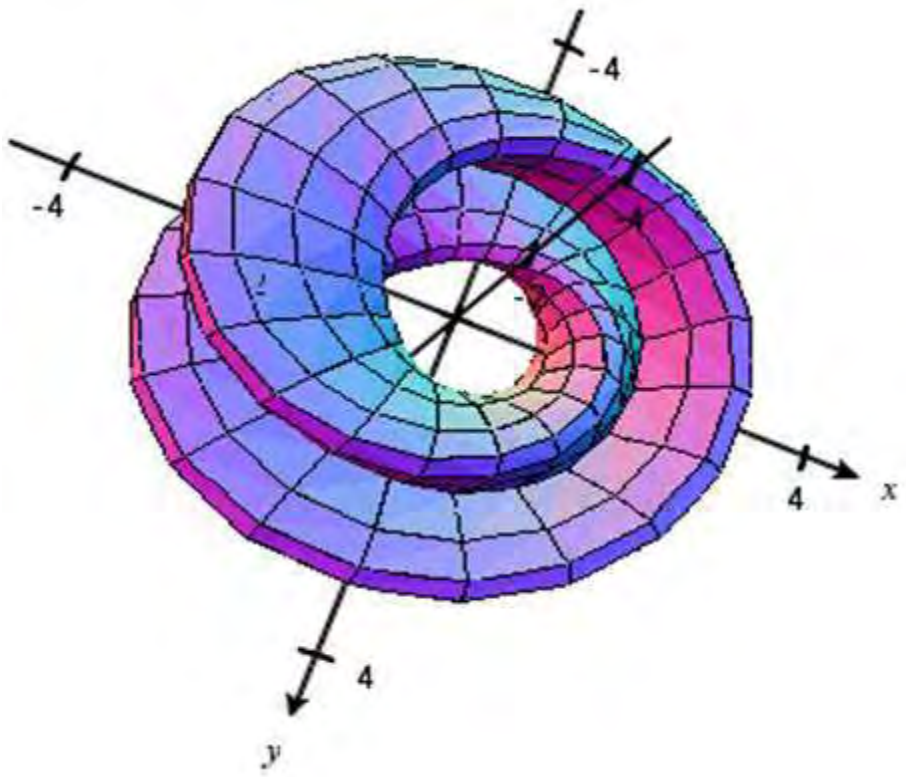
Coloma Sixth Form

Mathematics



Pure Mathematics is the poetry of logical ideas

Specification

The aims and objectives of this qualification are to enable you to:

● understand Mathematics and mathematical processes in a way that promotes confidence, fosters enjoyment and provides a strong foundation for progress to further study

● extend your range of mathematical skills and techniques

● understand coherence and progression in Mathematics and how different areas of Mathematics are connected

● use your mathematical skills and techniques to solve challenging problems that require them to decide on the solution strategy

● represent situations mathematically and understand the relationship between problems in context and mathematical models that may be applied to solve them

● interpret solutions and communicate your interpretation effectively in the context of the problem

● read and comprehend mathematical arguments, including justifications of methods and formulae, and communicate your understanding

● take increasing responsibility for your own learning and the evaluation of your own mathematical development.

Qualification at a glance

Content and assessment overview

The Pearson Edexcel Level 3 Advanced GCE in Mathematics consists of three externally-examined papers.

Students must complete all assessment in May/June in any single year.

Paper 1: Pure Mathematics 1 (*Paper code: 9MA0/01) **Paper 2: Pure Mathematics 2 (*Paper code: 9MA0/02)**
Each paper is: ***2-hour written examination*** ***33.33% of the qualification*** ***100 marks***
Content overview • Topic 1 – Proof • Topic 2 – Algebra and functions • Topic 3 – Coordinate geometry in the (x, y) plane • Topic 4 – Sequences and series • Topic 5 – Trigonometry • Topic 6 – Exponentials and logarithms • Topic 7 – Differentiation • Topic 8 – Integration • Topic 9 – Numerical methods • Topic 10 – Vectors
Assessment overview • Paper 1 and Paper 2 may contain questions on any topics from the Pure Mathematics content. • Students must answer all questions. • Calculators can be used in the assessment.

Paper 3: Statistics and Mechanics (*Paper code: 9MA0/03)
2-hour written examination ***33.33% of the qualification*** ***100 marks***
Content overview **Section A: Statistics** • Topic 1 – Statistical sampling • Topic 2 – Data presentation and interpretation • Topic 3 – Probability • Topic 4 – Statistical distributions • Topic 5 – Statistical hypothesis testing **Section B: Mechanics** • Topic 6 – Quantities and units in mechanics • Topic 7 – Kinematics • Topic 9 – Forces and Newton's laws • Topic 9 – Moments
Assessment overview • Paper 3 will contain questions on topics from the Statistics content in Section A and Mechanics content in Section B. • Students must answer all questions. • Calculators can be used in the assessment.

What could this qualification lead to?

Maths graduates are very popular with many employers, who value the analytical and problem-solving skills which you develop during your studies as well as the subject knowledge you can bring to a future job. In addition many Maths graduates go on to further study for an MSc or PhD.

Mathematicians work in

- business (for example, in logistics, financial analysis, market research, management consultancy or operational research)
- finance industry (in banking, insurance, pensions, accountancy or actuarial work)
- IT (in systems analysis or research); in the civil service (as scientists or statisticians)
- medicine (as medical or pharmaceutical researchers or as statisticians)
- engineering industry (in aerospace, building design, transport planning or telecommunications)
- scientific jobs (in biotechnology, meteorology, oceanography or research and development)
- and, of course, as teachers.

Relevant Links to Websites

- https://www.thecompleteuniversityguide.co.uk/courses/mathematics/5-reasons-why-you-should-study-mathematics/
- https://successatschool.org/advicedetails/186/Why-Study-Maths%3F

Summer Work

As Mathematicians, manipulation of numbers and expressions is a crucial skill and so try to solve the questions in Section 1 without a calculator.

Section 1

Evaluate the following

1. $2-\left(-\frac{7}{6}\right)$

2. $\left(-\frac{11}{9}\right)+\left(-\frac{19}{11}\right)$

3. $4\frac{2}{3}\times 7\frac{1}{6}$

4. $\frac{5}{4}-\frac{6}{7}\div\frac{3}{14}$

Write as a single fraction

5. $\frac{2x}{3}-\frac{x-1}{5}$

6. Simplify $\frac{x^2+x-6}{x^2-6x+8}$

Simplify the following expression

7. $3m(9+7m)-6(5-8m)$

Solve each equation

8. $\frac{9+r}{20} = 1$

9. $1 - \frac{2(x+4)}{3} = -7$

10. $5 - 3(x + 6) = 2(x + 4)$

Find each product, and simplify

11. $(6p - 1)(7p + 4)$

12. $(2d - 4)^2$

13 (x + 2)(x – 3)(x + 5)

Solve the following inequalities

14. $1 < \frac{x-1}{4}$

15. $-4 \geq -9 - \frac{9x}{3}$

Factorise fully each of the following:

16. $x^2 - 2x - 35$

17. $x^2 - 9x + 20$

18. $75x^2 - 3y^2$

Solve the following equations

19. $(x - 7)(2x + 3) = 0$

20. $2x^2 - 5x + 2 = 0$

21. $x^2 = 3x + 28$

Simplify the following

22. $\frac{6x^2+15x}{3x}$

23. $\frac{x^3}{(3x^4)^2}$

24. $9x^4\left(\frac{5}{3x}\right)^{-2}$

25. $\left(\frac{8}{27}\right)^{\frac{2}{3}}$

Make **t** the subject of the following formulae

26. $r = 5t^2 + 4$

27. $3w + 5 = \frac{7}{t}$

28. $q = 7\left(\sqrt[3]{\frac{t}{5}}\right)$

Find the gradient of the following lines

29. $y = 7x - 6$

30. $4 - 5x = y$

31. $2x + 3y = 10$

32. $y - 3 = 0$

33. Find the line <u>perpendicular</u> to 2x + 3y = 6, that passes through the point (4, 7).

34. Add (2 +3 $\sqrt{5}$) to (3 - $\sqrt{5}$).

35. Simplify 4($\sqrt{5}$ -3$\sqrt{2}$) + 2(3$\sqrt{5}$ + $\sqrt{2}$)

36. Simplify (3+ $\sqrt{7}$)^2.

37. Simplify by rationalising the denominator

$$\frac{2+\sqrt{3}}{\sqrt{3}}$$

38. Simplify by rationalising the denominator

$$\frac{2-\sqrt{3}}{1+\sqrt{3}}$$

Section 2

Activity 1

Proof

In A Level Maths you will meet a variety of different types of proof. The following 'proof', however, is a paradox. We think we know that 2 is not equal to 1, so why does this appear to prove otherwise?

A Proof that 1=2

Start with two equal numbers A & B

$$A = B$$

$$A^2 = AB$$

$$A^2 - B^2 = AB - B^2$$

$$(A - B)(A + B) = B(A - B)$$

$$A + B = B$$

$$B + B = B$$

$$2B = B$$

$$2 = 1$$

Write one of the statements from the list below on the left of each line of the proof.

Cancel the common factor on both sides

Multiply both sides by A

Factorise each side

Simplify

State that A and B are equal

Substitute A = B from step 1 and simplify

Divide both sides by B

Subtract B^2 from both sides

Substitute A = B (as stated at the beginning) and simplify

Now answer the following questions:

- What is the incorrect process?
- Why is it incorrect?
- Find another example of a mathematical paradox, or another 'proof' that 2=1 and include it with the rest of your work.

Activity 2

Have a look at the question below and for each option from (a) to (d), explain which will work and why. Do any of them not work, or do any work with only particular integers? Investigate!

Let r and s be integers.
Then the following product of powers

$$\frac{6^{r+s} \times 12^{r-s}}{8^r \times 9^{r+2s}}$$

is an integer if :

(a) $r + s \leq 0$

(b) $s \leq 0$

(c) $r \leq 0$

(d) $r \geq s$

Activity 3

The four digit number 2652 is such that any two consecutive digits from it make a multiple of 13. Another number N has the same property, is 100 digits long and begins in a 9. What is the last digit of N?

Choose one of the following options, explaining clearly how you reached your answer.

a) 2
b) 3
c) 6
d) 9

Activity 4

Complete the following activity, showing any working out that you do very clearly on paper.

Each line is a set of equivalent fractions.
Fill in the blanks in the fractions to make each line complete, including the multiplier used to get from one fraction to the next.

(1) $\frac{1}{\sqrt{2}}\left(\times \_\_\_\_\right) = \frac{\sqrt{2}}{\_\_\_\_}\left(\times \_\_\_\_\right) = \frac{\sqrt{6}}{\_\_\_\_}\left(\times \_\_\_\_\right) = \frac{\_\_\_\_}{6}$

(2) $\frac{2}{5\sqrt{3}}\left(\times \_\_\_\_\right) = \frac{\_\_\_\_}{15}\left(\times \_\_\_\_\right) = \frac{2\sqrt{6}}{\_\_\_\_}\left(\times \_\_\_\_\right) = \frac{\_\_\_\_}{60}$

(3) $\frac{5}{2+\sqrt{2}}\left(\times \_\_\_\_\right) = \frac{10-5\sqrt{2}}{\_\_\_\_}\left(\times \_\_\_\_\right) = \frac{\_\_\_\_}{20+10\sqrt{2}}$

(4) $\frac{2-\sqrt{3}}{4}\left(\times \_\_\_\_\right) = \frac{\_\_\_\_}{8+4\sqrt{3}}\left(\times \_\_\_\_\right) = \frac{\_\_\_\_}{16}$

Activity 5

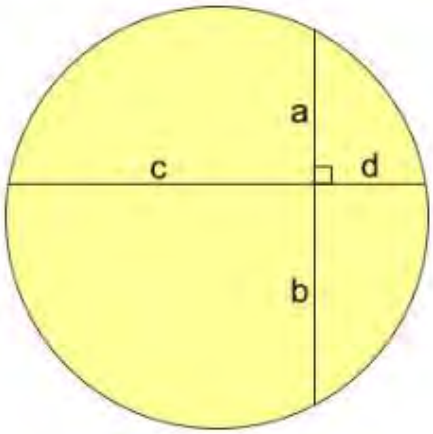
The Final Question

What is a Fields medal and who is Maryam Mirzakhani?

A Level Further Maths Preparation

Attempt each of these three problems. All the knowledge you need, you knew at GCSE. The key is can you select the correct knowledge required to solve each problem – this is a skill that is crucial for studying Further Maths! Write your answers, together with lots of lovely working and clear explanations, on paper ready to hand in during your first maths lesson.

Can you solve them and describe ways in which each might be connected to one or both of the others?

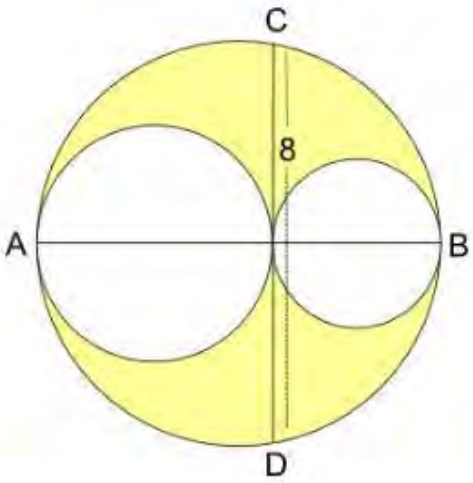


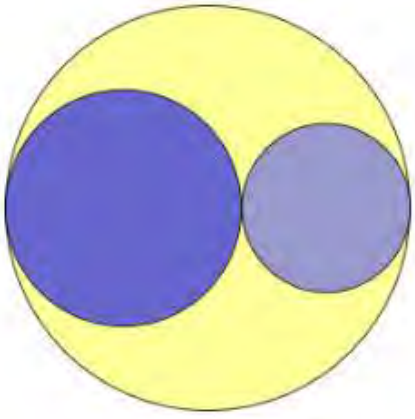
Firstly :

Why does ab = cd?

Secondly:

These three circles are drawn so that they touch each other and their centres are all on the line AB.
If CD is 8 units in length, what is the area of the part that is shaded yellow?

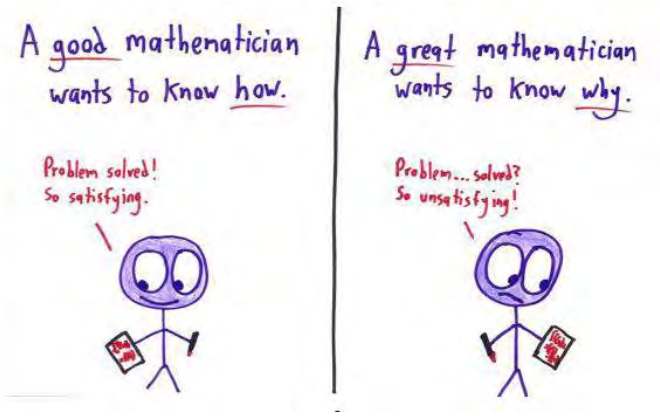




Lastly:

If the area shaded yellow is equal to the area of the larger of the two circles that are shaded blue, what is the relationship between the radii of the three circles?

Working with formulae



An A* Mathematician….

Knows the formula

Knows how to apply the formula

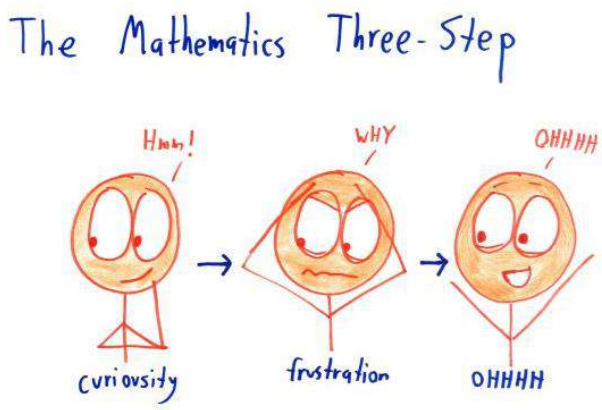
Knows why the formula works

Knows when it can be applied

Knows how to interpret the outcome

Knows the review-consolidate-check process will ensure understanding

Analysing a problem



Can sort and order the available information

Can identify connections and patterns, whether numerical algebraic or geometrical

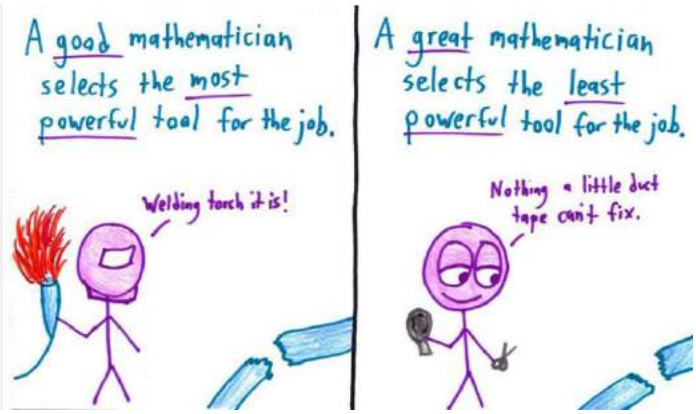
Can determine what form the final outcome will take

Can break down the task in to a series of intermediate stages

Can identify the appropriate process at each stage

Can get stuck but will persevere until 'the light bulb' moment

Carrying out the task



Uses concise, precise mathematical notation and language

Uses the most efficient method

Uses rigorous methods of proof

Uses feedback to hone their practice

Uses deliberate practice to develop their skills –a specific drill to achieve a specific skill

Uses their curiosity and enjoys a challenge

Extra Suggestions for the Summer

Films ***Enjoy popcorn and Maths at the same time! Fantastic!***

The Man Who Knew Infinity
A 2015 British biographical drama film about the Indian Mathematician Srinivasa Ramanujan based on the 1991 book of the same name by Robert Kanigel.

The Imitation Game
During World War 2 Mathematician Alan Turing (Benedict Cumberbatch) tries to crack the Enigma code with help from fellow Mathematicians.

Good Will Hunting
A maths genius is forced to see a therapist in order to avoid going to jail.

A Beautiful Mind
This is based on the life of Nobel Prize winner John Nash, an Economist and Mathematician.

Hidden figures
The story of a team of female African-American Mathematicians who served a vital role in NASA during the early years of the US space program.

Podcasts

The Infinite Monkey Cage
http://www.bbc.co.uk/podcasts/series/timc
If you chose the episode 'Randomness, Probability and Chance' then you hear Professor Brian Cox make a mess of adding numbers up to 7 as well as Tim Minchin singing about probability.

A Brief History of Mathematics
http://www.bbc.co.uk/podcasts/series/maths
This is a series of ten 15 minute podcasts about different mathematicians starting with Newton and finishing with Nicolas Bourbaki, 'the mathematician that never was'.

Reading

Letters to a Young Mathematician by Ian Stewart
So why do people study Mathematics; what is it like to study Mathematics beyond school? This book gives useful answers to these questions.

The Man who loved only Numbers by Paul Hoffman
The story of the mathematician Paul Erdos, his delight in numbers and the joy of beautiful proofs that he described as being like glimpsing a peek over the shoulder of the Supreme Being at 'The Book'.

Other books/films/ websites are available. Look up Rob Eastaway, Matt Parker, Simon Singh, or Marcus du Sautoy … **Let your teacher know what we should recommend next year!**