The Ashcombe 6th Form
Y11 into Y12 – #OneStepAhead

FURTHER MATHS

Pre-A level Preparation

Welcome to A Level Further Maths. We're really glad you've signed up. This document will give you some ideas about what you can do to prepare really well for success at A level Further Maths. Before you read this document, please refer to #OneStepAhead Maths as that gives you an overview of what we expect for all maths A level courses. If you are choosing Further Maths, we believe that you could not make a better choice! BUT - it is not an easy option, you will need to love wrestling with difficult problems, have the confidence to try a variety of approaches and expect to get stuck on a regular basis. On the plus side, almost half of your timetable will be some form of Maths – if you think that's an exciting statement, you're going to enjoy Further Maths.

Preparing for Success

Summer Workbook

As part of the induction day, we will run a taster session and will issue you with a Summer Workbook. This is compulsory pre-course work, which you will need to do in the booklet, showing full working and hand in on the first FM A level lesson in September. It is our first assessment of how well you will cope with the A level Further Maths course, so complete it with care. Feel free to drop us a line for help if you are struggling.

Take a Look at What a Further Maths A level might look like

This website has some videos to give you a flavour of the start of the Further Maths course Studying maths beyond GCSE Mathematics - AMSP

Feeling Curious

Look here for some websites with some interesting activities More maths for GCSE Mathematics students - AMSP

Level 2 Certificate
FURTHER MATHEMATICS

Algebra

Topic test – Algebraic fractions

v1.0

Name _____

Materials

For this paper you must have:
- Mathematical instruments
- You must not use a calculator

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 32

Advice
- In all calculations, show clearly how you work out your answer.

For Teacher's Use	
Pages	Mark
2 - 3	
4 - 5	
TOTAL	

1 Write each of these as a single fraction. Give your answers in the simplest form.

(a) $\frac{1}{x}+\frac{1}{y}$

[1 mark]

Answer _____

(b) $\frac{6}{5k}\times\frac{20k^2}{9}$

[2 marks]

Answer _____

(c) $\frac{3}{4p}\div\frac{6}{7p^2}$

[3 marks]

Answer _____

(d) $\frac{5}{6x}+\frac{2}{9}$

[2 marks]

Answer _____

2 Fully simplify each of these expressions.

(a) $\frac{8x^2y}{12xy^3}$

[2 marks]

Answer _____

(b) $\frac{5x-15}{(x-3)(x+1)}$

[2 marks]

Answer _____

(c) $\frac{y^2-y-6}{2y-6}$

[2 marks]

Answer _____

(d) $\frac{x^2-9}{x+3}$

[2 marks]

Answer _____

16

3 Simplify fully $\frac{x^3-4x}{3x^2+6x}$

You **must** show your working.

[3 marks]

Answer _____

4 Simplify fully $\frac{x}{x-2}-\frac{12}{(x-2)(x+4)}$

[4 marks]

Answer _____

5 Simplify fully $\frac{5x^2+14x-3}{4x^2-1} \div \frac{x+3}{2x-1}$

[5 marks]

Answer _____

6 Simplify fully $\frac{14p^2}{(p^2+4p-12)} \times \frac{10-5p}{7p}$

[4 marks]

Answer _____

END OF QUESTIONS

16

AQA

Level 2 Certificate FURTHER MATHEMATICS

Algebra

Topic test – Completing the square

v1.0

Name _____

Materials

For this paper you must have:
- Mathematical instruments
- You must not use a calculator

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 30.

Advice
- In all calculations, show clearly how you work out your answer.

For Teacher's Use	
Pages	Mark
2 - 3	
4 - 5	
6	
TOTAL	

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1 (a) You are given that $x^2 + 8x - 10 \equiv (x + a)^2 + b$

Work out the values of a and b.

[2 marks]

$a =$ _____

$b =$ _____

1 (b) Write down the coordinate of the minimum point on the curve $y = x^2 + 8x - 10$

[1 mark]

Answer (_____ , _____)

1 (c) Solve the equation $x^2 + 8x - 10 = 0$

Give your answer in the form $a \pm \sqrt{b}$

[1 mark]

Answer _____

2 Write $3x^2 + 18x - 4$ in the form $a(x + b)^2 + c$ where a, b and c are integers.

[4 marks]

$a =$ _____

$b =$ _____

$c =$ _____

3 The nth term of a sequence is $2n^2 - 8n + 13$

By completing the square show that every term in the sequence is positive.

[3 marks]

Turn over for the next question

11

4 Write $12x^2 + 36x - 7$ in the form $a(bx + c)^2 + d$ where a, b, c and d are integers.

[5 marks]

5 Write $7 - 6x - 9x^2$ in the form $8 - a(bx + c)^2$ where a, b and c are positive integers.

[4 marks]

$a =$ _____

$b =$ _____

$c =$ _____

6 $4x^2 + 12x + p \equiv 4(x + q)^2 + 5$ where p and q are rational numbers.

Work out the values of p and q.

[4 marks]

$p =$ _____

$q =$ _____

Turn over for the next question

13

7 $3x^2 + 12bx + a^2$ can be written in the form $2(x + 3a)^2 - 26$

Work out the **two** possible pairs of values for a and b.

[6 marks]

$a =$ _____ $b =$ _____

$a =$ _____ $b =$ _____

END OF QUESTIONS

6

AQA

Level 2 Certificate FURTHER MATHEMATICS

Number

Topic test – Expanding brackets

v1.0

Name _____

Materials

For this paper you must have:
- Mathematical instruments
- You must not use a calculator

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 32.

Advice
- In all calculations, show clearly how you work out your answer.

For Teacher's Use	
Pages	Mark
2 - 3	
4 - 5	
6 - 7	
8	
TOTAL	

1 Expand and simplify $3x(4x-7y)$

[2 marks]

Answer _____

2 Expand and fully simplify $(y-5)^2$

[2 marks]

Answer _____

3 Expand and fully simplify $7(2x-3)-5(x+3)$

[2 marks]

Answer _____

4 Expand and fully simplify $(2x+3)(3x-4)$

[2 marks]

Answer _____

5 Expand and fully simplify $(3x+4y)(2x-5y)$

[3 marks]

Answer _____

6 If: $(5x+c)(2x-3) \equiv 10x^2-7x+d$

Work out values of c and d

[3 marks]

Answer $c =$ _____ $d =$ _____

14

7 Expand and fully simplify $(3x-2)(2x-3)(x+4)$

[3 marks]

Answer _____

8 Expand and simplify fully $(3x^3-4)(2x^2+5)+x(x-3)^2$

[4 marks]

Answer _____

7

9 If: $m(x-2)+4(2x+p)\equiv 4(x+5)$

Work out values of m and p

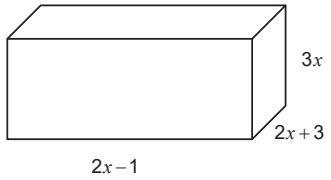
[4 marks]

Answer m = _____ p = _____

10 A cuboid has length $(2x-1)$, width $(2x+3)$ and height $(3x)$.

Find an expression for its volume.

Give your answer in the form ax^3+bx^2+cx where a, b and c are integers.



[4 marks]

Answer _____

8

11 Expand and fully simplify $\left(3x^2 - 2y^3\right)^2$

[3 marks]

Answer _____

END OF QUESTIONS

3

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AQA

Level 2 Certificate
FURTHER MATHEMATICS

Number

Topic test – Factorising

v1.0

Name _____

Materials

For this paper you must have:
- Mathematical instruments
- You must not use a calculator

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 33.

Advice
- In all calculations, show clearly how you work out your answer.

For Teacher's Use	
Pages	Mark
2 - 3	
4 - 5	
6 - 7	
8	
TOTAL	

1 Fully factorise each of these expressions

(a) $5x^2 + 10x$

[1 mark]

Answer _____

(b) $24x^2 - 16x$

[2 marks]

Answer _____

(c) $4a^2b + 6ab^2 + 8a^2b^2$

[2 marks]

Answer _____

(d) $x^3y^2 - 3xy^4$

[2 marks]

Answer _____

(e) $y^2 + y - 12$

[2 marks]

Answer _____

Turn over for next question

9

2 Fully factorise each of these expressions

(a) $6x^2y - 16xy$

[2 marks]

Answer _____

(b) $2x^2 - 13x + 15$

[2 marks]

Answer _____

(c) $3p^2 + 15p + 12$

[3 marks]

Answer _____

(d) $3x^2 - 13xy - 10y^2$

[3 marks]

Answer _____

Turn over for next question

10

3 Fully factorise each of these expressions

(a) $x^2 - 4$

[1 mark]

Answer _____

(b) $y^2 - p^2$

[1 mark]

Answer _____

(c) $2y^2 - 98$

[2 marks]

Answer _____

(d) $25 - 4x^2$

[1 mark]

Answer _____

(e) $x^5 - x^3$

[2 marks]

Answer _____

4 Factorise fully $x^4 - 16$

[2 marks]

Answer _____

5 Factorise fully $(w+7)^{10} - (w+7)^9$

[2 marks]

Answer _____

11

6 Factorise $8(x+5)^5+(6x+4)(x+5)^4$

Give your answer in its simplest form.

Do **not** attempt to expand $(x+5)^5$ or $(x+5)^4$

[3 marks]

Answer _____

END OF QUESTIONS

3

AQA

Level 2 Certificate FURTHER MATHEMATICS

Algebra

Topic test – Index laws

v1.0

Name _____

Materials

For this paper you must have:
- Mathematical instruments
- A calculator.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 29.

Advice
- In all calculations, show clearly how you work out your answer.

For Teacher's Use	
Pages	Mark
2 - 3	
4 - 5	
6	
TOTAL	

1 For each of the following circle the correct expression.

1 (a) The expression that is equivalent to $2x^{-3}$

$\frac{-2}{x^3}$ $\frac{2}{x^3}$ $-\frac{1}{2x^3}$ $\frac{1}{2x^3}$

[1 mark]

1 (b) The expression that is equivalent to $y^{\frac{1}{4}}$

$0.25y$ $\frac{1}{y^4}$ $\sqrt[4]{y}$ $\frac{1}{\sqrt[4]{y}}$

[1 mark]

1 (c) The expression that is equivalent to $w^{\frac{2}{3}}$

$\sqrt[3]{w^2}$ $\frac{1}{\sqrt[3]{w^2}}$ $\sqrt{w^3}$ $\frac{w^2}{3}$

[1 mark]

1 (d) The expression that is equivalent to $\frac{4}{\sqrt{p}}$

$-4p^{\frac{1}{2}}$ $(4p)^{-\frac{1}{2}}$ $4p^{-2}$ $4p^{-\frac{1}{2}}$

[1 mark]

2 Express as a single power of x

$$\frac{x^3 \times x^7}{\sqrt{x^4}}$$

[2 marks]

Answer _____

3 Write $\sqrt[3]{\left(\frac{y^8}{y^{-1}}\right)}$ as an integer power of y

[2 marks]

Answer _____

4 Simplify fully $\frac{18a^{10}}{\left(3a^2\right)^3}$

[2 marks]

Answer _____

5 Solve $x^{-\frac{1}{2}} = \frac{2}{5}$

[3 marks]

Answer _____

13

6 $a^3bc^4 = a^7b^{13}$ write c in terms of a and b

Give your answer in its simplest form.

[2 marks]

Answer _____

7 Write $8^{3x} \times 16^{2x-1}$ as a power of 2.

[2 marks]

Answer _____

8 Solve $9^{x-1} = 27$

[2 marks]

Answer _____

9 Find all the values of x that satisfy $\left(x^{\frac{1}{2}} + x^{\frac{3}{2}}\right)^2 = 5x + 2x^2$

[4 marks]

Answer _____

10 $\sqrt[5]{x^2} \div \sqrt[3]{x} = \sqrt[k]{x}$ where k is a positive integer.

Work out the value of k

[2 marks]

Answer _____

12

11 Using powers of 3, or otherwise, work out the non-zero value of x for which

$$(27^x)^x = 3^{2x}$$

[4 marks]

Answer _____

END OF QUESTIONS

4

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AQA

Level 2 Certificate
FURTHER MATHEMATICS

Algebra

Topic test – Rearranging formulae

v1.0

Name _____

Materials

For this paper you must have:
- Mathematical instruments
- You must not use a calculator

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 32.

Advice
- In all calculations, show clearly how you work out your answer.

For Teacher's Use	
Pages	Mark
2 - 3	
4 - 5	
6	
TOTAL	

1 $S = \dfrac{a}{1-r}$

1 (a) Make r the subject of the formula.

[3 marks]

1 (b) Work out the value of r when $S = 2a$

[2 marks]

2 Rearrange $a = \sqrt{\dfrac{2b+c}{s}}$ to make b the subject.

[3 marks]

3 Make p the subject of the formula $\dfrac{p+4q}{p-q} = r$

[4 marks]

12

4 Make x the subject of the formula $\sqrt{\frac{5xy}{y+x}} = 12$

[4 marks]

5 Rearrange $\frac{4(3-2x)}{6+3x} = y$ to make x the subject of the formula.

[4 marks]

6 Rearrange $\frac{2}{cd} = 9 - \frac{4}{d}$ to make c the subject.

[3 marks]

7 Rearrange $xy = \frac{2x+5}{5}$ to make x the subject.

[3 marks]

14

8 Rearrange $h = \frac{4g+3}{8g} + \frac{2g-1}{3g}$ to make g the subject.

[4 marks]

9 Rearrange $s = \frac{t^2+6}{t^2+8}$ to make t the subject.

[2 marks]

END OF QUESTIONS

6

AQA

Level 2 Certificate FURTHER MATHEMATICS

Algebra

Topic test – Simultaneous equations two unknowns

v1.0

Name _____

Materials

For this paper you must have:
- Mathematical instruments
- You may not use a calculator

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 32.

Advice
- In all calculations, show clearly how you work out your answer.

For Teacher's Use	
Pages	Mark
2 - 3	
4 - 5	
6 - 7	
8	
TOTAL	

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1 It takes Ash half an hour to iron four shirts and two dresses.

It takes her 40 minutes to iron three shirts and four dresses.

Use simultaneous equations to work out how long it takes to iron one shirt and to iron one dress.

Do **not** use trial and improvement.

You **must** show your working and state the units of your answer.

[4 marks]

Shirt _____

Dress _____

2 In these simultaneous equations $k > 0$

$5kx + 3y = 4k$

$y = kx + 1$

Solve the simultaneous equations.

Give your answers in their simplest forms in terms of k

[3 marks]

$x =$ _____

$y =$ _____

Turn over for the next question

7

3 (a) A circle has centre (0, 0) and radius $\sqrt{5}$

A straight line has equation $y + 5 = 2x$

Work out the coordinates of the point(s) where the line and the circle intersect.

Do **not** use trial and improvement.

You **must** show your working.

[6 marks]

Answer _____

3 (b) Use your answer to part **(a)** to explain the geometric relationship between the line and the circle.

[1 mark]

4 Solve the simultaneous equations

$q = p^2 - 6p + 4$

$q + 2p = 16$

Do **not** use trial and improvement.

You **must** show your working.

[4 marks]

Answer _____

Turn over for the next question

11

5 The sum of two numbers is 13

The product of the same two numbers is –68

Find the two numbers.

[5 marks]

Answer _____

6 A straight line has equation $x + y = 7$

A curve has equation $y^2 - 6x = 13$

Work out the coordinates of the two points where the curve and the line intersect.

Do **not** use trial and improvement.

You **must** show your working.

[4 marks]

Answer _____

Turn over for the next question

9

7 Solve the simultaneous equations

$\frac{x-1}{y+6}=2$ and $\frac{y+8}{x-7}=3$

Do **not** use trial and improvement.

You **must** show your working.

[5 marks]

Answer _____

END OF QUESTIONS

5

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AQA

Level 2 Certificate
FURTHER MATHEMATICS

Algebra

Topic test – Solutions of linear and quadratic equations

v1.0

Name _____

Materials

For this paper you must have:
- Mathematical instruments
- You must not use a calculator

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 30.

Advice
- In all calculations, show clearly how you work out your answer.

For Teacher's Use	
Pages	Mark
2 - 3	
4 - 5	
6	
TOTAL	

1 Solve $\frac{5c+7}{3}+\frac{c-4}{5}=65$

[4 marks]

2 $(x + 8)$ is increased by 30%.

Its value is now the same as $2x - 5$

Work out the value of x.

[3 marks]

3 The first three terms of a linear sequence are

$15 \qquad 15 + 2k \qquad 15 + 4k$

Where k is a constant.

The 150th term of the sequence is 760.

Work out the value of k.

[4 marks]

4 The ratio of the length of the base of a triangle to its perpendicular height is 3 : 4.

The area of the triangle is 60 cm^2.

Work out the length of the base of the triangle.

Give your answer in the form $a\sqrt{b}$ where a and b are integers.

[4 marks]

15

5 Solve $9(x + 3)^2 = k^2$ where k is a constant.

Give your answers in their simplest form in terms of k.

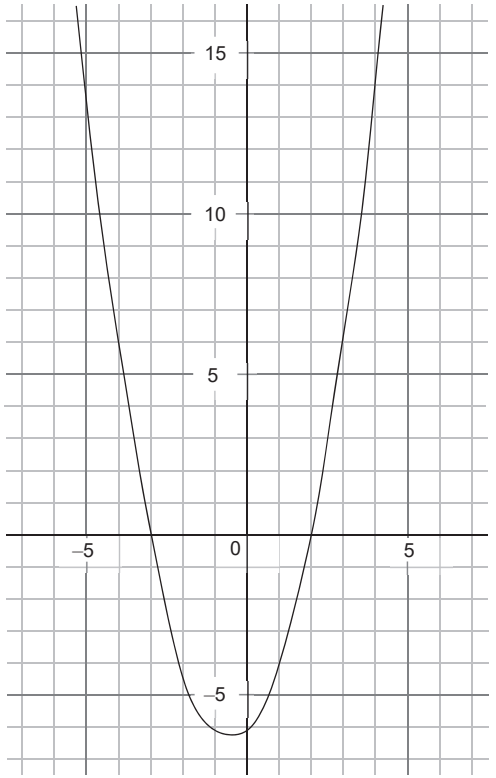
[3 marks]

6 Solve $6x^2 = 7 - 4x$

Give your answers in the form $\frac{a \pm \sqrt{46}}{b}$ where a and b are integers.

[4 marks]

7 Here is the graph of $y = x^2 + x - 6$.



By drawing a suitable linear graph on the grid, work out approximate solutions to:

$$x^2 - x - 7 = 0$$

[3 marks]

10

8 Bag A and Bag B contain counters in the ratio 5 : 7.

Six counters are removed from Bag A and put into Bag B.

The ratio of counters in Bag A to Bag B is now 1 : 2.

Use an algebraic method to work out the number of counters in Bag A **after** the six counters have been removed.

[5 marks]

END OF QUESTIONS

5

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AQA

Level 2 Certificate
FURTHER MATHEMATICS

Number

Topic test – Surds

v1.1

Name _____

Materials

For this paper you must have:
- Mathematical instruments
- You may not use a calculator.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 33.

Advice
- In all calculations, show clearly how you work out your answer.

For Teacher's Use	
Pages	Mark
2 - 3	
4 - 5	
6 - 7	
TOTAL	

1 Write $\sqrt{180}$ in the form $a\sqrt{5}$ where a is an integer.

[2 marks]

Answer _____

2 Rationalise and simplify fully $\frac{2}{\sqrt{6}}$

[2 marks]

Answer _____

3 Write $\left(3-2\sqrt{2}\right)\left(4\sqrt{2}+7\right)$ in the form $a+b\sqrt{2}$ where a and b are integers.

[2 marks]

Answer _____

4 Rationalise and simplify fully $\frac{4}{2+\sqrt{3}}$

[2 marks]

Answer _____

5 Simplify $\sqrt{5}\left(\sqrt{80}+\sqrt{45}\right)$ giving your answer as an integer.

[2 marks]

Answer _____

6 Write $\left(2\sqrt{3}\right)^3$ as a multiple of $\sqrt{3}$

[1 mark]

Answer _____

11

7 Rationalise and simplify fully $\frac{\sqrt{2}}{2-\sqrt{2}}$

[3 marks]

Answer _____

8 Solve $\sqrt{128}-\sqrt{18}=\sqrt{8}+\sqrt{x}$

[3 marks]

Answer _____

9 Rationalise and simplify fully $\frac{2\sqrt{5}-\sqrt{2}}{\sqrt{5}+\sqrt{2}}$

[4 marks]

Answer _____

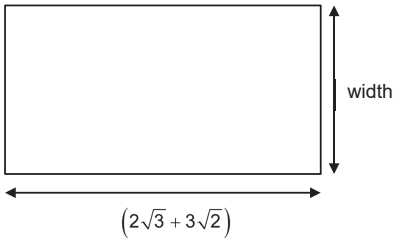
10 Simplify fully $\frac{\sqrt{45}+\sqrt{125}}{\sqrt{180}}$

[3 marks]

Answer _____

13

11 A rectangle is $\left(2\sqrt{3}+3\sqrt{2}\right)$ cm long and has an area of $\left(12+5\sqrt{6}\right)$ cm^2.



Not drawn accurately

Work out the width of the rectangle.

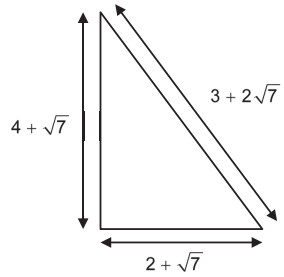
Give your answer in its simplest form.

[5 marks]

Answer _____

12 Is this triangle right angled?

Not drawn accurately



Tick a box

Yes ☐ No ☐

You **must** show working to support your answer.

[4 marks]

END OF QUESTIONS

9

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