## Progression - Maths

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## CGP head start to A level Maths

CGP have kindly made the Kindle edition of their transition workbook free for the next few months. This is excellent preparation for the A level maths course as well as supporting the first few weeks of the course. We recommend you download this book and use it to help you through in tackling the work that follows.


You can get your copy here

## Introduction

A Level Mathematics is far more challenging than your GCSE Mathematics course. Most of the course relies on advanced algebra and so your algebra skills from GCSE need to be strong; they are the foundation upon which we will be building right from the start.

We have provided you with this preparation booklet as we want you to be able to meet these challenges in September. If you can complete most of the questions set over the next few pages correctly you will be well prepared for the start of your course. If you are finding them difficult, or feel that you need further practice, try refreshing your memory by looking at any GCSE higher textbook, revision guide or online resources such as www.corbettmaths.com or www.examsolutions.net/gcse-maths

Every question in this booklet is non calculator.

We are looking forward to seeing you in September.

## Essential work

Please complete the following questions and bring to your first session of A Level Mathematics.

Be prepared to hand in your solutions, showing your working. Please either print out the document and write your solutions on it or do it on paper write the section headings and question numbers clearly on your work to indicate which questions you are working on your work.

## Indices

Q1 Write in the form $2^{\text {n }}$

1) $2^{5} \times 2^{3}$
2) $2 \times 2^{6}$
3) 1
4) $2^{6} \div 2^{2}$
5) $2^{5} \div 2$
6) $\left(2^{7}\right)^{2}$

Q2 Simplify

1) $2 p^{2} \times 4 p^{5}$
2) $x^{2} \times x^{3} \times x^{5}$
3) $12 x^{7} \div 2 x^{2}$
4) $\left(x^{3}\right)^{4}$
5) $x^{5} \div x^{5}$

Q3 Evaluate without a calculator

1) $64^{\frac{1}{3}}$
2) $25^{\frac{1}{2}}$
3) $9^{\frac{1}{2}}$
4) $32^{\frac{1}{5}}$
5) $125^{\frac{1}{3}}$

Q4 Evaluate without a calculator, leaving answers as fractions

1) $3^{-1}$
2) $2^{-3}$
3) $3^{-2}$
4) $6^{-2}$
5) $4^{-3}$

Q5 Evaluate without a calculator, leaving answers as fractions

1) $9^{-\frac{1}{2}}$
2) $64^{-\frac{1}{2}}$
3) $64^{-\frac{1}{3}}$
4) $81^{-\frac{1}{4}}$
5) $125^{-\frac{1}{3}}$

Q6 Evaluate without a calculator

1) $4^{\frac{3}{2}}$
2) $27^{\frac{2}{3}}$
3) $9^{\frac{3}{2}}$
4) $16^{\frac{3}{2}}$
5) $8^{\frac{2}{3}}$

Q1 Write in the form $x^{n}$

1) $\sqrt{x}$
2) $\frac{1}{x}$
3) $\frac{1}{x^{3}}$
4) $\frac{3}{\sqrt{x}}$
5) $\sqrt[3]{x}$
6) $\frac{5}{\sqrt[3]{x}}$
7) $\sqrt{x^{5}}$
8) $\frac{x^{6}}{x^{3}}$

## Algebraic Expressions

Q1 Expand and simplify

1) $5 a+3(a+4)$
2) $7(y+2)-3(y+1)$
3) $4(\mathrm{k}-4)-6(2 \mathrm{k}+7)$

Q2 Expand and simplify

1) $(2 y+2)(y+6)$
2) $(5 c-7)(2 c+3)$
3) $(y-5)^{2}$

Q3 Factorise fully

1) $2 x^{3}-4 x^{2}$
2) $x^{2} y^{2}-6 x y$
3) $x y-4 x^{2}$
4) $2 x^{2} y^{2}+6 x^{2} y$

## Q4 Factorise

1) $2 x^{2}+5 x+3$
2) $2 x^{2}+7 x+5$
3) $2 x^{2}-9 x+7$
4) $2 x^{2}-13 x+15$
5) $2 x^{2}+5 x-18$
6) $4 x^{2}+16 x+15$
7) $6 x^{2}+17 x+12$
8) $6 x^{2}+x-12$

Q5 Factorise

1) $x^{2}-1$
2) $x^{2}-25$
3) $4 x^{2}-49$
4) $100-9 x^{2}$
5) $a^{2}-b^{2}$

Q6 Write these expressions in the form $(x \pm a)^{2} \pm b$. This is also known as completing the square.

1) $x^{2}+4 x-1$
2) $x^{2}+14 x-5$
3) $x^{2}-6 x+3$
4) $x^{2}+5 x+1$
5) $2 x^{2}+8 x+1$
6) $2 x^{2}-6 x+7$

## Solving Linear Equations

Q1 Solve

1) $6 x+12=48$
2) $9-2 x=17$
3) $6+\frac{x}{4}=9$
4) $8=3-\frac{x}{2}$

Q2 Solve

1) $3 x=12+x$
2) $2 x-27=5 x$
3) $4 x-6=8-3 x$
4) $2 x+9=3-x$

Q3 Solve, leaving answers as fractions as appropriate

1) $\frac{2 x}{3}+1=5$
2) $\frac{5(x-4)}{9}=10$
3) $\frac{2 x+4}{5}=x$
4) $\frac{x-2}{3}=\frac{x}{5}$

Q4 Solve the simultaneous equations, leaving answers as fractions as appropriate

1) $\begin{array}{r}4 x-5 y=5 \\ 2 x-3 y=2\end{array}$

$$
\text { 2) } \begin{gathered}
6 x-2 y=9 \\
3 x+4 y=12
\end{gathered}
$$

3) $6 x-5 y=-7$
$3 x+4 y=16$

## Fractions

Q1 Evaluate and simplify without a calculator

1) $\frac{2}{3} \times \frac{4}{5}$
2) $\frac{2}{5} \times \frac{2}{3}$
3) $\frac{2}{3} \times 15$
4) $\frac{2}{7} \div \frac{3}{8}$
5) $\frac{5}{6} \div \frac{1}{2}$
6) $9 \div \frac{3}{4}$

Q2 Evaluate and simplify without a calculator

1) $\frac{2}{3}+\frac{4}{5}$
2) $\frac{2}{5}-\frac{2}{3}$
3) $\frac{2}{9}+\frac{1}{3}$
4) $\frac{5}{6}-\frac{3}{8}$

Q3 Simplify

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

Q4 Simplify

1) $\frac{x}{3} \times \frac{x}{2}$
2) $\frac{4 x}{5} \div \frac{x}{2}$
3) $\frac{4 x}{3 y} \div \frac{x}{2 y}$
4) $\frac{4}{y+1} \times \frac{5}{y+2}$

## Inequalities

Q1 Solve

1) $3 x-10<29$
2) $\frac{x}{4}+10 \geq 13$
3) $2-3 x \leq 20$
4) $9 x+1<2 x+22$

## Graphs

Sketch the following graphs

1) $y=x^{2}$

2) $y=x^{3}$

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


## Equations of Straight Lines

Q1 State the gradient and $y$-intercept of the following lines. You may have to rearrange them first into the form $y=m x+c$.

1) $y=2 x-3$
2) $y=5-4 x$
3) $3 x-2-y=0$
4) $4 x-3-2 y=0$

Q2 Find the gradient of the line through each pair of points.

1) $(3,4)$ and $(5,10)$
2) $(3,5)$ and $(5,1)$
3) $(-1,8)$ and $(1,2)$
4) $(3,-2)$ and $(15,2)$

Q3 Find the midpoint of each pair of points.

1) $(4,7)$ and $(6,11)$
2) $(-3,4)$ and $(5,8)$
3) $(1,0)$ and $(7,5)$
4) $(-7,-5)$ and $(4,8)$

Q4 Find the equation of the straight line passing through the given point and with the stated gradient:

1) Through $(2,1)$ with gradient 3
2) Through (-2,3) with gradient 5
3) Through (3, -7) with gradient -4
4) Through (-6, -1) with gradient $-\frac{2}{3}$
5) Through (3,5) with gradient perpendicular to 7
6) Through ( $-3,-7$ ) with gradient perpendicular to $\frac{-7}{12}$

## Solving Quadratic Equations

Q1 Solve

1) $(x+3)(x-7)=0$
2) $(2 x-3)(4 x+5)=0$
3) $(3 x+1)^{2}=0$
4) $(3-x)(x-5)=0$

Q2 Solve these equations by factorising.

1) $x^{2}+5 x+4=0$
2) $x^{2}+7 x+12=0$
3) $4 x^{2}-6 x=0$

Q3 Solve these equations by using the quadratic formula:
$x=\frac{-b \pm \sqrt{b^{2}-4 a c}}{2 a}$
You don't need a calculator.

1) $5 x^{2}+7 x+2=0$
2) $2 x^{2}-9 x+7=0$

## Problem Solving

1. Two numbers have a product of 44 and a mean of 7.5

Use an algebraic method to find the numbers.
You must show all your working.

2. Caleb either walks to school or travels by bus.

The probability that he walks to school is 0.75
If he walks to school, the probability that he will be late is 0.3
If he travels to school by bus, the probability that he will be late is 0.1
Work out the probability that he will not be late.
3. In a parallel circuit, the total resistance is given by the formula $\frac{1}{R}=\frac{1}{R_{1}}+\frac{1}{R_{2}}$

Make $R_{1}$ the subject of the formula
4. Sarah intended to spend exactly $£ 6.00$ on prizes for her class but each prize cost her 10 p more than expected, so she had to buy 5 fewer prizes.
Calculate the cost of each prize.
5. Arthur and Florence are going to the theatre.

Arthur buys 6 adult tickets and 2 child tickets and pays $£ 39$
Florence buys 5 adult tickets and 3 child tickets and pays $£ 36.50$
Work out the costs of both adult and child tickets.
6. Colin has made a mistake in his 'simplifying surds' homework. Explain his error and give the correct answer.

$$
4 \sqrt{3} \times 5 \sqrt{12}=20 \sqrt{36}
$$

7. A piece of land is the shape of an isosceles triangle with sides $7.5 \mathrm{~m}, 7.5 \mathrm{~m}$ and 11 m . Turf can be bought for $£ 11.99$ per $5 \mathrm{~m}^{2}$ roll.
How much will it cost to turf the piece of land?

## $\underline{\text { RAG }}$

Complete a RAG rating for the key topics from this booklet.

RED: I really need help with this

AMBER: I do not fully understand this, but I am getting there.

GREEN: I've got this sorted.

| Topic | Red | Amber | Green |
| :--- | :--- | :--- | :--- |
| Indices |  |  |  |
| Algebraic expressions |  |  |  |
| Solving linear <br> equations |  |  |  |
| Fractions |  |  |  |
| Inequalities |  |  |  |
| Graphs |  |  |  |
| Equations of straight <br> lines |  |  |  |
| Quadratic Functions |  |  |  |
| Problem solving |  |  |  |

Do this in pencil first and then in pen once your work has been marked

## Extra Practice

## 1. Algebraic fractions

Watch the video, and then answer the exam questions and mark your answers. Where have you made mistakes? Is there something you need to do more work on?
http://www.mathsgenie.co.uk/algebraic-fractions.html http://www.mathsgenie.co.uk/resources/algebraic-fractions.pdf
2. Complete $\mathbf{3 0}$ questions from the 'quadratics' section on completing the square and factorising.
https://kangaroomaths.co.uk/kennys-pouch-teach-secondary/
Then select Maths to Infinity > Quadratics to download a spreadsheet of questions.
(Macros must be enabled)
3. Watch the video and then complete the tasks at the end.
https://library.leeds.ac.uk/skills-algebra
4. Underground Mathematics

This resource is FULL of lots of tasks and challenges. If you are feeling less confident with a topic then use the 'building block'. If you want more of a challenge then carry out one of the 'fluency exercise'.
https://undergroundmathematics.org/

## Exciting and Interesting Bits!

Below are some articles and videos to view.
These are all going to extend your understanding of maths in the real world.


1. Follow the 'WATCH, THINK, DIG DEEPER, DISCUSS'

The Wizard standoff riddle.
https://ed.ted.com/lessons/can-you-solve-the-wizard-standoff-riddle-daniel-finkel
2. Follow the 'WATCH, THINK, DIG DEEPER, DISCUSS'

Solve the false positive riddle.
https://ed.ted.com/lessons/can-you-solve-the-false-positive-riddle-alex-gendler
3. Maths Magic.

Can you create your own version of the problem? Investigate other magic tricks which are based around maths.
https://nrich.maths.org/1051
4. Problems with many solution methods. Try some of these problems. Look for different ways of finding the solutions. Which are most efficient? Which do you like best? https://nrich.maths.org/10219

Hegarty maths have produced a series of transition lessons, each about half an hour, covering some of the main skills from GCSE that you will need to have at your fingertips so as to make a good start at A level maths. I recommend working through these before you start the course.

Hegarty Maths transition lessons

