



Course Start

Name:

Course Start is independent learning you need to complete as a fundamental part of your introduction to the course. It should take you approximately 3 hours to complete.

Course Name	IB Maths Analysis and Approaches Higher Level
How this Course Start fits into the first term of the course	All topics covered in the course start are prerequisites for the work covered in the first term.
How will my Course Start learning be used in lessons?	In the first few weeks we jump straight into one of the most important topics in mathematics - calculus. The work in the summer booklet is tailored towards giving you a flying start in this area.
Course Start learning objectives	• Refresh memory from GCSE topics • Fill in any gaps which may be present from GCSE • Start the course with confidence!
Study Skills	We are developing resilience and the ability to work independently here.

What this course involves
Completing Planned Study (independent learning) of 2-3 hours per week.
Developing independent learning skills (e.g. time management, preparing for each week's lessons, completing learning tasks outside lessons)
Completing an internally assessed exploration in which you research and explore an area of mathematics of your choice (20% of final grade)
The higher maths course is challenging and will require a good deal of independent work and commitment. Some of the topics reach towards and into 1st year university material. Expect to be challenged, but also rewarded with plenty of interesting mathematics and the satisfaction of solving problems.

IB HIGHER MATHS

Course Start Booklet

Are you ready for Higher Maths Test %

Need help completing or understanding anything in this booklet? Watch the videos at the start of each exercise.

Need more help? Come to our Maths Support Sessions at 10:00-12:00 on Wednesday 2nd September, Thursday 3rd September, Friday 4th September. Come to the STEM Centre, room S6.

Welcome to Varndean Maths. We aim high as a Department, and we want you to be aiming high too! This booklet has been designed to help you to bridge the gap between GCSE Maths and IB Maths. Be sure to complete it all and bring it to your first lesson!

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Read the below carefully before you start this booklet

Things to do before enrolment:

You must complete **all** of this booklet and bring it to your **first lesson**. Your teacher will expect this to be **100% complete and correct** when you arrive. Write all your working in the booklet.

Check all of your answers to the questions against those on the answer sheet (Page 3) and tick them off as you go.

Developing strong Algebra is very important in IB level maths. When you see this icon the exercises should be completed **without** using a calculator. These questions will help you practice and hone your skills.



Get help when you are stuck! Maths can be tough and getting stuck is normal. What makes a successful Varndean maths student is one who proactively seeks help to solve problems.

How to get help:

Watch the videos on any concept you need help with. You could also attend the Maths Support Sessions at 10:00-12:00 on Wednesday 2nd September, Thursday 3rd September and Friday 4th September. Come to the STEM Centre, room S6.

Make sure you are confident with all of the concepts in this booklet. There will be a **test** in your **second maths lesson** on the topics in this booklet to assess your skills.

The Recreational maths section (see next page for more details) is just for 'fun, and is not compulsory for anyone. If you enjoy maths challenges, check this section out. You may want to join our maths challenge team next year!

WHEN (NOT IF) YOU GET STUCK

Studying Maths at Advanced Level is all about Problem Solving. This is a skill that takes work and development. The first stage of solving problems is being stuck. You may get stuck for a short while, or you may find that if you leave the problem for a day or so something clicks and you figure it out (which is a great feeling!). Sometimes you will be stuck to the point that you need help. This is perfectly normal. In fact, it is **expected** that you will get stuck and will need help at some point.

Some of these topics may seem unfamiliar to you, but they are all GCSE level topics and you need to be able to perform all of these techniques **before** you begin studying here.

So, when you get stuck:

- Watch the 'Need Help?' YouTube videos by scanning the QR codes for more explanation and examples, or type the video titles directly into YouTube to access them
- Look again at the examples in the booklet and work through them to make sure you understand each step they have taken.
- Try looking up the topic in a GCSE higher tier textbook or revision guide (your local library will have one) or look online
- Meet up with a friend if you know they too are studying maths here and work through the problem together
- Attend the help sessions in the days after enrolment as detailed on the front page of this booklet
- If you have any questions about the course you could also e mail Tim (higher maths teacher) on tow@varndean.ac.uk

FUN MATHS?

There is also some extra maths right at the end of this booklet. These are 'Maths Challenge' type questions. We enter the Senior Maths Challenge and the Senior Maths **Team** Challenge. If you like different and challenging maths problems, feel free to have a go. These are entirely optional, and are meant to be for fun, but if you would like to be considered for the Varndean Maths Team we suggest getting used to questions such as these early on. There is a weekly maths club where we look at problems like these as well as other recreational maths problems.

ANSWERS - SECTIONS 1, 2, 3, 4, & 5

SECTION 1 – INDICES

EX 1A:

1) $\frac{1}{64}$ 2) $\frac{1}{3}$ 3) $\frac{1}{3}$ 4) 32 5) 8 6) $\frac{1}{128}$

EX 1B:

1) $\frac{1}{5}x$ 2) $\frac{3}{2}x^{-\frac{1}{2}}$ 3) $\frac{1}{3}x^{-\frac{3}{2}}$ 4) $2x^{\frac{2}{3}}$ 5) $2x^{-\frac{3}{2}} + 4x^{-2}$

6) $\frac{2}{3}x^{-1} - \frac{4}{3}x^{-2}$ 7) $\frac{1}{4}x^{-3} - x^{-2}$ 8) $x^{-1} - 4x^{-\frac{1}{2}}$ 9) $x^{\frac{3}{2}} - 3x^{-\frac{1}{2}}$

10) $x^{-1} - 2x^{-2}$ 11) $2x^{-\frac{1}{2}} + 1$ 12) $\frac{1}{2} + x^{-1}$ 13) $\frac{1}{3}x^{-\frac{3}{2}} + 2x^{-2}$

14) $2x^{-1} - x^{-2}$

EX 1C:

1) $x = \frac{1}{27}$ 2) $x = \frac{1}{25}$ 3) $x = 32$ 4) $x = 64$ 5) $x = \frac{1}{81}$ 6) $x = \frac{1}{125}$

SECTION 2 – FRACTIONS

EX 2A:

1) $3x$ 2) $\frac{2x+3}{x^2}$ 3) $\frac{3x}{10}$ 4) 2 5) $\frac{27}{8}$ 6) $-\frac{8}{11}$

7) $\frac{3x-4}{2x}$ 8) $\frac{2x^2+25}{5x}$

EX 2B:

1) $x = \frac{10}{33}$ 2) $x = \frac{23}{2}$ 3) $x = \frac{6}{5}$ 4) $x = \frac{5}{9}$ 5) $x = \frac{14}{45}$ 6) $x = \frac{1}{4}$

SECTION 3 – SURDS

EX 3A:

1) $3\sqrt{3}$ 2) $3\sqrt{5}$ 3) $2\sqrt{3}$ 4) $4\sqrt{3}$ 5) $5\sqrt{3}$ 6) $\sqrt{3}$

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

EX 3B:

1) $17\sqrt{3}$ 2) $\sqrt{2}$ 3) $-4\sqrt{5}$ 4) $-4\sqrt{7} - 14\sqrt{2}$

EX 3C:

1) $\frac{\sqrt{2}}{2}$ 2) $\frac{2\sqrt{7}}{7}$ 3) $-\frac{7\sqrt{5}}{20}$ 4) $\frac{\sqrt{6}}{9}$ 5) $-1 + \sqrt{2}$

6) $10 + 5\sqrt{3}$ 7) $2 + 2\sqrt{3}$ 8) $\frac{-4+6\sqrt{2}}{7}$

SECTION 4 – EXPANDING BRACKETS

EX 4:

1) $2x^3 - 11x^2 - 21x$ 2) $10x^3 - 11x^2y + 20x^2 + 3xy^2 - 12xy$

3) $x^3 - 13x - 12$ 4) $18x^3 - 15x^2 - 4x + 4$

5) $3x^3 - 3xy^2 - 2x^2 + 2y^2$ 6) $8x^3 - 36x^2y + 54xy^2 - 27y^3$

$$7) abc + abd + c^2a + cad + b^2c + b^2d + bc^2 + bcd$$

SECTION 5 – FACTORISING

EX 5A:

$$1) (x + 1)(x - 1) \quad 2) (2x - 3)(2x + 3) \quad 3) (7 - 3x)(7 + 3x)$$

$$4) (2\sqrt{2} - \sqrt{2}x)(2\sqrt{2} + \sqrt{2}x) \quad 5) (b^2 - c^4)(b^2 + c^4) \quad 6) (\sqrt{a} - \sqrt{b})(\sqrt{a} + \sqrt{b})$$

EX 5B:

$$1) x(3x + 4) \quad 2) 2y(2y + 5) \quad 3) x(x + y + y^2) \quad 4) 2xy(4y + 5x)$$

$$5) (x + 1)(x + 2) \quad 6) (2x - 3)(x + 1) \quad 7) (5x + 2)(x - 3)$$

$$8) (1 - x)(6 + x) \quad 9) x(x + 6)(x - 6) \quad 10) x(2x - 3)(x + 5)$$

MINI TEST 1 - SECTIONS 1, 2, 3, 4 & 5 ANSWERS

$$1) \text{ a) } \frac{1}{3} \quad \text{ b) } \frac{1}{128}$$

$$2) \text{ a) } \frac{2}{3}x^{-1} - \frac{4}{3}x^{-2} \quad \text{ b) } x^{\frac{3}{2}} - 3x^{-\frac{1}{2}}$$

$$3) \text{ a) } x = \frac{1}{25} \quad \text{ b) } x = \frac{1}{125}$$

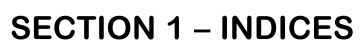
$$4) \text{ a) } \frac{2x^2 + 25}{5x} \quad \text{ b) } 2$$

$$5) x = \frac{1}{4}$$

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

$$7) 18x^3 - 15x^2 - 4x + 4$$

$$8) \text{ a) } 2xy(5x + 4y) \quad \text{ b) } x(x - 6)(x + 6)$$



At Varndean we may use a lot of video learning for students to feel prepared before classes and to access help. Scan the QR codes using your SmartPhone or Tablet (or type in the video title into Youtube) and we can get started 😊

EXERCISE 1A – SIMPLIFYING INDICES



Need help? or type 'COSBICMATHS HELP EX1A' into Youtube

1) $2^{-6} =$	2) $9^{-\frac{1}{2}} =$	3) $81^{-\frac{1}{4}} =$
4) $4^{\frac{5}{2}} =$	5) $32^{\frac{3}{5}} =$	6) $16^{-\frac{7}{4}} =$

EXERCISE 1B

Write these in the form of $ax^n + bx^m$:



Need help?  or type 'COSBICMATHS HELP EX1B' into Youtube

1) $\frac{x}{5} =$	2) $\frac{3}{2\sqrt{x}} =$	3) $\frac{\sqrt{x}}{3x^2} =$

4) $\sqrt[3]{8x^2} =$	5) $\frac{2\sqrt{x+4}}{x^2} =$	6) $\frac{2x-4}{3x^2} =$
7) $\frac{1-4x}{4x^3} =$	8) $\frac{(1-4\sqrt{x})}{x} =$	9) $\frac{(x^2-3)}{\sqrt{x}} =$
10) $\frac{x-2}{x^2} =$	11) $\frac{(2+\sqrt{x})}{\sqrt{x}} =$	12) $\frac{2x+4}{4x} =$
13) $\frac{\sqrt{x+6}}{3x^2} =$	14) $\frac{2x-1}{x^2} =$	

Solve each of the following equations for x . Remember to tick your answers once you have checked you are correct.



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SECTION 2 – FRACTIONS



Fractions play an extremely important role in mathematics, and being able to manipulate them fluidly will really help you when working with more complicated problems.

EXERCISE 2A – WRITING AS A SINGLE FRACTION

Write the following as a single fraction



Need help?  or type 'COSBICMATHS HELP EX2A' into Youtube

1) $\frac{3x}{5} \times 5 =$

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

3) $\frac{3x}{2} \div 5 =$

4) $\frac{3}{2} \div \frac{1}{4} \div 3 =$

5) $\left(\frac{3}{2} \times \frac{1}{4}\right) + 3 =$

6) $\left(\frac{12}{11} - \frac{4}{3}\right) \div \frac{1}{3} =$

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

$$8) \frac{5}{x} + \frac{2x}{5} =$$

EXERCISE 2B – SIMPLIFYING FRACTIONS & SOLVING FOR X

Let's combine everything we have done so far.

Put the following into a single fraction and solve each of the following equations for x .



Need help?  or type 'COSBICMATHS HELP EX2B' into Youtube

$$1) 3 - \frac{x+2}{4} = 8x$$

$$2) \frac{x+1}{3} + \frac{4x}{12} = 8$$

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

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

$$5) \frac{\sqrt{16x^2}}{3x^2} - 4 = \frac{2}{7}$$

$$6) 3x^{-\frac{1}{2}} - \frac{2\sqrt{x}+4}{5x} = \frac{1}{\sqrt{x}}$$

SECTION 3 – SURDS



A surd is an example of an irrational number where the $\sqrt{}$ sign remains. An irrational number means that the number cannot be written as a whole number or as a fraction. So $\sqrt{4}$ is not a surd, as $\sqrt{4} = 2$, and 2 is a rational number.

However, $\sqrt{3}$ is a surd because it cannot be broken down any further and the $\sqrt{}$ sign has remained.

EXERCISE 3A – SIMPLIFYING SURDS

Simplify the below into surd form as far as possible, writing your answers as $a\sqrt{b}$
Remember to tick off your answers as you go.



Need help?  or type 'COSBICMATHS HELP EX3A' into Youtube

1) $\sqrt{27} =$ 	2) $\sqrt{45} =$ 	3) $\sqrt{12} =$
4) $\sqrt{48} =$ 	5) $\sqrt{75} =$ 	6) $\frac{\sqrt{12}}{2} =$
7) $\frac{\sqrt{98}}{7} =$ 	8) $\frac{\sqrt{18}}{\sqrt{2}} =$ 	9) $\frac{\sqrt{27}}{\sqrt{3}} =$

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EXERCISE 3B – COLLECTING SURD TERMS

Collect the terms and simplify the below into a single surd, broken down as far as possible into the form $a\sqrt{b}$



Need help? or type 'COSBICMATHS HELP EX3B' into Youtube

1) $\sqrt{12} + 3\sqrt{75} =$

2) $\sqrt{200} + \sqrt{18} - 2\sqrt{72} =$

3) $\sqrt{20} + 2\sqrt{45} - 3\sqrt{80} =$

$$4) 4\sqrt{7} - 2\sqrt{98} - 4\sqrt{28} =$$

EXERCISE 3C – RATIONALISING DENOMINATORS

Rationalise the denominators and then simplify to put the following in the form $a\sqrt{b}$ or if appropriate $a + b\sqrt{c}$



Need help? or type 'COSBICMATHS HELP EX3C' into Youtube

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

$$2) \frac{2}{\sqrt{7}} =$$

$$3) \frac{-7}{4\sqrt{5}} =$$

$$4) \frac{\sqrt{2}}{3\sqrt{3}} =$$

$$5) \frac{1}{1+\sqrt{2}} =$$

$$6) \frac{5}{2-\sqrt{3}} =$$

$$7) \frac{4}{\sqrt{3}-1} =$$

$$8) \frac{2\sqrt{2}}{\sqrt{2}+3} =$$

Factorise the following by splitting these expressions into the difference of two squares – using the rule that $a^2 - b^2 = (a + b)(a - b)$



Factorise the following completely:


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

$$2) 4y^2 + 10y =$$

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3) $x^2 + xy + xy^2 =$

11

4) $8xy^2 + 10x^2y =$

10

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

11

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

11

$$7) 5x^2 - 13x - 6 =$$

11

8) $6 - 5x - x^2 =$

11

9) $x^3 - 36x =$

11

10) $2x^3 + 7x^2 - 15x =$

11

MINI TEST 1 - SECTIONS 1, 2, 3, 4



You've completed all the exercises in Sections 1, 2, 3, 4, well done!

The important question now is whether your brain has really learned the techniques covered so far. To find out, use this mini-test in exam conditions then mark it yourself using the answers at the back of the booklet and give yourself a score. You should aim for 13/13 of course but certainly anything less than 8/13 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. If you feel you need help, follow the tips on pages 3 and 4 of this booklet, or watch the video help again for more explanation.

Time: 30 minutes. No Calculator allowed. Good Luck!

FROM SECTION 1

1) Evaluate the following:

a) $81^{-\frac{1}{4}}$ b) $16^{-\frac{7}{4}}$

2) Write these in the form of $ax^n + bx^m$:

a) $\frac{2x-4}{3x^2}$ b) $\frac{(x^2-3)}{\sqrt{x}}$

3) Solve each of the following equations for x .

a) $x^{-\frac{1}{2}} = 5$ b) $x^{\frac{2}{3}} = \frac{1}{25}$

FROM SECTION 2

4) Write the following as a single fraction

a) $\frac{5}{x} + \frac{2x}{5}$ b) $\frac{3}{2} \div \frac{1}{4} \div 3$

5) Put the following into a single fraction and solve each of the following equations for x .

$$3x^{-\frac{1}{2}} - \frac{2\sqrt{x}+4}{5x} = \frac{1}{\sqrt{x}}$$

FROM SECTION 3

6) Rationalise the denominators and then simplify to put the following in the form $a\sqrt{b}$ or $c + a\sqrt{b}$

$$\frac{5}{2-\sqrt{3}}$$

FROM SECTION 4

7) Expand the following brackets and collect like-terms:

$$(3x - 2)(2x + 1)(3x - 2)$$

FROM SECTION 5

8) Factorise the following completely:

a) $8xy^2 + 10x^2y$ b) $x^3 - 36x$

Out of 13

ANSWERS - SECTIONS 6, 7, & 8

SECTION 6 – QUADRATICS

EX 6A:

- 2) Discriminant = 0, repeated real roots 3) Discriminant = 52, two distinct real roots
4) Discriminant = -36, no real roots 5) Discriminant = 25, two distinct real roots
6) Discriminant = -248, no real roots

EX 6B:

- 1) $x = -1, x = -2$ 2) $x = 5, x = 3$ 3) $x = 0, x = 4$ 4)
 $x = -\frac{1}{2}, x = -3$
5) $x = \frac{3}{2}, x = -\frac{2}{3}$ 6) $x = \frac{5}{2}, x = \frac{3}{2}$

EX 6C:

- 1) $x = \frac{3+\sqrt{17}}{2}, x = \frac{3-\sqrt{17}}{2}$ 2) $x = -3 + \sqrt{3}, x = -3 - \sqrt{3}$ 3)
 $x = \frac{-9+\sqrt{101}}{10}, x = \frac{-9-\sqrt{101}}{10}$
4) $x = \frac{3+3\sqrt{17}}{4}, x = \frac{3-3\sqrt{17}}{4}$ 5) $x = \frac{8+2\sqrt{10}}{3}, x = \frac{8-2\sqrt{10}}{3}$ 6) $x = \frac{11+\sqrt{337}}{6}, x = \frac{11-\sqrt{337}}{6}$

EX 6D:

- 1) $\frac{3+\sqrt{17}}{2}, x = \frac{3-\sqrt{17}}{2}$ 2) $x = -3 + \sqrt{3}, x = -3 - \sqrt{3}$ 3)
 $x = \frac{-9+\sqrt{101}}{10}, x = \frac{-9-\sqrt{101}}{10}$
4) $x = \frac{3+3\sqrt{17}}{4}, x = \frac{3-3\sqrt{17}}{4}$ 5) $x = \frac{8+2\sqrt{10}}{3}, x = \frac{8-2\sqrt{10}}{3}$ 6)
 $x = \frac{11+\sqrt{337}}{6}, x = \frac{11-\sqrt{337}}{6}$

SECTION 7 – LINE GEOMETRY

EX 7A:

- 1) $m = -\frac{1}{3}$ 2) $m = -2$ 3) $m = \frac{11}{7}$

EX 7B:

- 1) $x - y + 2 = 0$ 2) $4x - y - 23 = 0$ 3) $x - 2y + 2 = 0$ 4) $8x + y + 33 = 0$

SECTION 8 – GCSE STATISTICS REVISION

EX 8A:

- 1) $Mode = 9, Mean = 9.5, Q_1 = 2.5, Q_2 = 6, Q_3 = 9$
2) $Mode = no\ mode, Mean = 39.3, Q_1 = 9, Q_2 = 44, Q_3 = 76$
3) $Mode = 86, Mean = 143.8, Q_1 = 86, Q_2 = 87, Q_3 = 94$

EX 8B:

- 1) $\bar{x} = 34.5$ 2) $\bar{x} = 345.1$ 3) $\bar{x} = 82.3$

MINI TEST 2 - SECTIONS 6, 7, & 8 ANSWERS

1) a) *discriminant* = 0, *repeated real roots* b) *discriminant* = 52, *2 distinct real roots*

2) a) $x = -\frac{1}{2}, x = -3$

b) $x = \frac{3}{2}, x = -\frac{2}{3}$

3) a) $x = \frac{3+3\sqrt{17}}{4}, x = \frac{3-3\sqrt{17}}{4}$

b) $x = \frac{8+2\sqrt{10}}{3}, x = \frac{8-2\sqrt{10}}{3}$

4) a) $\frac{3+\sqrt{17}}{2}, x = \frac{3-\sqrt{17}}{2}$

b) $x = -3 + \sqrt{3}, x = -3 - \sqrt{3}$

5) a) $m = -2$

b) $m = \frac{11}{7}$

6) a) $4x - y - 23 = 0$

b) $x - 2y + 2 = 0$

7) *Mode* = no mode, *Mean* = 39.3, $Q_1 = 9$, $Q_2 = 44$, $Q_3 = 76$

8) $\bar{x} = 345.1$

SECTION 6 – QUADRATICS

You should already know what a quadratic is, but in order to start IB Maths you need to REALLY understand how to manipulate and interpret quadratics. That's why this time, we've made videos for each exercise to help out!

EXERCISE 6A – FINDING THE DISCRIMINANT

Write down the discriminant of each of these quadratics, and state whether each equation has one repeated real root, two distinct real roots, or no real roots



Need help?  or type 'COSBICMATHS HELP EX6A' into Youtube

Quadratic	Discriminant	Number of roots (circle)
1) EXAMPLE $x^2 + 8x + 7 = 0$	$(8)^2 - 4(1)(7) = 36$ > 0	Repeated real roots Two distinct real roots No real roots ☒
2) $4x + 2x^2 + 2 = 0$		Repeated real roots Two distinct real roots No real roots ☐
3) $4x - 3x^2 = -3$		Repeated real roots Two distinct real roots No real roots ☐
4) $2x = 2x^2 + 5$		Repeated real roots Two distinct real roots No real roots ☐
5) $-5x + 4x^2 = 0$		Repeated real roots Two distinct real roots No real roots ☐
6) $-2x + 9x^2 = -7$		Repeated real roots Two distinct real roots No real roots ☐

EXERCISE 6B – SOLVING QUADRATICS THROUGH FACTORISING

Solve the following quadratics **by factorising**



Need help?  or type 'COSBICMATHS HELP EX6B' into Youtube

1) $x^2 + 3x + 2 = 0$

2) $x^2 - 8x + 15 = 0$

3) $x^2 = 4x$

4) $2x^2 + 7x + 3 = 0$

$$5) 6x^2 - 5x - 6 = 0$$

$$6) 4x^2 - 16x + 15 = 0$$

EXERCISE 6C – SOLVING QUADRATICS BY COMPLETING THE SQUARE

Solve the following quadratics **by Completing the Square** i.e. writing the quadratic in

$(x + p)^2 + q = 0$ form and solving for x



Need help?  or type 'COSBICMATHS HELP EX6C' into Youtube

$$1) x^2 - 3x - 2 = 0$$

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

$$3) 5x^2 + 9x - 1 = 0$$

$$4) 2x^2 - 3x - 18 = 0$$

$$5) 3x^2 + 8 = 16x$$

$$6) 2x^2 + 11x = 5x^2 - 18$$

EXERCISE 6D – SOLVING QUADRATICS USING THE QUADRATIC FORMULA

Solve the same quadratics as in EX 6C, but this time using **the quadratic formula** $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$



Need help?  or type 'COSBICMATHS HELP EX6D' into Youtube

$$1) x^2 - 3x - 2 = 0$$

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

$$3) 5x^2 + 9x - 1 = 0$$

$$4) 2x^2 - 3x - 18 = 0$$

$$5) 3x^2 + 8 = 16x$$

$$6) 2x^2 + 11x = 5x^2 - 18$$

SECTION 7 – LINE GEOMETRY

We know that you will have seen a straight line equation being represented as $y = mx + c$. We are going to expand on this knowledge and generate a new formula $y - y_1 = m(x - x_1)$.

EXERCISE 7A – THE GRADIENT BETWEEN POINTS

Work out the gradient of the line joining the following points:



Need help? or type 'COSBICMATHS HELP EX7A' into Youtube

1) $(-2, 7)$ and $(4, 5)$ $m =$ 	2) $(2, -5)$ and $(3, -7)$ $m =$ 	3) $(-3, -1)$ and $(4, 10)$ $m =$
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EXERCISE 7B – LINE EQUATIONS

Using the formula $y - y_1 = m(x - x_1)$, write the following line equations passing through the two given points in the form $ax + by + c = 0$ where a , b , and c are integers



Need help? or type 'COSBICMATHS HELP EX7B' into Youtube

1) $(0, 2)$ and $(3, 5)$

2) $(5, -3)$ and $(7, 5)$

3) $(-4, -1)$ and $(6, 4)$

4) $(-4, -1)$ and $(-3, -9)$

SECTION 8 – GCSE STATISTICS REVISION

EXERCISE 8A – FINDING AVERAGES OF DISCRETE DATA

By listing the following numbers in ascending order, write down the mean, median (Q_2) and upper and lower quartiles (Q_1 and Q_3), and the mode.



Need help?  or type 'COSBICMATHS HELP EX8A' into Youtube

1) 3, 7, 1, 40, 5, 9, 2, 9

Mode =

Mean =

Q_2 =

Q_1 =

Q_3 =

2) 76, 56, 44, 77, 12, 1, 9

Mode =

Mean =

Q_2 =

Q_1 =

Q_3 =

3) 101, 90, 91, 87, 86, 86, 86, 94, 104, 1000, 3, 20, 21

Mode =

Mean =

$Q_2 =$

$Q_1 =$

$Q_3 =$

MINI TEST 2 - SECTIONS 6, 7, & 8



You've completed all the exercises in Sections 6, 7, & 8, well done!

The important question now is whether your brain has really learned the techniques covered so far. To find out, use this mini-test in exam conditions then mark it yourself using the answers at the back of the booklet and give yourself a score. You should aim for 14/14 of course but certainly anything less than 9/14 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. If you feel you need help, follow the tips on pages 3 and 4 of this booklet, or watch the video help again for more explanation.

Time: 30 minutes. Are **are** allowed a calculator for this test. Good Luck!

FROM SECTION 6

- 1) Write down the discriminant of each of these quadratics, and state whether each equation has one repeated real root, two distinct real roots, or no real roots

a) $4x + 2x^2 + 2 = 0$ b) $4x - 3x^2 = -3$

- 2) Solve the following quadratics **by factorising**

a) $2x^2 + 7x + 3 = 0$ b) $6x^2 - 5x - 6 = 0$

- 3) Solve the following quadratics **by Completing the Square**

a) $2x^2 - 3x - 18 = 0$ b) $3x^2 + 8 = 16x$

- 4) Solve the following quadratics **using the quadratic formula**

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

FROM SECTION 7

- 5) Work out the gradient of the line joining the following points:

a) $(2, -5)$ and $(3, -7)$ b) $(-3, -1)$ and $(4, 10)$

- 6) Using the formula $y - y_1 = m(x - x_1)$, write the following line equations passing through the two given points in the form $ax + by + c = 0$ where a , b , and c are integers

a) $(5, -3)$ and $(7, 5)$ b) $(-4, -1)$ and $(6, 4)$

FROM SECTION 8

- 7) By listing the following numbers in ascending order, write down the mean, median (Q_2) and upper and lower quartiles (Q_1 and Q_3), and the mode.

76, 56, 44, 77, 12, 1, 9

[Optional] RECREATIONAL MATHS (for fun!)

At Varndean we encourage students who are interested to do maths outside of the curriculum. We enter individual students to the Maths Challenge, enter a Team in to the Senior Maths Team Challenge and run maths clubs and events looking at maths in a broader sense.

Looking at these type of questions can also help students who are thinking about applying to Oxbridge or other high achieving Universities where you may need to sit an entrance exam.

If you are interested in being part of Varndean Maths Club, being on the Varndean Maths Team or just love a challenge, have a look at the questions below. They are taken from the 2017/18 Senior Maths Team Challenge, but I have deliberately left out the answers to encourage you to take your time at coming to the answers (you can of course type these papers into Google and you'll find the answers straight away. Try the questions first though before having a look!). All of the questions can be solved using GCSE knowledge, but remember, they are meant to be tricky, so don't get disheartened if you can't solve them all !

QUESTION 1

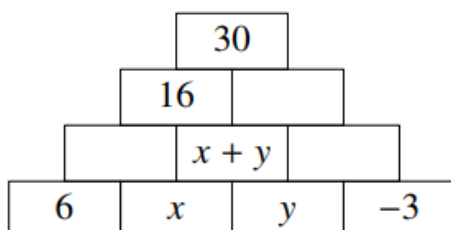
Find the value of

$$\frac{99}{100} \times \frac{80}{81} \times \frac{63}{64} \times \frac{48}{49} \times \frac{35}{36} \times \frac{24}{25} \times \frac{15}{16} \times \frac{8}{9} \times \frac{3}{4}.$$

Write your answer in the form $\frac{a}{b}$, where a and b are positive integers with no common factors other than 1.

[6 marks]

QUESTION 2



In this number pyramid, two numbers in adjacent cells are added to form the number in the cell above.

What is the sum of the ten numbers in the completed pyramid?

[6 marks]

QUESTION 4

A sequence is defined as follows:

$$u_1 = 123.$$

For $n \geq 1$, define u_{n+1} = the sum of the squares of the digits of u_n .

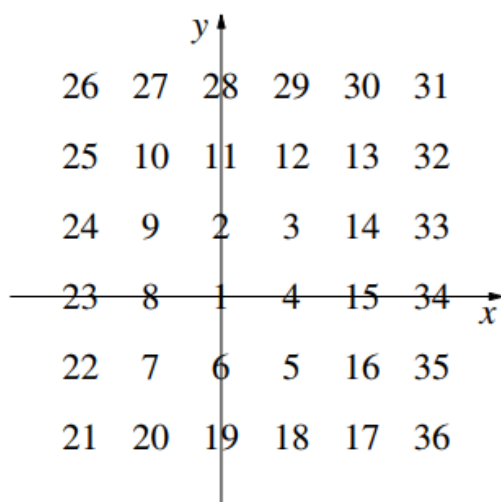
For example, $u_2 = 1^2 + 2^2 + 3^2 = 14$, $u_3 = 1^2 + 4^2 = 17$.

What is the value of u_{100} ?

[6 marks]

QUESTION 6

The positive integers $1, 2, 3, \dots$ are placed on the Cartesian plane as shown. For example, the number 1 is positioned at $(0, 0)$ and the number 22 is positioned at $(-2, -1)$.



If this spiral is continued, what are the coordinates of the position at which 2017 would be placed?

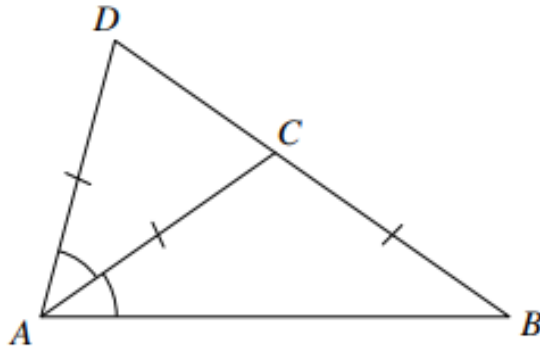
[6 marks]

In the following questions, your answer to the previous question is used in the subsequent question.

D1

In the triangle ABD , the line AC is the bisector of $\angle DAB$.

Also $AD = AC = BC$.



Pass on the size, in degrees, of $\angle BDA$.

D2

T is the number you will receive.

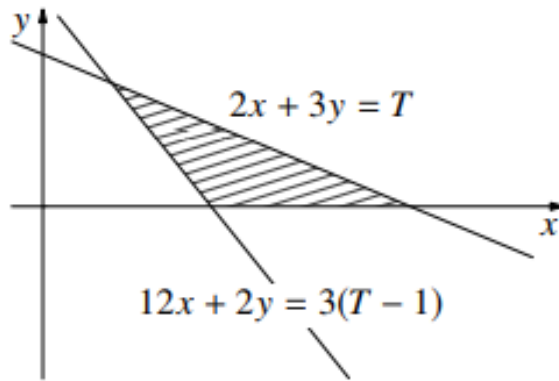
The lowest common multiple of $\frac{1}{2}T$, $\frac{1}{3}T$ and 40 is k times larger than the highest common factor of $2T$, $3T$ and 120.

Pass on the value of k .

T is the number you will receive.

D3

The diagram shows the lines $2x + 3y = T$ and $12x + 2y = 3(T - 1)$.



Pass on the value of the hatched area.

T is the number you will receive.

D4

The expression $\frac{T\sqrt{2} + 2\sqrt{T}}{\sqrt{3} + 1}$ can be written in the form $\sqrt{k}$,
where k is an integer.

Write down the value of k .

INTERESTED IN GOING TO OXFORD OR CAMBRIDGE (OR ANY OF THE TOP RATED UNIVERSITIES)?

The following 2 questions are multiple choice questions from the Oxford Entrance Exam sample materials. See how you get on!

A. The point lying between $P(2, 3)$ and $Q(8, -3)$ which divides the line PQ in the ratio $1 : 2$ has co-ordinates

- (a) $(4, -1)$ (b) $(6, -2)$ (c) $(\frac{14}{3}, 2)$ (d) $(4, 1)$

E. The fact that

$$6 \times 7 = 42,$$

is a counter-example to which of the following statements?

- (a) the product of any two odd integers is odd;
- (b) if the product of two integers is not a multiple of 4 then the integers are not consecutive;
- (c) if the product of two integers is a multiple of 4 then the integers are not consecutive;
- (d) any even integer can be written as the product of two even integers.