 95%

**Daily Mean Windspeed;**

**Daily Maximum Gust**  
knots (1kn = 1.15mph)  
and Beaufort scale

**Daily Mean Wind Direction;**  
**Daily Maximum Gust Direction;**  
bearing (°)  
and cardinal direction

**Cloud Cover**  
oktas (eighths); 0 – 8

**Visibility**  
Dm (decametres)  
1 Dm = 10 m

**Pressure**  
hPa (hectoPascal)  
1 hPa = 100 Pa

n/a

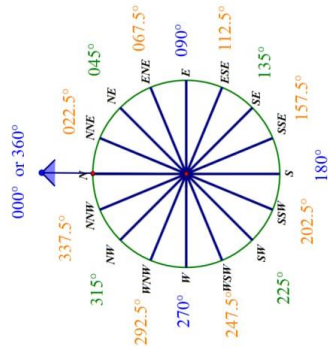
reading not available

**tr (trace)**  
rainfall < 0.05mm

### Beaufort Scale

Discrete, scale of 13 values:  
0 (calm, < 1kn)  
12 (hurricane, 64kn+)

### Cardinal Directions



### Oktas

Eighths of the sky covered by cloud  
Discrete, scale of 9 values:  
0 (clear sky)  
8 (completely overcast)

Sources

Maps: Pearson

Compass: mathsmutt.co.uk

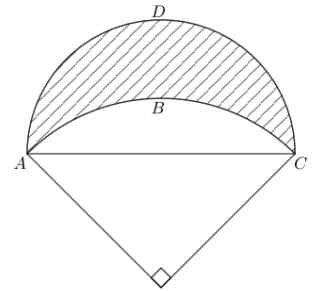


**Task 5: Develop your Problem-Solving and Reasoning Skills**

Have a go at these senior maths team challenge materials from 2020 and see how you get on with them:

**1.** The sum of all the digits in the numbers from 1 to 10 is 46, since  $1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 1 + 0 = 46$ . What is the sum of all the digits in the numbers from 1 to 100?

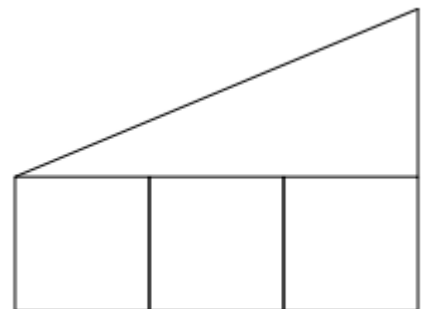
**2.**  
 $AC$  is a straight line of length 16. The point  $D$  lies on a semicircular arc that has endpoints  $A$  and  $C$ . The point  $B$  lies on an arc of a quarter circle that also has endpoints  $A$  and  $C$ . What is the area of the shaded region?



**3.** Barry commutes to work every day by the same route. He leaves the house at the same time every morning. If his average speed is 30mph, then he arrives at work three minutes early. If his average speed is 20mph, he arrives at work three minutes late. What speed, in mph, must he average to arrive at work exactly on time?

**4.** What is the largest odd factor of  $320^4$  ?

**5.**  
A shape is said to be equable if its perimeter, in centimetres, is numerically the same as its area in square centimetres. The trapezium shown is made up of three equable squares and an equable right-angled triangle.



What is the perimeter, in centimetres, of the trapezium?

6.

The positive integers  $m$  and  $n$  satisfy the equation

$$\left(\frac{m^2}{2}\right)^2 - \left(\frac{n^2}{2}\right)^2 = 2020.$$

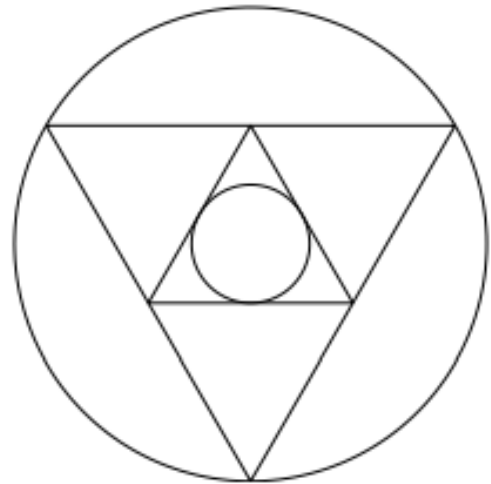
What is the value of  $m + n$ ?

7.

The midpoints of the three sides of an equilateral triangle are joined up to form a smaller equilateral triangle. A circle is inscribed in the smaller triangle and another circle is circumscribed around the larger triangle.

The ratio of the area of the larger circle to the area of the smaller circle can be written as  $x : 1$ .

What is the value of  $x$ ?



8.

A display board has three coloured lights.

Initially when the lights are turned on, the three coloured lights all flash at the same time. The blue light then flashes every 3 seconds, the green light every 5 seconds and the red light every 7 seconds.

In the fifth, sixth and seventh seconds, there are three consecutive flashes of three different colours, namely, green, blue and red, in that order.

After how many seconds do the lights first flash red, then blue, then green, in three consecutive seconds?

Specify your answer by giving the time, in seconds, when the green flash occurs – this will be a multiple of 5.

Answers are available at: <https://amsp.org.uk/resource/stmc-materials>