INTRODUCTION

Maths is beautiful and amazing - a fascinating subject in its own right. It is also one of the biggest facilitating subjects and essential for many higher education courses and careers.

There are three overarching themes to A-level maths:
- ✓ Mathematical argument, language and proof
- ✓ Mathematical problem solving
- ✓ Mathematical modelling

Mathematical modelling and problem solving are used in a whole range of real-life applications and having these skills is hugely desirable.

"Demand for mathematical expertise across a wide range of subjects is booming: in addition to perennial demand for first-rate mathematical talent from financial markets, developing fields such as AI and machine learning, genomics, autonomous vehicle development, robotics, data science, the digital economy and many others are creating highly paid jobs for appropriately skilled people."

— The Bond Report, House of Lords, 2018
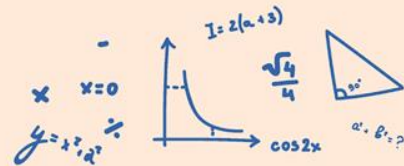
DID YOU KNOW..?

Every Premier league club and many in the lower leagues employ Mathematicians as statistical analysts. For example, Liverpool employ 56 statisticians and Manchester City has 11 analysts as far back as 2016.

The computer generated images (cgi) that are now an essential part of movies and computer games would be impossible without the underlying mathematics. Neither would the design process which lies at the heart of almost everything you buy or use these days.

Mathematical modelling is used extensively by team GB to improve the performance of the cyclists by altering the design of the machines.

AQA A Level GCE in Mathematics

Entry Requirements

In addition to meeting the requirements to study A-levels, you need a grade 6 or higher in GCSE Maths.

Why do AS level?

You will sit the AS level at the end of Year 12. This will give you invaluable experience in taking A-level exams. Students who prepare well for these exams go on to do well in the A-level exams in Year 13.

How is the AS course assessed?

There are two written exams each lasting 90 minutes. Each exam is 50% of the AS level. Paper 1 covers questions on pure maths and mechanics. Paper 2 is on pure maths and statistics.

The papers use a mix of question styles, from short, single mark questions to multi-step problems.

All AS content can be examined again in the A-level exams.

How is the A-level course assessed?

There are three written exams each lasting 2 hours. All exams have equal weighting. Paper 1 covers questions on pure maths; paper 2 is on pure maths and mechanics; paper 3 covers pure maths and statistics.

As at AS level, the papers use a mix of question styles, from short, single mark questions to multi-step problems.

The Teachers...

I love Mechanics, cooking and travelling!
Fun fact: I am very fond of creative projects

I am interested in Pure and Statistics and their use in real-life.
Fun fact: I am a passionate cyclist!

Mr Coyle: teaches Pure and Statistics (Year 13)
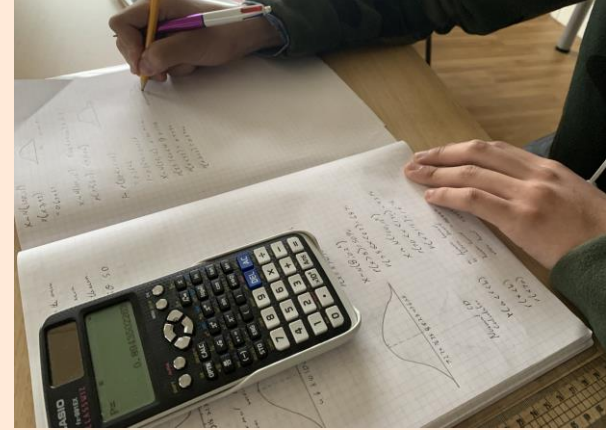
Mrs Lijo: teaches Mechanics (Year 12 and Year 13)

Mrs Mac: teaches Pure and Statistics (Year 12)

I always look for better ways to teach and find A level maths very interesting.
Fun fact: I speak 5 languages and have 5 degrees but I am not a nerd!

The places... 6ᵗʰ Form Building 6F1

What pupils say...

I chose maths because I enjoy the challenge of the subject. I am able to push myself and, if you put in the effort, it opens up so many opportunities in the future.

The work in lessons extends well from the work I did at GCSE. It adds on to the work I have done without feeling repetitive.

Isaac Year 12

I really enjoy maths, particularly pure maths. There is a different way of learning in maths as there is lots of problem solving and you have to try and understand the topics for yourself.

There are always topics that you like more and find easier and topics that are more challenging.

If you genuinely like maths and like to challenge yourself then Maths is a great option.

Kathryn Year 12

Maths is a subject that you need to be passionate about. If you aren't then you will find that it gets a lot more abstract and challenging.

Celestine Year 13

Maths can be challenging but I find it satisfying when I put in the effort and succeed.

I am happy having chosen Maths A-level as it has helped me better understand mathematical concepts in other subjects.

Evie Year 13

I chose maths because I realised the number of degrees and careers it could lead into.

At times I thought that I should have chosen History instead but even though I am studying a completely different subject at university, I do not regret choosing to get a qualification in A-level Maths.

Leeford Year 13

Previous results...

Headlines AS/A	2017 Exams	2018 Exams	2019 Exams
Average grade	C	C+	B-
A*- B	36% (4)	37.5% (3)	62.5%
A*- E	91% (10)	100% (8)	100%

Typical lesson... we picked something you all can have a go at!

|	
CLICK To see examples	✍ **Retrieval starter**: targeted questions referring to skills/knowledge pupils were taught previously.
	✍ Outcomes explained
CLICK To see examples	✍ **Introduction of a new knowledge** using example pairs
CLICK To see examples	✍ **Your go** at questions using whiteboards
	✍ Discussion about misconceptions (when/if needed)
CLICK To see examples	✍ **Independent work** (self-marking or teacher marking)
	✍ Homework- every lesson

END

Examples:
Retrieval Starter:

Pure

Starter
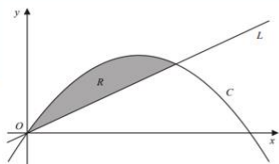
In the diagram above the curve C has equation $y = 6x - x^2$ and the line L has equation $y = 2x$.

(a) Show that the curve C intersects the x-axis at $x = 0$ and $x = 6$.

(1)

(b) Show that the line L intersects the curve C at the points $(0, 0)$ and $(4, 8)$.

(3)

The region R, bounded by the curve C and the line L, is shown shaded in the diagram above.

(c) Use calculus to find the area of R.

(6)
(Total 10 marks)

Mechanics

RETRIEVAL STARTER

Three forces $F_1 = 2i - 3j$, $F_2 = 5j$ and $F_3 = 2i + 8j$ act on a particle (i and j are perpendicular).
Find the angle of the resultant force with i

Blocks A (15kg) and B(20kg) are attached to the ends of an inextensible string which hang over a smooth pulley. The blocks are released from rest, calculate the acceleration of block A.

A puck of mass 2kg is initially moving with a speed of 4ms^{-1} and glides to rest over a distance of 20m. Assuming that the force of resistance is constant, calculate the magnitude of the resistive force.

A particle moves in a straight line and the distance from P is given by $r = 3t^3 + \frac{3}{2}t^2 - 2t + 4$. Calculate the acceleration when the particle is a rest.

Statistics

Starter:

The events A and B are such that $P(A) = \frac{2}{5}$, $P(B) = \frac{1}{2}$ and $P(A \mid B') = \frac{4}{5}$

(a) Find

(i) $P(A \cap B')$, (ii) $P(A \cap B)$, (iii) $P(A \cup B)$,

(b) State, with a reason, whether or not A and B are

(i) mutually exclusive, (ii) independent.

From past records a manufacturer of ceramic plant pots knows that 20% of them will have defects. To monitor the production process, a random sample of 25 pots is checked each day and the number of pots with defects is recorded.

(a) Find the critical regions for a two-tailed test of the hypothesis that the probability that a plant pot has defects is 0.20. The probability of rejection in either tail should be as close as possible to 2.5%.

BACK

Worked Examples: fraction multiplication

Worked Example 1	**Reflective Process**	**Worked Example 2**	**Your Turn**

Worked Example 1

Simplify
$$\frac{2x^2+7x-15}{x^2-36} \times \frac{2x+12}{2x^3-3x^2}$$
fully.

$2x^2 + 7x - 15$
$= 2x^2 + 10x - 3x - 15$
$= 2x(x + 5) - 3(x + 5)$
$= (2x - 3)(x + 5)$

$x^2 - 36$
$= (x + 6)(x - 6)$

$2x + 12$
$= 2(x + 6)$

$2x^3 - 3x^2$
$= x^2(2x - 3)$

$$\frac{(2x-3)(x+5)}{(x+6)(x-6)} \times \frac{2(x+6)}{x^2(2x-3)}$$

$$\frac{2(x + 5)}{x^2(x - 6)}$$

Reflective Process

- Factorise the numerators (if you can)

- Factorise the denominators (if you can)

- Replace the expressions with their factorised versions

- Cancel the common factors

- Rewrite without the expressions that you have crossed out

BACK

Worked Example 2

Simplify
$$\frac{3x^2+8x+5}{x^2-25} \div \frac{3x^2+5x}{5x^2-25x}$$ fully.

$$\frac{3x^2 + 8x + 5}{x^2 - 25} \times \frac{5x^2 - 25x}{3x^2 + 5x}$$

$3x^2 + 8x + 5$
$= 3x^2 + 3x + 5x + 5$
$= 3x(x + 1) + 5(x + 1)$
$= (3x + 5)(x + 1)$

$x^2 - 25$
$= (x + 5)(x - 5)$

$5x^2 - 25x$
$= 5x(x - 5)$

$3x^2 + 5x$
$= x(3x + 5)$

$$\frac{(3x+5)(x+1)}{(x+5)(x-5)} \times \frac{5x(x-5)}{x(3x+5)}$$
Cancel the common factors
$$\frac{5(x + 1)}{(x + 5)}$$

Your Turn

Simplify
$$\frac{2x^2-17x+21}{x^2-49} \times \frac{5x^2+15x}{2x^2-3x}$$ fully.
FACTORISE EVERYTHING

$2x^2 - 17x + 21$
$= 2x^2 - 3x - 14x + 21$
$= x(2x - 3) - 7(2x - 3)$
$= (x - 7)(2x - 3)$

$x^2 - 49$
$= (x + 7)(x - 7)$

$5x^2 + 15x$
$= 5x(x + 3)$

$2x^2 - 3x$
$= x(2x - 3)$

Replace
$$\frac{(x-7)(2x-3)}{(x+7)(x-7)} \times \frac{5x(x+3)}{x(2x-3)}$$

Cancel the common factors
$$\frac{5(x + 3)}{(x + 7)}$$

Whiteboard Questions: Solving Quadratics

1
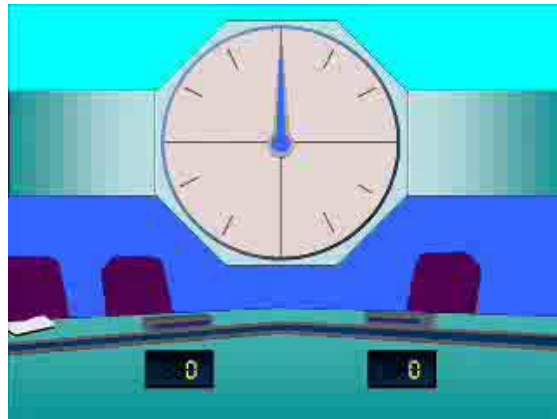
Find the solutions to the following quadratic equation:
$$x^2 + 5x + 6 = 0$$

a) $x = 2, 3$
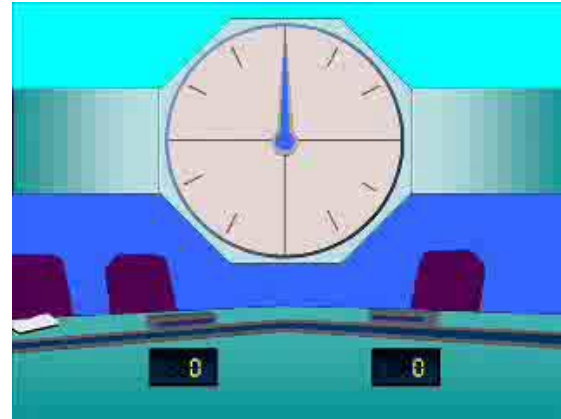
b) $x = 2, -3$

c) $x = -2, 3$

d) $x = -2, -3$

2

Find the solutions to the following quadratic equation:
$$4x^2 - 9 = 0$$

a) $x = \dfrac{3}{2}, -\dfrac{3}{2}$

b) $x = \dfrac{9}{4}$

c) $x = \dfrac{3}{2}$

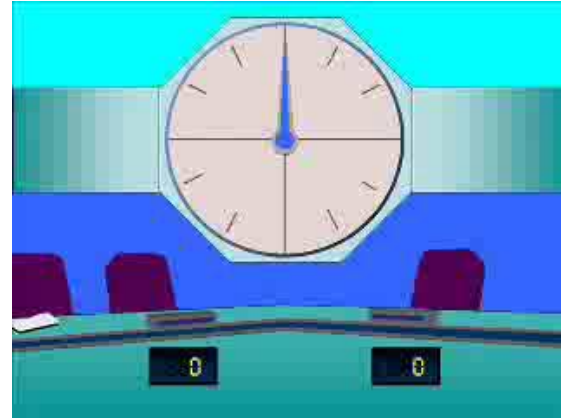d) $x = \dfrac{9}{4}, -\dfrac{9}{4}$

Click to see more

BACK

3

Find the solutions to the following quadratic equation:
$$3x^2 - 18 = 9$$

a) $x = 3$

b) $x = -3$

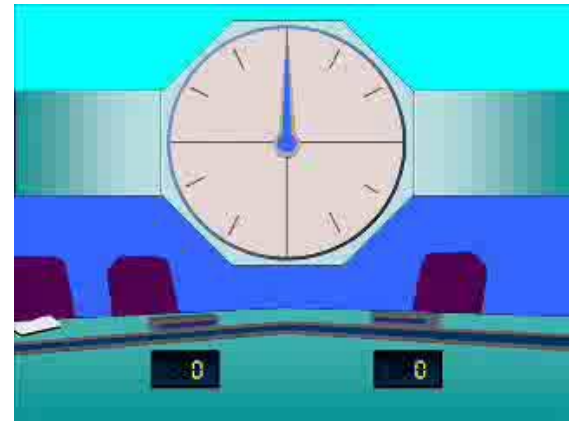c) $x = 3, -3$

d) $x = \sqrt{3}, -\sqrt{3}$

Click to see more

BACK

4

Find the solutions to the following quadratic equation:
$$5x^2 - 39x - 8 = 0$$

a) $x = -8, -\dfrac{1}{5}$

b) $x = 8, -\dfrac{1}{5}$
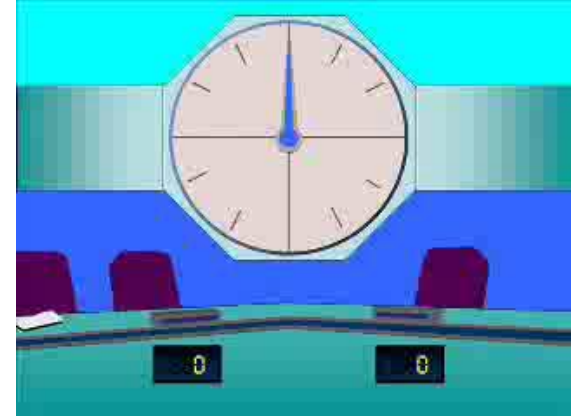
c) $x = 8, \dfrac{1}{5}$

d) $x = -8, \dfrac{1}{5}$

Click to see more

BACK

5

Here are two statements about the equation $(x - 3)^2 = 17$:

(1) The roots of the equations are real
(2) The roots of the equation are equal
Which of the following is true?

a) Neither statement is correct

b) Only statement (1) is correct

c) Only statement (2) is correct

d) Both statements are correct

BACK

Example:
Independent Work

Questions

Simplify the following as far as possible:

1) $\dfrac{6}{2xy} + \dfrac{2}{x}$ $\qquad$ $\color{red}\dfrac{2y+3}{xy}$

2) $\dfrac{6}{2xy} + \dfrac{2}{3x}$ $\qquad$ $\color{red}\dfrac{2y+9}{3xy}$

3) $\dfrac{6}{2xy} - \dfrac{2}{3x^2}$ $\qquad$ $\color{red}\dfrac{9x-2y}{3x^2y}$

4) $\dfrac{6y}{2xy} + \dfrac{2}{3x^2}$ $\qquad$ $\color{red}\dfrac{2+9x}{3x^2}$

5) $\dfrac{y}{2xy} - \dfrac{2}{3x^3}$ $\qquad$ $\color{red}\dfrac{3x^2-4}{6x^3}$

Simplify the following as far as possible:

1) $\dfrac{1}{x^2-4} - \dfrac{1}{x-2}$ $\qquad$ $\color{red}\dfrac{-x-1}{(x+2)(x-2)}$

2) $\dfrac{x}{x^2-4} - \dfrac{1}{x-2}$ $\qquad$ $\color{red}\dfrac{-2}{(x+2)(x-2)}$

3) $\dfrac{x}{x^2-x-2} - \dfrac{1}{x-2}$ $\qquad$ $\color{red}\dfrac{-1}{(x+1)(x-2)}$

4) $\dfrac{x-3}{x^2-x-2} - \dfrac{1}{x-2}$ $\qquad$ $\color{red}\dfrac{-4}{(x+1)(x-2)}$

5) $\dfrac{x-3}{x^2-x-2} - \dfrac{2x}{x-2}$ $\qquad$ $\color{red}\dfrac{-2x^2-x-3}{(x+1)(x-2)}$

Simplify the following as far as possible:

1) $\dfrac{2x+1}{x+4} - \dfrac{x-5}{x-2}$ $\qquad$ $\color{red}\dfrac{x^2-2x+18}{(x+4)(x-2)}$

2) $\dfrac{11x+27}{2x^2+11x-6} - \dfrac{3}{x+6}$ $\qquad$ $\color{red}\dfrac{5}{2x-1}$

Challenge- Express the following as a fraction in its simplest form:
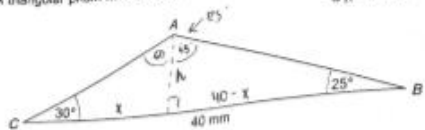
$\dfrac{3}{x-1} + \dfrac{2}{x+1} + \dfrac{4}{x-3}$ $\qquad$ $\color{red}\dfrac{9x^2-14x-7}{(x-1)(x+1)(x-3)}$

BACK

Example:
Pupils' Independent Work

Emma Putzer

5. A triangular prism has a cross section ABC as shown in the diagram below.

Angle $ABC = 25°$

Angle $ACB = 30°$

$BC = 40$ millimetres.

The length of the prism is 300 millimetres.

Calculate the volume of the prism, giving your answer to three significant figures.

[4 marks]

$V_{prism} = \left(\frac{1}{2} \times a \times h_a\right) \times h$

I $\tan(30°) = \frac{h}{x} \rightarrow h = \tan(30°) \times x$

II $\tan(25°) = \frac{h}{40-x} \rightarrow h = \tan(25°) \times (40-x)$

I = II $\tan(30°)x = 40\tan(25°) - x\tan(25°)$

$x(\tan(30°) + \tan(25°)) = 40\tan(25°)$

$x = 8.872049...$

$h = \tan(30°) \times 17.87...$

$h = 10.318432...$

$V = \frac{1}{2} \times 40 \times 10.3184... \times 300$

$= 61910.59616$

$\approx 61900 \text{ mm}^3$ ✓✓✓

Luke Hodgson

Andrea is the manager of a company which makes mobile phone chargers.

In the past, she had found that 12% of all chargers are faulty.

Andrea decides to move the manufacture of chargers to a different factory.

Andrea tests 60 of the new chargers and finds that 4 chargers are faulty.

Investigate, at the 10% level of significance, whether the proportion of faulty chargers has reduced.

[7 marks]

$H_0: P = 0.12$

$H_1: P < 0.12$ (one-tailed)

$X \sim B(60, 0.12)$

* Let X = number of faulty Chargers.
* Assuming H_0 is true:

$P(X \leq 4) = 0.13880846$ ✓

* Significance level is 0.1

as $P(X \leq 4) > 0.1$ ✓ there isn't sufficient evidence to reject H_0 for H_1.

Isaac Bates

9 A curve cuts the x-axis at (2, 0) and has gradient function

$$\frac{dy}{dx} = \frac{24}{x^3}$$

[4 marks]

9 (a) Find the equation of the curve.

$\frac{dy}{dx} = 24x^{-3}$ dx

$y = -12x^{-2} + c$

$0 = -12 \times 2^{-2} + c$

$0 = -3 + c$

$c = 3$

$y = -12x^{-2} + 3$