



**Preparing to Study**  
**A Level Maths**  
**And**  
**A Level Further Maths**  
**(Edexcel)**

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## **Introduction to those considering A Level Mathematics/ Further Mathematics next year**

Due to the coronavirus pandemic it has been a while since you have studied some Maths. So to bridge the gap the following worksheets have been put together to enable the transition from GCSE to A Level to go smoothly.

These are topics that you would have studied for GCSE Maths and so you should be able to complete them. There are many sites to help you eg MyMaths A Level, Maths Genie A Level etc.

The order the worksheets should be completed is as follows:

1. Algebra
2. Equations 1
3. Algebraic Fractions
4. Simultaneous Equations
5. Surds and Indices
6. Quadratic Functions
7. Inequalities
8. Functions 1
9. Functions 2
10. Algebra Revision

Please ensure this work is completed.

I look forward to seeing you all in September

Kind regards

M Carpenter

Subject Leader Mathematics

1. Expand and simplify the following

a)  $(3 - 4x)(4x + 3)$

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

b)  $(7x + 5y)(7x - 5y)$

e)  $5(x - 3)^2(x + 2)$

c)  $(2x - 3)^2$

f)  $(x + 2)^2$

2. Factorise completely the following

a)  $x^2 + 7x + 10$

e)  $x^2 - 3x$

i)  $2x^2 - 108$

b)  $x^2 + 12x + 20$

f)  $2x^2 - 6x$

j)  $2x^2 - x - 3$

c)  $x^2 + x - 12$

g)  $x^2 - 25$

k)  $6x^2 - x - 1$

d)  $x^2 - 3x - 18$

h)  $x^2 - 169$

l)  $6x^2 + x - 12$

3. Simplify

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

d)  $\frac{15xy - 10y^2}{5y}$

g)  $\frac{12n}{8n^2 - 4n}$

b)  $\frac{6y - 9x}{3}$

e)  $\frac{x^2y - 2xy^2}{xy}$

h)  $\frac{8xz}{4x^2z - 12xz^2}$

c)  $\frac{x^2 - x}{x}$

f)  $\frac{6}{2x - 4}$

i)  $\frac{9k}{18k - 27kp + 3nk}$

4. Simplify the following

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

e)  $\frac{2p - 3}{12 - 8p}$

i)  $\frac{x + 2}{x^2 + 5x + 6}$

m)  $\frac{n - 5}{n^2 - 25}$

b)  $\frac{x - 3}{7x - 21}$

f)  $\frac{x + x^2}{x + 1}$

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

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

c)  $\frac{2n - 3}{8n - 12}$

g)  $\frac{4n^2 + 8n}{2n + 4}$

k)  $\frac{x^2 - 5x + 6}{x - 3}$

o)  $\frac{x^2 - 7x - 18}{x^2 + 5x + 6}$

d)  $\frac{k + 3}{k^2 + 3k}$

h)  $\frac{x + 1}{x^2 + 2x + 1}$

l)  $\frac{x^2 - x - 12}{x - 4}$

p)  $\frac{x^2 + x - 20}{x^2 + 9x + 20}$

1. Solve the following equations by factorising.

a)  $x^2 + 6x + 8 = 0$   
 b)  $x^2 + 2x - 3 = 0$   
 c)  $x^2 - 5x - 14 = 0$   
 d)  $x^2 - 9x + 14 = 0$

e)  $2x^2 + 3x + 1 = 0$   
 f)  $3x^2 - 13x + 4 = 0$   
 g)  $7x^2 + 13x - 2 = 0$   
 h)  $8x^2 + 10x - 3 = 0$

2. Solve the following equations.

a)  $x^2 - 49 = 0$   
 b)  $x^2 - 9 = 0$   
 c)  $16x^2 - 25 = 0$

d)  $x^2 + 9x = 0$   
 e)  $5x^2 + 6x = 0$   
 f)  $3x^2 - 4x = 0$

3. Solve the following.

a)  $x^2 - 3x = 4$   
 b)  $12 - 7x + x^2 = 0$   
 c)  $x(x + 7) + 6 = 0$   
 d)  $x(4x + 5) = -1$

e)  $x(4x + 1) = 3x$   
 f)  $x(3x - 2) = 8$   
 g)  $4 + x^2 = 2(x + 2)$   
 h)  $1 - x^2 = x(1 + x)$

4. Solve the following by "completing the square". Give answers in surd form

a)  $x^2 + 8x = 1$   
 b)  $x^2 - 2x - 2 = 0$   
 c)  $x^2 + 4x = 2$   
 d)  $x^2 + x - 1 = 0$

e)  $x^2 + 3x + 1 = 0$   
 f)  $2x^2 - x - 2 = 0$   
 g)  $x^2 - x = 3$   
 h)  $2x^2 + 4x = 7$

5. Find, in surd form, the roots of the following equations.

a)  $5x^2 + 9x + 2 = 0$   
 b)  $2x^2 - 7x + 4 = 0$

c)  $4x^2 - 7x - 1 = 0$   
 d)  $1 = 5x - 5x^2$

6. By forming an equation solve the following.

- a) The sides of a right - angled triangle are  $x$  cm,  $(x + 7)$  cm and  $(x + 8)$  cm. Find the lengths of the sides.
- b) The length of a rectangle is 5cm more than its width. If the area of the rectangle is  $36\text{cm}^2$  find its dimensions.

7.  $x^2 - 8x - 29 \equiv (x + a)^2 + b$  where  $a$  and  $b$  are constants
- Find the value of  $a$  and the value of  $b$ .
  - Hence, or otherwise, show that the roots of  $x^2 - 8x - 29 = 0$  are  $c \pm d\sqrt{5}$ , where  $c$  and  $d$  are integers to be found.

**MATHEMATICS****ALGEBRAIC FRACTIONS****Simplify:**

1.  $\frac{x+1}{3} + \frac{x+2}{4}$

3.  $\frac{4x+3}{5} + \frac{x-2}{2}$

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

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

4.  $\frac{x-2}{6} - \frac{x-3}{7}$

6.  $\frac{5x-2}{6} - \frac{3x-2}{5}$

7.  $\frac{2x+3}{3} + \frac{3x-4}{6}$

8.  $\frac{5x-2}{12} - \frac{x-5}{4}$

**Simplify**

9.  $\frac{2}{x} + \frac{5}{4x}$

10.  $\frac{1}{5x} - \frac{2}{13x}$

11.  $\frac{2}{x+3} + \frac{3}{x+4}$

12.  $\frac{4}{x-4} - \frac{2}{x+3}$

13.  $\frac{5}{x+3} + \frac{2}{x-1}$

14.  $\frac{8}{x+7} - \frac{3}{x-4}$

**Simplify**

15.  $\frac{3}{x+1} + \frac{2}{x^2 - 1}$

16.  $\frac{2}{x+2} - \frac{1}{x^2 - 4}$

17.  $\frac{2}{3x} + \frac{x-5}{x(x+3)}$

18.  $\frac{6}{x^2 - 2x - 8} + \frac{1}{x+2}$

19.  $\frac{1}{x-1} - \frac{x+2}{2x^2 - x - 1}$

20.  $\frac{10}{2x^2 - 3x - 2} - \frac{2}{x-2}$

**Simplify**

21.  $(x+2) \times \frac{1}{x^2 - 4}$

22.  $\frac{1}{a^2 + 6a + 9} \times \frac{a^2 - 9}{2}$

23.  $\frac{x^2 - 3x}{y^2 + y} \times \frac{y+1}{x}$

24.  $\frac{y}{y+3} \div \frac{y^2}{y^2 + 4y + 3}$

25.  $\frac{x+3}{x^2 + 10x + 25} \div \frac{x^2 + 5x}{x^2 + 3x}$

**Solve**

26.  $\frac{x-1}{3} + \frac{x}{4} = \frac{5}{6}$

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

1. Solve the following simultaneous equations.

a)  $2x + y = 18$   
 $x - 2y = -1$

b)  $7p + 3q = 5$   
 $5p - q = 2$

c)  $2p + 3q = -5$   
 $3p - 5q = 21$

d)  $2x - 7y = 57$   
 $3y - 11x = 6$

2. Solve the following pairs of equations.

a)  $x^2 + y^2 = 5$   
 $y - x = 1$

b)  $y^2 - x^2 = 8$   
 $x + y = 2$

c)  $3x^2 - y^2 = 3$   
 $2x - y = 1$

d)  $y^2 + xy = 3$   
 $2x + y = 1$

e)  $xy = 2$   
 $x + y - 3 = 0$

f)  $y - x = 4$   
 $y^2 - 5x^2 = 20$

g)  $4x + y = 1$   
 $4x^2 + y = 0$

h)  $x^2 + 4y^2 = 2$   
 $2y + x + 2 = 0$

i)  $y = 4x^2$   
 $y + 2x = 2$

j)  $2x - y = 2$   
 $x^2 - y = 5$

k)  $1 + 3xy = 0$   
 $x + 6y = 1$

l)  $x^2 - xy = 0$   
 $x + y = 1$

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

n)  $xy + x = -3$   
 $2x + 5y = 8$

**Simplify**

1.  $\sqrt{8}$

2.  $\sqrt{12}$

3.  $\sqrt{27}$

4.  $\sqrt{50}$

5.  $\sqrt{45}$

6.  $\sqrt{75}$

7.  $\sqrt{32}$

8.  $\sqrt{72}$

9.  $\sqrt{60}$

10.  $\sqrt{108}$

**Simplify**

11.  $\sqrt{8} + \sqrt{18} - 2\sqrt{2}$

12.  $\sqrt{75} + 2\sqrt{12} - \sqrt{27}$

13.  $\sqrt{28} + \sqrt{175} - \sqrt{63}$

14.  $\sqrt{1000} - \sqrt{40} - \sqrt{90}$

15.  $\sqrt{512} + \sqrt{128} + \sqrt{32}$

16.  $\sqrt{24} - 3\sqrt{6} - \sqrt{216} + \sqrt{294}$

**Rationalise the denominators**

17.  $\frac{1}{\sqrt{5}}$

18.  $\frac{1}{\sqrt{7}}$

19.  $\frac{2}{\sqrt{3}}$

20.  $\frac{3}{\sqrt{6}}$

21.  $\frac{1}{2\sqrt{2}}$

22.  $\frac{1}{\sqrt{2} + 1}$

23.  $\frac{1}{2 - \sqrt{3}}$

24.  $\frac{2}{\sqrt{6} + 2}$

25.  $\frac{1}{\sqrt{5} - \sqrt{3}}$

26.  $\frac{1}{3 - 2\sqrt{2}}$

**Find the values of**

27.  $7^0$

28.  $27^{\frac{1}{3}}$

29.  $3^{-1}$

30.  $2^{-3}$

31.  $27^{\frac{2}{3}}$

32.  $\left(\frac{4}{9}\right)^{\frac{1}{2}}$

33.  $\left(\frac{1}{2}\right)^{-1}$

34.  $\left(\frac{2}{3}\right)^{-2}$

35.  $4^{-\frac{3}{2}}$

36.  $27^{-\frac{2}{3}}$

37.  $64^{\frac{1}{3}}$

38.  $\left(2\frac{1}{4}\right)^{\frac{1}{2}}$

39.  $\left(\frac{8}{27}\right)^{\frac{2}{3}}$

40.  $(0.04)^{-\frac{3}{2}}$

41.  $\left(\frac{1}{16}\right)^{-\frac{3}{2}}$

**Solve the following quadratic equations leaving your answers in surd form.**

42.  $x^2 + 6x - 2 = 0$

43.  $2x^2 = 4 - 5x$

1. Given that  $3x^2 - 12x + 2 \equiv a(x + b)^2 + c$  , find the values of a, b and c

2. Given that  $4x^2 - 8x + 7 \equiv p(x + q)^2 + r$  , find the values of p, q and r.

3. By "completing the square " find the least value of the following. In each case state the value of x when the function takes this minimum value.

a)  $x^2 - 8x + 3$

b)  $x^2 - 7x + 1$

c)  $2x^2 + 4x - 7$

4. By "completing the square " find the maximum value of the following. In each case state the value of x when the function takes this maximum value.

a)  $-x^2 - x + 6$

b)  $-x^2 + 6x - 4$

c)  $-2x^2 - 6x + 3$

5. For the following graphs find

a) the point where each curve cuts the y-axis

b) the points where the curve cuts the x-axis

c) any maximum or minimum points

Hence sketch each of the graphs.

a)  $y = x^2 - 8x + 15$

b)  $y = x^2 - 4x - 12$

c)  $y = x^2 + 2x$

d)  $y = 3x - x^2$

e)  $y = 9 - x^2$

f)  $y = -x^2 + 5x - 6$

1. Find the range of values of  $x$  satisfying the following inequalities.

a)  $3x < 18$

b)  $5x > 20$

c)  $3x \leq -27$

d)  $2x \geq -36$

e)  $\frac{x}{2} < 6$

f)  $-x \geq 5$

g)  $-3x > 12$

h)  $-7x \leq -28$

2. Solve the following inequalities.

a)  $3x - 2 \geq 10$

b)  $5x + 3 < -2$

c)  $6 - 2x \leq 2$

d)  $25 - 4x > -3$

e)  $9x + 1 \leq -8$

f)  $-3 - 5x > 2$

3. Solve the following inequalities

a)  $3x - 2 \leq 2x + 5$

b)  $4x - 3 \geq 6 - 2x$

c)  $4x + 3 \leq x - 2$

d)  $5 - x < 2x - 1$

e)  $8 - 3x > x + 4$

f)  $7 - 2x \leq 4 + x$

4. Solve the following inequalities.

a)  $x^2 - 4x - 5 \geq 0$

b)  $3x^2 + 10x - 8 \geq 0$

c)  $x^2 - 8x < 9$

d)  $9x - 4 - 2x^2 > 0$

e)  $(x - 4)^2 \geq 25$

f)  $x^2 - 20 < 8x$

5. A rectangular tile has length  $x$  cm and breadth  $(6 - x)$  cm. Given that the area of the tile must be at least  $5 \text{ cm}^2$ , form a quadratic inequality in  $x$  and hence find the set of possible values of  $x$ .

6. Find the set of values of  $x$  for which  $2x(x + 3) > (x + 2)(x - 3)$

7. Find the set of values for which  $(2x + 1)^2 < 9(4 - x)$

8. Find the set of values of  $x$  for which

a)  $3(2x + 1) > 5 - 2x$

b)  $2x^2 - 7x + 3 > 0$

c) **both**  $3(2x + 1) > 5 - 2x$  **and**  $2x^2 - 7x + 3 > 0$

9. Find the set of values of  $m$  for which the equation  $x^2 - (m + 3)x + 4m = 0$  has real roots.

10. Determine the nature of the roots of the following equations

a)  $2x^2 + 7x - 15 = 0$

b)  $9x^2 - 6x + 1 = 0$

c)  $3x^2 - 7x + 1 = 0$

1. Given the functions  $f : x \rightarrow 3x - 2$ ,  $g : x \rightarrow 4 - 5x$ ,  $h : x \rightarrow x^2$  find the value of

- a)  $f(1)$
- b)  $g(-2)$
- c)  $h(-3)$
- d)  $fg(1)$
- e)  $hf(2)$
- f)  $gf(-2)$
- g)  $gg(-3)$
- h)  $fh(-1)$
- i)  $fff(2)$
- j)  $fgh(-2)$

2. For the functions in Qu. 1, solve the following equations.

- a)  $f(x) = 1$
- b)  $g(x) = -6$
- c)  $h(x) = 25$
- d)  $f(x) = x + 3$
- e)  $h(x) = f(x)$
- f)  $f(x) - g(x) = 3$
- g)  $h(x) - g(x) = 10$ .

3. Given  $f : x \rightarrow \frac{x}{x-2}$ ,  $x \in \mathbb{R}$ ,  $x \neq 2$

Find a)  $ff(3)$       b)  $fff(-1)$       c) Solve  $f(x) = 2$

4. Given  $f : x \rightarrow \frac{x+3}{x+2}$ ,  $x \in \mathbb{R}$ ,  $x \neq -2$ , find  $x$  if  $f(x) = x$

5. Given  $f : x \rightarrow x + 3$ ,  $g : x \rightarrow 2x - 1$ , find the following functions

- a)  $fg(x)$
- b)  $gf(x)$
- c)  $gg(x)$
- d)  $fff(x)$

6. Given  $f : x \rightarrow x - 2$ ,  $g : x \rightarrow x^2$  and  $h : x \rightarrow \frac{1}{x}$  find the following functions

- a)  $fg(x)$
- b)  $gf(x)$
- c)  $fgh(x)$

Solve the following equations.

- d)  $fg(x) = 2$
- e)  $gf(x) = 9$
- f)  $fg(x) = gf(x)$
- g)  $fg(x) - gh(x) = 5$

1. Given  $f : x \rightarrow 1 - x$ ,  $g : x \rightarrow 3x + 2$ ,  $h : x \rightarrow 2x$  find

- |            |             |             |
|------------|-------------|-------------|
| a) $fg(3)$ | b) $gfh(2)$ | c) $ggg(1)$ |
| d) $fg(x)$ | e) $hg(x)$  | f) $fgh(x)$ |

2. Given  $f : x \rightarrow x - 3$ ,  $g : x \rightarrow x^2$  solve the following equations.

- |                   |                   |                    |
|-------------------|-------------------|--------------------|
| a) $fg(x) = f(x)$ | b) $gf(x) = g(x)$ | c) $fg(x) = gf(x)$ |
|-------------------|-------------------|--------------------|

3. Given  $f(x) = \frac{1}{x}$ ,  $g(x) = x + 2$  solve the following equations

- |                   |                   |
|-------------------|-------------------|
| a) $fg(x) = g(x)$ | b) $gf(x) = g(x)$ |
|-------------------|-------------------|

4. Given  $f : x \rightarrow 2x$ ,  $g : x \rightarrow x + 1$ , express the following in terms of  $f$  and  $g$ .

- |                           |                       |                             |                          |
|---------------------------|-----------------------|-----------------------------|--------------------------|
| a) $x \rightarrow 2x + 1$ | b) $x \rightarrow 4x$ | c) $x \rightarrow 2(x + 1)$ | d) $x \rightarrow x + 3$ |
|---------------------------|-----------------------|-----------------------------|--------------------------|

5. Find the inverse function  $f^{-1}(x)$  for each of the following

- |                    |                         |                              |
|--------------------|-------------------------|------------------------------|
| a) $f(x) = 2x + 5$ | b) $f(x) = \frac{x}{3}$ | c) $f(x) = \frac{1}{2}x - 3$ |
|--------------------|-------------------------|------------------------------|

6. Find the inverse function of each of the following.

- |  |  |
|--|--|
| a) $f(x) = \frac{3x + 4}{5}$                             | b) $f(x) = \frac{2x + 1}{x - 3}$ , $x \neq 3$  |
| c) $f(x) = \frac{x - 3}{2x + 1}$ , $x \neq -\frac{1}{2}$ | d) $f(x) = \frac{3x - 2}{x + 4}$ , $x \neq -4$ |
| e) $f(x) = \frac{x + 4}{3x - 2}$ , $x \neq \frac{2}{3}$  | f) $f(x) = \frac{x + 3}{x - 1}$ , $x \neq 1$   |

g) What do you notice about your answer to part (f)

7. Find the inverse function of the following.

a)  $f : x \rightarrow x^2 + x - 6$      $x > -\frac{1}{2}$

b)  $f : x \rightarrow x^2 - 7x + 12$      $x > 3\frac{1}{2}$

1. Factorise

a)  $x^2 + 9x + 20$   
c)  $9 + 6x + x^2$   
e)  $4x^2 - 9$   
g)  $12 + 7x - 12x^2$

b)  $2x^2 - 3x + 1$   
d)  $x^2 - 16$   
f)  $9x^2 - 3x$   
h)  $4x^2 - 4xy - 3y^2$

2. Solve the following equations.

a)  $x^2 - 3x = 4$

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

c)  $x^2 = 10x$

d)  $1 - x^2 = x(1 + x)$

3. Solve the following equations leaving answers in surd form

a)  $4x^2 - 7x - 1 = 0$

b)  $2x = 5 - 4x^2$

4. Solve the simultaneous equations.

a)  $y^2 + xy = 3$   
 $2x + y = 1$

b)  $xy = 2$   
 $x + y - 3 = 0$

5. In each of the following find

- i) where the curve cuts the y-axis  
iii) any maximum or minimum points

- ii) where the curve cuts the x-axis  
iv) Hence sketch the curve

a)  $y = x^2 - 3x - 18$

b)  $y = -2x^2 + 7x + 4$

c)  $y = x^2 - 4x + 4$

6. Find the value of

a)  $8^{-\frac{2}{3}}$

b)  $(\frac{5}{6})^{-2}$

c)  $(1\frac{7}{9})^{\frac{1}{2}}$

d)  $(\frac{16}{25})^{-\frac{1}{2}}$

7. Simplify

a)  $\sqrt{48}$       b)  $\frac{\sqrt{18}}{\sqrt{2}}$       c)  $\frac{1}{\sqrt{3} - 1}$       d)  $\frac{\sqrt{3} + 2}{\sqrt{3} - 2}$       e)  $\frac{2 - 3\sqrt{5}}{2\sqrt{5} + 1}$

8. Find the set of values of x for which

a)  $(x - 1)(x - 4) < 2(x - 4)$

b)  $2(x + 1)(x - 4) > (x - 2)^2$

9. Without using a calculator, solve the equation

$$3^{(2x-1)} = 9^{-x}$$

10. Solve the following simultaneous equations

$$\begin{aligned}2x^2 - y^2 + 2y + 3x - 9 &= 0 \\2x - y &= 1\end{aligned}$$