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## Preparing for Year 12: Mathematics

We want you to begin your Year 12 Studies feeling prepared and confident. Therefore, you will be tasked with completing a range of Summer Work for the subjects you plan to continue studying. If you are unsure which subjects you might want to study, you should complete work for the subjects you are considering. This will help give you a “taster” of the subject, in place of the taster lessons you would normally be receiving face-to-face. **You should expect to spend a minimum of 15 hours on each subject.** All work should be submitted to your teacher in September, however not all will require feedback.

<p><b>Revision of key knowledge and skills</b></p> <p>Download the <a href="#">Head Start To A Level Maths</a> book on Moodle (the kindle version is free on Amazon).</p> <p>Work through the Diagnostic Test on Pages 1 to 5. Show clearly your workings out to the 39 questions, which we will ask to see evidence of. Mark your work (answers are on Page 61) using a different colour, working through any corrections needed. Spend time on topics which you can see you need practice.</p>	<p><b>Key Skills Development</b></p> <p>There is lots of ‘transition’ material online, getting students moving from Year 11 into Year 12. This one by the AMSP (Advanced Maths Support Program) is incredibly thorough, and easy to follow:</p> <p><a href="https://amsp.org.uk/resource/gcse-alevel-transition-resources">https://amsp.org.uk/resource/gcse-alevel-transition-resources</a></p> <p>For each of the six sets of resources (which are made live, staggered over May and June) work through the slides – making notes and completing the various questions - before checking your work.</p>
<p><b>Research and/or wider reading</b></p> <p>Have a look at the page Research: Some Interesting Challenges below. These are challenges that will take some time to solve. Choose one (or more if you are able) and have a go at working through it.</p> <p>While you might use scrap paper to begin with, write up your work clearly (even if you haven’t quite found a solution) as a submission piece.</p> <p>Getting stuck, yet persevering with a problem, is a good trait to develop during the A Level course.</p>	<p><b>Submission Pieces</b></p> <p>Work to bring in on the first lesson back:</p> <ul style="list-style-type: none"><li>- Your Diagnostic Test work, with clear workings out and marked in a different colour.</li><li>- Evidence of your notes, questions and marking from the AMSP Transition Material.</li><li>- Your solution (or attempted solutions) to at least one of the Challenge questions.</li><li>- Lastly, at the bottom of this document there are 15 multiple choice questions. Complete the questions, ready to be marked in lesson.</li></ul>



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## Supra-Learning Opportunities

*Activities which will broaden your knowledge and understanding of the wider world of your subject. Things to inspire and enjoy!*

### Websites:

GapMinder	Interactive graphs of how wealth, life expectancy, population, etc have changed over time in countries of the world
Desmos (Global Maths Art Content)	Use Desmos, a graphing piece of software, to make a drawing.

### YouTube Channels:

NumberPhile	Excellent, short fun videos looking at some famous maths problems and proofs.
MindYourDecisions	Clear solutions to some challenging, often current, maths brainteasers.

### Books:

Humans - Matt Haig	An alien visits earth with the solution to the Reimann Hypothesis, and therefore has the ability to find unknown prime numbers.
The Simpsons and their Mathematical Secrets – Simon Singh	The writers of the Simpson were mathematicians and so much interesting mathematics is found in the series.
Fermat's Last Theorem – Simon Singh	The history behind one of the most famous problems in mathematics, which was finally solved in the 1990s.
Humble Pi – Matt Parker	A collection of stories about maths going wrong in the real world.
Freakonomics – Steven Levitt	"A rogue economist [so a mathematician] explore the hidden side of everything."



## Research: Some Interesting Challenges

You've likely chosen to study mathematics because you like to be challenged, and so below are some interesting questions you might like to explore. Similar problems are often asked during University interviews to observe how a candidate thinks – it's not about getting the correct answer quickly, it is about observing how a student thinks and journeys towards a solution. Enjoy getting challenged, getting stuck, and also the satisfaction of slowly working towards a solution.

### Question 1:

If  $A = (6,2)$  and  $B = (10,5)$ , find the possible coordinates of  $C$ , to make  $ABC$  and equilateral triangle.

### Question 2:

A 3m ladder is placed against a wall. Adjoined to the wall is a  $1\text{m}^3$  cube shed. Clearly the ladder now can't rest against the wall, but what is the maximum height the ladder can reach?

### Question 3:

A cylindrical container of diameter 40cm rests on its side, with a hole in the top to pour in water. Clearly, when the vessel is half full the water level comes to a height of 20cm, and when the vessel is completely full the water level is 40cm. However, what is the water level when the container is a quarter full?

### Question 4:

How many solutions are there to:

$$(x^2 - 7x + 11)^{(x^2 - 5x + 6)} = 1$$

### Question 5:

How many zeros would there be at the end of the number if you calculated 100 factorial (also written as  $100!$ ), which is  $100 \times 99 \times 98 \times \dots \times 3 \times 2 \times 1$ .

### Question 6:

Name a value of  $x$  which makes this list of expressions ascend in order. For what range of values if this true?

$$2x, 1/x, x, x^2, 1-x, 1/x^2$$

### Question 7:

A sealed cone holds some water, although it is not completely full. With the base (a circle) resting on the table, there is an 8cm gap between the top of the water level and tip of the cone. When the cone is turned upside down and water falls to the tip, there is only a 2cm gap between the top of the water level and the top (actually, the base circle) of the cone.

How tall is the cone?



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## Submission Pieces: 15 Multiple Choice Questions

Please arrive at your first lesson in Year 12 with this work completed. Complete the below 15 questions, circling the correct answer for each.

Question	1	2	3	4	5	6	7	8	9	10
Answer (circle one)	A	A	A	A	A	A	A	A	A	A
	B	B	B	B	B	B	B	B	B	B
	C	C	C	C	C	C	C	C	C	C
	D	D	D	D	D	D	D	D	D	D

Question	11	12	13	14	15
Answer (circle one)	A	A	A	A	A
	B	B	B	B	B
	C	C	C	C	C
	D	D	D	D	D

Total Score: \_\_\_\_\_ out of 15

## The Questions

<b>Question 1</b>	<p>You are given that <math>x = 3</math>, <math>y = 7</math> and <math>z = -2</math>.</p> <p>Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p><b>A</b> <math>y - z = x^2</math></p> <p><b>B</b> <math>x = y + 2z</math></p> <p><b>C</b> <math>x + y + 5z = 0</math></p> <p><b>D</b> <math>y^2 - x^2 = 20z</math></p>
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<b>Question 2</b>	<p>The first four terms of a sequence are <math>-7, -2, 3, 8</math>.</p> <p>Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p><b>A</b> The next two terms of the sequence are 13 and 18.</p> <p><b>B</b> 93 is a term of the sequence..</p> <p><b>C</b> The <math>n</math>th term of the sequence is <math>5n - 7</math>.</p> <p><b>D</b> The 20th term is 50 more than the 10th term.</p>
<b>Question 3</b>	<p>Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p><b>A</b> <math>x^2 - 9 = (x - 3)(x + 3)</math></p> <p><b>B</b> <math>x^2 - 9x + 20 = (x - 4)(x + 5)</math></p> <p><b>C</b> <math>(2x - 3)(x + 3) = 2x^2 + 3x - 9</math></p> <p><b>D</b> <math>x(x + 3) - x(x - 3) = 6x</math></p>
<b>Question 4</b>	<p>Which <b>one</b> of the following is the <b>correct</b> solution of the inequality <math>3(x - 5) &gt; 2 - x</math>?</p> <p><b>A</b> <math>x &gt; 8\frac{1}{2}</math>    <b>B</b> <math>x &gt; 4\frac{1}{4}</math>    <b>C</b> <math>x &gt; 3\frac{1}{2}</math>    <b>D</b> <math>x &gt; 1\frac{3}{4}</math></p>
<b>Question 5</b>	<p>Michael and Madison are rearranging equations.</p> <p>Michael has rearranged <math>v^2 = u^2 + 2as</math> to give <math>a = \frac{(v - u)(v + u)}{2s}</math>.</p> <p>Madison has rearranged <math>s = \frac{1}{2}(u + v)t</math> to give <math>v = u + \frac{2s}{t}</math>.</p> <p>Which <b>one</b> of the following statements is <b>true</b>?</p> <p><b>A</b> Both Michael and Madison are incorrect.</p> <p><b>B</b> Both Michael and Madison and correct.</p> <p><b>C</b> Michael is correct and Madison is incorrect.</p> <p><b>D</b> Michael is incorrect and Madison is correct.</p>

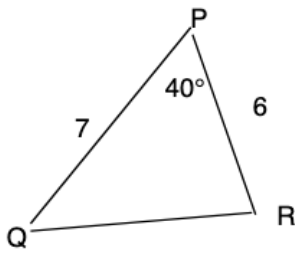


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<b>Question 6</b>	<p>Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p><b>A</b> 234.611 correct to the nearest integer is 235.</p> <p><b>B</b> 10 100 correct to the nearest thousand is 10 000.</p> <p><b>C</b> 0.003672 correct to 3 significant figures is 0.004.</p> <p><b>D</b> 2.0099 correct to 1 decimal place is 2.0.</p>
<b>Question 7</b>	<p>Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p><b>A</b> 48 is a factor of 144.</p> <p><b>B</b> 91 is a prime number.</p> <p><b>C</b> The lowest common multiple (LCM) of 24 and 40 is 120.</p> <p><b>D</b> The highest common factor (HCF) of 24 and 40 is 8.</p>
<b>Question 8</b>	<p>Which <b>one</b> of the following expressions can be correctly simplified to <math>\frac{x+1}{12}</math>?</p> <p><b>A</b> <math>\frac{x+2}{24}</math></p> <p><b>B</b> <math>\frac{x+3}{15} - \frac{2}{3}</math></p> <p><b>C</b> <math>\frac{5-x}{24} + \frac{x-1}{8}</math></p> <p><b>D</b> <math>\frac{x}{2} + \frac{1}{6}</math></p>
<b>Question 9</b>	<p>In a group of students, twenty are male and thirty are female. Three tenths of the students are aged 20 years or less and one fifth are over 40 years old.</p> <p>Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p><b>A</b> The ratio, the number of males: the number of females = 2:3.</p> <p><b>B</b> 35 students are aged over 20.</p> <p><b>C</b> The number of males in the group is <math>0.4 \times</math> (the total number in the group).</p> <p><b>D</b> 60% of students are aged over 20 but not over 40.</p>



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<p><b>Question 10</b></p>	<p>In the triangle PQR, <math>PQ = 7</math> cm, <math>PR = 6</math> cm and angle <math>QPR = 40^\circ</math>.</p>  <p>Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p>A <math>QR = 4.54</math> cm, correct to 2 decimal places.</p> <p>B Angle <math>Q = 58^\circ</math>, correct to the nearest degree.</p> <p>C Angle <math>R = 82^\circ</math>, correct to the nearest degree.</p> <p>D P is approximately 6.5 cm from QR.</p>
<p><b>Question 11</b></p>	<p>Which <b>one</b> of the following is the <b>correct</b> simplification of <math>2(x + 3) - 3(5 - 2x)</math>?</p> <p>A <math>-4x - 9</math></p> <p>B <math>8x - 9</math></p> <p>C <math>8x - 12</math></p> <p>D <math>4x - 12</math></p>
<p><b>Question 12</b></p>	<p>Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p>A <math>(3xy^2)^3 = 27x^3y^6</math></p> <p>B <math>(3xy^2) \times 3 = 27xy^2</math></p> <p>C <math>\frac{x^5 \times x^3}{x^4} = x^4</math></p> <p>D <math>2(x - 1) - 3(2 - x) = 5x - 8</math></p>
<p><b>Question 13</b></p>	<p>Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p>A <math>x = 3</math> is the solution of the equation <math>2(x + 1) = 8</math>.</p> <p>B <math>x = -4</math> is the solution of the equation <math>3x - 12 = 0</math>.</p> <p>C <math>x = -3</math> is one of the roots of the equation <math>x^2 - 9 = 0</math>.</p> <p>D The two roots of the equation <math>x^2 = 8x</math> are <math>x = 0</math> and <math>x = 8</math>.</p>



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<b>Question 14</b>	<p>In this question, <math>a = 2</math>, <math>b = 3</math>, <math>c = -1</math>. Three of the following statements are true and <b>one</b> is false. Which one is <b>false</b>?</p> <p><b>A</b>     <math>ab^2 = 18</math></p> <p><b>B</b>     <math>abc^3 = -6</math></p> <p><b>C</b>     <math>ab + bc + ca = 1</math></p> <p><b>D</b>     <math>\frac{a+2b}{4-2c} = 4</math></p>
<b>Question 15</b>	<p>Which one of the following gives the solution, correct to one decimal place, of the equation <math>x^2 + 3x = 1</math></p> <p><b>A</b>     <math>x = 0.3</math> and <math>x = -3.3</math></p> <p><b>B</b>     <math>x = -0.3</math> and <math>x = 3.3</math></p> <p><b>C</b>     <math>x = -0.4</math> and <math>x = 2.6</math></p> <p><b>D</b>     <math>x = 0.4</math> and <math>x = -2.6</math></p>