BRISTOL CATHEDRAL CHOIR SCHOOL

Pure Mathematics Transition

A level in mathematics will consist of core or pure Mathematics and two areas of applied Mathematics, statistics and mechanics.

A level mathematics uses many of the skills you developed at GCSE. The big difference is that you will be expected to recognise where to use these skills and apply them quickly and efficiently.

Your success at A level pure Mathematics will depend on how willing you are to maintain and perfect these skills.

In order to get off to a good start you need to be prepared. This booklet will help you get ready for A level Pure Mathematics.

During the first couple of weeks of year 12 expect that you will be given a transition test. If you do not meet the required standard in this test you will need to attend compulsory after school lessons to prepare for a retest in these basic skills.

Until you have understood the topics included in this booklet and been successfully tested on them you will be expected to continue with extra support classes.

The topics that will be included in this test can be found later in this booklet.

Skills for success

Be organised – keep your notes and work in clearly labelled folders. Make sure you know where everything is and that you can find it easily.

Make sure your notes are clear and detailed – not everything of use will be written on the board. Listen carefully to what the teacher says and note down any useful hints and tips. Your teacher will model the best way to approach problems or apply skills so you need to make sure your notes clearly show what they were doing. Re-write out any notes that are scruffy or not clear. Annotate any handouts that you are given. Read through your notes to check you have everything you need and, if not, talk to your teacher about what you think is missing.

Be precise with your notation – you will probably have developed some bad presentation habits at GCSE level. Look at the way the teacher models each technique and try to do things in the same way. One difference between AS level and GCSE is that the way things are set out becomes far more important.

Be accurate with your answers – AS level questions often have several joined par
next. You will need to be accurate so that your answers make sense. Feeding a w
results in something far more difficult to work out. Learn the quick checks that your teacher uses to test the accuracy of calculations.

Plan your time effectively – You will be taught a number of new skills. You will not become fluent in these unless you practise them. It is not enough to just understand what the teacher is telling you about a technique, you must practise it to become confident in it. This is true of all skills based subjects. Make sure you have the time to do all of the homework set for the deadline you are given.

Be prepared to change the way you do things – GCSE methods are not always the quickest or most efficient way of doing things. Skills you previously learned for GCSE often need to be refined. Try not to stubbornly stick to the GCSE way of doing things.

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Get help from as many places as possible – it is vitally important that you understand the work as you go along. Be honest with yourself when you don't understand something and seek help. You can get some help from your peers, the text book or your teacher. The important thing is not to allow a technique or skill to pass by without understanding it.

You will need to understand and be able to use these before starting the A level Mathematics course:

Indices

$a^0 = 1$

$a^{-1} = \frac{1}{a}$

$a^{\frac{1}{2}} = \sqrt{a}$

$a^{\frac{m}{n}} = \sqrt[n]{a^m} = \left(\sqrt[n]{a}\right)^m$

Laws of indices

$a^m \times a^n = a^{m+n}$

$\frac{a^m}{a^n} = a^m \div a^n = a^{m-n}$

$\left(a^m\right)^n = a^{mn}$

Surds

$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

$\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$

Quadratic Equations

For $ax^2 + bx + c = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ this is known as the quadratic formula

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Transition exercises.

YOU WILL BE TESTED ON THESE TOPICS IN THE FIRST COUPLE OF WEEKS OF YEAR 12. IF YOU DO NOT PASS YOU WILL BE REQUIRED TO COME TO AFTERSCHOOL CATCH UP SESSIONS UNTIL HALF TERM WHEN YOU WILL BE RETESTED.

1. Collecting like terms:

Simplify the following expressions

a) $x^3 + 2x^2 - 5x + 7x^2 + 3x - 4$ b) $x^4 - 3x^3 - 2x^2 + 2x^3 - 6x^2 - 4x$

c) $2ab - a^2 + 4b^2 - 2ab$ d) $3x^2 + 6xy - 12x - 2xy + 6y^2 + 8y$

2. Indices

Evaluate (i.e. work out)

a) 2^{-3} b) $25^{\frac{1}{2}}$ c) $\left(\frac{1}{3}\right)^{-2}$ d) $\left(\frac{64}{27}\right)^{-\frac{4}{3}}$ e) $\left(6\frac{1}{4}\right)^{\frac{1}{2}}$ f) $49^{\frac{3}{2}}$

3. Laws of Indices

Simplify the following expressions

a) $7^3 \times 7^4$ b) $\frac{3^4 \times 3^6}{3^5}$ c) $\left(4^3\right)^8$ d) $\frac{2^5 \times 2^9}{\left(2^3\right)^5}$ e) $4x^3 \times 2x^5$ f) $(3a)^3$

g) $\left(-2p^2q^3\right)^4$ h) $\frac{2x^2y^3z \times 6x^4yz^3}{\left(9xy^4z^2\right)^2}$

3. Changing the subject of a formula

Make the variable shown in brackets the subject

a) $v = u + at$ (a)

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

c) $A = 2\pi r^2 + 2\pi rh$ (h)

d) $y = \frac{x+1}{x-1}$ (x)

4. Expanding brackets

Multiply out and simplify

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a) $6(2x+3)$ b) $-2x(x-5)$ c) $2xy^2(3x-5y)$ d) $5y(4-3x)-2x(3-2y)$

e) $(x+7)(x-7)$ f) $(2x-3)(x+5)$ g) $(2x+y)(2-3y)$ h) $(3a+4b)(5b-2a)$

5. Factorising expressions

Factorise fully

a) $7x+21$ b) $3ab-12b$ c) $7x^2y+21x^3y^2$ d) $30xy+6x^2-15x$

6. Factorising quadratic expressions

Factorise

a) $x^2+9x+20$ b) $x^2-12x+35$ c) $y^2-2y-63$

d) $a^2-6a-16$ e) $2x^2+3x+1$ f) $2x^2+5xy-3y^2$

g) x^2-9 h) $9x^2-25y^2$ i) $16x^2-3$

7. Solving quadratic equations

Solve the following equations

a) $x^2+15x+54=0$ b) $t^2-3t-40=0$ c) $3x^2-x-14=0$

d) $7a-6a^2+20=0$ e) $9x^2+12x+4=0$ f) $x+1=\frac{6}{x}$

8. Solving quadratic equations

Solve the following equations giving your answer in surd form

a) $x^2+12x+20=0$ b) $t^2+9t+4=0$ c) $3x^2-7x=1$

9. Surds

Write the following in the form $a\sqrt{b}$

a) $\sqrt{44}$ b) $\sqrt{320}$ c) $\sqrt{75}$ d) $\sqrt{304}$

e) $\sqrt{\frac{32}{25}}$ f) $\sqrt{\frac{27}{16}}$ g) $\sqrt{\frac{50}{9}}$ e) $\sqrt{\frac{496}{304}}$

10. Surds

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Write each of the following as a single surd in its simplest form

a) $4\sqrt{7}-3\sqrt{7}+6\sqrt{7}$ b) $4\sqrt{2}-\sqrt{50}+\sqrt{98}$ c) $\sqrt{3}\left(7+2\sqrt{3}\right)$

d) $\left(\sqrt{7}-\sqrt{3}\right)\left(\sqrt{7}+\sqrt{3}\right)$

11. Solving Simultaneous equations

Solve each of the following pairs of simultaneous equations

a)
$3x+2y=13$
$2x-y=2$

b)
$2x+3y=10$
$5x+2y=3$

c)
$3x+y=7$
$2x-3y=23$

d)
$8x+4y=5$
$6x-8y=1$

12. Solving Simultaneous equations

Solve each of the following pairs of simultaneous equations

a)
$y=x^2-x-6$
$y=x+2$

b)
$y=2x+3$
$y(5-x)=20$

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MyMaths References

The following MyMaths paths will help you prepare for your AS level course

Indices	**Number ➲ Powers and Integers ➲ Indices part 1** **Number ➲ Powers and Integers ➲ Indices part 2**
Factorising	Algebra ➲ Use of Symbols ➲ Simplifying 2 Algebra ➲ Use of Symbols ➲ Factorise linear equations
Algebraic Fractions	Algebra ➲ Use of Symbols ➲ Cancelling Algebraic fractions Algebra ➲ Use of Symbols ➲ Adding Algebraic Fractions Algebra ➲ Use of Symbols ➲ Multiplying Algebraic Fractions
Changing the subject of a formula	Algebra ➲ Formulae ➲ Rearranging 1 Algebra ➲ Formulae ➲ Rearranging 2
Quadratic Equations	Algebra ➲ Quadratics ➲ Quadratic Equations Algebra ➲ Quadratics ➲ Quadratic Formula Algebra ➲ Quadratics ➲ Completing the Square
Simultaneous Equations	Algebra ➲ Simultaneous Equations ➲ Simultaneous Equations 2 Algebra ➲ Simultaneous Equations ➲ Simultaneous Equations 3 Algebra ➲ Simultaneous Equations ➲ Quadratic Simultaneous Equations

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Here are a number of interesting investigations and questions for you to dip into when you wish to over the summer holidays. These are optional and you will not be tested on them.

What number,

when multiplied by itself,

is equal to 27 x 147?

p and q are two numbers each greater than zero.

$$\sqrt{p^2 + 5q} = 8$$

$$\sqrt{p^2 - 3q} = 6$$

Find the values of p and q.

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Find the sum of any three consecutive numbers.

What do you notice about the total?

Is this true for any three consecutive numbers?

Can you **prove** why this is true?

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Over the course of numbering
every page in a book,
a mechanical stamp printed 2,929
individual digits.

How many pages does the book have?

Discuss your method and reasoning with
at least three other people

Explain to someone, or ask someone to explain, the joke

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CHOIR SCHOOL

Find the sum of *four* consecutive numbers.
What do you notice about the total?
Is this true for any *four* consecutive numbers?
Can you explain why this is true?

Discuss your method, reasoning and result with
at least three other people

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Use all the digits

0 1 5 0 1 5 0

To complete this multiplication:

___ ___ ___ x 2 = ___ ___ ___ ___

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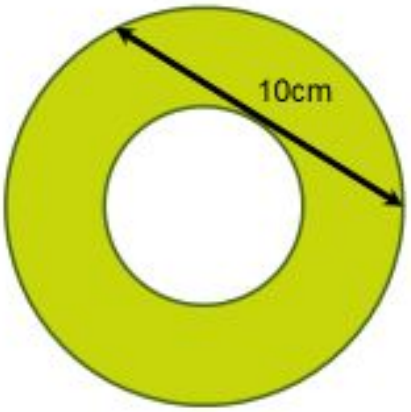
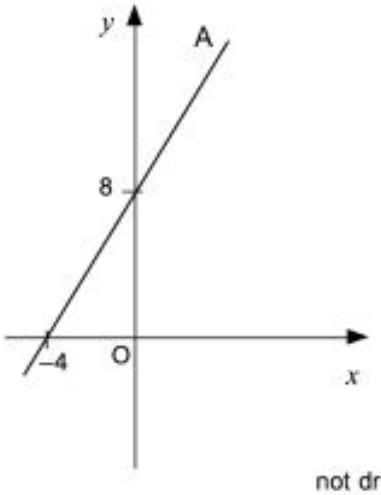
Work out the shaded area in the diagram.



(the line shown just touches the inner circle)

What is the equation of the line A?



not drawn to scale

Discuss your method and reasoning with someone else,
be able to state all formulae used.

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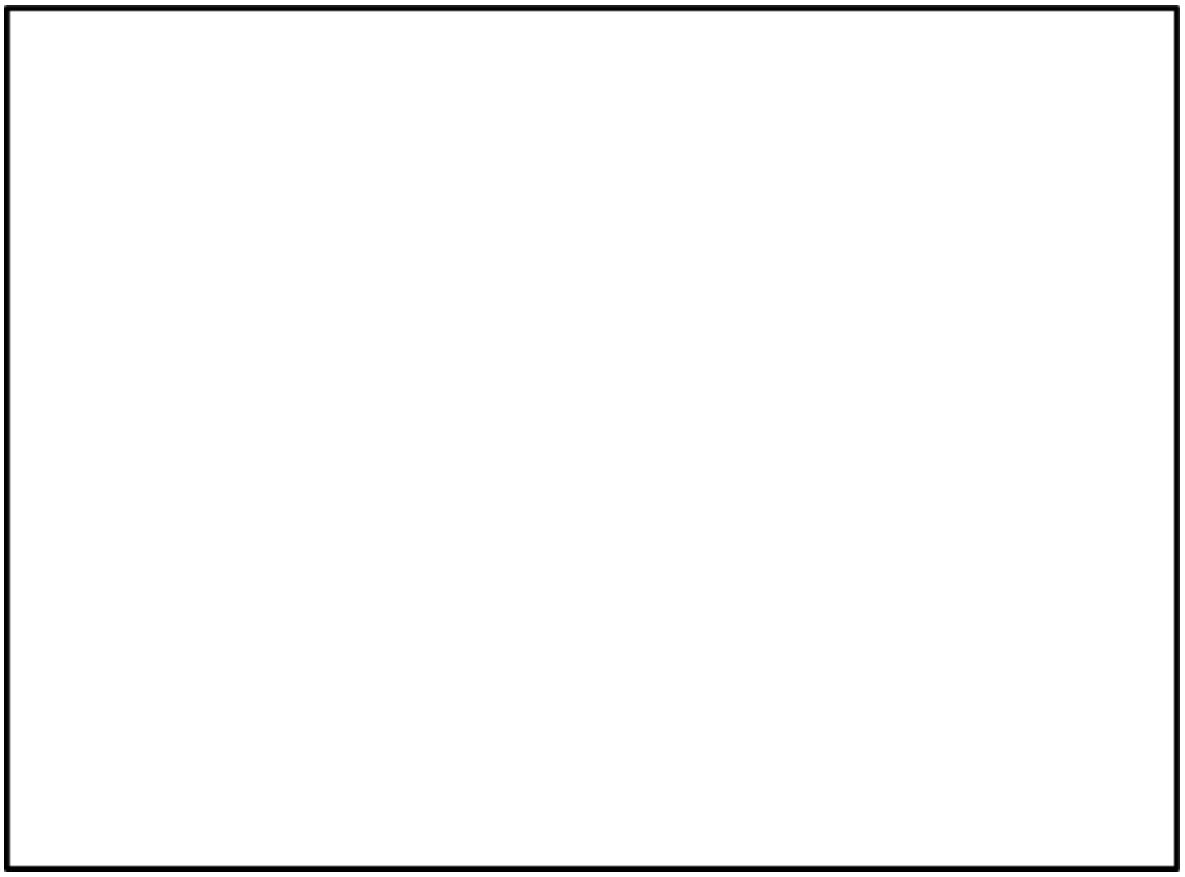

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Make the two columns add up to the same total
by swapping just two cards

1	3
2	4
7	5
9	8

Discuss
your methods

There are eight coins that all look identical
but only one is solid gold.

The gold coin weighs slightly less than the fakes.

Use the balance only twice to find the real gold coin.

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Take any prime number greater than 3.
Square it and take away 1.

Is the answer a multiple of 24?

Try again, and again, and again.

Why is that?

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Use only the digits 1 to 9
(you can repeat digits if you wish)

Start with a three digit number	497
Reverse the digits	794
Add the numbers together	1291

Find the largest three-digit starting number that produces a total less than 1000.

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Suppose that a, b, and c are real numbers and $a(b + c) = 0$.

What can you say is certain? (Choose just one option)

a)	$a = 0$
b)	$b + c = 0$
c)	$b = c = 0$
d)	$a = 0$ or $b = -c$

Suppose that a, c, and d are real numbers and $ac = ad$.

What can you say is certain? (Choose just one option)

a)	$c = d$
b)	$c = 0$ or $d = 0$
c)	$a = 0$ or $c = d$
d)	$a = 0$

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Suppose that a and b are real numbers and $a^2 - b^2 = a + b$.

What can you say is certain? (Choose just one option)

a) $a - b = 1$ or $a + b = 0$

b) $a - b = 0$ or $a + b = 0$

c) $a = b$ or $a + b \neq 0$

d) $a = b$

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Three numbers have a total of 10

and

when multiplied make 30.

What are the numbers?

_____ _____ _____

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Three numbers have a total of 30.

Two of the numbers are equal.

The third number is half the size of the other two.

What are the numbers?

_____ _____ _____

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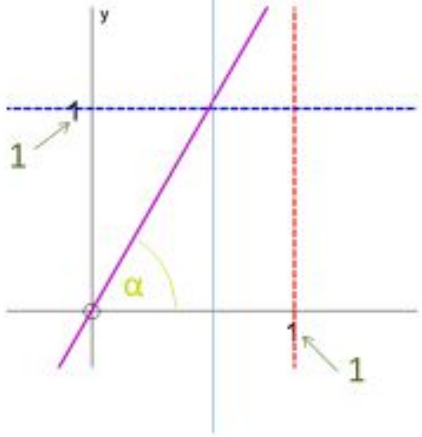
The equation of the line shown in the diagram below is $y = \sqrt{3}x$

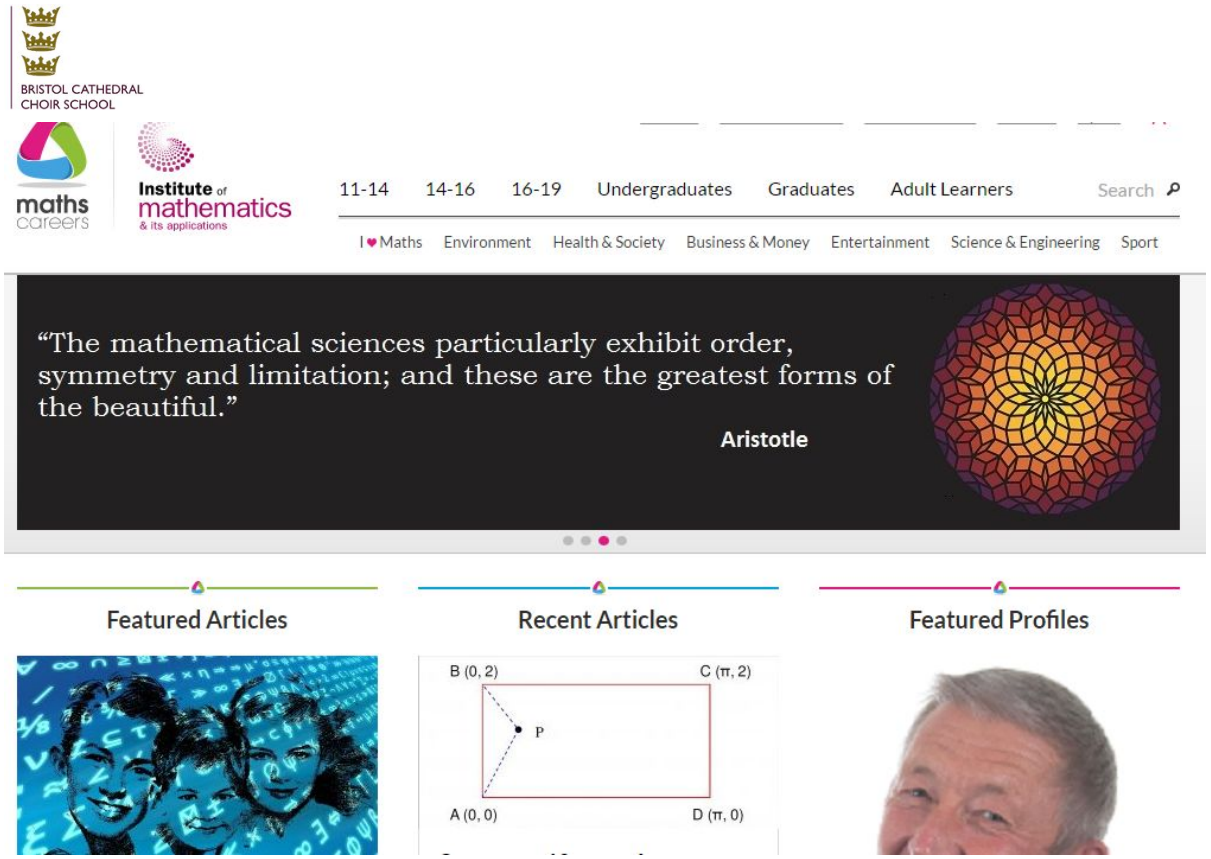


What is the value of α?

[Bonus points for not using a calculator]

Websites:

http://plus.maths.org



http://www.mathscareers.org.uk

Maths Beyond the Curriculum

Why Not Try This?	I've Done This! (Tick the box when done)
Complete the FMSP problem solving questions	
Explore the universities section of the FMSP website	
Listen to the podcasts featured on the FMSP website	
Try some of the nrich monthly problems	
Complete the STEP prep modules on nrich	
Take part in the UKMT Individual Maths Challenges	
Try out for a place in your school's UKMT Senior Team Challenge	
Take part in the MOG (for real if you're a girl, or just for fun if you're a boy)	
Join The Society of Young Mathematicians (a part of the Mathematical Association)	
Go to the Maths Inspiration lectures	
Watch some Numberphile videos	
Watch some Khan Academy videos	
Watch some mathispower4u videos	

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Watch episodes of the TV program School of Hard Sums with Dara O'Briain & Marcus Du Sautoy	
Regularly explore the mathsplus website	
Attempt some MAT & STEP questions	
Try the Advanced Problems in Maths or the Advanced Problems in Pure Maths	
Take part in the STEP Correspondence Course	
Read some maths reading books from the Cambridge University undergraduate reading list	
Read Chalk Dust Magazine	
Do the regular questions on brilliant.org	
Find out about the millennium maths problems (but don't expect to solve them just yet!)	
Attend a local Summer School	
Take part in university maths events such as those at UCL	
Investigate areas of maths that your A level course doesn't cover	
Apply early for university summer schools	
Support with Key Stage 3 maths classes at school	
Take part in mentoring of less experienced students at your sixth form	

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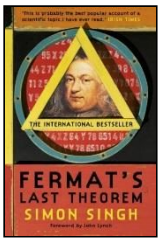
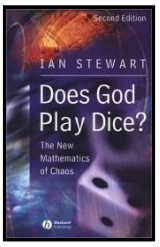
Great Mathematics Reading Books for Sixth-formers

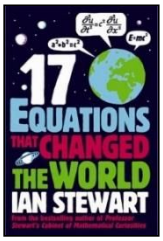


Fermat's Last Theorem - Simon Singh

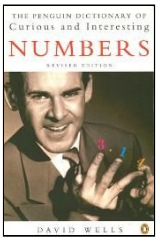


Does God Play Dice - Ian Stewart

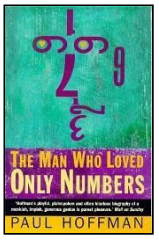
A Beautiful Mind - Sylvia Nasar



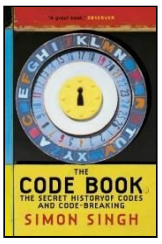
17 Equations that Changed the World – Ian Stewart



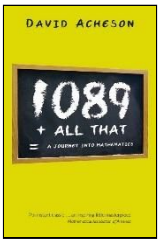
The Penguin Book of Curious and Interesting Numbers - David Wells



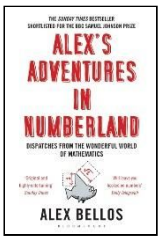
The Man Who Loved Only Numbers – Paul Hoffman



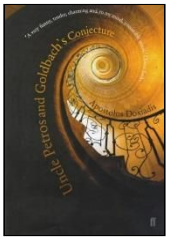
The Code Book - Simon Singh



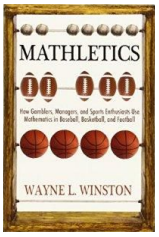
1089 And All That - David Acheson



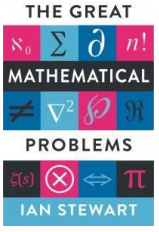
Alex's Adventures in Numberland – Alex Bellos



Uncle Petros and Goldbach's Conjecture - Apostolos Doxiadis



Mathletics – Wayne L Winston



The Great Mathematical Problems – Ian Stewart