Getting Started with First Year A Level Maths

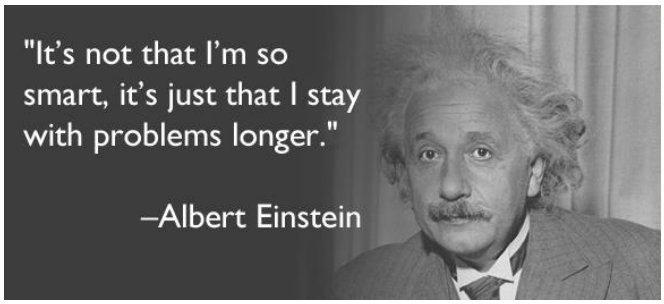
Bridging the gap from GCSE to A Level

for new students starting in September 2020

Introduction

Congratulations on choosing to study A Level Maths. To help you prepare, this booklet will enable you to brush up on some of the skills you have learned at GCSE. You are going to need to use them from day 1, and if you don't have a good grasp of the basics you need to work on them NOW so that you can start with confidence.

Do the questions in this booklet in pencil, then check your answers. If you get something wrong, revise the topic then try again. The aim is to get EVERYTHING right!



Studying A Level Maths is about learning how to solve problems, and getting stuck is part of the learning process. You should expect to get stuck while working through this booklet but these are all GCSE techniques that you will need to master.

There are loads of great resources on the internet to help you, but if you get stuck we recommend **ExamSolutions.net** which contains video tutorials for all GCSE Higher content. We also recommend using this site throughout the A Level course.

http://www.examsolutions.net/gcse-maths

Tip - Download a QR code reader app if you have a smartphone or tablet. The QR codes throughout this booklet link to helpful websites and tutorials, but if you don't have a smartphone or tablet with this function, you should be able to find them by name on the relevant websites.

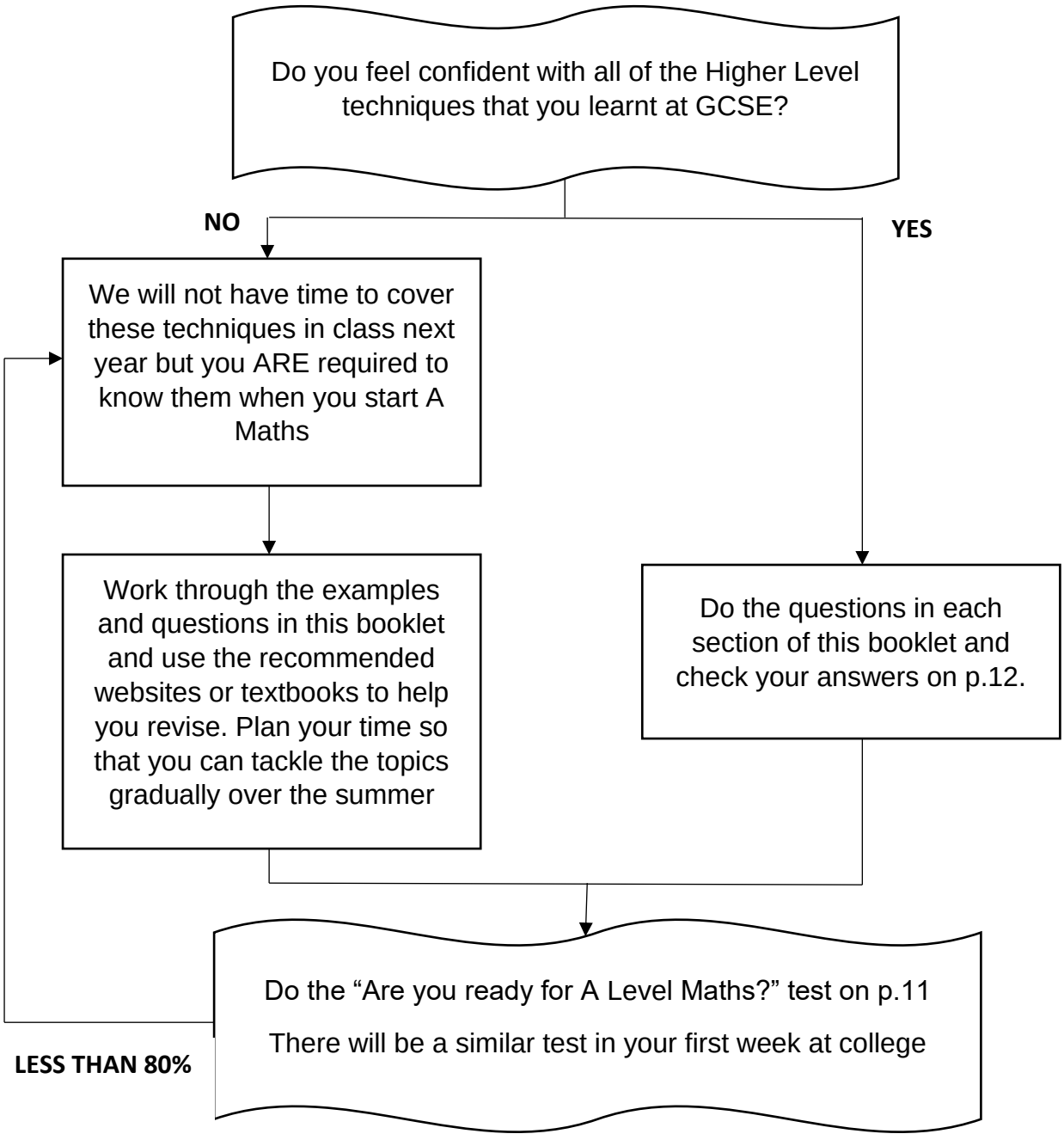
If you want a more comprehensive revision guide, there are several books available from Amazon but please note it is NOT compulsory to buy either of these:

- Collins Maths - Bridging GCSE and A Level: Student Book
- Head Start to A Level Maths by CGP Books

Finally, there is an interactive online course called 'Step up! To A Level Maths' hosted by the University of Plymouth that is packed with extra resources and examples:

http://www.cimt.org.uk/projects/mepres/step-up/index.htm

GCSE Maths	*A Level Maths*
If you're naturally good at maths you can do well without much extra studying	You will do a lot of study outside of class
It's the answer that matters most, but you should show working	It's the method that matters, not the answer. Often you are given the answer but need to show steps in the method.
You have an exercise book to keep all your work together	You will need to buy a folder and some dividers to organise your notes. It is a good idea to keep your 'neat' notes separate from your rough work so you can find them easily for revision.
Nobody minds how you set out your workings so long as you get there in the end	How you present your work can make a big difference to whether you get the right answer at all and whether anyone can understand your method.



1. Fractions

You need to be really confident with numerical fractions so that you know what to do with algebraic ones.

Multiplication: $\frac{2}{3}\times\frac{4}{5}=\frac{2\times4}{3\times5}=\frac{8}{15}$ and $2\times\frac{3}{5}=\frac{2}{1}\times\frac{3}{5}=\frac{6}{5}$ NOT $\frac{6}{10}$!!!

When using algebra you will make fewer mistakes if you write things next to each other like $3x$ rather than $3\times x$ and use brackets

So, using algebra:

$$2x\left(\frac{3x}{4}\right)=\left(\frac{2x}{1}\right)\left(\frac{3x}{4}\right)=\frac{6x^2}{4}=\frac{3x^2}{2}$$

(Always simplify fractions by dividing top and bottom by any common factors as far as possible)

Division: $\frac{8}{3}\div\frac{2}{3}=\frac{8}{3}\times\frac{3}{2}=\frac{8\times3}{3\times2}=\frac{8}{2}=4$ and $5x\div\frac{1}{x}=\left(\frac{5x}{1}\right)\left(\frac{x}{1}\right)=5x^2$

Addition and subtraction - start by making the denominators the same:

$\frac{5}{4}+\frac{3}{2}=\frac{5}{4}+\frac{6}{4}=\frac{11}{4}$ (At A Level we prefer this as an 'improper' fraction NOT $2\frac{3}{4}$)

Where there is no obvious common denominator you can make one by multiplying the denominators together. Whatever you do to the bottom of a fraction, you have to do the same to the top.

e.g. $\frac{2x}{5}-\frac{1}{2}=\frac{2x\times2}{5\times2}-\frac{1\times5}{2\times5}=\frac{4x}{10}-\frac{5}{10}=\frac{4x-5}{10}$

Exercise 1

Without a calculator, work these out as a single simplified fraction and check your answers at the end of the booklet on p.12 (tick the box when you have got it right).

1. $\frac{3}{4}\times\frac{2}{5}$ ☐	2. $2+\frac{3}{5}$ ☐	3. $\frac{3}{2}\div\frac{1}{4}$ ☐
4. $\frac{2/7}{4}$ ☐	5. $\frac{3x}{5}\times4$ ☐	6. $\frac{1}{x}+\frac{2}{x}$ ☐
7. $\frac{5}{3/2}$ ☐	8. $\frac{2/3}{3/4}$ ☐	9. $\frac{3/5}{9}$ ☐
10. $\frac{3}{x}+\frac{2}{x^2}$ (Hint: multiply the top and bottom of $\frac{3}{x}$ by x first) ☐	11. $\left(\frac{3}{2}\times\frac{1}{4}\right)+3$ ☐	12. $\frac{2x+7}{2}-\frac{3}{5}$ ☐

2. Indices

You will literally be using indices all the time at A Level so get to grips with them now!

These are the **rules of indices** you need to know:

$$a^m a^n = a^{m+n} \qquad \frac{a^m}{a^n} = a^{m-n} \qquad (a^m)^n = a^{mn}$$

Also: $(ab)^n = a^n b^n$ $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$ $a^0 = 1$ $a^1 = a$

A <u>negative</u> power means a <u>reciprocal</u> e.g. $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$ and $\left(\frac{1}{2}\right)^{-2} = \left(\frac{2}{1}\right)^2 = 4$

A <u>fractional</u> power indicates a <u>root</u> e.g. $8^{\frac{1}{3}} = \sqrt[3]{8} = 2$ (since 2 x 2 x 2 = 8)

Example 1: cube, square root

$$16^{\frac{3}{2}} = \left(\sqrt{16}\right)^3 = 4^3 = 64$$

Example 2: reciprocal, to the power of 4, cube root

$$8^{-\frac{4}{3}} = \left(\frac{1}{8}\right)^{\frac{4}{3}} = \left(\frac{1}{\sqrt[3]{8}}\right)^4 = \left(\frac{1}{2}\right)^4 = \frac{1}{16}$$

HINT – do the reciprocal first, then the root, then the top power

Look on examsolutions.net for the video tutorial Indices – Rational (fractional) type

Exercise 2a – Do this exercise without a calculator

Simplify the following – leave your answer in the form a^n

1. $b^4 \times b^3$	2. $a^5 \div a^3$	3. $(x^3)^2$

Evaluate the following **without using a calculator** (i.e. find the value of)

4. $\left(\frac{2}{5}\right)^3$	5. $27^{\frac{1}{3}}$	6. $9^{\frac{3}{2}}$
7. $81^{-\frac{1}{4}}$	8. $\left(\frac{2}{3}\right)^{-2}$	9 $\sqrt{\frac{4}{9}}$

Indices – Expressing terms in the form ax^n

It is often necessary to write expressions in the form (number)x^{power} or ax^n

Common mistake:

$\frac{1}{3x^2} = 3x^{-2}$ WRONG!

Actually: $\frac{1}{3x^2} = \left(\frac{1}{3}\right)\left(\frac{1}{x^2}\right) = \frac{1}{3}x^{-2}$

Common mistake:

$\sqrt{4x} = 4x^{\frac{1}{2}}$ WRONG!

Actually: $\sqrt{4x} = \sqrt{4}\sqrt{x} = 2x^{\frac{1}{2}}$

One important technique is 'sliding' the number away from the x term so that you can simplify them separately.

Example 1: $\frac{2}{x} = 2 \times \frac{1}{x} = 2x^{-1}$

Example 2: $\frac{6}{5x^2} = \left(\frac{6}{5}\right)\left(\frac{1}{x^2}\right) = \frac{6}{5}x^{-2}$

Watch this video on examsolutions.net Indices – Expressing in the form ax^n

You can split the numerator of a fraction to make two separate terms, but you can never do this with the denominator

Example 3: $\frac{2+x}{\sqrt{x}} = \frac{2}{\sqrt{x}} + \frac{x}{\sqrt{x}} = 2\left(\frac{1}{\sqrt{x}}\right) + \frac{x^1}{x^{\frac{1}{2}}} = 2x^{-\frac{1}{2}} + x^{\frac{1}{2}}$

BUT $\frac{x^2}{x+1} \neq \frac{x^2}{x} + \frac{x^2}{1}$ THIS IS WRONG! In fact this fraction cannot be simplified .

Exercise 2b – write these expressions in the form ax^n

1. $5\sqrt{x}$ ☐	2. $\frac{2}{x^3}$ ☐	3. $\frac{3}{\sqrt{x}}$ ☐
4. $\frac{\sqrt{x}}{5}$ ☐	5. $\left(\frac{2x}{3}\right)^2$ ☐	6. $\frac{1}{\sqrt[3]{x}}$ ☐
7. $\left(2\sqrt{x}\right)^3$ ☐	8. $\frac{4}{3x^5}$ ☐	9. $\frac{\sqrt{x}}{3x}$ ☐
10. $\frac{3x^2}{\sqrt{x}}$ ☐	11. $\frac{x-2}{x^2}$ (The answer to this one has two separate terms) ☐	

3. Surds

A surd is an irrational root e.g. $\sqrt{2}, \sqrt{3}$ but not $\sqrt{9}$ because $\sqrt{9} = 3$.

Exam Solutions – Simplifying Surds

How to simplify surds:

$\sqrt{ab} = \sqrt{a}\sqrt{b}$ $\quad e.g \quad \sqrt{20} = \sqrt{4 \times 5} = \sqrt{4}\sqrt{5} = 2\sqrt{5}$

$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ $\quad e.g. \quad \sqrt{\frac{3}{4}} = \frac{\sqrt{3}}{\sqrt{4}} = \frac{\sqrt{3}}{2}$

Look for multiples of square numbers e.g. 4, 9, 16 etc

Example: $\sqrt{75} + 2\sqrt{12} = \sqrt{25 \times 3} + 2\sqrt{4 \times 3} = \sqrt{25}\sqrt{3} + 2\sqrt{4}\sqrt{3}$

$= 5\sqrt{3} + 4\sqrt{3} = 9\sqrt{3}$

Rationalising the denominator:

This means re-writing a fraction so that there is no surd on the bottom. We do this by multiplying both top and bottom by the surd on the bottom.

Example 1: $\frac{1}{\sqrt{5}} = \frac{1}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{5}}{\sqrt{5}\sqrt{5}} = \frac{\sqrt{5}}{5}$

Remember: $\sqrt{5}\sqrt{5} = (\sqrt{5})^2 = 5$ NOT 25!

Where the denominator has two parts we multiply the top and bottom by the whole denominator but we need to change the sign in the middle.

Example 2: $\frac{3}{1+\sqrt{2}} = \frac{3}{1+\sqrt{2}} \times \frac{1-\sqrt{2}}{1-\sqrt{2}} = \frac{3(1-\sqrt{2})}{(1+\sqrt{2})(1-\sqrt{2})} = \frac{3-3\sqrt{2}}{1-\sqrt{2}+\sqrt{2}-\sqrt{2}\sqrt{2}}$

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

Note: dividing by -1 has the same effect as multiplying by -1 i.e. it changes all the signs

Example 3: Write $\frac{1}{3-\sqrt{3}}$ in the form $a + b\sqrt{3}$

$\frac{1}{3-\sqrt{3}} \times \frac{3+\sqrt{3}}{3+\sqrt{3}} = \frac{3+\sqrt{3}}{(3-\sqrt{3})(3+\sqrt{3})} = \frac{3+\sqrt{3}}{9-3\sqrt{3}+3\sqrt{3}-\sqrt{3}\sqrt{3}} = \frac{3+\sqrt{3}}{9-3} = \frac{3+\sqrt{3}}{6} = \frac{3}{6} + \frac{\sqrt{3}}{6} = \frac{1}{2} + \frac{1}{6}\sqrt{3}$

Exercise 3 -

Write in the form $a\sqrt{b}$

1. $\sqrt{27}$ ☐
2. $\sqrt{48}$ ☐
3. $\frac{\sqrt{12}}{2}$ ☐
4. $\sqrt{20} - 3\sqrt{45}$ ☐
5. $\sqrt{200} + \sqrt{18} - 2\sqrt{50}$ ☐

Rationalise the denominator

6. $\frac{2}{\sqrt{3}}$ ☐
7. $\frac{1}{1+\sqrt{2}}$ ☐
8. $\frac{3}{4-\sqrt{2}}$ ☐

4. Quadratics

Quadratics are everywhere in A Level Maths! However, you should already be pretty good at the basic techniques so just keep practising.

Factorisation

These two numbers multiply to give + 6…

$$x^2 - 5x + 6 = (x - 3)(x - 2)$$

…. and add together to give - 5

Remember – not all quadratics can be factorised!

There are other techniques for factorising quadratics if you can't do it 'by inspection' (i.e. just looking at the numbers). Watch this video from examsolutions.net to learn a different approach called 'grouping'

Difference of two squares (special kind of factorisation)

$$\boldsymbol{a^2 - b^2 = (a + b)(a - b)}$$

Example 1: $9 - x^2 = (3 + x)(3 - x)$

Example 2: $4x^2 - 25 = (2x + 5)(2x - 5)$

The quadratic formula

You need to learn this formula as you are not given it in A Level exams.

Always check the sign in front of *a*, *b*, and *c*, not just the number

If $\boldsymbol{ax^2 + bx + c = 0}$ **then** $\boldsymbol{x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}}$ (Note - Your answer might involve surds)

Exercise 4a

Factorise the following quadratics. Remember to expand out the brackets to check your answers. The first one has been partially completed for you.

1. $x^2 + 2x - 15$ $= (x - 3)(\quad)$ Check by expanding: $(x - 3)(\quad)$ = ☐	2. $x^2 - 9x - 10$ ☐	3. $6x^2 + 2x$ (hint – just take out the common factors) ☐
4. $49 - 4x^2$ ☐	5. $2x^2 + 5x - 3$ ☐	6. $4x^2 + 4x + 1$ ☐

Solve using the quadratic formula without a calculator (where necessary leave in surd form):

7. $x^2 - 5x + 4 = 0$ ☐	8. $3x^2 + 2x - 1 = 0$ ☐	9. $x^2 = 3x + 2$ Hint: rearrange to get $= 0$ first ☐

Completing the square

Some quadratics are 'perfect squares' e.g. $x^2 + 4x + 4 = (x + 2)(x + 2) = (x + 2)^2$

Most quadratics are not like this, but can be written as a square that is 'adjusted' slightly.

e.g. $x^2 + 4x + 7$ the first two terms are the same as above so try $(x + 2)^2$, but this gives + 4 as the constant and we want + 7, hence $x^2 + 4x + 7 = (x + 2)^2 - 4 + 7 = (x + 2)^2 + 3$

In general:

$$\boldsymbol{x^2 + bx + c = (x + half\ of\ b)^2 - (half\ of\ b)^2 + c}$$

examsolutions.net – Completing the Square

Example 1: $x^2 + 6x + 2 = (x + 3)^2 - (3)^2 + 2 = (x + 3)^2 - 7$

Example 2: $x^2 - 4x + 3 = (x - 2)^2 - (-2)^2 + 3 = (x - 2)^2 - 4 + 3 = (x - 2)^2 - 1$

Example 3: $x^2 + 5x - 2 = \left(x + \frac{5}{2}\right)^2 - \left(\frac{5}{2}\right)^2 - 2 = \left(x + \frac{5}{2}\right)^2 - \frac{25}{4} - 2 = \left(x + \frac{5}{2}\right)^2 - \frac{33}{4}$

Exercise 4b

By completing the square, write these quadratic expressions in the form $(x + p)^2 + q$

1. $x^2 + 8x + 7$	2. $x^2 - 2x - 15$	3. $x^2 + 6x + 10$
4. $x^2 + 12x + 100$	5. $x^2 - 3x - 1$	6. $x^2 - \frac{1}{2}x + 1$

Going a step further:

You can solve a quadratic equation in this way: e.g. $x^2 - 4x - 5 = 0$

1. Complete the square: $(x - 2)^2 - 9 = 0$
2. Put the number of the right hand side $(x - 2)^2 = 9$
3. Square root both sides (remembering the $\pm$ sign!) $x - 2 = \pm 3$
4. Add 2 to both sides to get TWO answers $x = 2 \pm 3$ so $x = 5\ or\ x = -1$

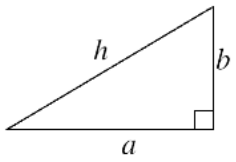
Exercise 4c Solve by completing the square

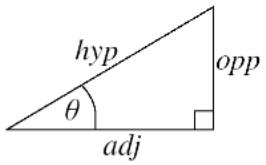
1. $x^2 + 6x - 7 = 0$	2. $x^2 - 2x - 3 = 0$	3. $x^2 + 5x = -6$

5. Trigonometry

This won't pop up until a bit later in the year, but it is stuff you should already know!

formulae for right-angled triangles





Pythagoras's Theorem

$a^2 + b^2 = h^2$

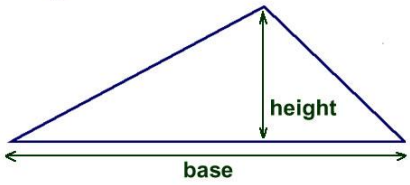
Trigonometric Ratios

$\sin(\theta) = \frac{opp}{hyp}$

$\cos(\theta) = \frac{adj}{hyp}$

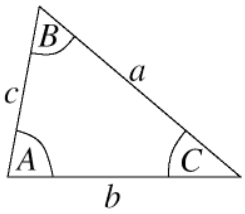
$\tan(\theta) = \frac{opp}{adj}$

Area = $\frac{1}{2}$ x base x perpendicular height



This is the ONLY trigonometry formula you are given in A Level Maths exams, you have to LEARN the rest.

formulae for all triangles



Sine Rule

$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$ or $\frac{\sin(A)}{a} = \frac{\sin(B)}{b} = \frac{\sin(C)}{c}$

(for finding sides) (for finding angles)

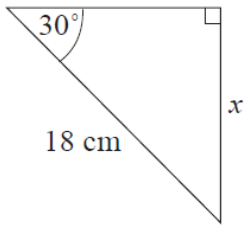
Cosine Rule

$a^2 = b^2 + c^2 - 2bc\cos A$ or $\cos(A) = \frac{b^2 + c^2 - a^2}{2bc}$

(for finding sides) (for finding angles)

Exercise 5 – find the side marked x or the angle marked θ in each triangle to 1 d.p.

1.



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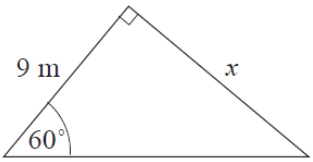

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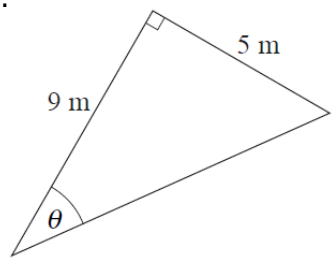

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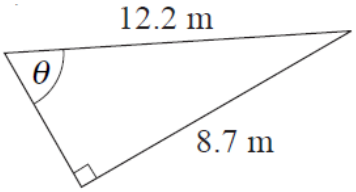

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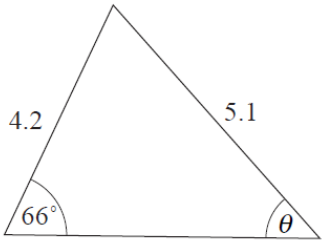
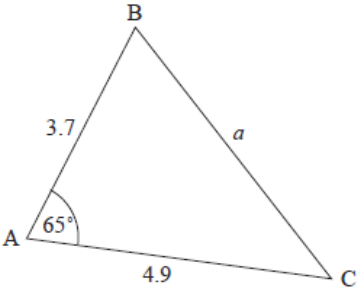


6. Find *a*



ARE YOU READY FOR A LEVEL MATHS? - PRACTICE TEST

Try this test in exam conditions (write on lined paper, not this booklet) then mark it using the answers at the back of the booklet and give yourself a score. You should aim for over 80% but certainly anything less than 60% should be a worry. Go back to the exercises containing the questions you got wrong then try this test again in a few days' time.

Time: 1 hour. No calculator allowed except for Q9 and Q10.

Quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Cosine rule:

$$a^2 = b^2 + c^2 - 2bcCosA$$

1. Write as a single fraction:

   a) $\frac{3}{2/5}$ b) $\frac{3x}{2} \div 5$

2. Evaluate:

   a) $4^{\frac{5}{2}}$ b) $16^{-\frac{1}{2}}$

3. Write in the form ax^n:

   a) $\frac{2}{3x}$ b) $\frac{4\sqrt{x}}{5}$

4. Simplify:

   a) $\sqrt{32}$ b) $\sqrt{20} + 2\sqrt{45} - 3\sqrt{80}$

5. Rationalise the denominator:

   a) $\frac{1}{\sqrt{2}}$ b) $\frac{5}{2-\sqrt{3}}$

6. Factorise these quadratics:

   a) $x^2 - 5x - 24$ b) $9x^2 - 4$

7. Solve using the quadratic formula (leave your answer in surd form if necessary):

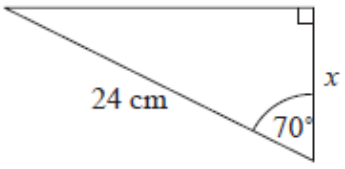
   a) $6x^2 + x - 1 = 0$ b) $x^2 - 7x + 9 = 0$

8. Write in the form $(x + p)^2 + q$ (i.e. complete the square):

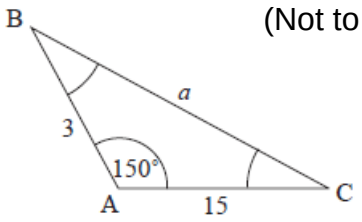
   a) $x^2 + 2x - 6$ b) $x^2 + 3x + \frac{1}{4}$

9. Find the side marked x *or* a to 1 d. p.:

   a)

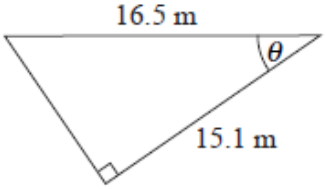


   b) (Not to scale)

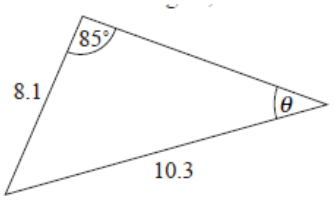


10. Find the angle marked θ to 1 d.p.:

    a)



    b)



Score

/40

Solutions to Exercises

Exercise 1 - Fractions

1. $\frac{3}{10}$ 2. $\frac{13}{5}$ 3. 6 4. $\frac{1}{14}$ 5. $\frac{12x}{5}$ 6. $\frac{3}{x}$
7. $\frac{10}{3}$ 8. $\frac{8}{9}$ 9. $\frac{1}{15}$ 10. $\frac{3x+2}{x^2}$ 11. $\frac{27}{8}$ 12. $\frac{10x+29}{10}$

Exercise 2a - Indices

1. b^7 2. a^2 3. x^6
4. $\frac{8}{125}$ 5. 3 6. 27 7. $\frac{1}{3}$ 8. $\frac{9}{4}$ 9. $\frac{2}{3}$

Exercise 2b – Writing as ax^n

1. $5x^{\frac{1}{2}}$ 2. $2x^{-3}$ 3. $3x^{-\frac{1}{2}}$ 4. $\frac{1}{5}x^{\frac{1}{2}}$ 5. $\frac{4}{9}x^2$ 6. $x^{-\frac{1}{3}}$
7. $8x^{\frac{3}{2}}$ 8. $\frac{4}{3}x^{-5}$ 9. $\frac{1}{3}x^{-\frac{1}{2}}$ 10. $3x^{\frac{3}{2}}$ 11. $x^{-1} - 2x^{-2}$

Exercise 3 - Surds

1. $3\sqrt{3}$ 2. $4\sqrt{3}$ 3. $\sqrt{3}$ 4. $-7\sqrt{5}$ 5. $3\sqrt{2}$
6. $\frac{2\sqrt{3}}{3}$ 7. $-1+\sqrt{2}$ 8. $\frac{12+3\sqrt{2}}{14}$

Exercise 4a – Factorising and the quadratic formula

1. $(x-3)(x+5)$ 2. $(x-10)(x+1)$ 3. $2x(3x+1)$
4. $(7+2x)(7-2x)$ (Difference of two squares)
5. $(2x-1)(x+3)$ 6. $(2x+1)^2$
7. $x=4\ or\ x=1$ 8. $x=\frac{1}{3}\ or\ x=-1$ 9. $x=\frac{3+\sqrt{17}}{2} or\ x=\frac{3-\sqrt{17}}{2}$

Exercise 4b – Completing the square

1. $(x+4)^2-9$ 2. $(x-1)^2-16$ 3. $(x+3)^2+1$
4. $(x+6)^2+64$ 5. $\left(x-\frac{3}{2}\right)^2-\frac{13}{4}$ 6. $\left(x-\frac{1}{4}\right)^2+\frac{15}{16}$

Exercise 4c – Solving by completing the square

1. $x=-7\ or\ x=1$ 2. $x=3\ or\ x=-1$ 3. $x=-2\ or\ x=-3$

Exercise 5 - Trigonometry

1. $x=9$ 2. $x=15.6$ 3. $\theta s=29.1°$
4. $\theta=45.5°$ 5. $\theta=48.8°$ (Sine Rule) 6. $a=4.7$ (Cosine Rule)

ARE YOU READY FOR AS MATHS? - SOLUTIONS

For each part, give yourself 2 marks for a perfect answer (including working), 1 mark if you used the correct method but made a mistake and 0 marks for doing it totally wrong! The total test is out of 40 and **anything below 24/40 is worrying and means you must go back to the exercises and try again to master the techniques, using the tips on page 2 of the booklet for help.**

1. a) $\frac{3}{2/5} = \frac{3/1}{2/5} = \frac{3}{1} \times \frac{5}{2} = \frac{15}{2}$ b) $\left(\frac{3x}{2}\right)\left(\frac{1}{5}\right) = \frac{3x}{10}$

2. a) $\left(\sqrt{4}\right)^5 = 2^5 = 32$ b) $16^{-\frac{1}{2}} = \left(\frac{1}{16}\right)^{\frac{1}{2}} = \sqrt{\frac{1}{16}} = \frac{1}{4}$

3. a) $\left(\frac{2}{3}\right)\left(\frac{1}{x}\right) = \frac{2}{3}x^{-1}$ b) $\frac{4}{5}x^{\frac{1}{2}}$

4. a) $\sqrt{16}\sqrt{2} = 4\sqrt{2}$

   b) $\sqrt{4}\sqrt{5} + 2\sqrt{9}\sqrt{5} - 3\sqrt{16}\sqrt{5} = 2\sqrt{5} + 6\sqrt{5} - 12\sqrt{5} = -4\sqrt{5}$

5. a) $\frac{1}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{\sqrt{2}\sqrt{2}} = \frac{\sqrt{2}}{2}$

   b) $\frac{5}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} = \frac{10+5\sqrt{3}}{4-2\sqrt{3}+2\sqrt{3}-\sqrt{3}\sqrt{3}} = \frac{10+5\sqrt{3}}{4-3} = 10 + 5\sqrt{3}$

6. a) $(x-8)(x+3)$ b) $(3x+2)(3x-2)$ Difference of two squares

7. a) $x = \frac{-1\pm\sqrt{1-4(6)(-1)}}{2(6)} = \frac{-1\pm\sqrt{1+24}}{12} = \frac{-1\pm\sqrt{25}}{12} = \frac{-1\pm5}{12}$

$$x = \frac{-1+5}{12} = \frac{1}{3} \text{ or } x = \frac{-1-5}{12} = -\frac{1}{2}$$

   b) $x = \frac{7\pm\sqrt{49-4(1)(9)}}{2} = \frac{7\pm\sqrt{49-36}}{2} = \frac{7\pm\sqrt{13}}{2}$, $x = \frac{7+\sqrt{13}}{2}$ or $x = \frac{7-\sqrt{13}}{2}$

8. a) $(x+1)^2 - 1 - 6 = (x+1)^2 - 7$

   b) $\left(x+\frac{3}{2}\right)^2 - \left(\frac{3}{2}\right)^2 + \frac{1}{4} = \left(x+\frac{3}{2}\right)^2 - \frac{9}{4} + \frac{1}{4} = \left(x+\frac{3}{2}\right)^2 - 2$

9. a) $\cos 70° = \frac{x}{24}$, $x = 24\cos 70° = 8.2$

   b) Cosine Rule: $a^2 = 3^2 + 15^2 - 2(3)(15)\cos 150° = 311.9$, $a = 17.7$

10. a) $\cos\theta = \frac{15.1}{16.5}$, $\theta = \cos^{-1}\left(\frac{15.1}{16.5}\right) = 23.8°$

   b) Sine Rule: $\frac{\sin\theta}{8.1} = \frac{\sin 85°}{10.3}$, $\sin\theta = \frac{8.1\times\sin 85°}{10.3} = 0.7834$ ....

$$\theta = \sin^{-1}(0.7834\ldots) = 51.6°$$

Staple your completed test to this booklet and bring it with you to your first lecture in September so you have a record that you can discuss with your lecturer.