Sixth Form
Kineton High School

A Level Maths
Bridging Course

Congratulations on your choice to study Mathematics at A-level! Mathematics at A-level is both a demanding and rewarding course. The Mathematics Department at Kineton High School is committed to ensuring that you make good progress throughout your A-level course. To ensure that you make the best possible start to the course, we have prepared this booklet.

It is <u>vitally important</u> that you spend time working through all sections of this booklet over the summer, including the initial questions and the PiXL Gateway Pack - you will need to have a good knowledge of these topics <u>before</u> you commence your course in September. You should have met all the topics before at GCSE (there is nothing new here!). There are 6 sections in this booklet covering what we deem to be the basic skills required to start your A-level course on the best footing. As a result, if you find that you are struggling with a particular section or set of questions, you must seek to independently review this area of mathematics using the sources of information detailed in this booklet or your own GCSE notes/ revision guides/web resources. For each topic there are video numbers – these correspond to videos on the Corbett Maths website (www.corbettmaths.com/contents) which has help videos to explain each topic in detail.

During your first maths lesson in September, the work completed from this booklet must be handed to your class teacher.

Any pupil who has not completed this work over the summer, having had the opportunity to do so, is unlikely to have the level of commitment required in order to succeed in A-level maths.

We hope that you will use this introduction to give you a good start to your A-level work and that it will help you enjoy and benefit from the course.

You may find the following websites useful:

https://www.corbettmaths.com/contents
Revision videos (specific video numbers given at the start of each topic in this booklet)

http://www.hegartymaths.com/
Revision videos

http://www.themathsteacher.com/index.php
Revision videos and worksheets

http://www.bbc.co.uk/schools/gcsebitesize/maths/
Information, videos and online tests

http://www.khanacademy.org/exercisedashboard
Revision videos and online questions

<u>CONTENTS</u>

1. Quadratics (videos 10, 118, 119, 120, 266, 267 & 267a)

You need to be confident when factorising quadratic expressions and solving quadratic equations. Some of the methods that you may have been introduced to during your GCSE course include:

- Factorising expressions of the form $ax^2 + bx + c$ (for cases where a = 1 <u>and</u> a ≠ 1)
- Completing the square
- The quadratic formula
- Difference of two squares.

The following questions require application of the above skills.

<u>Section 1</u>

Factorise the following:

a) $x^2 + 8x + 15$
b) $x^2 + 8x + 7$
c) $x^2 + 9x + 20$
d) $x^2 - 6x + 5$
e) $x^2 - 2x + 1$
f) $x^2 + 3x - 18$
g) $x^2 - x - 12$

<u>Section 2</u>

Factorise the following:

a) $x^2 - 100$
b) $x^2 - 36$
c) $w^2 - 2500$
d) $y^2 - 144$
e) $10,000 - a^2$
f) $(x+1)^2 - 4$

Section 3

Factorise the following:

a) $5x^2 + 16x + 3$

b) $2x^2 + 11x + 5$

c) $3x^2 + 4x + 1$

d) $8x^2 + 6x + 1$

e) $6x^2 + 13x + 6$

f) $5x^2 - 7x + 2$

g) $3x^2 - 10x - 8$

h) $2x^2 + 7xy + 5y^2$

Section 4

Complete the square on the following:

a) $x^2 + 4x + 5$

b) $x^2 + 8x + 17$

c) $x^2 + 10x - 20$

d) $x^2 - 6x + 11$

e) $x^2 - 20x + 80$

f) $x^2 - 26x - 1$

g) $x^2 - x + 1$

h) $x^2 + 5x - 5$

Section 5

Use any of the above methods of factorisation or the quadratic formula to solve the following quadratics. Where necessary, give answers to 3 significant figures.

a) $2x^2 - 108 = 0$

b) $2k^2 - 11k + 5 = 0$

c) $4m^2 - 4m = 3$

d) $(2n - 1)(3n + 2) = 24$

e) $x^2 - 5x - 8 = 0$

f) $10x^2 - 5x - 4 = 0$

g) $2w^2 + 5w - 3 = 0$

h) $3(x + 2)^2 - 3x(x + 2) = 0$

4

2. Simultaneous equations (videos 295 & 298)

At GCSE you will have met two methods of solving simultaneous equations (elimination and substitution). You must know how to use the substitution method of solving simultaneous equations as this method can also be used for solving non-linear simultaneous equations.

<u>Section 1</u>

Solve the following linear simultaneous equations:

a) $8x + 3y = 57$ and $6x + 3y = 51$
b) $6x + 7y = 32$ and $11x + 7y = 47$
c) $12x - 4y = 132$ and $20x - 4y = 228$
d) $3x - y = 30$ and $3x + 2y = 21$
e) $12y - 7x = -77$ and $-8y - 7x = -77$
f) $4x - 3y = 14$ and $2x + 2y = -7$
g) $3x + 2y = 11$ and $2x - 5y = 1$
h) $5x + 4y = 5$ and $3x - 5y = -34$
i) $7x - 2y = 13$ and $4x - 3y = 13$
j) $4x - 3y = 5$ and $2x + 2y = -1$

<u>Section 2</u>

Solve the following simultaneous equations (one is linear and one is quadratic):

a) $x^2 + y = 6$ and $y = x$
b) $x^2 - 2y = 2$ and $y = x + 3$
c) $x^2 + 4y = 7$ and $2y + x = 2$
d) $y = 3x^2 - 2$ and $y = 3 - 2x$
e) $y = 3 - x^2$ and $y = 5 - 3x$
f) $2y = 4x^2 - 7$ and $y = 6x$

3. Indices (videos 173, 174 & 175)

At GCSE, you will have dealt with different types of powers including positive integers, fractional and negative powers.

Section 1

Re-write the following in fractional form (that do not contain indices), without using a calculator:

a) $4^{-2} =$ b) $6^{-3} =$ c) $9^{\frac{1}{2}} =$

d) $27^{\frac{1}{3}} =$ e) $16^{\frac{3}{4}} =$ f) $4^{\frac{5}{2}} =$

Section 2

Find the value of x, without using a calculator:

a) $3^x = \frac{1}{81}$ b) $17^x = \frac{1}{17}$ c) $125^x = 5$

d) $a^x = \frac{1}{a^3}$ e) $\sqrt{m} = m^x$ f) $\frac{1}{p^2} = p^x$

g) $\sqrt[3]{q} = q^x$ h) $\sqrt[3]{q^2} = q^x$ i) $\sqrt[5]{q^2} = q^x$

Section 3

a) Express $81^{-\frac{1}{2}}$ as a fraction in the form $\frac{a}{b}$, where a and b are integers.
b) Simplify $a^6 \div a^2$
c) Find the value of y for which $2 \times 4^y = 64$

4. Algebraic fractions (videos 21 & 24)

Work done on adding, subtracting, multiplying and dividing numerical fractions is built upon at A-level through the use of algebraic fractions. You will need skills from the previous section in order to answer the following questions.

<u>Section 1</u>
Simplify fully:

a) $\dfrac{x^2+3x}{x+3}$

b) $\dfrac{2x-4x^2}{2x-1}$

c) $\dfrac{x^2+4x+3}{x^2+5x+6}$

d) $\dfrac{2x^2-8}{x^2+4x+4}$

e) $\dfrac{2x^2+5x+3}{3x^2+5x+2}$

f) $\dfrac{16-x^2}{x-4}$

<u>Section 2</u>
Write as a single fraction in its simplest form:

a) $\dfrac{3}{10x}+\dfrac{4}{10x}$

b) $\dfrac{x}{5}+\dfrac{2x}{15}$

c) $\dfrac{x}{2}-\dfrac{x}{8}$

d) $\dfrac{1}{x+2}+\dfrac{1}{x+3}$

e) $\dfrac{4}{x+2}-\dfrac{3}{x+1}$

f) $\dfrac{1}{2x-1}-\dfrac{1}{2x+3}$

g) Factorise x^2+3x+2

Write $\dfrac{1}{x+2}+\dfrac{1}{x^2+3x+2}$ as a single fraction in its simplest form.

h) Factorise $2x^2-3x+1$

Write $\dfrac{2}{2x-1}+\dfrac{1}{2x^2-3x+1}$ as a single fraction in its simplest form.

i) Write $\dfrac{1}{2x+6}+\dfrac{1}{x^2+4x+3}$ as a single fraction in its simplest form.

5. Straight lines (videos 12, 87, 88, 191, 194, 195, 196 & 197)

From GCSE you should be familiar with:
- Finding the midpoint of a line segment
- The gradient and y intercept of a straight line
- The equation of a straight line ($y = mx + c$)
- The relationships between parallel and perpendicular lines
- Finding the distance between two points/length of a line segment.

The following exercise will review some of these skills.

<u>Section 1</u>

Work out the midpoint of the line joining:

a) (2, 3) and (7, 11)
b) (0, 0) and (2, 4)
c) (-3, 5) and (0, 1)
d) (-1, -4) and (6, 3)

<u>Section 2</u>

a) A line passes through the point (0, 5) and has gradient 2. Write down the equation of this line.
b) Find the gradient and the y intercept of the following lines:
    i. $y = 4x + 1$
    ii. $y = 3x - 4$
    iii. $4x - 3y = 12$
    iv. $2x + 5y = 20$
    v. $x - 2y = 0$
c) A line passes through the points with coordinates (1, 3) and (2, 8). Find the equation of the line.
d) The gradient of a line is 3. The point (4, 2) lies on the line. Find the equation of the line.

Section 3

a) Find the equation of a line that is parallel to the line with equation
 $y = 4x – 1$ which passes through the point (0, 3).

b) Find the equation of a line that is parallel to the line with equation
   $2x + y = 4$ which passes through the origin.

c) Find the equation of a line that is perpendicular to the line with equation
   $y = \frac{1}{4}x$ which passes through the point (2, -8).

d) Find the equation of a line that is parallel to the line with equation
   $y + x = 10$ which passes through the point (-2, -5).

Section 4

Work out the length of the line joining each of these pairs of points:

a) (3, 1) and (11, 7)
b) (2, 5) and (12, 29)
c) (-6, 9) and (8, 13)
d) (9, -15) and (-11, 6)
e) A circle has centre point O(4, 2). The point A (9, 14) lies on the circle.

   i) Work out the radius of the circle.

   ii) Which of the following points also lie on the circle?

   (16, 7)   (-1, -10)   (7, 16)   (4, 15)

6. Pythagoras' theorem and trigonometry (videos 257, 259 & 330 – 337)

At GCSE you will have covered Pythagoras in both 2D and 3D and used both right angled trigonometry (SOH CAH TOA) as well as non-right angled trigonometry (sine rule and cosine rules). At A-level this will be built upon mainly by giving the problems a more contextual basis to be solved from.
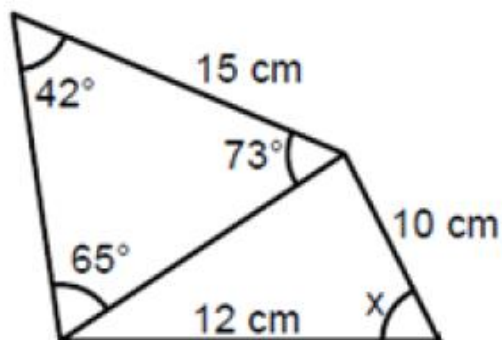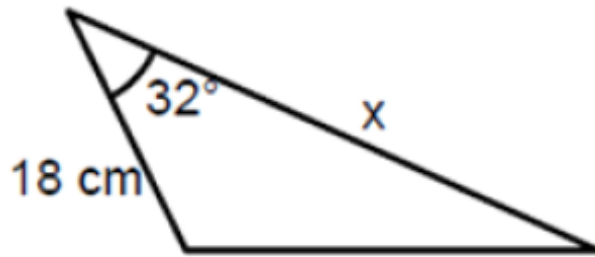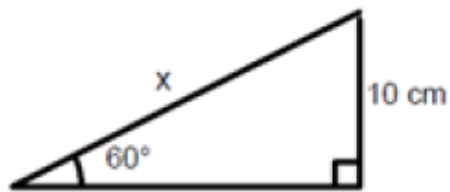
a) Calculate the length of AB.

10.5 cm

15 cm

12 cm

A

B

b) Calculate the length of AB.

B

4 cm

6 cm

A   15 cm
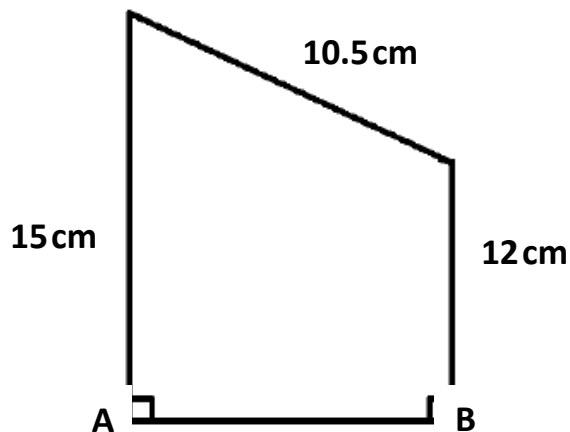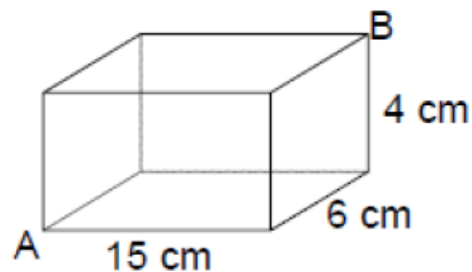
c) Calculate the value of x.

15 cm

42°

73°

10 cm

65°

12 cm   x
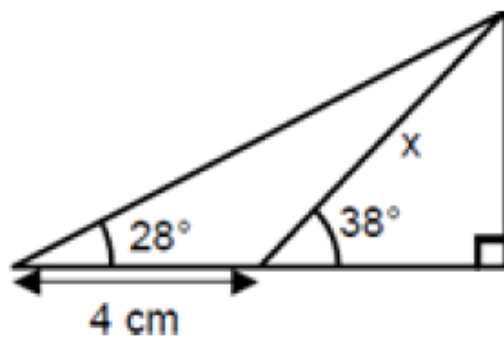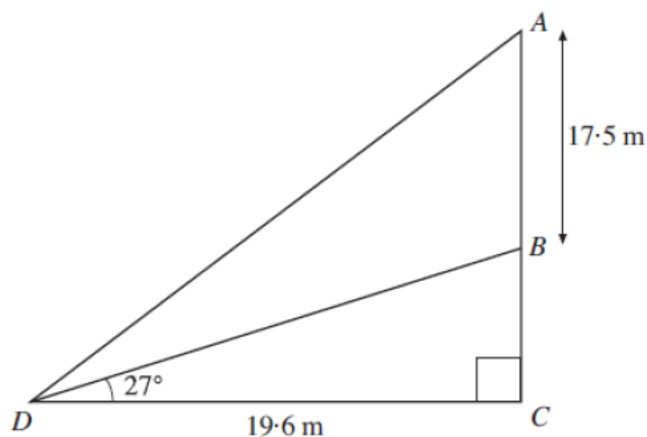
d) The area of the triangle is 182.2cm². Find the value of x.

e) Calculate the value of x.

f) Find the value of x.

g) In the following diagram, AB = 17.5m, DC = 19.6m, BDC = 27º, DCA = 90º. Calculate the size of angle ADC.

h) Calculate the value of x.
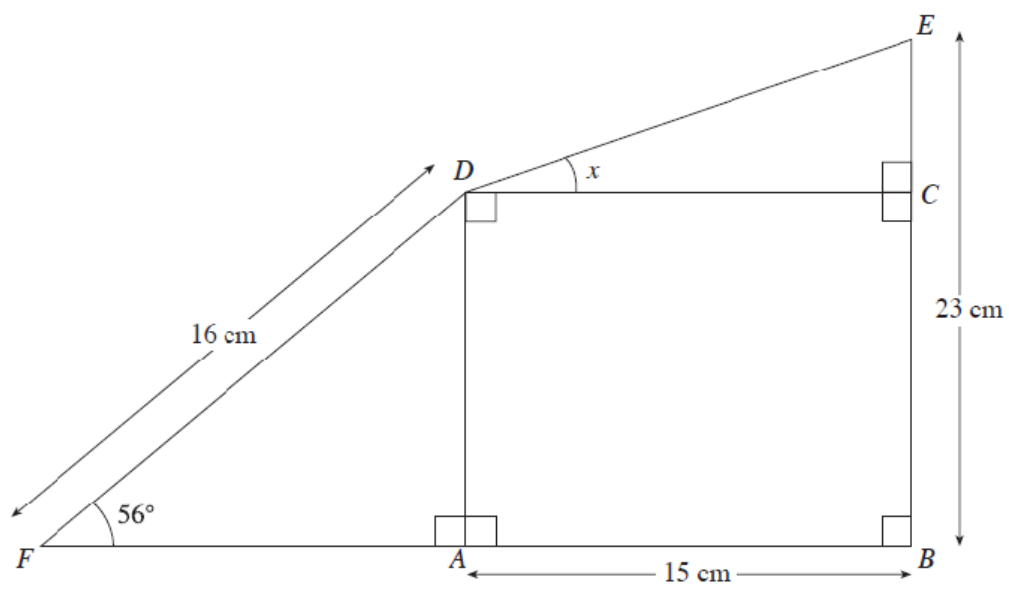
PiXL Independence:

PiXL Gateway: Progression - Maths

Contents:

I.   RAG

II.   Basic Skills Check

III.   Problem Solving

IV.   Extra Practice

V.   Exciting and Interesting Bits!

VI.   RAG

I. RAG

For each of the following topics RAG rate yourself based on what you know from GCSE. Then complete the booklet and redo at the end. Having a secure understanding of these topics will mean that you are in the best possible position to start your A Level course.

Topic	Red	Amber	Green
Solving quadratics			
Changing the subject			
Simultaneous equations			
Surds			
Indices			
Properties of lines			
Sketching curves			
Transformations of functions			
Pythagoras			
Sine/Cosine Rule			
Inequalities			
Proof			
Vectors			
Probability			

Basic Skills Check

1. Expand the brackets $(2x - 4)(-4 + x)$

2. Given $f(x) = x^2 + 5x - 2$ find the value of $f(4)$
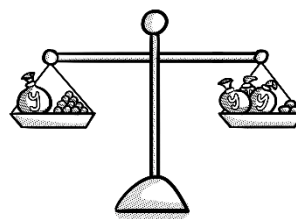
3. Solve the simultaneous equations.
$$3x - 4y = 20$$
$$5x + 5y = 10$$

4. Solve each of these equations.

   (i) $4x - 3 = 15$ (ii) $\dfrac{y}{3} + 4 = 9$

   (iii) $5m - 8 = 2m + 13$

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

6. Express $\dfrac{1 + \sqrt{2}}{3 - \sqrt{2}}$ in the form $a + b\sqrt{2}$ where a and b are rational.

7. Simplify $\dfrac{(x^2 y^3 z)^5}{4y^2 z}$

8. A $(0,2)$, B $(7,9)$ and C $(6,10)$ are three points.

   (i) Show that AB and BC are perpendicular.
   (ii) Find the length of AC.

9. Sketch the graph of $y = 9 - x^2$

10. The curve $y = x^2 - 4$ is translated by $\binom{2}{0}$

    Write down an equation for the translated curve. You need not simplify your answer.

11. Given that $\cos\theta = \dfrac{1}{3}$ and θ is acute, find the exact value of $\tan\theta$.

12. Solve

    (i) $x^2 - 36 \leq 0$

    (ii) $9x^2 - 25 \geq 0$

    (iii) $3x^2 + 10x < 0$

13. Prove that the square of an odd number is also odd.

14. Caleb either walks to school or travels by bus. The probability that
he walks to school is 0.75
If he walks to school, the probability that he will be late is 0.3 If he
travels to school by bus, the probability that he will be late is 0.1
Work out the probability that he will not be late.

Problem Solving

1. Two numbers have a product of 44 and a mean of 7.5

   Use an algebraic method to find the numbers.

   You must show all your working.

2. In a parallel circuit, the total resistance is given by the
formula

   $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

   Make R_1 the subject of the formula

3. Sarah intended to spend exactly £6.00 on prizes for her class but each prize cost her 10p
more than expected, so she had to buy 5 fewer prizes.
Calculate the cost of each prize.

4. Arthur and Florence are going to the theatre.
Arthur buys 6 adult tickets and 2 child tickets and pays £39 Florence
buys 5 adult tickets and 3 child tickets and pays £36.50 Work out
the costs of both adult and child tickets.

5. Colin has made a mistake in his 'simplifying surds' homework. Explain his error and give the correct answer.

$$4\sqrt{3} \times 5\sqrt{12} = 20\sqrt{36}$$

6. Below is a sketch of (x).

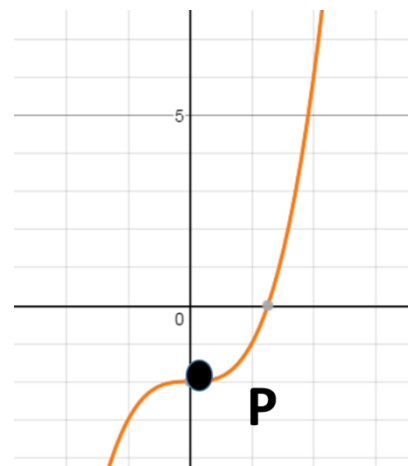   The coordinates of P are (0,-2)

   State the coordinates of P after each translation:

   (i) $g(x) = f(x) + 1$

   (ii) $h(x) = f(x - 2)$

   (iii) $j(x) = -f(x)$

   (iv) $k(x) = f(-x)$

7. The equation of a curve is $y = (x)$ where $(x) = x^2 - 4x + 5$ C is the minimum point of the curve.
   (i)   Find the coordinates of C after the transformation $f(x + 1) + 2$

   (ii)   Determine if $(x - 3) - 1 = 0$ has any real roots.
   Give reasons for your answer.

8. A piece of land is the shape of an isosceles triangle with sides 7.5m, 7.5m and 11m.
   Turf can be bought for £11.99 per 5m² roll.
   How much will it cost to turf the piece of land?

9. Plane A is flying directly toward the airport which is 20 miles away. The pilot notices a second plane, B, 45° to her right. Plane B is also flying directly towards the airport. The pilot of plane B calculates that plane A is 50° to his left. Based on that information how far is plane B from the airport? Give your answer to 3 significant figures.

10. A farmer has a triangular field. He knows one side measures 450m and another 320m. The angle between these two sides measures 80°. The farmer wishes to use a fertiliser that costs £3.95 per container which covers 1500m². How much will it cost to use the fertiliser on this field?

11. Katie chooses a two-digit number, where the digits are different, reverses the digits, and subtracts the smaller number from the larger.

    For example

    42 – 24 = 18

    She tries several different numbers and finds the answer is never a prime number.
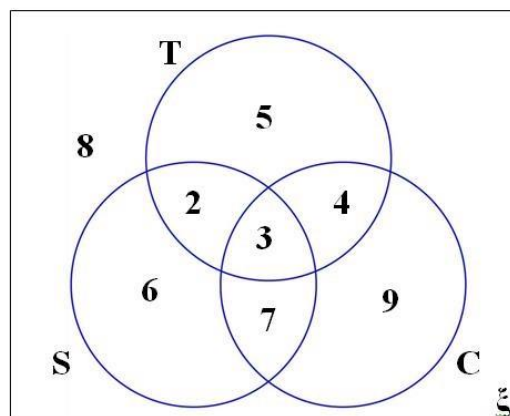
    Prove that Katie can never get an answer that is a prime number.

12. The Venn diagram shows the ice-cream flavours chosen by a group of 44 children at a party.

    The choices are strawberry (S), choc-chip (C) and toffee (T). A child is picked at random.

Work out :

   (i) $P(S)$
   (ii) $P(T \cap C|C)$
   (iii) $P(C|S \cup T)$

Extra Practice

1. **Exam style practice.** For each of the topics you should watch the video, and then answer the exam questions and mark your answers. Where have you made mistakes? Is there something you need to do more work on?

   Algebraic fractions http://www.mathsgenie.co.uk/algebraic-fractions.html
   http://www.mathsgenie.co.uk/resources/algebraic-fractions.pdf

   Forming equations http://www.mathsgenie.co.uk/forming-and-solving-equations.html
   http://www.mathsgenie.co.uk/resources/64_forming-and-solving-equations.pdf

2. **Complete 30 questions from the 'quadratics' section on completing the square and factorising.**
   http://www.kangaroomaths.com/kenny4.php?page=Kmathsinfinity

3. **Watch the video and then complete the tasks at the end.**
   https://library.leeds.ac.uk/skills-algebra

4. **Complete the A Level transition questions.**
   https://gryphonmaths.wordpress.com/a-level/transition/task-1/

5. **Underground Mathematics**
   This resource is FULL of lots of tasks and challenges. If you are feeling less confident with a topic then use the '*building block'*. If you want more of a challenge then carry out one of the '*fluency exercise'*.
   https://undergroundmathematics.org/

Exciting and Interesting Bits!

Below are some articles and videos to view.

These are all going to extend your understanding of maths in the real world.

1. **Follow the 'WATCH, THINK, DIG DEEPER, DISCUSS'** The Wizard standoff riddle.
   https://ed.ted.com/lessons/can-you-solve-the-wizard-standoff-riddle-daniel-finkel

2. **Follow the 'WATCH, THINK, DIG DEEPER, DISCUSS'** Solve the false positive riddle.
   https://ed.ted.com/lessons/can-you-solve-the-false-positive-riddle-alex-gendler

3. **Read the notes on the page and carry out the algebraic investigation. Complete the worksheet included.**
   https://www.teachmathematics.net/page/7566/oxo

4. **Create a PINTREST board with images of maths in nature. Investigate the maths behind some of the images you have found.**

5. **Maths Magic.**
   Can you create your own version of the problem? Investigate other magic tricks which are based around maths.
   https://nrich.maths.org/1051

6. **Golden Ratio Day**
   Golden ratio day is 1st June 2018. Investigate the golden ratio and its history.
   https://www.teachengineering.org/activities/view/nyu_phi_activity1
   https://www.quora.com/How-is-the-golden-ratio-useful-to-students
   Find more articles on this and create a poster all about the golden ratio.

7. **Complete module 1- Advanced Problem Solving** https://nrich.maths.org/10209

RAG

Complete a RAG rating for the key topics from this booklet. Remember if you are still unsure on any of these topics then try the MathsApp for further help and support. GOOD LUCK!

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Solving quadratics			
Changing the subject			
Simultaneous equations			
Surds			
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Properties of lines			
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Transformations of functions			
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