



The material in this booklet has been designed to enable you to prepare for the demands of A-Level maths. When your course starts in September you will find that your ability to get the most from lessons, and to understand new material, depends crucially upon both having a good facility with algebraic manipulation and undertaking plenty of independent study.

It is **vitally important** that you spend some time working through the questions in this booklet over the summer – you will need to have a good knowledge of these topics **before** you commence the course in September. You will need to hand in your completed booklet during your first maths lesson in September. You should attempt every question in each exercise.

In addition, you should register and begin the Transition to A Level Mathematics online course run by the AMSP. This free self-study online course is designed to ensure you experience a smooth transition from GCSE to A level Mathematics. The course focuses on the techniques and concepts from Higher Tier GCSE, which will be further developed at A level, and gets you thinking about the key mathematical concepts that underpin A level Mathematics. Go to [https://my.integralmaths.org/integral/management/self\\_reg\\_students.php](https://my.integralmaths.org/integral/management/self_reg_students.php) and click 'I am a student' to register for free.

If you are taking **Further Maths**, you should **also** complete the research task on the last page of this booklet. Your Further Maths work should be handed in separately, in your first Further Maths lesson.

Name .....

# 1. Arithmetic of Fractions

Corbett Maths video numbers 133, 134 and 142

1. Express each of the following as a fraction in its simplest form. For example  $\frac{3}{21}$  can be written as  $\frac{1}{7}$ . Remember, no calculators!

a)  $\frac{20}{45}$       b)  $\frac{16}{36}$       c)  $-\frac{42}{21}$       d)  $\frac{18}{16}$       e)  $\frac{30}{30}$       f)  $\frac{17}{21}$       g)  $-\frac{49}{35}$       h)  $\frac{90}{30}$

2. Calculate

a)  $\frac{1}{2} + \frac{1}{3}$       b)  $\frac{1}{2} - \frac{1}{3}$       c)  $\frac{2}{3} + \frac{3}{4}$       d)  $\frac{5}{6} - \frac{2}{3}$       e)  $\frac{8}{9} + \frac{1}{5} + \frac{1}{6}$       f)  $\frac{4}{5} + \frac{3}{7} - \frac{9}{10}$

3. Evaluate the following, expressing each answer in its simplest form.

a)  $\frac{4}{5} \times \frac{3}{16}$       b)  $2 \times 3 \times \frac{1}{4}$       c)  $\frac{3}{4} \times \frac{3}{4}$       d)  $\frac{4}{9} \times 6$       e)  $\frac{15}{16} \times \frac{4}{5}$       f)  $\frac{9}{5} \times \frac{1}{3} \times \frac{15}{27}$

4. Evaluate

a)  $3 \div \frac{1}{2}$       b)  $\frac{1}{2} \div \frac{1}{4}$       c)  $\frac{6}{7} \div \frac{16}{21}$       d)  $\frac{3}{4}$       e)  $5 \div \frac{10}{9}$       f)  $\frac{3}{4} \div \frac{4}{3}$

## 2. Rules and Manipulation of Indices

Corbett Maths video numbers 172-175 and 17

1. Simplify the following algebraic expressions.

- a)  $x^3 \times x^4$     b)  $y^2 \times y^3 \times y^5$     c)  $z^3 \times z^2 \times z$     d)  $t^2 \times t^{10} \times t$   
e)  $a \times a \times a^2$     f)  $t^3 t^4$     g)  $b^6 b^3 b$     h)  $z^7 z^7$

2. Simplify

- a)  $\frac{x^6}{x^2}$     b)  $\frac{y^{14}}{y^{10}}$     c)  $\frac{t^{16}}{t^{12}}$     d)  $\frac{z^{10}}{z^9}$     e)  $\frac{v^7}{v^0}$     f)  $x^7/x^4$

3. Simplify the following:

- a)  $\frac{10^7}{10^6}$     b)  $\frac{10^{19}}{10^{16}}$     c)  $\frac{x^7}{x^{14}}$     d)  $\frac{x^7}{y^4}$   
e)  $\frac{(ab)^4}{a^2 b^2}$     f)  $\frac{9^9 10^{10}}{10^9}$     g)  $\frac{x^9 y^8}{y^7 x^6}$     h)  $\frac{(abc)^3}{(abc)^2}$

4. Write the following expressions using only *positive* indices. For example  $\frac{x^{-4}}{x^{-2}}$  can be written as  $\frac{1}{x^2}$ .

- a)  $x^{-2} x^{-1}$     b)  $\frac{3x}{x^{-4}}$     c)  $\frac{t^{-2}}{t^{-3}}$   
d)  $(2a^2 b^3)(6a^{-3} b^{-5})$     e)  $\frac{x^{-3}}{5^{-2}}$     f)  $\frac{(27)^{-1} x^{-1}}{y^{-2}}$

### 3. Expanding Brackets and Factorising

Corbett Maths vide numbers 13, 14, 117 and 118

1. Write the following expressions without using brackets:

a)  $2(mn)$     b)  $2(m + n)$     c)  $a(mn)$     d)  $a(m + n)$     e)  $a(m - n)$

f)  $(am)n$     g)  $(a + m)n$     h)  $(a - m)n$     i)  $5(pq)$     j)  $5(p + q)$

k)  $5(p - q)$     l)  $7(xy)$     m)  $7(x + y)$     n)  $7(x - y)$     o)  $8(2p + q)$

p)  $8(2pq)$     q)  $8(2p - q)$     r)  $5(p - 3q)$     s)  $5(p + 3q)$     t)  $5(3pq)$

2. Write the following expressions without using brackets and simplify where possible:

a)  $(2 + a)(3 + b)$     b)  $(x + 1)(x + 2)$     c)  $(x + 3)(x + 3)$     d)  $(x + 5)(x - 3)$

3. Factorise

a)  $5x + 15y$     b)  $3x - 9y$     c)  $2x + 12y$     d)  $4x + 32z + 16y$     e)  $\frac{1}{2}x + \frac{1}{4}y$

4. Factorise

a)  $\frac{1}{3}x + \frac{1}{6}xy$     b)  $\frac{2}{3}\pi r^3 + \frac{1}{3}\pi r^2h$     c)  $a^2 - a + \frac{1}{4}$     d)  $\frac{1}{x^2} - \frac{2}{x} + 1$

## 4. Surds

Corbett Maths video numbers 305-308

1. Write the following in their simplest forms

a)  $\sqrt{180}$     b)  $\sqrt{63}$

2. By multiplying numerator and denominator by  $\sqrt{2} + 1$  show that

$$\frac{1}{\sqrt{2} - 1} \quad \text{is equivalent to} \quad \sqrt{2} + 1$$

3. Simplify, if possible, a)  $\sqrt{x^2y^2}$     b)  $\sqrt{x^2 + y^2}$ .

4. Study the following expressions and simplify where possible.

a)  $\sqrt{(x + y)^4}$     b)  $(\sqrt[3]{x + y})^6$     c)  $\sqrt{x^4 + y^4}$

5. By considering the expression  $(\sqrt{x} + \sqrt{y})^2$  show that

$$\sqrt{x} + \sqrt{y} = \sqrt{x + y + 2\sqrt{xy}}$$

Find a corresponding expression for  $\sqrt{x} - \sqrt{y}$ .

## 5. Linear Equations

Corbett Maths video number 110

Solve the equations below

1.  $3y - 8 = \frac{1}{2}y$    2.  $7t - 5 = 4t + 7$    3.  $3x + 4 = 4x + 3$    4.  $4 - 3x = 4x + 3$

5.  $3x + 7 = 7x + 2$    6.  $3(x + 7) = 7(x + 2)$    7.  $2x - 1 = x - 3$    8.  $2(x + 4) = 8$

9.  $-2(x - 3) = 6$    10.  $-2(x - 3) = -6$   
11.  $-3(3x - 1) = 2$    12.  $2 - (2t + 1) = 4(t + 2)$

13.  $5(m - 3) = 8$    14.  $5m - 3 = 5(m - 3) + 2m$   
15.  $2(y + 1) = -8$    16.  $17(x - 2) + 3(x - 1) = x$

17.  $\frac{1}{3}(x + 3) = -9$    18.  $\frac{3}{m} = 4$    19.  $\frac{5}{m} = \frac{2}{m + 1}$    20.  $-3x + 3 = 18$

## 6. Changing the Subject of a Formulae

Corbett Maths video numbers 7 and 8

1. Make  $t$  the subject of the formula  $p = \frac{c}{\sqrt{t}}$ .

2. Make  $N$  the subject of the formula  $L = \frac{\mu N^2 A}{\ell}$ .

3. In each case make the specified variable the subject of the formula:

a)  $h = c + d + 2e$ ,  $e$       b)  $S = 2\pi r^2 + 2\pi rh$ ,  $h$

c)  $Q = \sqrt{\frac{c+d}{c-d}}$ ,  $c$       d)  $\frac{x+y}{3} = \frac{x-y}{7} + 2$ ,  $x$

4. Make  $n$  the subject of the formula  $J = \frac{nE}{nL + m}$ .

## 7. Solving Quadratic Equations - Factorising

Corbett Maths video numbers 118-120 and 266

1.  $x^2 - 3x + 2 = 0$     2.  $x^2 - x - 2 = 0$     3.  $x^2 + x - 2 = 0$     4.  $x^2 + 3x + 2 = 0$

5.  $x^2 + 8x + 7 = 0$     6.  $x^2 - 7x + 12 = 0$     7.  $x^2 - x - 20 = 0$     8.  $x^2 - 1 = 0$

9.  $x^2 - 2x + 1 = 0$     10.  $x^2 + 2x + 1 = 0$     11.  $x^2 + 11x = 0$     12.  $2x^2 + 2x = 0$

13.  $x^2 - 3x = 0$     14.  $x^2 + 9x = 0$     15.  $2x^2 - 5x + 2 = 0$     16.  $6x^2 - x - 1 = 0$



## 8. Solving Quadratic Equations – Completing the Square and Using the Quadratic Formula

Corbett Maths video numbers 10, 267, 267a and 267b

Solve each of the following quadratic equations twice: once by using the formula, then again by completing the square. Obtain your answers in surd, not decimal, form.

1.  $x^2 + 8x + 1 = 0$     2.  $x^2 + 7x - 2 = 0$     3.  $x^2 + 6x - 2 = 0$   
4.  $4x^2 + 3x - 2 = 0$     5.  $2x^2 + 3x - 1 = 0$     6.  $x^2 + x - 1 = 0$

## 9. Solving Simultaneous Linear Equations

Corbett Maths video numbers 295 and 296

Solve each of the pairs of simultaneous equations. Where the answer is not a whole number, give your answer as an improper fraction.

1.  $4x + 3y = 6$   
 $5x - 3y = 21$

4.  $2a + b = 3$   
 $4a - 5b = 20$

2.  $3x + 5y = 13$   
 $2x + 3y = 8$

5.  $5x + 3y = 4$   
 $3x + 4y = 9$

3.  $x + 4y = 5$   
 $4x - 2y = 11$

6.  $6x - 2y = 13$   
 $2x + 3y = -3$

## 10. Algebraic Fractions

Corbett Maths video numbers 21-24

1. Express each of the following as a single fraction.

a)  $2 \times \frac{x+y}{3}$    b)  $\frac{1}{3} \times 2(x+y)$    c)  $\frac{2}{3} \times (x+y)$

2. Simplify

a)  $3 \times \frac{x+4}{7}$    b)  $\frac{1}{7} \times 3(x+4)$    c)  $\frac{3}{7} \times (x+4)$    d)  $\frac{x}{y} \times \frac{x+1}{y+1}$   
e)  $\frac{1}{y} \times \frac{x^2+x}{y+1}$    f)  $\frac{\pi d^2}{4} \times \frac{Q}{\pi d^2}$    g)  $\frac{Q}{\pi d^2/4}$    h)  $\frac{1}{x/y}$

3. Simplify   a)  $\frac{6/7}{s+3}$    b)  $\frac{3/4}{x-1}$    c)  $\frac{x-1}{3/4}$

4. Simplify  $\frac{3}{x+2} \div \frac{x}{2x+4}$

## Further Maths Research Task

This task concerns calendar dates of the form

$$d_1d_2/m_1m_2/y_1y_2y_3y_4$$

in the order day/month/year.

The question specifically concerns those dates which contain no repetitions of a digit. For example, the date *23/05/1967* is such a date but *07/12/1974* is not such a date as both  $1 = m_1 = y_1$  and  $7 = d_2 = y_3$  are repeated digits.

We will use the Gregorian calendar throughout (this is the calendar system that is standard throughout most of the world; see below.)

- i. Show that there is no date with no repetition of digits in the years from *2000* to *2099*.
- ii. What was the last date before, *03/11/2010*, with no repetition of digits? Explain your answer.
- iii. When will the next such date be? Explain your answer.
- iv. How many such dates were there in years from *1900* to *1999*? Explain your answer.

[The Gregorian Calendar uses 12 months, which have, respectively 31, 28 or 29, 31, 30, 31, 30, 31, 31, 30, 31, 30 and 31 days. The second month (February) has 28 days in years that are not divisible by 4, or that are divisible by 100 but not 400 (such as 1900); it has 29 days in the other years (leap years).]