A – Level Mathematics

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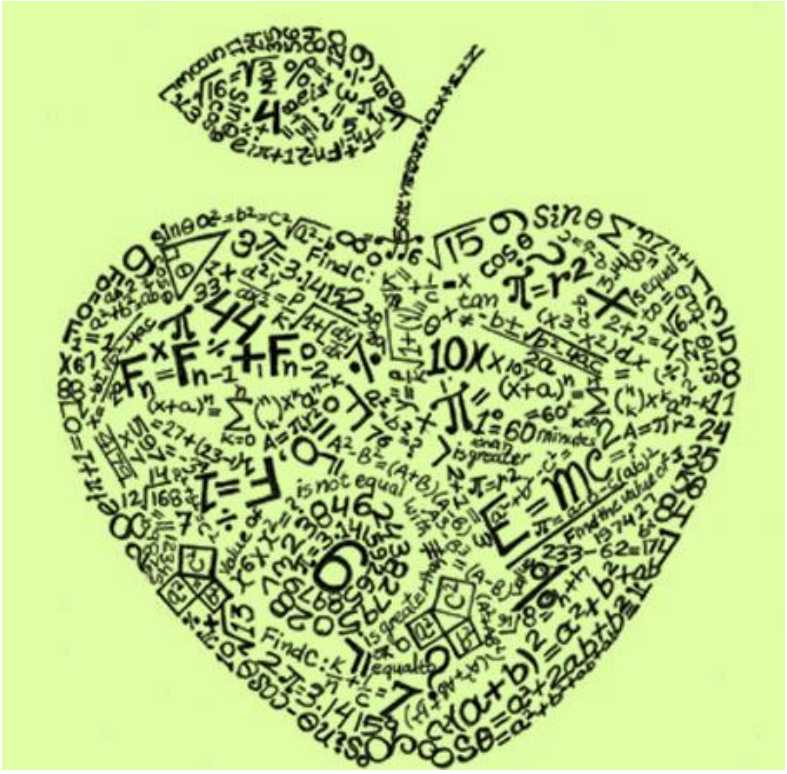
Further Mathematics



GCSE to A-Level Booklet

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Preparatory Work

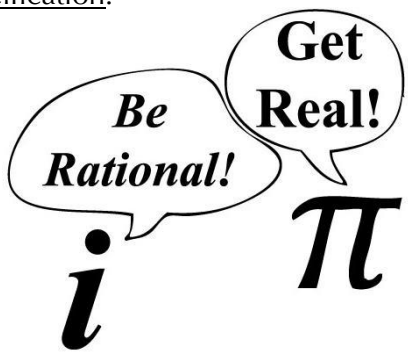
Introduction to this Booklet

A section on Firefly has been created so that you can access more details about all of the information referred to in this booklet and the solutions to the questions provided. Any item underlined can be found on Firefly, including a copy of this booklet.

To access this information, go to Firefly, click on Maths in the subject list and then A-level in the side bar list on the left. This will give you the option to select Course Content, Fifth into Sixth or useful websites.

On the following pages you will find a summary of the two courses, some compulsory preparatory work to complete before September and suggested reading and challenge work. There is a log sheet at the end of the booklet for you to keep a record of the work you have completed.

The A-Level Mathematics and Further Mathematics courses are offered by Edexcel. A summary of the contents of these courses will be provided in this booklet, but you may wish to see the full details in the specification.



A-Level Mathematics

A-level Mathematics has been newly reformed this year and students must now take three 2 hour examinations at the end of the two year course. Each paper is equally weighted and counts as a third of a student's overall mark. Two papers come under the heading of Pure Mathematics which covers a range of topics, all with a strong algebraic content. The final paper is a Statistics and Mechanics examination. This exam will be split into 2 sections: section A on Statistics and section B on Mechanics. Each section is worth 50 marks and all questions must be answered. A calculator is permitted in every examination and a formulae and statistics booklet is provided to be used.

Exam Overview

A-Level Mathematics - Course code 9MA0			
Paper	**Time**	**Marks**	**% of Qualification**
Pure Mathematics 1	2 hours	100 marks	33.3%
Pure Mathematics 2	2 hours	100 marks	33.3%
Statistics and Mechanics	2 hours	100 marks	33.3%

Preparatory Work for A-Level Mathematics

In Mathematics, plenty of practice will be the key to success. Your algebra skills will be particularly important for success, particularly in the two Pure examinations which count as two thirds of the qualification. After completing each section of questions you must mark your work to ensure that you have fully understood the topic and make corrections if necessary. Extension work is also available to help you prepare for the other AS modules you will be studying later in the year. A log sheet has been provided at the end of this booklet, which you should fill in after you have completed any of the compulsory or extension work.

Further Mathematics

Further Mathematics has also been reformed this year and similar to A-level Mathematics all of the examinations occur at the end of the 2 year course. Further Mathematics differs from A-Level Mathematics in that a student will sit four exams each of 1.5 hours. Two exams are compulsory: Core Pure Mathematics 1 and Core Pure Mathematics 2 (please note these are different to the two Pure Mathematics examinations in A-level Mathematics and cover different content). The first optional examination for Further Mathematics can be chosen from a list of four different topics: Further Pure Mathematics 1, Further Statistics 1, Further Mechanics 1 and Decision Mathematics 1. The selection for the second optional examination is dependent on the first optional examination. A calculator is permitted in all examinations and a formulae and statistics booklet is provided to be used.

Exam Overview

A-Level Further Mathematics - Course code 9FM0				
Paper	**Compulsory/Optional**	**Time**	**Marks**	**% of Qualification**
Core Pure Mathematics 1	Compulsory	1.5 hours	75 marks	25%
Core Pure Mathematics 2	Compulsory	1.5 hours	75 marks	25%
Further Pure Mathematics 1	Option 1	1.5 hours	75 marks	25%
Further Statistics 1	Option 1 or 2	1.5 hours	75 marks	25%
Further Mechanics 1	Option 1 or 2	1.5 hours	75 marks	25%
Decision Mathematics 1	Option 1	1.5 hours	75 marks	25%
Further Pure Mathematics 2	Option 2	1.5 hours	75 marks	25%
Further Statistics 2	Option 2	1.5 hours	75 marks	25%
Further Mechanics 2	Option 1	1.5 hours	75 marks	25%
Decision Mathematics 2	Option 2	1.5 hours	75 marks	25%

Preparatory Work for Further Mathematics

Further Mathematics is a very demanding A-Level, but it will be less challenging if you can start the course with strong algebra skills. In order to best prepare you for the demands of the course, you will be expected to complete all of the compulsory and extension preparatory work provided for the A-Level Mathematics in this booklet. It is important that you check your work using the solutions and record it on the log sheet. There is also voluntary extension work provided for the Further Mathematics A-Level.

Completing the Log sheet

Working independently is an essential skill in order to succeed at A Level and University. The step up to A-Level from GCSE is a large one which requires you to develop the skills of research and self-motivation. The compulsory tasks you have been set are directly relevant to your topics of study and will enable you to be competent. The extension tasks are designed to extend and develop your knowledge. Our experience shows that those girls who begin to work independently gain better grades at A-Level so start NOW!

You must record all work completed on the log sheet at the end of this booklet and mark your work using the solutions found on Firefly in the Fifth into Sixth section of A-Level Maths. An example entry has been done for you below.

Date	**Task / Research done / completed.**
6th July 2017	Completed, marked and corrected the compulsory solving equations questions – 82% correct.

01- Linear Equations

Solve the following linear equations.

1. $7x + 9 = 2x - 19$
2. $21 - 8x = 3x - 13$
3. $5(3x + 7) = 20$
4. $4(1 - 2x) = 3(2 - x)$
5. $28 - 3(2x - 4) = 7x + 2(5x - 3)$
6. $\frac{x}{7} = 6$
7. $\frac{3}{4} = \frac{2x}{3}$
8. $\frac{2x}{3} + \frac{4}{5} = \frac{1}{2}$
9. $\frac{3x}{5} - \frac{2x}{7} = \frac{1}{2}$
10. $\frac{2x+1}{6} + \frac{3x-5}{10} = 2$
11. $\frac{2(3x-4)}{3} - \frac{3(5x-2)}{7} = 2$
12. $\frac{7}{x} = 21$
13. $\frac{5}{x} = 3$
14. $\frac{12}{2x-3} = 4$
15. $\frac{7}{x+5} = \frac{10}{3x-2}$

Compulsory

02- Simultaneous Equations

1. Solve the following simultaneous equations.

a) $2x + 5y = 24$, $4x + 3y = 20$

b) $3x + y = 11$, $9x + 2y = 28$

c) $2x - 3y = 1$, $5x + 9y = 19$

d) $9x + 5y = 15$, $3x - 2y = -6$

e) $2x + 7y = 17$, $5x + 3y = -1$

f) $3x + 2y = 7$, $2x - 3y = -4$

g) $5x - 7y = 27$, $3x - 4y = 16$

h) $8x + 3y = -17$, $7x - 4y = 5$

i) $3x + 4y = 7$, $2x = 5 - 3y$

j) $7x = 23 - 2y$, $3x - 4 = 5y$

Compulsory

Simultaneous equations can be used to solve problems – for each of the following form a pair of simultaneous equations and solve.

2. The line $y = mx + c$ passes through (2, 5) and (4, 13). Find m and c.

3. A stone is thrown into the air and its height, h metres above the ground, is given by the equation

$h = at - bt^2$

From an experiment we know that h = 40 when t = 2 and that h = 45 when t = 3.

Show that: $a - 2b = 20$

$a - 3b = 15$.

Solve these equations to find a and b.

4. Three mp3 players and four mp4 players cost £720. Five mp3 players and two mp4 players cost £640. Find the cost of each type of player.

Extension

03- Substitution

1. If $x = -5$, $y = 2$ and $z = 3$, evaluate the following expressions:

a) $10 - x^2$

b) $(2x)^2 - 3y^2$

c) xy^2

d) $-7 - 2x$

e) $4xyz - \frac{xy}{4z}$

f) $\frac{(4y - z)^2}{(4y - z^2)}$

2. The volume of a box is given by $(x + 3)(2x - 1)(x - 4)$.

Find the volume if $x = 7$.

3. One of the equations of motion for constant acceleration is given as:

$v^2 = u^2 + 2as$ Find v if: u = 2.3, a = 0.8 and s = 28.6.

Compulsory

4. Evaluate the polynomial expression: $f(x) = x^3 + 3x^2 - 2x - 16$, when:

a) $x = 0$

b) $x = 1$

c) $x = -1$

d) $x = 2$

e) $x = -2$

f) $x = \frac{1}{2}$ *(Work in fractions)*.

Extension

04- Brackets and Algebraic Fractions

1. Expand and simplify the following:

a) $15 - (7 - x)$

b) $15 - 7(1 - x)$

c) $15 - 7(x - 1)$

d) $(2x - y) - x(1 + y)$

e) $x(a + b) - x(a + 3b)$

f) $2(5a + 3b) + 3(a - 2b)$

g) $-(4a + 5b - 3c) - 2(2a + 3b - 4c)$

h) $2x(x - 5) - x(x - 2) - 3x(x - 5)$

2. Expand and simplify

a) $(x + 9)(x - 2)$

b) $(7 + x)(2 + x)$

c) $(x + 2)x$

d) $(3x + 1)(x + 1)$

e) $(3x + 5)(2x + 7)$

f) $(5 - 3x)(x + 1)$

Compulsory

3. Expand and simplify the following triple brackets

a) $(s + 1)(s + 5)(s - 3)$

b) $(x + y)^3$

4. Simplify

a) $\frac{x}{4}+\frac{x}{7}$

b) $\frac{2x}{5}+\frac{x}{9}$

c) $\frac{2x}{3}-\frac{3x}{4}$

d) $\frac{x}{x+1}-\frac{2}{x+2}$

e) $\frac{x+1}{x}+\frac{3}{x+2}$

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

5. Simplify

a) $\frac{1}{x+2}+\frac{2}{x+3}$

b) $\frac{2}{x+3}+\frac{5}{x+1}$

c) $\frac{2}{2x+1}-\frac{3}{3x+2}$

d) $\frac{x+1}{x+3}+\frac{x+4}{x+2}$

e) $\frac{x-1}{x-3}+\frac{x-1}{(x-3)^2}$

Compulsory

6. Simplify the following:

a) $\frac{3}{x+2}\div\frac{x}{2x+4}$

b) $\frac{5}{2x+1}\div\frac{x}{3x-1}$

7. Simplify the following:

a) $\frac{5x}{25x+10y}$

b) $\frac{x+2}{x^2+3x+2}$

c) $\frac{x+2}{x^2+9x+20}\times\frac{x+5}{x+2}$

Extension

8. Express the following expression as a single fraction:

$$-\frac{6}{s+3}-\frac{4}{s+2}+\frac{3}{s+1}+2$$

05- Factorising Quadratics

Type 1: Taking out Common Factors

1. Factorise fully the following expressions:

a) $10x^2 - 5x$

b) $35x^2 + 14x$

c) $18a^2b^2x^2 + 27\pi ab^3x$

d) $\frac{1}{2}x^2 + \frac{1}{2}x$ (Remove Fractions from inside brackets)

e) $\frac{1}{2}x^2 + \frac{1}{8}x$

f) $\frac{ab^3}{4}x^2 + \frac{a^3b^2}{5}x$

Compulsory

Type 2: The Difference of Two Squares

2. Factorise fully the following expressions:

a) $x^2 - 25$

b) $x^2 - 16$

c) $4x^2 - 9$

d) $49x^2 - 121$

e) $5x^2 - 500$ (Hint take out a Common Factor first)

f) $28x^2 - 567$

Type 3(i): Two Brackets [Coefficient of x^2 is One]

3. Factorise fully the following expressions:

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

b) $x^2 + 8x + 15$

c) $x^2 - 5x + 6$

d) $x^2 - 12x + 35$

e) $x^2 + 4x - 12$

f) $x^2 + 7x - 30$

g) $x^2 - 5x - 6$

h) $x^2 - 3x - 40$

Type 3(ii): Two Brackets [Coefficient of x^2 is Prime]

4. Factorise fully the following expressions:

a) $2x^2 + 11x + 15$

b) $7x^2 - 72x + 20$

c) $3x^2 - 16x - 12$

d) $5x^2 + 11x - 12$

Compulsory

Type 3(iii): Two Brackets [Coefficient of x^2 is Non-Prime]

5. Factorise fully the following expressions:

a) $6x^2 + 17x + 12$

b) $36x^2 - 23x - 8$

c) $22x^2 - 111x + 54$

d) $60x^2 + 76x - 105$

Extension

06- Quadratic Equations

1. Solve the following by factorising where necessary.

a) $(x-3)(x-5)=0$

b) $10(x+2)(3x-5)=0$

c) $2\pi(3x-4\pi)(\pi x+\sqrt{2})=0$

d) $x^2+7x+10=0$

e) $x^2-4x-21=0$

f) $x^2-11x+30=0$

g) $x^2+7x-18=0$

h) $x^2-49=0$

i) $x^2-5x=0$

j) $3x^2-75=0$

k) $6x^2+9x=0$

l) $14=x^2+5x$

m) $6-5x=x^2$

n) $x(x+10)=-21$

Compulsory

2. Solve the following by factorising.

a) $2x^2+7x+3=0$

b) $2x^2-3x-2=0$

c) $3x^2+10x-8=0$

d) $4x^2-29x+7=0$

e) $10x^2-x-3=0$

f) $4x^2-3x-10=0$

Compulsory

3. Solve the following, giving answers to two decimal places.

a) $2x^2 + 6x + 3 = 0$

b) $x^2 + 4x + 1 = 0$

c) $5x^2 - 5x + 1 = 0$

d) $2x^2 + 5x - 1 = 0$

e) $3x^2 - x - 6 = 0$

f) $x^2 - 2 - 3x = 0$

g) $2 - x - 6x^2 = 0$

h) $4x + 3 - 2x^2 = 0$

Compulsory

4. Solve the following, giving answers to two decimal places where necessary.

a) $6x(x+1) = 5 - x$

b) $(x+1)^2 - 10 = 2x(x-2)$

c) $x = \frac{15}{x} - 22$

d) $x + 5 = \frac{14}{x}$

e) $\frac{2}{x} + \frac{2}{x+1} = 3$

f) $\frac{3}{x-1} + \frac{3}{x+1} = 4$

Extension

Using quadratic equations to solve problems – for each of the following form a quadratic equation and then solve.

5. The perimeter of a rectangle is 42 cm. If the diagonal is 15 cm find the width of the rectangle.

6. The length of a rectangle is 1 metre more than its width. Its area is $9m^2$. Find the dimensions of the rectangle to 3 s.f.

7. An increase of speed of 4 km/h on a journey of 32 km reduces the time taken by 4 hours. Find the original speed.

07- Rearranging Formulae

Section 1

Compulsory

Make the letter in brackets the subject of the following:

1. $a = k + 3t$ [t]

2. $y = mx + c$ [c]

3. $p = \frac{t}{4} - r$ [t]

4. $r^2 = s^2 + 2tv$ [v]

5. $a = 2b\sqrt{t} - y$ [t]

6. $y = \frac{3k}{r}$ [k]

7. $y = x^2 - 2$ [x]

8. $f = \left(\frac{p}{5}\right)^2$ [p]

Section 2

Extension

9. $3y = 4 - 2x$ [x]

10. $k = r - m\sqrt{p}$ [p]

11. $t = \frac{x}{y} + 4$ [y]

12. $f = 3(g - h)$ [h]

13. $T = r - \frac{5}{k}$ [k]

Section 3

14. $3x + 2y = r - kx$ [x]

15. $4m - 3n = rn - pm$ [m]

16. $4m - 3n = rn - pm$ [n]

17. $4m - 3n = rn - pm$ [p]

18. $k = \frac{t + 2}{t - 5}$ [t]

19. $3r = \frac{d + p}{f - d}$ [d]

20. $\frac{1}{x} + \frac{1}{y} = \frac{1}{z}$ [x]

08- Co-ordinate Geometry

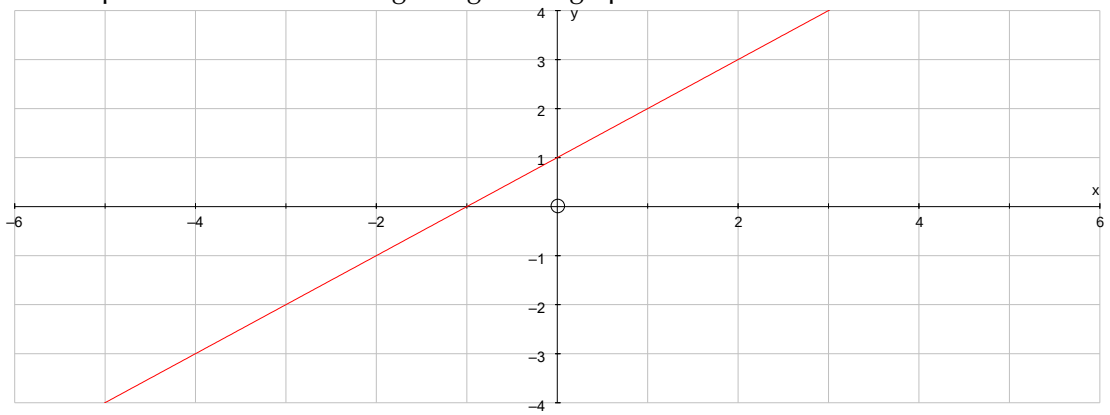
EQUATION OF A STRAIGHT LINE $y = mx + c$

Question 1

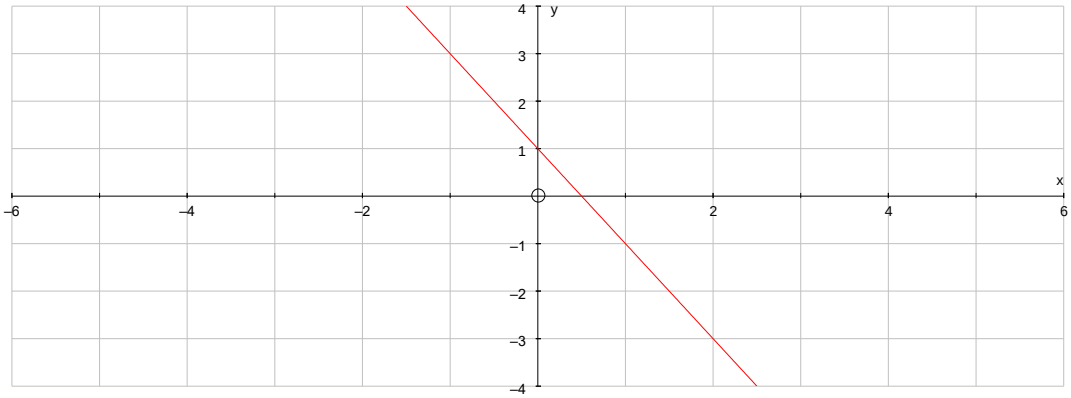
Compulsory

Find the equations of the following straight line graph.

a.



b.



Question 2.

a. Find the gradient of the line given by the equation $2x + y = 7$.

b. Find the gradient and y-intercept of the line given by the equation $3x + 2y = 4$.

c. Write down three lines that are parallel to the line $y = 7x - 3$

Question 3.

a. What can you say about the gradients of the lines:
$y = 4x + 1$ and $y = -0.25x + 5$?

b. Find the line perpendicular to $y = 3x - 1$, which passes through the point (6, 8).

c. Sketch the following three lines on graph paper.

$y = 2x + 2$ $\quad$ $y = -0.5x + 4$ $\quad$ $x + y = 8$

Show that the triangle that you have made is a right-angle triangle

Extension

09- Inequalities

1. Solve the following linear inequalities:

a) $x-9>2$
b) $3x+7>12$
c) $4-2x<6$
d) $\frac{(7+2x)}{3}\geq 9$
e) $\frac{(8-3x)}{4}\leq -1$
f) $7x+6<3x-4$
g) $4(x-3)\geq 9(2x-1)$
h) $-7<3x-2<4$

Compulsory

2. Solve the following quadratic inequalities:

a) $x^2>9$
b) $x^2\leq 4$
c) $x^2-3x\geq 0$
d) $x^2+6x<0$
e) $(x+3)(x-5)>0$
f) $(x-2)^2>0$
g) $x^2+2x-15>0$
h) $x^2-10x+24\leq 0$

Extension

10- Indices *Do these questions without a calculator*

1. In each case simplify the expression:

i) $x^4\times x^9$ ii) $y^{-4}\times y^2\times y^{-7}$ iii) $4x^3\times 5x^4\times 3y^{-2}$

2. In each case simplify the expression:

i) $x^8\div x^5$ ii) $y^4\div y^{-8}$ iii) $\frac{x^4\times x^9}{x^3}$ iv) $\frac{12x^7y^{-4}}{4x^2y^3}$

3. In each case simplify the expression:

i) $(x^3)^5$ ii) $(2y^3)^4$ iii) $(2x^2y^{-5})^3$

Compulsory

4. Find the value of each of the following, simplifying your answer as far as possible:

i) $16^{\frac{1}{2}}$ ii) 3^{-3} iii) $25^{\frac{3}{2}}$ iv) $\left(\frac{3}{4}\right)^{-2}$

v) $6\times 2^{-1}\times 3^7$ *give your answer as a power of 3*

5. Write each expression as a power of x:

i) $\frac{1}{x^4}$ ii) $\frac{1}{\sqrt{x}}$ iii) $\sqrt{x}\times\sqrt{x}\times x^{\frac{3}{2}}$ iv) $\frac{x^2\times x^{-3}}{\sqrt{x}}$

6. Write each of these in fraction form:

i) $6x^{-1}$ ii) $4x^{-7}$ iii) $\frac{5}{6}x^{-3}$

7. Change each fraction to index form:

i) $\frac{7}{x^8}$ ii) $\frac{4}{3x}$ iii) $\frac{2}{3x^9}$

8. Write each answer as a single power of 3:

i) $3^2 \times 3^4$ ii) $3^8 \div 3^{1/2}$ iii) $(3^4)^2 \times 3^{-5}$

9. Evaluate each of the following where ***a = 4, b = 25, c = 8, d = 9***

i) $a^{1/2}b^{3/2}$ iv) $\left(\frac{a}{b}\right)^{-1}$

ii) $c^{1/3}d^{1/2}$ v) $\left(\frac{a}{d}\right)^{-0.5}$

iii) $\left(\frac{a}{b}\right)^{1/2}$

Extension

10. Simplify and write each answer in Standard Form:

i) $(4.2\times10^3)\times(5\times10^6)$ iii) $\frac{4.5\times10^9}{1.5\times10^7}$

ii) $(6.5\times10^8)\times(4\times10^{-3})$ iv) $\frac{3\times10^4}{6\times10^{-6}}$

Extension Work for Further Mathematics Students

An excellent introduction to the broad range of topics you will encounter in Further Mathematics can be found in the book, 'Fermat's Last Theorem' by Simon Singh. I highly recommend reading this if you would like a more challenging activity before starting the course in September. You should then be able to explain the joke on the first page of this booklet. Imaginary numbers and proof by induction are particularly relevant to the first module you will be studying.

Log Sheet for A-Level Mathematics and Further Mathematics

Name: _____

Date	Task / Research done / completed.

Log Sheet for A-Level Mathematics and Further Mathematics

Name: _____

Date	Task / Research done / completed.