A1
Double Maths Starting With Confidence Booklet

Name: …………………………………………………………

Are you ready for A1 Double Maths Test % …………

Welcome to BHASVIC Maths. We are an Outstanding Department and we aim for you to be outstanding too! This booklet has been designed to help you to bridge the gap between GCSE Maths and A1 Double Maths. Be sure to complete it all and bring it to your first lesson!

CONTENTS

Read the below carefully before you start this booklet

Things to do before enrolment

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

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

3. Developing strong Algebra is very important in A 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.

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

   <u>How to get help:</u> Watch the videos on any concept you need help with and join BHASVIC Maths Facebook to ask for advice. You could email your transition mentor or **attend the support sessions on September 1st, 4th, and 5th** after enrolment.

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

6. A level Maths is a big step up from GCSE and your calculator needs to step up too! You will need at least the **<u>CASIO FX-991EX</u>** calculator for this course (£20-£25). Better still, especially if you are going to be studying Further Maths and/or considering a degree in Maths, Physics or Engineering, we recommend a **graphical calculator** such as the CASIO FX-CG50 (approx. £120). *(Please contact our Welfare Co-ordinator Aoife Tobin if you think you might be eligible for financial assistance)*

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 A level 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.

- Post a question on the Facebook 'BHASVIC Maths' wall

- Try looking up the topic in a GCSE higher tier textbook or revision guide (your local library will have one) or look online

- E mail your transition mentor (the letter you got on Moving On Day) to ask for help

- Meet up with a friend if you know they too are studying maths here and work through the problem together

- Attend the Drop In help sessions in the days after enrolment on 31st August, 1st September, and 4th September from 9am until midday in room 3 (if you go Reception, they will show you where to go)

- If you have any questions about the course you could also e mail Scott (Head of Maths) on s.cosby@bhasvic.ac.uk

SECTION 1, 2, 3, 4, & 5 ANSWERS

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

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) $(x + 1)(x - 1)$

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

3) $(7 - 3x)(7 + 3x)$

4) $(2\sqrt{2} - \sqrt{2}x)(2\sqrt{2} + \sqrt{2}x)$

5) $(b^2 - c^4)(b^2 + c^4)$

6) $(\sqrt{a} - \sqrt{b})(\sqrt{a} + \sqrt{b})$

EX 5B:

1) $x(3x + 4)$

2) $2y(2y + 5)$

3) $x(x + y + y^2)$

4) $2xy(4y + 5x)$

5) $(x + 1)(x + 2)$

6) $(2x - 3)(x + 1)$

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

8) $(1 - x)(6 + x)$

9) $x(x + 6)(x - 6)$

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

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

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

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

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

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

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

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

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

8) a) $2xy(5x + 4y)$ b) $x(x - 6)(x + 6)$

SECTION 1 – INDICES 🚫🧮

WRITE YOUR ANSWERS DIRECTLY INTO THIS BOOKLET, AND TICK THE BOXES WHEN YOU HAVE CHECKED THAT YOU ARE CORRECT

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

EXERCISE 1A – SIMPLIFYING INDICES
Evaluate the following:

Need help? [QR code] BHASVICMATHS SWC HELP EX1A

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? [QR code] BHASVICMATHS SWC HELP EX1B

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) $\frac{2x-1}{x^2} =$

EXERCISE 1C – MANIPULATING INDICES TO SOLVE FOR X

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

1) $x^{-\frac{2}{3}} = 9$	2) $x^{-\frac{1}{2}} = 5$	3) $x^{\frac{2}{5}} = 4$
4) $x^{\frac{2}{3}} = 16$	5) $x^{\frac{3}{4}} = \frac{1}{27}$	6) $x^{\frac{2}{3}} = \frac{1}{25}$

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? BHASVICMATHS SWC HELP EX2A

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? BHASVICMATHS SWC HELP EX2B

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? BHASVICMATHS SWC HELP EX3A

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) $\frac{\sqrt{27}}{\sqrt{3}} =$

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? BHASVICMATHS SWC HELP EX3B

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 $a\sqrt{b}$

Need help? BHASVICMATHS SWC HELP EX3C

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

SECTION 4 – EXPANDING BRACKETS

Knowing how to manipulate algebra really quickly is SO important in A level maths. Whether this is through expanding brackets and collecting terms, or through finding common factors and factorising into brackets.

EXERCISE 4 – EXPANDING BRACKETS & COLLECTING TERMS

Expand the following brackets and collect like-terms:

Need help? BHASVICMATHS SWC HELP EX4

1) $x(2x + 3)(x - 7) =$

2) $x(5x - 3y)(2x - y + 4) =$

3) $(x - 4)(x + 3)(x + 1) =$

4) $(3x - 2)(2x + 1)(3x - 2) =$

5) $(x + y)(x - y)(3x - 2) =$

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

7) $(a + b)(b + c)(c + d) =$

SECTION 5 – FACTORISING

EXERCISE 5A – FACTORISING USING THE DIFFERENCE OF TWO SQUARES

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

Need help? BHASVICMATHS SWC HELP EX5A

1) $x^2 - 1 =$	2) $4x^2 - 9 =$
3) $49 - 9x^2 =$	4) $8 - 2x^2 =$
5) $b^4 - c^8 =$	6) $a - b =$

EXERCISE 5B – FACTORISING EXPRESSIONS
Factorise the following completely:

Need help? BHASVICMATHS SWC HELP EX5B

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

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

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

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

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

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

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

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

9)
$x^3 - 36x =$

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

MINI TEST 1 - SECTIONS 1, 2, 3, 4 & 5 🚫🔢

You've completed all the exercises in Sections 1, 2, 3, 4 & 5, 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

SECTION 6, 7, & 8 ANSWERS

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) $Mode = 86, \ Mean = 143.8 \ , Q_1 = 86, \ Q_2 = 87, \ Q_3 = 9$

EX 8B:
   1) $\bar{x} = 34.5, \ \sigma = 2.07$ 2) $\bar{x} = 345.1, \ \sigma = 61.9$ 3) $\bar{x} = 82.3, \ \sigma = 7.30$

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) $\bar{x} = 345.1$, $\sigma = 61.9$

SECTION 6 – QUADRATICS

You should already know what a quadratic is, but in order to start A Level 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? BHASVICMATHS SWC HELP EX6A

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 $\sqrt{}$
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? BHASVICMATHS SWC HELP EX6B

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? BHASVICMATHS SWC HELP EX6C

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? BHASVICMATHS SWC HELP EX6D

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? BHASVICMATHS SWC HELP EX7A

1) $(-2,7)$ and $(4,5)$	2) $(2, -5)$ and $(3, -7)$	3) $(-3, -1)$ and $(4,10)$
$m =$	$m =$	$m =$

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? BHASVICMATHS SWC HELP EX7B

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

The New A Level requires you to learn both Statistics and Mechanics. To get you back into the swing of Stats, we will revise some work on averages here.

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? BHASVICMATHS SWC HELP EX8A

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

Mode =

Mean =

$Q_2 =$

$Q_1 =$

$Q_3 =$

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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 =

$Q_2 =$

$Q_1 =$

$Q_3 =$

EXERCISE 8B – FINDING THE MEAN OF GROUPED DATA
Find the mean of the following grouped data:

Need help? BHASVICMATHS SWC HELP EX8B

1)

Length of Pine Cone (mm)	Frequency (f)	Mid value (x)	fx
30 – 31	2		
32 – 33	25		
34 – 36	30		
37 - 39	13		

Mean $\bar{x} =$

2)

Weekly wage (£)	Frequency (f)	Mid value (x)	fx
175 – 225	4		
226 – 300	8		
301 – 350	18		
351 - 400	28		
401 - 500	7		

Mean $\bar{x} =$

3)

Noise (decibels)	Frequency (f)	Mid value (x)	fx
65 – 69	1		
70 – 74	4		
75 – 79	6		
80 – 84	6		
85 - 89	8		
90 – 94	4		
95 - 99	1		

Mean $\bar{x} =$

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.

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

8) Find the mean of the following grouped data:

Weekly wage (£)	Frequency (f)	Mid value (x)	fx
$175 - 225$	4		
$226 - 300$	8		
$301 - 350$	18		
$351 - 400$	28		
$401 - 500$	7		

Out of 14

SECTION 9, 10, & 11 ANSWERS

SECTION 9 – VECTORS
EX 9:

1) a) $\underline{p} + \underline{q}$ b) $\frac{2}{3}\underline{p} + \frac{2}{3}\underline{q}$ c) $\frac{2}{3}\underline{p} - \frac{1}{3}\underline{q}$

2) a) $2\underline{b} - 2\underline{a}$ b) $2\underline{b} - \underline{a}$
   c) Rhombus – because **EF**=**HG**, **FG**=**EH**, all sides equal length, angles not all same

SECTION 10 – GRAPH TRANSFORMATIONS
EX 10A:
Research!

EX 10B:
   a) crosses at (0,5) [also min here]

   b) crosses at (-2,0) [also max here] and (0, -4)

   c) crosses at (-3/2,0) and (-5/2,0) and (0,15), and min at (-2,-1)

SECTION 11 – COMPLEX NUMBERS
EX 11:
1) $x = \pm 2i$
2) $x = -\frac{5}{4} \pm \frac{\sqrt{23}}{4}i$
3) $x = -\frac{2}{5} \pm \frac{\sqrt{11}}{5}i$
4) $x = 0, x = \frac{7}{6} \pm \frac{\sqrt{23}}{6}i$

As double mathematicians you really want to hit the ground running when you first come into class, and **start as you mean to go on**. Lessons are great fun, but very fast paced, and the assignments require a lot of time and effort each week to complete – but as double mathematicians, these assignments **should** be a struggle, and therefore become a great source of pride and satisfaction when you actually manage to finish them **100% complete and correct**.

SECTION 9 – VECTORS

Below is testing your vector theory from GCSE level. See if you can answer the below:

1)
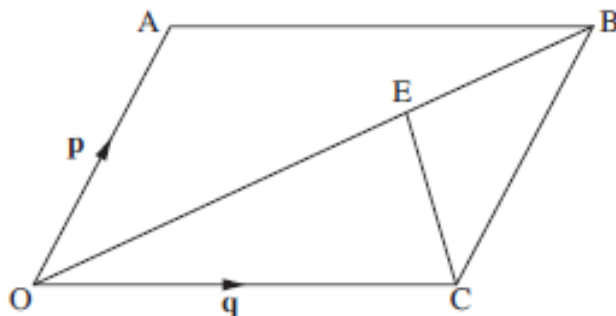
OABC is a parallelogram.

$\overrightarrow{OA} = p$ and $\overrightarrow{OC} = q$.

E lies on OB so that OE : EB = 2 : 1.

Find the following vectors in terms of p and q.

a) **OB**

b) **OE**

c) **CE**

2)

PQRS is an isosceles trapezium.
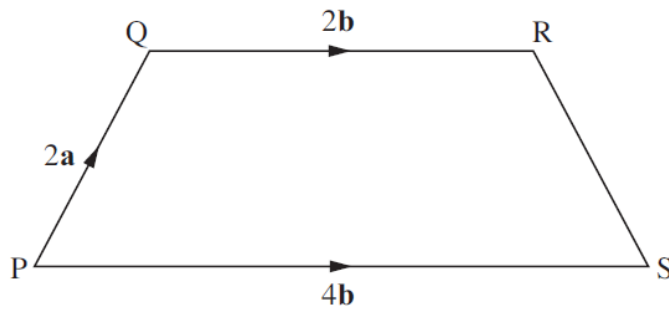
Not to scale

$\overrightarrow{PQ} = 2\textbf{a}$, $\overrightarrow{QR} = 2\textbf{b}$ and $\overrightarrow{PS} = 4\textbf{b}$.

E, F, G and H are the midpoints of the sides of the isosceles trapezium PQRS.
The midpoints are joined to make a quadrilateral.
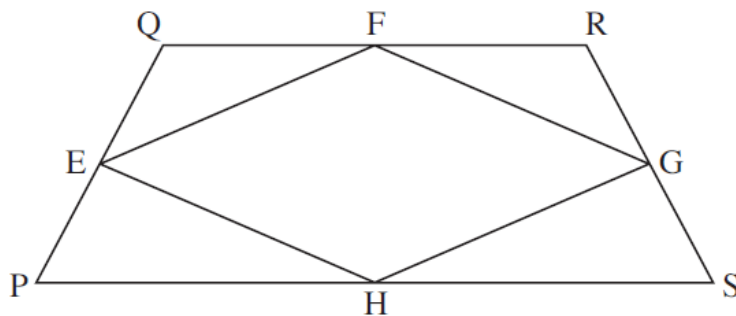
Not to scale

a) Find an expression for **RS** in terms of **a** and **b** only

b) Find an expression for **FG** in terms of **a** and **b** only

c) What type of quadrilateral is FEGH and use vectors to PROVE why this is so

SECTION 10 – GRAPH TRANSFORMATIONS

If y = f(x), then below are the possible rules that can be applied to that graph. You need to fill out the impact of these rules on f(x) using mathematical language e.g. reflection, translation, etc – the first one has been done for you to illustrate the task:

TOP TIP when doing multiple transformations: if you remember cf(a(x – b)) + d, this tells you the order you perform the transformation rules in. So, 'a' represents the multiplication of the x values by scale factor 1/a, and then 'b' is performed, then 'c', and then finally 'd'.

E.G. If you had f(x) = x and you wanted to transform this graph by 3f(2x + 2) + 5, this could be re-written in terms of the tip above like this: 3f(2(x+1)) + 5, which means that the graph has been: Stretched by scale factor ½ parallel to the x-axis first,

Followed by translation by vector $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$

Followed by a stretch of scale factor 3 parallel to the y-axis

Followed by translation by vector $\begin{pmatrix} 0 \\ 5 \end{pmatrix}$

EXERCISE 10A – TRANSFORMATION RULES

Fill in the table below, detailing what each transformation rule does using mathematical language.

e.g. f(x+a) means a translation by vector $\begin{pmatrix} -a \\ 0 \end{pmatrix}$ [This is saying that assuming a>0, the graph will move by 'a' units to the left along the x-axis, and no units along the y-axis]

f(x – a) means…	f(ax) means…	af(x) means…
f(x) – a means…	f(x) + a means…	-f(x) means…
f(-x) means…		

EXERCISE 10B – GRAPH SKETCHES

Sketch the graph f(x) = x^2 in the space below, labelling on the graph the exact co-ordinates it crosses the x and y axis and the co-ordinates of the minimum/maximum point of the curve. Now sketch the transformed graphs below separately, again writing all the co-ordinates where the graphs cross the x and y axis

a) y = f(x) + 5

b) y = -f(x + 2)

c) y = f(2x + 4) − 1

SECTION 11 – COMPLEX NUMBERS

During Moving On Day you were exposed to the idea of complex numbers, whereby you could finally solve the mystery of how to square root a negative number! (though of course we still can't *really* square root a negative number, can we ☺)

Below is more opportunity for you to practice this, using the quadratic formula to solve the equations below.

Remember $i^2 = -1$

TASK: Find x in the form $x = a + ib$

EXAMPLE: $x^2 + 16 = 0$

So, $x^2 = -16$
Then, $x = \pm\sqrt{-16}$
Then, $x = \pm i\sqrt{16}$
Therefore, $x = \pm 4i$

EXERCISE 12 – SOLVING QUADRATICS WITH COMPLEX SOLUTIONS

Solve the following quadratics

1) $x^2 + 4 = 0$	2) $2x^2 + 5x + 6 = 0$
3) $-4x = 5x^2 + 3$	4) $3x^3 - 7x^2 + 6x = 0$

ARE YOU READY FOR A1 DOUBLE MATHS? TEST

This is your second to last task. In order to be confident starting A1 Double maths you need to be confident with the techniques in this booklet. When you start the course we will give you a test like this one to check that you are ready to start A1 Doubles. Do this test in exam conditions, write your answers on file paper, then mark it using the answers at the back of the booklet; record your result on the front cover sheet. You should aim for over 80% (at least 17 answers completely correct) but certainly anything less than 60% should be a worry and you should go back to the exercises containing the questions you got wrong then try this test again in a few days' time. In addition, attend the drop in help sessions on 31st August, 1st September, and 4th September.

Time: 1 hour. Calculator

1) Evaluate the following:

   a) $\left(\frac{1}{27}\right)^{-\frac{1}{3}}$

   b) $\left(\frac{64}{25}\right)^{\frac{3}{2}}$

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

   a) $\frac{\sqrt{16x^2}-\sqrt[3]{27x^2}}{\sqrt{x}}$

   b) $\frac{5x^3+\sqrt[4]{81x^2}}{3x}$

3) Solve the following equation for x:

   $$2x^{-\frac{3}{2}} = 54$$

4) Write the following as a simplified, single fraction

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

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

5) By rationalising the denominator, write the below in the form $c + a\sqrt{b}$:

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

6) Expand the following brackets and collect like-terms:
   $(2x + 3)(3x - 1)(x + 2)$

7) Fully factorise the following:
   a) $(36 - 4x^2)$ b) $3x^3 + 27x^2 + 60x$

8) Consider the quadratic $x^2 - 4x - 12 = 0$:
   a) Write the value of the discriminant. What does this tell you about the number of solutions you should expect?

   b) Solve the equation, finding values of x using:
   i)   Completing the square   ii) Factorisation   iii) The quadratic formula

9) Consider the points $A(9, -1)$ and $B(-2, -3)$
   a) Write down the gradient m of the line passing through these two points
   b) Hence, find the equation of the line passing through $A\ and\ B$ in the form $ax + by + c = 0$ where $a, b, and\ c$ are integers

10) Find the mean, mode, median and upper and lower quartiles of:

   4, 7, 1, 0, 13, 15, 90, 12, 7

11) Find the mean of the following:

Length of oak leaves (mm)	Frequency (f)
20 – 22	4
23 – 26	20
27 – 30	23
31 – 50	5

12) a) Sketch the graph of $y = 2(x - 3)^2 + 1$, stating the coordinates of the minimum point, and the coordinates of where the graph crosses the axis.

b) State, in the correct order, the transformations that have taken place to move from $y = x^2$ to get to $y = 2(x - 3)^2 + 1$

13) Find the values of x such that:

$2x^2 - 4x + 9 = 0$

Out of 21

<u>ARE YOU READY FOR A1 DOUBLE MATHS? TEST - ANSWERS</u>

1) a) 3   b) $\frac{512}{125}$

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

3) $x = \frac{1}{9}$

4) a) $\frac{-2x^2 + 8x + 4}{(x+1)(x-2)}$ b) $\frac{4x-3}{(x+1)(x-1)}$

5) $-1 + \sqrt{3}$

6) $6x^3 + 19x^2 + 11x - 6$

7) a) $(6 - 2x)(6 + 2x)$ b) $3x(x + 5)(x + 4)$

8) a) $b^2 - 4ac = 64$, $2\ distinct\ real\ solutions$ b) all 3 versions should give $x = 6,\ x = -2$

9) a) $m = \frac{2}{11}$ b) $2x - 11y - 29 = 0$

10) $mode = 7, mean = 16.6,\ Q_1 = 4,\ Q_2 = 7,\ Q_3 = 13$

11) $\bar{x} = 27.5$

12) a) Look this graph up using 'desmos' on your phone or computer, or use a graphical calculator or Google to check!

b) Translation by vector $\binom{3}{0}$ followed by stretch s.f. 2 parallel to y axis, followed by translation $\binom{0}{1}$

13) $x = 1 + \frac{\sqrt{14}}{2}i,\ \ x = 1 - \frac{\sqrt{14}}{2}i$

GCSE HIGHER TIER EXAM PAPER

This is the last task in this booklet. We will assume that everything in GCSE is known the moment you come in and begin on this course. It will be such a great experience for you, we promise. But since you have been away from GCSE Maths for a whole Summer now, making sure you remember everything in GCSE is highly important. So, treat this like an exam, write your answers on a separate booklet of paper, and staple them together to slip inside this booklet. You have 1 hour 30 mins, and the answers are at the end. Good luck!

1)   Which sequence is a geometric progression?

Circle your answer.

[1 mark]

1   2   3   4   1   2   4   7

1   2   4   8   1   2   3   5

2)   Which of these is **not** used to prove that triangles are congruent?

Circle your answer.

[1 mark]

SSS   SAS   AAA   RHS

3)   Circle the expression that is equivalent to $2a + 5a \times 4a - a$

$a + 20a^2$ $21a^2$ $28a^2 - a$ $2a + 15a^2$

[1 mark]

4)   Circle the equation of a line that is parallel to $y = 5x - 2$

[1 mark]

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

5)   In a sale, the original price of a bag was reduced by 20%
The sale price of the bag is £29.40
Work out the original price.

[3 marks]

6) $\xi = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$

S = square numbers

E = even numbers

6   (a)   Complete the Venn diagram.

6   (b)   One of the numbers is chosen at random.

Write down P (S ∩ E)

7)   A coin is rolled onto a grid of squares.

It lands randomly on the grid.

To win, the coin must land completely within one of the squares.

Meera and John each roll the coin a number of times and record their results.

	Number of wins	Number of losses
Meera	6	44
John	28	72

7 (a)   Work out **two** different estimates for the probability of winning.

[2 marks

7 (b)   Which of your estimates is the better estimate for the probability of winning?

Give a reason for your answer.

[1 mark

8)   Here is the graph of $4x - 3y = 12$ for values of x from 0 to 4

43
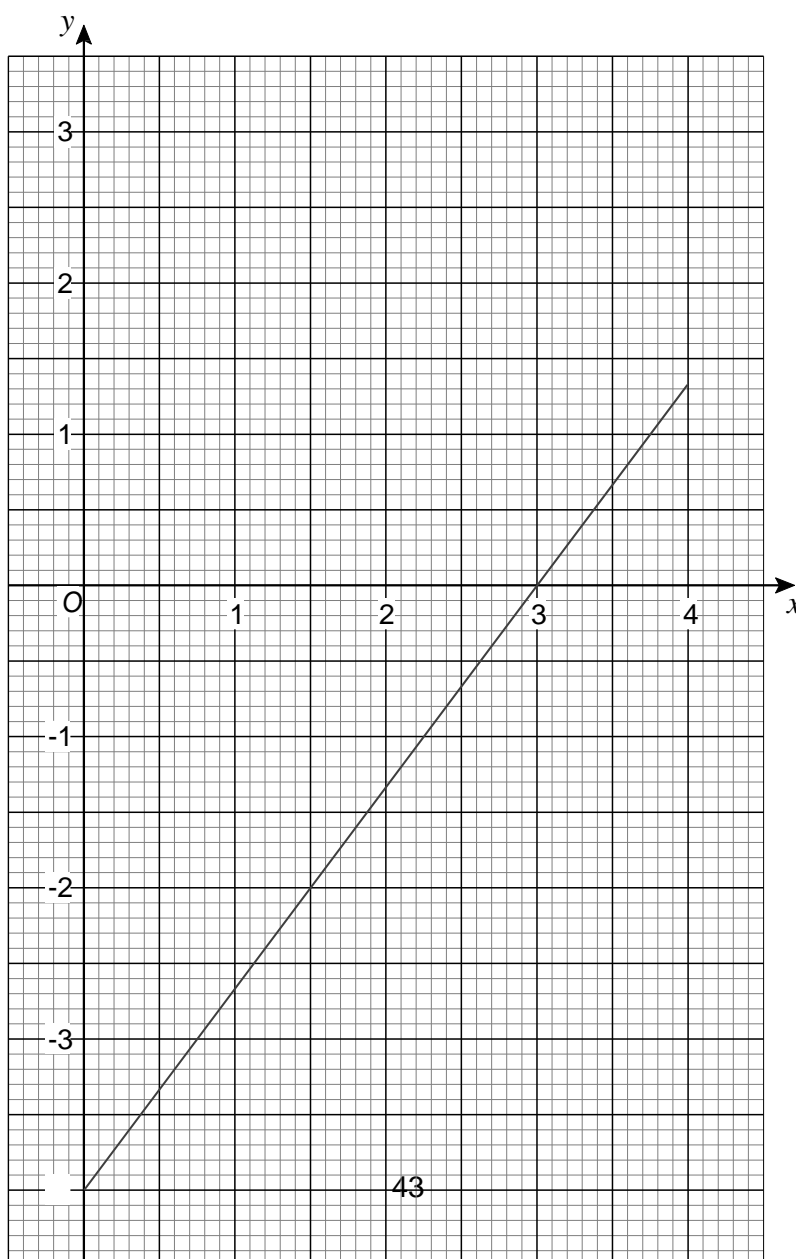
By drawing a second graph on the grid, work out an approximate solution to the simultaneous equations

$$4x - 3y = 12 \quad \text{and} \quad 3x + 2y = 6$$

[3 marks

9   Written as the product of its prime factors

$$672 = 2^5 \times 3 \times 7$$

9 (a)   Write 252 as the product of its prime factors.

[2 marks

9 (b)   Work out the value of the highest common factor of 672 and 252

[1 mark

10   At a school number of boys : number of girls $=$ 9 : 7
There are 116 **more** boys than girls
Work out the total number of students at the school

[3 marks

11   Circle the equation with roots 4 and -8

[1 mark]

$$4x(x - 8) = 0 \qquad\qquad\qquad (x - 4)(x + 8) = 0$$

$$x^2 - 32 = 0 \qquad\qquad\qquad (x + 4)(x - 8) = 0$$

12 $R = \dfrac{x^2}{y}$

$$x = 3.6 \times 10^5$$
$$y = 7.5 \times 10^4$$

Work out the value of R.

Give your answer in standard form to an appropriate degree of accuracy

[3 marks

13   Two spheres have radii in the ratio 5 : 3
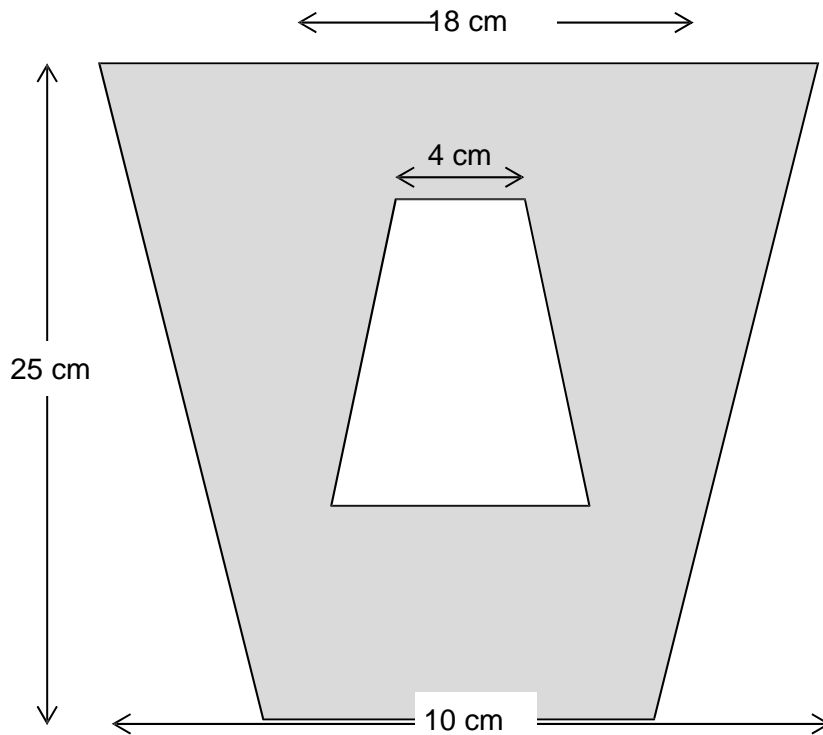Circle the ratio of their volumes.

5 : 3   15 : 9   25 : 9   125 : 27

[1 mark

14 (a) A pattern is made from two **similar** trapeziums

Show that the shaded area is 294 cm

[4 marks

The pattern has one line of symmetry
Work out the size of angle x

[3 marks

15 Ann picks a 4-digit number.

The first digit is **not** zero.

The 4-digit number is a multiple of 5

How many different 4-digit numbers could she pick?

[3 marks

16 c is a positive integer
Prove that

$$\frac{6c^3 + 30c}{3c^2 + 15}$$

is an even number

[3 marks

17 The distance from the Earth to the Sun is 93 million miles.

Assume it takes 365 days for the Earth to travel once around the Sun the Earth travels in a circle with the Sun at the centre.

17 (a) Work out the average speed of the Earth in miles per hour.

[4 marks

17 (b) It actually takes 365.25 days for the Earth to travel once around the Sun

How does this affect your answer to part (a)?

18 In the formula $T = (n - 6)^2 + 1$ n is a positive integer.

45

18 (a) Kim says The value of T is always greater than 1 because $(n-6)^2$ is always greater than 0. Comment on her statement

[1 mark

18 (b) What is the only value of T that is a square number?

[1 mark

19 $f(x) = 3x$

Circle the expression for $f^{-1}(x)$

[1 mark

$$-3x \qquad \frac{3}{x} \qquad \frac{1}{3x} \qquad \frac{x}{3}$$

20 y is directly proportional to $\sqrt{x}$

x	36	a
y	2	5

Work out the value of a

21   A company makes boxes of cereal.

A box usually contains 450 grams of cereal.

Here are two options for a special offer.

Option A	Option B
20% more cereal	Usual amount of cereal
Price remains the same	15% off the price

Which option is the better value for the customer?

You **must** show your working.

[3 marks]

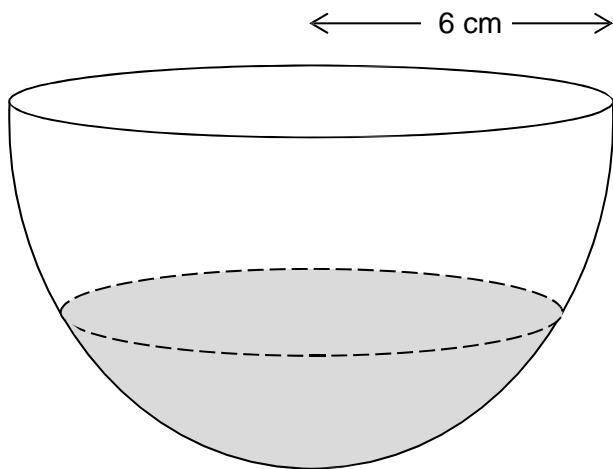22   The histogram shows the ages, in years, of members of a chess club.
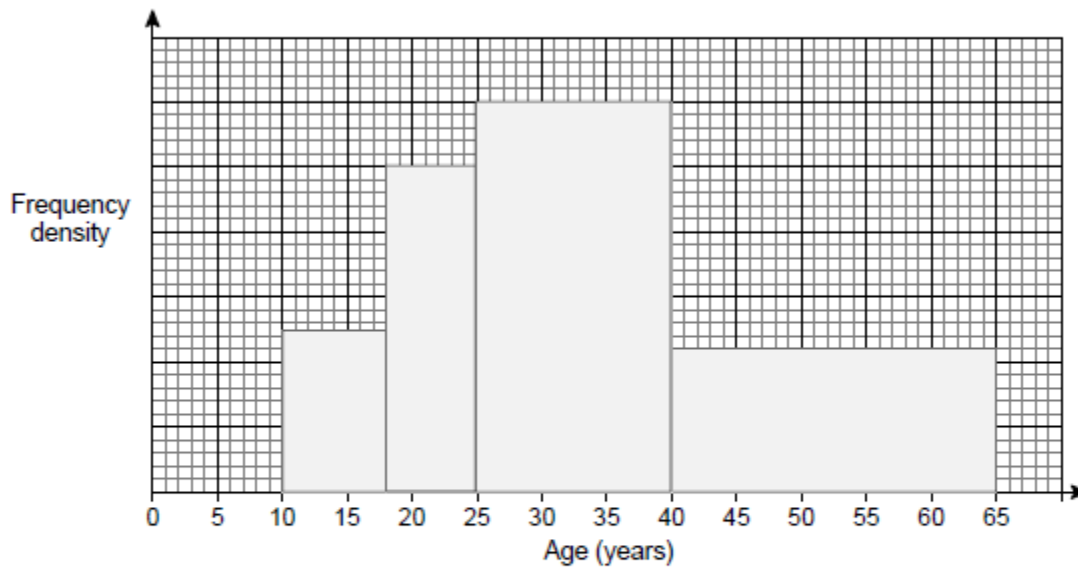
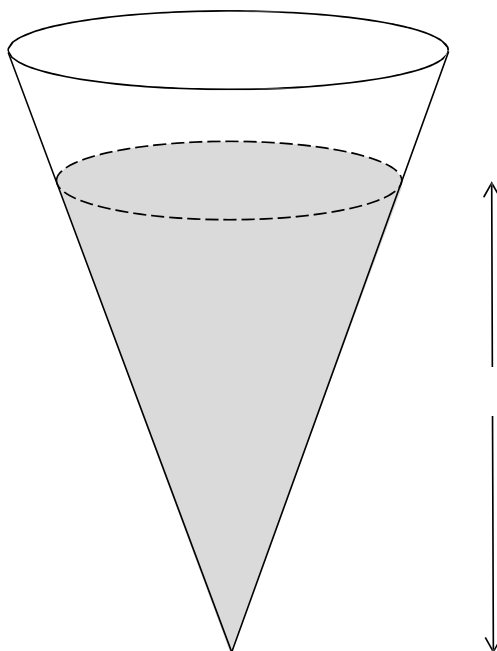There are 22 members with ages in the range $40 \leqslant$ age < 65

Work out the number of members with ages in the range $25 \leqslant$ age < 40

[4 marks]

23   A bowl is a hemisphere with radius 6 cm

Water fills two-fifths of the volume of the bowl.

$\longleftarrow$ 6 cm $\longrightarrow$

The water is poured into a hollow cone.

The depth of the water in the cone is 12 cm

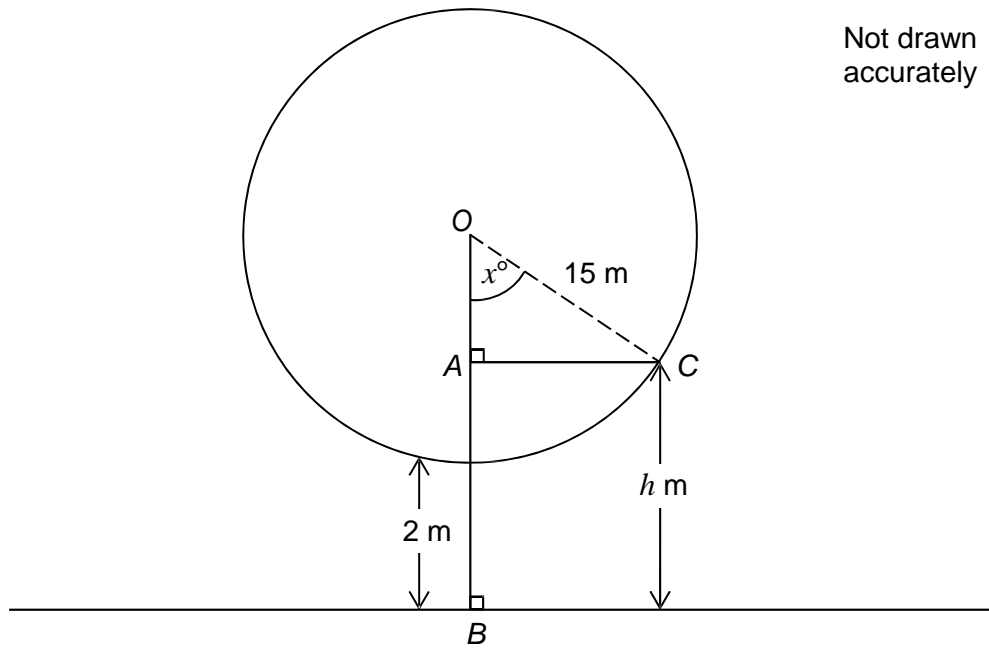

Volume of a sphere $= \frac{4}{3}\pi r^3$

Volume of a cone $= \frac{1}{3}\pi r^2 h$

Work out the radius of the   surface of the water in the
cone

24   A Big Wheel is modelled as a circle with centre O and radius 15 metres.

The wheel turns in an anticlockwise direction.

The lowest point on the wheel is always 2 metres above horizontal ground.
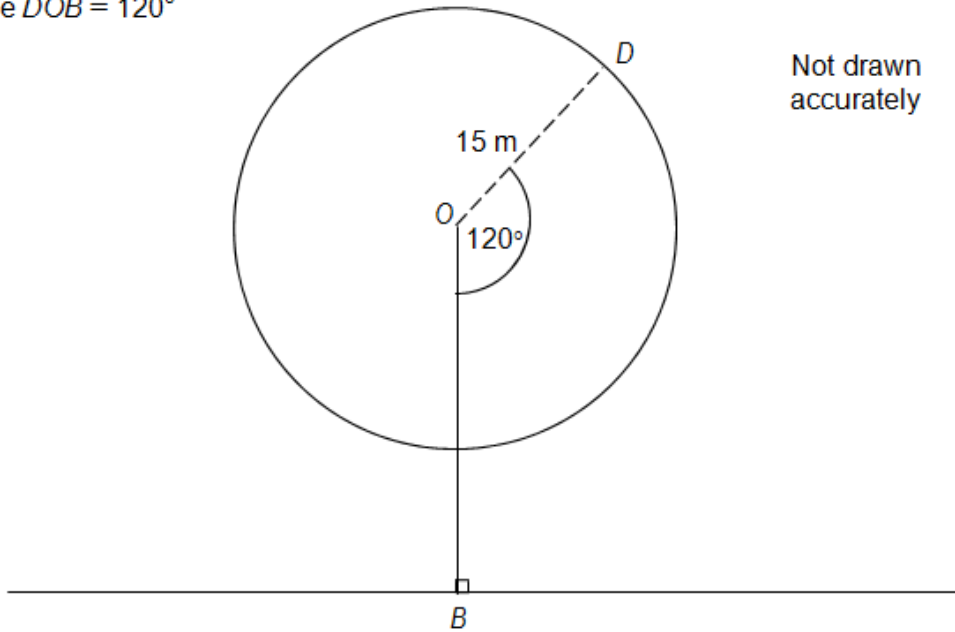

Not drawn accurately

24 (a) C is a point on the wheel, h metres above horizontal ground.

Angle $COB = x°$

Show that $h = 17 - 15 \cos x°$ **[2 marks]**

24 (b) *D* is a point on the wheel.

Angle *DOB* = 120°
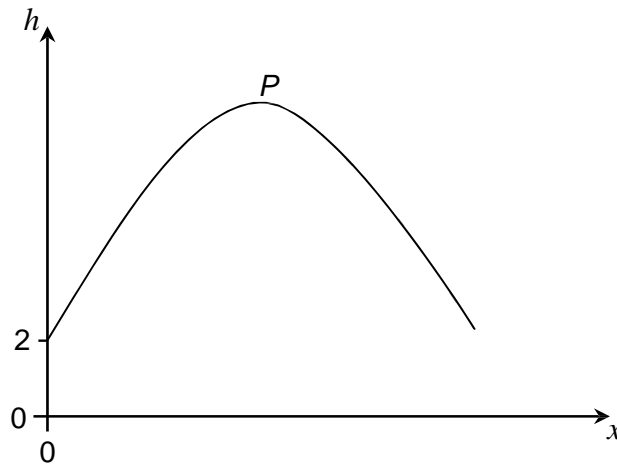

15 m

O

120°

D

Not drawn accurately

B

Work out the height of *D* above horizontal ground.

[2 marks]

24 (c) Here is a sketch of the graph $h = 17 - 15 \cos x°$ for one **complete** turn of the wheel.

P is the highest point on the graph.

h

P

2

0

0

x

Work out the coordinates of *P*.

(2 marks]

25 $2x^2 - 6x + 5$ can be written in the form $a(x - b)^2 + c$

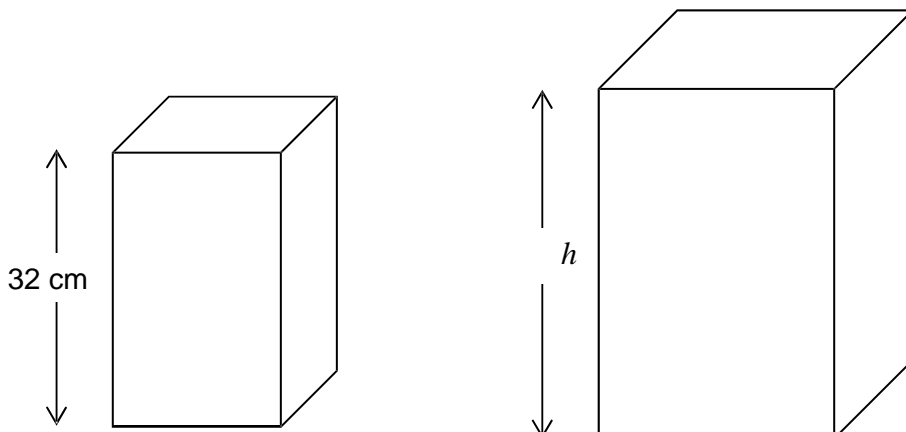where a, b and c are positive numbers.

25 (a)   Work out the values of a, b and c.   **[3 marks]**

25 (b)   Using your answer to part (a), or otherwise, solve $2x^2 - 6x + 5 = 8.5$ **[3 marks]**

26   Two boxes are made with card.

The boxes are similar cuboids. The

smaller box has height 32 cm

It takes 44% more card to make the larger box.
Work out the height, h, of the larger box.   **[4 marks]**

GCSE HIGHER TIER EXAM PAPER ANSWERS

1) 1 2 4 8
2) AAA
3) $a + 20a^2$
4) $y = 5x + 2$
5) 36.75
6)
    a. Venn diagram
    b. $\frac{1}{12}$
7)
    a. $\frac{6}{50}$ *or* $\frac{28}{100}$ or $\frac{34}{150}$
    b. More trials
8) $x = 2.5, y = -0.7$
9)
    a. $2^2 \times 3^2 \times 7$
    b. 84
10) 928
11) $(x - 4)(x + 8) = 0$
12) 1.7×10^6
13) $125 : 27$
14) 294
15) 1800
16) Proof
17)
    a. 6.6×10^4
    b. Average speed would be lower
18)
    a. Wrong, 1
    b. 1
19) $\frac{x}{3}$
20) 225
21) A
22) 36
23) 3.79
24) f

    a. $17 - 15 \cos x$
    b. 24.5
    c. $(180,32)$
25) G
    a. $a = 2, b = 1.5, c = 0.5$
    b. 3.5 and 0.5
26) 38.4