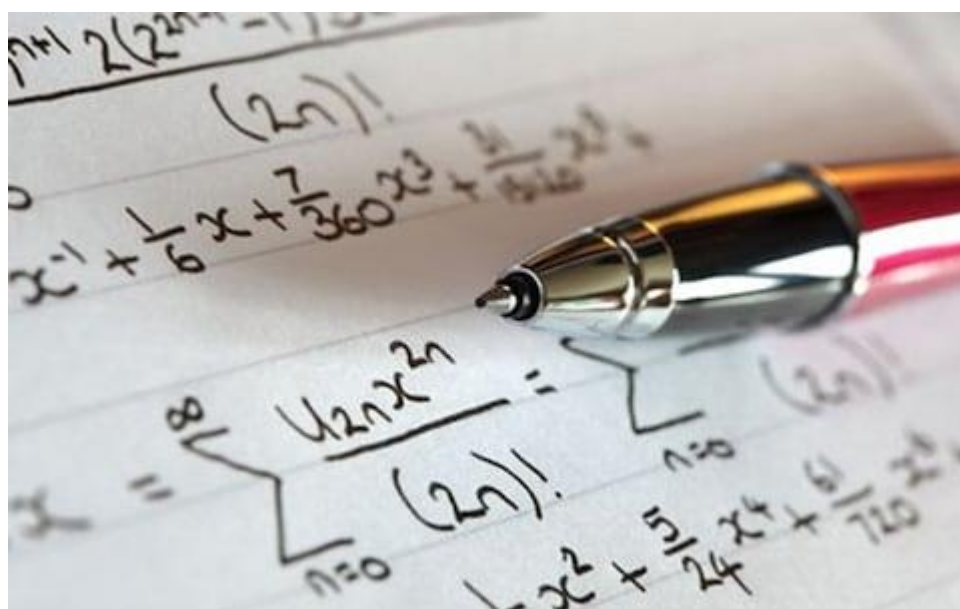# INVICTUS
VITH FORM

Advanced Level

Maths

@ Invictus Sixth Form

Welcome to A Level Mathematics. In this booklet you will be given an overview of what A Level Maths involves and some introductory tasks for you to get back into the swing of things!

Thank you for choosing to study Mathematics in Invictus Sixth Form.
Over the course, you will study topics in Pure Maths, Mechanics and Statistics.

The Mathematics Department is committed to ensuring that you make good progress throughout your A level course. In order that you make the best possible start to the course, we have prepared this booklet. It is vital that you spend time working through Maths questions over the summer as well as completing the summer homework. You need to have a good knowledge of fractions, algebra, indices, trigonometry and surds before you commence your course in September so that using these techniques is quick and automatic.

In the first week of term, you will have induction homework to check how well you understand these topics, so it is important that you have revised these topics by then. The pass mark is 70%. If you do not pass this homework, you will be asked to complete a programme of additional work in order to bring your basic skills to the required standard. If you still fail to meet the required standard, your place on the course will be reconsidered.

Use this introduction to give you a good start to your Year 12 work that will help you to enjoy, and benefit from, the course. The more effort you put in right from the start the better you will do.

Points of contact:

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Mrs R Blake (Head of Mathematics, Wombourne High School, rblake@wombournehighschool.co.uk)
Mr S Knowles (A Level teacher, Crestwood High School, sknowles@crestwood-s.dudley.sch.uk)

Sources for further help are indicated throughout the booklet. All topics can be found on the Hegarty website. You can also find help on the Corbett Maths website should you not yet have a Hegarty log in

You may also find the following book useful
A Level Maths Head Start
Published by CGP Workbooks
ISBN: 978-1782947929

Cost: Approximately £6 from Amazon,

https://www.amazon.co.uk/Head-Start-Level-Maths-2017-2018/dp/1782947922/ref=asc_df_1782947922/?tag=googshopuk-21&linkCode=df0&hvadid=310810203983&hvpos=1o2&hvnetw=g&hvrand=14419411477848798450&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=1007125&hvtargid=pla-487224277129&psc=1&th=1&psc=1

What is the subject about?

A level Mathematics is an interesting and challenging course, which extends the methods you learned at GCSE and includes applications of mathematics, such as Statistics and Mechanics.
At first, you may find the jump in demand from GCSE a little daunting, but if you follow the tips and advice in this guide, you will soon adapt.

What skills will I need and develop in this course?

You will need numerical, problem solving and communication skills. The new A-Level in Mathematics has a greater emphasis on modelling than in previous years. This will be particularly prevalent in the Mechanics content, but evident also in the Pure and Statistics content.

Skills developed include
- Critical thinking.
- Problem solving.
- Analytical thinking.
- Quantitative reasoning.
- Ability to manipulate precise and intricate ideas.
- Construct logical arguments and expose illogical arguments.

What can the course lead to in terms of higher education and future careers?

Studying Maths at A-level or degree opens up all sorts of career opportunities.
Not limited to:

- accountant
- actuary
- computer programmer
- doctor
- engineer
- investment manager
- lawyer
- government research and laboratories
- theoretical mathematician
- mathematician
- numerical analyst
- statistician
- teacher
- market researcher
- systems analyst
- banking
- government
- space/aircraft industry

What we do in Year 12 Mathematics

Content Overview

Pure Mathematics

Algebra and functions
Algebraic expressions – basic algebraic manipulation, indices and surds
Quadratic functions – factorising, solving, graphs and the discriminants
Equations – quadratic/linear simultaneous
Inequalities – linear and quadratic (including graphical solutions)
Graphs – cubic, quartic and reciprocal
Transformations – transforming graphs – $f(x)$ notation
Coordinate geometry in the (x, y) plane
Straight-line graphs, parallel/perpendicular, length and area problems
Circles – equation of a circle, geometric problems on a grid
Further algebra
Algebraic division, factor theorem and proof
The binomial expansion
Trigonometry
Trigonometric ratios and graphs
Trigonometric identities and equations
Vectors (2D)
Definitions, magnitude/direction, addition and scalar multiplication
Position vectors, distance between two points, geometric problems
Differentiation
Definition, differentiating polynomials, second derivatives
Gradients, tangents, normals, maxima and minima
Integration
Definition as opposite of differentiation, indefinite integrals of x^n
Definite integrals and areas under curves
Exponentials and logarithms: Exponential functions and natural logarithms

Statistics

Statistical sampling
Introduction to sampling terminology; Advantages and disadvantages of sampling
Understand and use sampling techniques; Compare sampling techniques in context
Data presentation and interpretation
Calculation and interpretation of measures of location; Calculation and interpretation of measures of variation; Understand and use coding
Interpret diagrams for single-variable data; Interpret scatter diagrams and regression lines; Recognise and interpret outliers; Draw simple conclusions from statistical problems
Probability: Mutually exclusive events; Independent events
Statistical distributions: Use discrete distributions to model real-world situations; Identify the discrete uniform distribution; Calculate probabilities using the binomial distribution (calculator use expected)
Statistical hypothesis testing
Language of hypothesis testing; Significance levels
Carry out hypothesis tests involving the binomial distribution

Mechanics

Quantities and units in mechanics
Introduction to mathematical modelling and standard S.I. units of length, time and mass
Definitions of force, velocity, speed, acceleration and weight and displacement; Vector and scalar quantities
Kinematics 1 (constant acceleration)
Graphical representation of velocity, acceleration and displacement
Motion in a straight line under constant acceleration; *suvat* formulae for constant acceleration; Vertical motion under gravity
Forces & Newton's laws
Newton's first law, force diagrams, equilibrium, introduction to **i**, **j** system
Newton's second law, '$F = ma$', connected particles (no resolving forces or use of $F = \mu R$); Newton's third law: equilibrium, problems involving smooth pulleys
Kinematics 2 (variable acceleration)
Variable force; Calculus to determine rates of change for kinematics
Use of integration for kinematics problems i.e. $r = \int v \, dt$, $v = \int a \, dt$

Assessment Overview (External Exams taken the end of Year 13)
Y12 will involve 2 Mock Examinations on the above content (1 Pure Paper and 1 Applied)

A level Mathematics	
Paper 1: Pure Mathematics 33%, 2 hours, 100 marks	Any pure content can be assessed on either paper
Paper 2: Pure Mathematics 33%, 2 hours, 100 marks	
Paper 3: Statistics and Mechanics 33%, 2 hours, 100 marks	Section A: Statistics (50 marks) Section B: Mechanics (50 marks)

Mathematics Advanced Level Useful Information

Equipment

Below are the minimum stationery requirements to successfully cater for your A-level Maths course:

2 x A4 folders   – for notes, worked examples, classwork, homework and exam prep
     - At least 1 for Pure 1 for applied
2 x A4 folder dividers
Scientific Calculator - A Level Maths ready
     – Recommended Calculator - [classwiz fx 991ex](#)
Pens
Pencils
Ruler
Rubber
Highlighters

Websites

These are websites that you should bookmark. They are extremely useful to either help you do additional research, explain a topic you are finding difficult or support your revision program.

1. Edexcel Website https://qualifications.pearson.com/en/qualifications/edexcel-a-levels/mathematics-2017.html

You will find:

- The specification – this explains exactly what you need to learn for your exams.
- Practice exam papers
- Lists of command words and subject specific vocabulary – so you understand the words to use in exams
- Past papers from the old specification. Some questions won't be relevant to the new AS and A-level so please check with your teacher.

2. Physics and Maths tutor. www.physicsandmathstutor.com/

You will find:

Past Papers and model answers for the Old Specification

Exam questions by topic

Solution Bank – Fully Worked solutions to all exercises in the Pearson text books provided

3. Exam Solutions http://www.examsolutions.net/

This website is full of tutorial videos and has worked solutions o many exam papers.

4. And another for videos to help when you get stuck http://www.themathsteacher.com/index.php it's like having a Maths teacher at home!

5. The student room www.thestudentroom.co.uk

Join the A-level Maths forums and share thoughts and idea with other students if you're stuck with your homework.

6. Youtube
YouTube has thousands of Maths videos. Just be careful to look at who produced the video and why because some videos can be confusing. Check the author, date and comments – these help indicate whether the clip is reliable. If in doubt, ask your teacher

Wider reading - Reading List

As a student who is choosing to study Mathematics at A Level we assume that you have an interest in the subject; the following books may be of interest to you.

Alex's Adventures in Numberland by Alex Bellos

Cabinet of Mathematical Curiosities by Ian Stewart

The Num8er My5teries by Marcus du Sautoy

How Many Socks Make a Pair?: Surprisingly Interesting Maths by Rob Eastway

The Curious Incident of the Dog in the Night-time by Mark Haddon

The Penguin Dictionary of Curious & Interesting Numbers by David Wells

The Calculus Wars by Jason Socrates Bardi

The Code Book by Simon Singh

50 Mathematical Ideas You Really Need to Know by Tony Crilly

Hegarty Maths

For those students who have a Hegarty Maths log in the following tasks are useful to prepare for A level maths

If you do not have a login Colin Hegarty, the creator of Hegarty maths is currently running live lessons everyday (correct at time of writing 28/04/2020) at 2pm on YouTube https://www.youtube.com/HEGARTYMATHS/live to help students prepare for A level, on his YouTube channel you can also find past live lessons he has done.

As you transition from Year 11 to Year 12, it is very important to refresh your memory on certain core mathematical skills. Moreover, it is vital that you have a sound understanding of some more difficult skills. In the tables below, you will find **180 skills** that you should be confident with as you start Year 12. Get 100% on each and use the videos if you are stuck.

Number

Topics	Clip Number	R	A	G
Indices, powers & roots				
Index form 1 (intro)	102			
Index form 2 (power of 0 & 1)	103			
Index form 3 (power of negative integers)	104			
Index form 4 (multiplying indices)	105			
Index form 5 (dividing indices)	106			
Index form 6 (power of power rule)	107			
Index form 7 (powers of unit fractions)	108			
Index form 8 (powers of non-unit fractions)	109			
Index form 9 (combination of rules)	110			
Multiplication & division with surds 1	113			
Multiplication & division with surds 2	114			
Simplifying surds	115			
Brackets involving surds 1	116			
Brackets involving surds 2	117			
Rationalising surds 1	118			
Rationalising surds 2	119			
Order of operations 3 (indices & roots)	120			

Algebra

Topics	Clip Number	R	A	G
Substitution				
Substitution 1	780			
Substitution 2	781			
Substitution 3	782			
Substitution 4	783			
Substitution 5	784			
Substitution 6	785			
Substitution 7	786			
Substitution 8	787			
Substitution (Equations of motion 1)	788			
Substitution (Equations of motion 2)	789			

Topics	Clip Number	R	A	G
Manipulating expressions				
Collecting like terms 2	157			
Simplifying expressions involving multiplication	158			
Simplifying expressions involving division	159			
Expand two single brackets & simplify	161			
Expand double brackets 1	162			
Expand double brackets 2	163			
Expand double brackets 3	164			
Expand brackets (difference of two squares)	165			
Expand triple brackets	166			
HCF of algebraic expressions	167			
Factorise simple expressions 1	168			
Factorise simple expressions 2	169			
Simplifying expressions by factorising 1	170			
Simplifying expressions by factorising 2	171			
Expressions with algebraic fractions	172			
Indices with algebraic expressions 1	173			
Indices with algebraic expressions 2	174			
Indices with algebraic expressions 3	175			

Linear equations				
Solve 1 step equations (balance method)	178			
Solve 2 step equations (involving multiplication)	179			
Solve 2 step equations (involving division)	180			
Solve 2 step equations (x on denominator)	181			
Solve 2 step equations (x negative)	182			
Solve 3 step equations	183			
Solve equations with x on both sides 1	184			
Solve equations with x on both sides 2	185			
Solve equations with x on both sides 3	186			
Solve equations with algebraic fractions	187			
Setup & solve equations (in context)	188			
Simultaneous equations by elimination 4	193			
Simultaneous equations by substitution	194			
Simultaneous equations (in context)	195			

Topics	Clip Number	R	A	G
Linear sequences and graphs				
Midpoint of a line segment	200			
Gradient of a line segment 1	201			
Gradient of a line segment 2 (negative)	202			
Gradient of a line segment 3 (fractions)	203			
Gradient of a line segment 4 (summary)	204			
Straight line graphs 1	206			
Straight line graphs 2	207			
Straight line graphs 3	208			
Straight line graphs 4	209			
Straight line graphs 5	210			
Straight line graphs 6	211			
Straight line graphs 7	212			
Straight line graphs 8	213			
Straight line graphs (parallel)	214			
Straight line graphs (perpendicular) 1	215			
Straight line graphs (perpendicular) 2	216			
Straight line graphs (alternative way to define)	220			
Solving equations & straight lines	217			
Solving simultaneous equations using straight lines 1	218			
Solving simultaneous equations using straight lines 2	219			
Quadratics				
Factorise quadratic expressions 1	223			
Factorise quadratic expressions 2	224			
Factorise quadratic expressions 3	225			
Factorise quadratic expressions 4	226			
Factorise quadratic expressions 5	227			
Factorise quadratic expressions 6	228			
Simplify algebraic fractions (involving quadratics)	229			
Completing the square 1	235			
Completing the square 2	236			
Completing the square 3	237			
Using the discriminant	243			
Solving quadratic equations 1 (by factorising)	230			
Solving quadratic equations 2 (by factorising)	231			
Solving quadratic equations 3 (by factorising)	232			
Solving quadratic equations 4 (by factorising)	233			
Solving quadratic equations 5 (inverse operations)	234			
Solving by completing the square 1	238			
Solving by completing the square 2	239			
Solving using the quadratic formula 1	241			
Solving using the quadratic formula 2	242			
Quadratic equations from algebraic fractions	244			
Quadratic equations in context	245			
Simultaneous equations involving quadratics	246			

Inequalities				
Integer solutions to inequalities	267			
Multiple inequalities on a number line	268			
Solve single linear inequalities 1 (positive x)	269			
Solve single linear inequalities 2 (negative x)	270			
Solve single linear inequalities 3 (difficult)	271			
Linear inequalities as graph regions 1	273			
Linear inequalities as graph regions 2	274			
Linear inequalities as graph regions 3	275			
Linear inequalities as graph regions 4	276			
Solving quadratic inequalities	277			

Topics	Clip Number	R	A	G
Formulae				
Change the subject of the formula 1 (1 step)	280			
Change the subject of the formula 2 (2 step)	281			
Change the subject of the formula 3 (negative x)	282			
Change the subject of the formula 4 (x on denominator)	283			
Change the subject of the formula 5 (x with powers)	284			
Change the subject of the formula 6 (x on both sides)	285			
Change the subject of the formula 7 (x on both sides/denominator)	286			
Important graphs				
Cubic graphs (recognising)	299			
Reciprocal graphs 1	300			
Reciprocal graphs 2	301			
Sine graph	303			
Cosine graph	304			
Tangent graph	305			
Sine, cosine, tangent summary	306			

Graph transformations				
Graph transformations 1 f(x)±a	307			
Graph transformations 2 f(x±a)	308			
Graph transformations 3 af(x)	309			
Graph transformations 4 f(ax)	310			
Graph transformations 5 f(x)	311			
Graph transformations 6 f(x)	312			
Graph transformations 7 (combined)	313			

Geometry and measures

Topics	Clip Number	R	A	G
Non-calculator trigonometry 1	845			
Non-calculator trigonometry 2	846			
Non-calculator trigonometry 3	847			
Non-calculator trigonometry 4	848			
Non-calculator trigonometry 5	849			
Non-calculator trigonometry 6	850			
Non-calculator trigonometry 7	851			
Non-calculator trigonometry (Problem solving 1)	852			
Non-calculator trigonometry (Problem solving 2)	853			

A Level Maths—Enrolment Task

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Answer all questions on a separate piece of paper, showing clear working out.

For Section A, please mark your own work and hand in so we can see methods used.

If you get stuck the following website might be of use (google them)

HegartyMaths, Corbettmaths, physicsandmathstutor

Section A: Basic Maths Work

Here are some questions to keep your mind sharp over the summer before you start in September

Fractions

1. $\dfrac{2}{3} + \dfrac{1}{5}$

2. $\dfrac{5}{6} - \dfrac{1}{4}$

3. $\dfrac{7}{8} \times \dfrac{4}{5}$

4. $\dfrac{5}{6} \div \dfrac{3}{4}$

5. $2\dfrac{2}{3} + 1\dfrac{1}{4}$

6. $3\dfrac{5}{8} + 2\dfrac{3}{7}$

7. $7\dfrac{7}{8} - 4\dfrac{2}{5}$

8. $5\dfrac{1}{6} - 2\dfrac{3}{4}$

9. $2\dfrac{3}{4} \times 1\dfrac{1}{2}$

10. $3\dfrac{1}{2} \times 2\dfrac{3}{7}$

11. $5\dfrac{3}{7} \div 4\dfrac{2}{5}$

12. $3\dfrac{1}{2} \div 2\dfrac{1}{4}$

Algebra:

Expanding Brackets

EXERCISE A   Multiply out the following brackets and simplify.

1. $7(4x + 5)$
2. $-3(5x - 7)$
3. $5a - 4(3a - 1)$
4. $4y + y(2 + 3y)$
5. $-3x - (x + 4)$
6. $5(2x - 1) - (3x - 4)$

7. $(x + 2)(x + 3)$
8. $(t - 5)(t - 2)$
9. $(2x + 3y)(3x - 4y)$
10. $4(x - 2)(x + 3)$
11. $(2y - 1)(2y + 1)$
12. $(3 + 5x)(4 - x)$

EXERCISE B   Expand the following

1. $(x - 1)^2$
2. $(3x + 5)^2$
3. $(7x - 2)^2$

4. $(x + 2)(x - 2)$
5. $(3x + 1)(3x - 1)$
6. $(5y - 3)(5y + 3$

Linear Equations

EXERCISE A: Solve the following equations, showing each step in your working:

1) $2x + 5 = 19$

2) $5x - 2 = 13$

3) $11 - 4x = 5$

4) $5 - 7x = -9$

5) $11 + 3x = 8 - 2x$

6) $7x + 2 = 4x - 5$

EXERCISE B: Solve the following equations.

1) $5(2x - 4) = 4$

2) $4(2 - x) = 3(x - 9)$

3) $8 - (x + 3) = 4$

4) $14 - 3(2x + 3) = 2$

Equations involving Fractions

Exercise: Solve these equations

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

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

3) $\frac{y}{4} + 3 = 5 - \frac{y}{3}$

4) $\frac{x - 2}{7} = 2 + \frac{3 - x}{14}$

5) $\frac{7x - 1}{2} = 13 - x$

6) $\frac{y - 1}{2} + \frac{y + 1}{3} = \frac{2y + 5}{6}$

7) $2x + \frac{x - 1}{2} = \frac{5x + 3}{3}$

8) $2 - \frac{5}{x} = \frac{10}{x} - 1$

Simultaneous Equations:

Exercise: Solve the pairs of simultaneous equations in the following questions:

1) $x + 2y = 7$
   $3x + 2y = 9$

2) $x + 3y = 0$
   $3x + 2y = -7$

3) $3x - 2y = 4$
   $2x + 3y = -6$

4) $9x - 2y = 25$
   $4x - 5y = 7$

5) $4a + 3b = 22$
   $5a - 4b = 43$

6) $3p + 3q = 15$
   $2p + 5q = 14$

Factorising Linear Expressions

EXERCISE A   Factorise each of the following

1) $3x + xy$

2) $4x^2 - 2xy$

3) $pq^2 - p^2q$

4) $3pq - 9q^2$

5) $2x^3 - 6x^2$

6) $8a^5b^2 - 12a^3b^4$

7) $5y(y - 1) + 3(y - 1)$

Factorising quadratic expressions

EXERCISE B   Factorise

1) $x^2 - x - 6$

2) $x^2 + 6x - 16$

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

4) $2x^2 - 3x$

5) $3x^2 + 5x - 2$

6) $2y^2 + 17y + 21$

7) $7y^2 - 10y + 3$

8) $10x^2 + 5x - 30$

9) $4x^2 - 25$

10) $x^2 - 3x - xy + 3y$

11) $4x^2 - 12x + 8$

12) $16m^2 - 81n^2$

13) $4y^3 - 9a^2y$

14) $8(x + 1)^2 - 2(x + 1) - 10$

Changing the subject of a formula

EXERCISE A   Make x the subject of each of these formulae:

1) $y = 7x - 1$

2) $y = \dfrac{x + 5}{4}$

3) $4y = \dfrac{x}{3} - 2$

4) $y = \dfrac{4(3x - 5)}{9}$

EXERCISE B: Make t the subject of each of the following

1) $P = \dfrac{wt}{32r}$

2) $P = \dfrac{wt^2}{32r}$

3) $V = \dfrac{1}{3}\pi t^2 h$

4) $P = \sqrt{\dfrac{2t}{g}}$

5) $Pa = \dfrac{w(v - t)}{g}$

6) $r = a + bt^2$

Surds

EXERCISE A

Simplify

1) $\sqrt{50}$

2) $\sqrt{72}$

3) $\sqrt{27}$

4) $\sqrt{80}$

5) $\sqrt{360}$

6) $\frac{\sqrt{900}}{\sqrt{3}}$

EXERCISE B

Simplify

1) $\sqrt{3} \times \sqrt{7}$

2) $5\sqrt{2} \times 4\sqrt{5}$

3) $3\sqrt{3} \times 2\sqrt{6}$

4) $\sqrt{8} \times \sqrt{27}$

5) $\frac{5\sqrt{20}}{6\sqrt{5}}$

6) $\frac{8\sqrt{18}}{4\sqrt{2}}$

7) $(\sqrt{2} + 1)(\sqrt{2} + 5)$

8) $(5 - \sqrt{3})(\sqrt{2} - 8)$

Exercise C

Simplify

1) $\sqrt{3} + \sqrt{7}$

2) $5\sqrt{2} + 4\sqrt{2}$

3) $3\sqrt{6} + \sqrt{24}$

4) $\sqrt{50} + \sqrt{8}$

5) $\sqrt{27} + \sqrt{75}$

6) $2\sqrt{5} - \sqrt{5}$

7) $\sqrt{72} - \sqrt{50}$

8) $6\sqrt{3} - \sqrt{12} + \sqrt{27}$

9) $\sqrt{200} + \sqrt{90} - \sqrt{98}$

10) $\sqrt{72} - \sqrt{75} + \sqrt{108}$

Exercise D

Rationalise the following:

1

a) $\frac{1}{\sqrt{2}}$

b) $\frac{3}{\sqrt{5}}$

c) $\frac{10}{\sqrt{5}}$

d) $\frac{5}{2\sqrt{7}}$

e) $\frac{\sqrt{3}}{\sqrt{2}}$

f) $\frac{10}{\sqrt{10}}$

g) $\frac{4+\sqrt{7}}{\sqrt{3}}$

h) $\frac{6+8\sqrt{5}}{\sqrt{2}}$

i) $\frac{6-\sqrt{5}}{\sqrt{5}}$

2

a) $\frac{1}{\sqrt{2}-1}$

b) $\frac{2}{\sqrt{6}-2}$

c) $\frac{6}{\sqrt{7}+2}$

d) $\frac{1}{3+\sqrt{5}}$

e) $\frac{1}{\sqrt{6}-\sqrt{5}}$

Graphs

1. Rearrange the following in the form $ax + by + c = 0$ or $ax + by = c$ as convenient, where a, b and c are integers and $a > 0$.

   (a) $y = 3x - 2$ (b) $y = \frac{1}{2}x + 3$

   (c) $y = -\frac{3}{4}x + 3$ (d) $y = \frac{7}{2}x - \frac{5}{4}$

   (e) $y = -\frac{2}{3}x + \frac{3}{4}$ (f) $y = \frac{4}{7}x - \frac{2}{3}$

2. Rearrange the following in the form $y = mx + c$. Hence find the gradient and the y-intercept of each line.

   (a) $2x + y = 8$ (b) $4x - y + 9 = 0$

   (c) $x + 5y = 10$ (d) $x - 3y = 15$

   (e) $2x + 3y + 12 = 0$ (f) $5x - 2y = 20$

   (g) $3x + 5y = 17$ (h) $7x - 4y + 18 = 0$

3. Sketch the following lines. Show on your sketches the coordinates of the intercepts of each line with the x-axis and with the y-axis.

   (a) $2x + y = 8$ (b) $x + 5y = 10$

   (c) $2x + 3y = 12$ (d) $3x + 5y = 30$

   (e) $3x - 2y = 12$ (f) $4x + 5y + 20 = 0$

Trigonometry

Exercise

1. Solve the following equations for $0 \le x < 360$. Give your answers to the nearest $0.1°$.

   (a) $\sin x° = 0.9$ (b) $\cos x° = 0.6$ (c) $\tan x° = 2$

   (d) $\sin x° = -0.4$ (e) $\cos x° = -0.5$ (f) $\tan x° = -3$

2. Solve the following equations for $-180 \le x < 180$. Give your answers to the nearest $0.1°$.

   (a) $\sin x° = 0.9$ (b) $\cos x° = 0.6$ (c) $\tan x° = 2$

   (d) $\sin x° = -0.4$ (e) $\cos x° = -0.5$ (f) $\tan x° = -3$

SECTION B — HIGHER GCSE SKILLS

1. Expand and simplify
   (a) $(2x + 3)(2x - 1)$
   (b) $(a + 3)^2$
   (c) $4x(3x - 2) - x(2x + 5)$

2. Factorise
   (a) $x^2 - 7x$
   (b) $y^2 - 64$
   (c) $2x^2 + 5x - 3$
   (d) $6t^2 - 13t + 5$

3. Simplify
   (a) $\dfrac{4x^3 y}{8x^2 y^3}$
   (b) $\dfrac{3x + 2}{3} + \dfrac{4x - 1}{6}$
   (c) $\dfrac{2}{x-2} + \dfrac{4}{x+3}$

4. Solve the following equations
   (a) $\dfrac{h-1}{4} + \dfrac{3h}{5} = 4$
   (b) $x^2 - 8x = 0$
   (c) $p^2 + 4p = 12$

5. If $2^{2x+1} \times 4^{x+1} = 8^{x+2}$, find the value of x.

6. a) Solve the simultaneous equations
      $3x - 5y = -11$
      $5x - 2y = 7$

   b) Solve the simultaneous equations
      $x^2 + y^2 = 25$
      $x + y = -1$

7. Rearrange the following equations to make x the subject
   (a) $v^2 = u^2 + 2ax$
   (b) $V = \dfrac{1}{3}\pi x^2 h$
   (c) $y = \dfrac{x+2}{x+1}$

8. Solve $5x^2 - x - 1 = 0$ giving your solutions in surd form

9. Find the values of x which satisfy the following inequalities
   (a) $5x - 2 < 6$
   (b) $4 - 2x > 9$
   (c) $x^2 - 6x - 16 > 0$

10. Given $f(x) = 7x - 2$ and $g(x) = 2x^2 + 5x - 1$, find
    (a) $f(3)$
    (b) $g(3)$
    (c) $g(-4)$
    (d) $fg(-2)$

11. Simplify
    (a) $\sqrt{18} \times \sqrt{75}$
    (b) $\sqrt{54} + \sqrt{27}$
    (c) $\dfrac{5}{\sqrt{2}}$
    (d) $\dfrac{3-\sqrt{2}}{\sqrt{6}}$
    (e) $\dfrac{1-\sqrt{2}}{3+\sqrt{2}}$

1) Give your answer in the form a + b√2 , where a and b are rational numbers, find $(3 - \sqrt{8})^2$

2) The line with equation y = x - 2, intersects the circle with equation $y^2 + x^2 = 10$.

a) Write down the centre and radius of the circle

b) Write down the coordinates of the points of intersection of the line and the circle

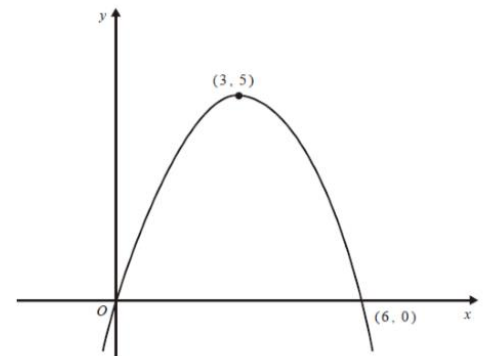3) The diagram shows a sketch of the curve with equation

y = f(x). The curve passes through the origin O

and through the point (6, 0).

The maximum point on the curve is (3, 5).

On separate diagrams, sketch the curve with equation

a) y = 3f(x)

b) y = f(x + 2)

Show clearly the coordinates of the maximum point and of each point at which the curve crosses the x - axis.
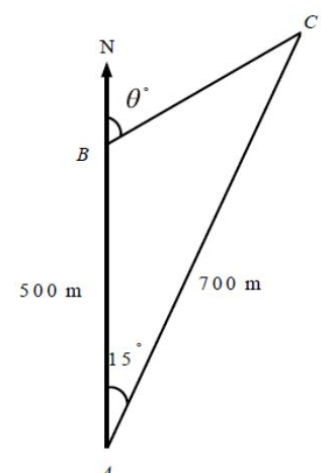
4) The diagram shows 3 yachts A, B and C which are assumed to be in the same horizontal plane. Yacht B is 500m due north of yacht A and yacht C is 700m from A. The bearing of C from A is 015°.

a) Calculate the distance between yacht B and yacht C, in metres

     to 3 significant figures.

The bearing of yacht C from yacht B is θ°, as shown in the diagram.

b)   Calculate the value of θ.

SECTION A

Solutions to the Exercises

1 Fractions

1) $\frac{13}{15}$ 4) $\frac{10}{9}$ 7) $3\frac{19}{40}$ 10) $8\frac{1}{2}$

2) $\frac{7}{12}$ 5) $3\frac{11}{12}$ 8) $2\frac{5}{12}$ 11) $1\frac{18}{77}$

3) $\frac{7}{10}$ 6) $6\frac{3}{56}$ 9) $4\frac{1}{8}$ 12) $1\frac{5}{9}$

2.1 Expanding Brackets

Ex A

1) $28x + 35$ 4) $6y + 3y^2$ 7) $x^2 + 5x + 6$ 10) $4x^2 + 4x - 24$

2) $-15x + 21$ 5) $-4x - 4$ 8) $t^2 - 7t + 10$ 11) $4y^2 - 1$

3) $-7a + 4$ 6) $7x - 1$ 9) $6x^2 + xy - 12y^2$ 12) $12 + 17x - 5x^2$

Ex B

1) $x^2 - 2x + 1$ 3) $49x^2 - 28x + 4$ 5) $9x^2 - 1$

2) $9x^2 + 30x + 25$ 4) $x^2 - 4$ 6) $25y^2 - 9$

2.2 Linear Equations

Ex A

1) 7   2) 3   3) 1½   4) 2   5) $-\frac{3}{5}$ 6) $-\frac{7}{3}$

Ex B

1) 2.4   2) 5   3) 1   4) ½

2.3 Equations Containing Fractions

1) 7   3) 24/7   5) 3   7) 9/5

2) 15   4) 35/3   6) 2   8) 5

2.6 Simultaneous Equations

1) $x = 1, y = 3$ 3) $x = 0, y = -2$ 5) $a = 7, b = -2$

2) $x = -3, y = 1$ 4) $x = 3, y = 1$ 6) $p = 11/3, q = 4/3$

2.7 Factorising Linear Expressions

1) $x(3 + y)$ 4) $3q(p - 3q)$ 7) $(y - 1)(5y + 3)$

2) $2x(2x - y)$ 5) $2x^2(x - 3)$

3) $pq(q - p)$ 6) $4a^3b^2(2a^2 - 3b^2)$

2.8 Factorising Quadratic Expressions

1) $(x - 3)(x + 2)$ 6) $(2y + 3)(y + 7)$ 11) $4(x - 2)(x - 1)$

2) $(x + 8)(x - 2)$ 7) $(7y - 3)(y - 1)$ 12) $(4m - 9n)(4m + 9n)$

3) $(2x + 1)(x + 2)$ 8) $5(2x - 3)(x + 2)$ 13) $y(2y - 3(a)(2y + 3(a)$

4) $x(2x - 3)$ 9) $(2x + 5)(2x - 5)$ 14) $2(4x - 1)(x + 2)$

5) $(3x - 1)(x + 2)$ 10) $(x - 3)(x - y)$

2.11 Changing the Subject of a Formula

Ex A

1) $x = \dfrac{y+1}{7}$

2) $x = 4y - 5$

3) $x = 3(4y + 2)$

4) $x = \dfrac{9y + 20}{12}$

Ex B

1) $t = \dfrac{32rP}{w}$

2) $t = \pm\sqrt{\dfrac{32rP}{w}}$

3) $t = \pm\sqrt{\dfrac{3V}{\pi h}}$

4) $t = \dfrac{P^2 g}{2}$

5) $t = v - \dfrac{Pag}{w}$

6) $t = \pm\sqrt{\dfrac{r-a}{b}}$

Ex C

1) $x = \dfrac{c-3}{a-b}$

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

3) $x = \dfrac{2y + 3}{5y - 2}$

4) $x = \dfrac{ab}{b-a}$

2.13 Surds

Ex A

1) $5\sqrt{2}$
2) $6\sqrt{2}$

3) $3\sqrt{3}$
4) $4\sqrt{5}$

5) $6\sqrt{10}$
6) $10\sqrt{3}$

Ex B

1) $\sqrt{21}$
2) $20\sqrt{10}$
3) $18\sqrt{2}$

4) $6\sqrt{6}$
5) $\dfrac{5}{3}$
6) 6

7) $7 + 6\sqrt{2}$
8) $5\sqrt{2} - 40 - \sqrt{6} + 8\sqrt{3}$

Ex C

1) $\sqrt{3} + \sqrt{7}$
2) $9\sqrt{2}$
3) $5\sqrt{6}$

4) $7\sqrt{2}$
5) $8\sqrt{3}$
6) $\sqrt{5}$

7) $\sqrt{2}$
8) $7\sqrt{3}$
9) $3\sqrt{2} + 3\sqrt{10}$

10) $6\sqrt{2} + \sqrt{3}$

Ex D

1

a) $\dfrac{\sqrt{2}}{2}$

b) $\dfrac{3\sqrt{5}}{5}$

c) $2\sqrt{5}$

d) $\dfrac{5\sqrt{7}}{14}$

e) $\dfrac{\sqrt{6}}{2}$

f) $\sqrt{10}$

g) $\dfrac{4\sqrt{3} + \sqrt{21}}{3}$

h) $3\sqrt{2} + 4\sqrt{10}$

i) $\dfrac{6\sqrt{5} - 5}{5}$

2

a) $\sqrt{2} + 1$

b) $\sqrt{6} + 2$

c) $2(\sqrt{7} - 2)$
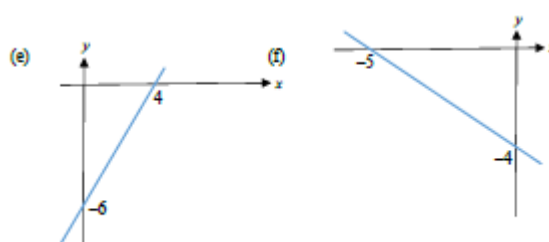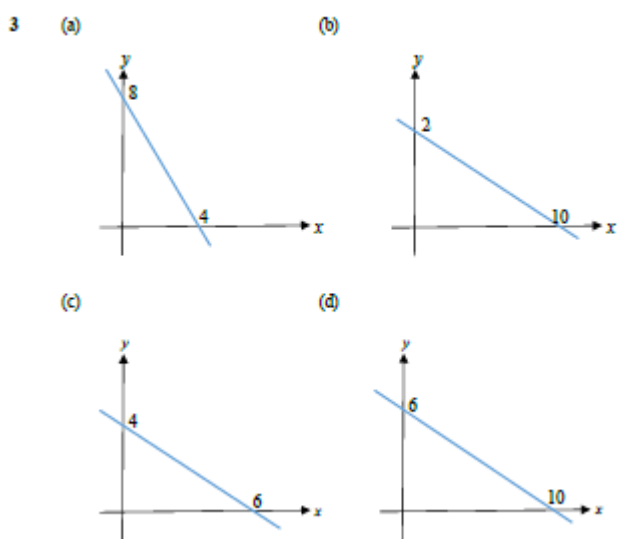
d) $\tfrac{1}{4}(3 - \sqrt{5})$

e) $\sqrt{6} + \sqrt{5}$

Graphs

4.1 Straight Line Graphs

1   (a) $3x - y = 2$ (b) $x - 2y + 6 = 0$
      (c) $3x + 4y = 12$ (d) $14x - 4y = 5$
      (e) $8x + 12y = 9$ (f) $12x - 21y = 14$

2   (a) $y = -2x + 8; -2, 8$ (b) $y = 4x + 9; 4, 9$
      (c) $y = -\frac{1}{5}x + 2; -\frac{1}{5}, 2$ (d) $y = \frac{1}{3}x - 5; \frac{1}{3}, -5$
      (e) $y = -\frac{2}{3}x - 4; -\frac{2}{3}, -4$ (f) $y = \frac{5}{2}x - 10; \frac{5}{2}, -10$
      (g) $y = -\frac{3}{5}x + \frac{17}{5}; -\frac{3}{5}, \frac{17}{5}$ (h) $y = \frac{7}{4}x + \frac{9}{2}; \frac{7}{4}, \frac{9}{2}$

3   (a)   (b)

    (c)   (d)

5 Trigonometry

1   (a)   64.2, 115.8   (b)   53.1, 306.9   (c)   63.4, 243.4
      (d)   203.6, 336.4   (e)   120, 240   (f)   108.4, 288.4

2   (a)   64.2, 115.8   (b)   53.1, –53.1   (c)   63.4, –116.6
      (d)   –23.6, –156.4   (e)   120, –120   (f)   –71.5, 108.4

If you need any assistance with any work you complete please use the websites earlier in this booklet or for extra help you can contact any of the staff mentioned earlier in this booklet

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