A Level Mathematics Bridging Work

In order to achieve in A Level Mathematics it is **vital** that you have a secure knowledge of GCSE Mathematics content. In particular, you must be **fluent** in the following topics:

- Expanding brackets and simplifying expressions
- Surds and rationalising the denominator
- Rules of indices
- Factorising expressions
- Solving quadratic equations by factorising
- Completing the square
- Solving quadratic equations by completing the square
- Solving quadratic equations by the quadratic formula
- Solving linear simultaneous equations using both elimination and substitution
- Solving linear and quadratic simultaneous equations
- Linear inequalities
- Quadratic inequalities

We expect that most students will already be confident in the vast majority of these topics. However, we are aware that students may have not finished the entire GCSE syllabus in Year 11 and may have significant gaps in understanding. It is essential that all students spend a significant amount of time practising these topics at regular intervals between the end of Year 11 and the start of Year 12.

Mathematical fluency does not simply mean that you have met this topic before and think that you remember how to do it. To reach fluency, you must be able to **quickly** and **accurately** recall concepts and methods.

For each topic listed above, you must complete all of the following steps:

- Watch the revision videos uploaded on Google Classroom.
- Once you feel confident then attempt all of the 'Practice' questions.
- If you find any questions difficult, go back over the revision videos. If you still do not understand a skill, please go watch the Hegarty Maths videos or email me on s.fernando@astleycooper.herts.sch.uk.
- Complete the 'Extend' questions to make sure that you do have an excellent understanding.

Please bring all of your **completed** bridging work to your first maths lesson where it will be checked by your maths teacher. We expect you to complete the questions on lined or squared paper, showing a **full method** and **working out**. Please be organised and create a maths folder for all your work to go in.

There will be an assessment covering these topics in the first week of Year 12. It is expected that all A Level Mathematics students will demonstrate an excellent understanding of all topics in this assessment.

Expanding brackets and simplifying expressions

Practice

1 Expand.

    a $3(2x - 1)$ **b** $-2(5pq + 4q^2)$

    c $-(3xy - 2y^2)$

Watch out!
When multiplying (or dividing) positive and negative numbers, if the signs are the same the answer is '+'; if the signs are different the answer is '−'.

2 Expand and simplify.

    a $7(3x + 5) + 6(2x - 8)$ **b** $8(5p - 2) - 3(4p + 9)$

    c $9(3s + 1) - 5(6s - 10)$ **d** $2(4x - 3) - (3x + 5)$

3 Expand.

    a $3x(4x + 8)$ **b** $4k(5k^2 - 12)$

    c $-2h(6h^2 + 11h - 5)$ **d** $-3s(4s^2 - 7s + 2)$

4 Expand and simplify.

    a $3(y^2 - 8) - 4(y^2 - 5)$ **b** $2x(x + 5) + 3x(x - 7)$

    c $4p(2p - 1) - 3p(5p - 2)$ **d** $3b(4b - 3) - b(6b - 9)$

5 Expand $\frac{1}{2}(2y - 8)$

6 Expand and simplify.

    a $13 - 2(m + 7)$ **b** $5p(p^2 + 6p) - 9p(2p - 3)$

7 The diagram shows a rectangle.

Write down an expression, in terms of x, for the area of the rectangle.

Show that the area of the rectangle can be written as $21x^2 - 35x$

$3x - 5$

$7x$

8 Expand and simplify.

    a $(x + 4)(x + 5)$ **b** $(x + 7)(x + 3)$

    c $(x + 7)(x - 2)$ **d** $(x + 5)(x - 5)$

    e $(2x + 3)(x - 1)$ **f** $(3x - 2)(2x + 1)$

    g $(5x - 3)(2x - 5)$ **h** $(3x - 2)(7 + 4x)$

    i $(3x + 4y)(5y + 6x)$ **j** $(x + 5)^2$

    k $(2x - 7)^2$ **l** $(4x - 3y)^2$

Extend

9 Expand and simplify $(x + 3)^2 + (x - 4)^2$

10 Expand and simplify.

    a $\left(x + \dfrac{1}{x}\right)\left(x - \dfrac{2}{x}\right)$ **b** $\left(x + \dfrac{1}{x}\right)^2$

Surds and rationalising the denominator

Practice

1 Simplify.

a $\sqrt{45}$

b $\sqrt{125}$

c $\sqrt{48}$

d $\sqrt{175}$

e $\sqrt{300}$

f $\sqrt{28}$

g $\sqrt{72}$

h $\sqrt{162}$

> **Hint**
>
> One of the two numbers you choose at the start must be a square number.

2 Simplify.

a $\sqrt{72}+\sqrt{162}$

b $\sqrt{45}-2\sqrt{5}$

c $\sqrt{50}-\sqrt{8}$

d $\sqrt{75}-\sqrt{48}$

e $2\sqrt{28}+\sqrt{28}$

f $2\sqrt{12}-\sqrt{12}+\sqrt{27}$

> **Watch out!**
>
> Check you have chosen the highest square number at the start.

3 Expand and simplify.

a $(\sqrt{2}+\sqrt{3})(\sqrt{2}-\sqrt{3})$

b $(3+\sqrt{3})(5-\sqrt{12})$

c $(4-\sqrt{5})(\sqrt{45}+2)$

d $(5+\sqrt{2})(6-\sqrt{8})$

4 Rationalise and simplify, if possible.

a $\dfrac{1}{\sqrt{5}}$

b $\dfrac{1}{\sqrt{11}}$

c $\dfrac{2}{\sqrt{7}}$

d $\dfrac{2}{\sqrt{8}}$

e $\dfrac{2}{\sqrt{2}}$

f $\dfrac{5}{\sqrt{5}}$

g $\dfrac{\sqrt{8}}{\sqrt{24}}$

h $\dfrac{\sqrt{5}}{\sqrt{45}}$

5 Rationalise and simplify.

a $\dfrac{1}{3-\sqrt{5}}$

b $\dfrac{2}{4+\sqrt{3}}$

c $\dfrac{6}{5-\sqrt{2}}$

Extend

6 Expand and simplify $\left(\sqrt{x}+\sqrt{y}\right)\left(\sqrt{x}-\sqrt{y}\right)$

7 Rationalise and simplify, if possible.

a $\dfrac{1}{\sqrt{9}-\sqrt{8}}$

b $\dfrac{1}{\sqrt{x}-\sqrt{y}}$

Rules of indices

Practice

1 Evaluate.

a 14^0 b 3^0 c 5^0 d x^0

2 Evaluate.

a $49^{\frac{1}{2}}$ b $64^{\frac{1}{3}}$ c $125^{\frac{1}{3}}$ d $16^{\frac{1}{4}}$

3 Evaluate.

a $25^{\frac{3}{2}}$ b $8^{\frac{5}{3}}$ c $49^{\frac{3}{2}}$ d $16^{\frac{3}{4}}$

4 Evaluate.

a 5^{-2} b 4^{-3} c 2^{-5} d 6^{-2}

5 Simplify.

a $\dfrac{3x^2 \times x^3}{2x^2}$ b $\dfrac{10x^5}{2x^2 \times x}$

c $\dfrac{3x \times 2x^3}{2x^3}$ d $\dfrac{7x^3y^2}{14x^5y}$

e $\dfrac{y^2}{y^{\frac{1}{2}} \times y}$ f $\dfrac{c^{\frac{1}{2}}}{c^2 \times c^{\frac{3}{2}}}$

g $\dfrac{\left(2x^2\right)^3}{4x^0}$ h $\dfrac{x^{\frac{1}{2}} \times x^{\frac{1}{2}}}{x^{-2} \times x^3}$

> **Watch out!**
>
> Remember that any value raised to the power of zero is 1. This is the rule $a^0 = 1$.

6 Evaluate.

a $4^{-\frac{1}{2}}$ b $27^{-\frac{2}{3}}$ c $9^{-\frac{1}{2}} \times 2^3$

d $16^{\frac{1}{4}} \times 2^{-3}$ e $\left(\dfrac{9}{16}\right)^{-\frac{1}{2}}$ f $\left(\dfrac{27}{64}\right)^{-\frac{2}{3}}$

7 Write the following as a single power of x.

a $\dfrac{1}{x}$ b $\dfrac{1}{x^7}$ c $\sqrt[4]{x}$

d $\sqrt[5]{x^2}$ e $\dfrac{1}{\sqrt[3]{x}}$ f $\dfrac{1}{\sqrt[3]{x^2}}$

8 Write the following without negative or fractional powers.

a x^{-3} **b** x^0 **c** $x^{\frac{1}{5}}$

d $x^{\frac{2}{5}}$ **e** $x^{-\frac{1}{2}}$ **f** $x^{-\frac{3}{4}}$

9 Write the following in the form ax^n.

a $5\sqrt{x}$ **b** $\dfrac{2}{x^3}$ **c** $\dfrac{1}{3x^4}$

d $\dfrac{2}{\sqrt{x}}$ **e** $\dfrac{4}{\sqrt[3]{x}}$ **f** 3

Extend

10 Write as sums of powers of x.

a $\dfrac{x^5+1}{x^2}$ **b** $x^2\left(x+\dfrac{1}{x}\right)$ **c** $x^{-4}\left(x^2+\dfrac{1}{x^3}\right)$

Factorising expressions

Practice

1 Factorise.

a $6x^4y^3 - 10x^3y^4$

b $21a^3b^5 + 35a^5b^2$

c $25x^2y^2 - 10x^3y^2 + 15x^2y^3$

2 Factorise

a $x^2 + 7x + 12$

b $x^2 + 5x - 14$

c $x^2 - 11x + 30$

d $x^2 - 5x - 24$

e $x^2 - 7x - 18$

f $x^2 + x - 20$

g $x^2 - 3x - 40$

h $x^2 + 3x - 28$

3 Factorise

a $36x^2 - 49y^2$

b $4x^2 - 81y^2$

c $18a^2 - 200b^2c^2$

4 Factorise

a $2x^2 + x - 3$

b $6x^2 + 17x + 5$

c $2x^2 + 7x + 3$

d $9x^2 - 15x + 4$

e $10x^2 + 21x + 9$

f $12x^2 - 38x + 20$

5 Simplify the algebraic fractions.

a $\dfrac{2x^2 + 4x}{x^2 - x}$

b $\dfrac{x^2 + 3x}{x^2 + 2x - 3}$

c $\dfrac{x^2 - 2x - 8}{x^2 - 4x}$

d $\dfrac{x^2 - 5x}{x^2 - 25}$

e $\dfrac{x^2 - x - 12}{x^2 - 4x}$

f $\dfrac{2x^2 + 14x}{2x^2 + 4x - 70}$

6 Simplify

a $\dfrac{9x^2 - 16}{3x^2 + 17x - 28}$

b $\dfrac{2x^2 - 7x - 15}{3x^2 - 17x + 10}$

c $\dfrac{4 - 25x^2}{10x^2 - 11x - 6}$

d $\dfrac{6x^2 - x - 1}{2x^2 + 7x - 4}$

Extend

7 Simplify $\sqrt{x^2 + 10x + 25}$

8 Simplify $\dfrac{(x+2)^2 + 3(x+2)^2}{x^2 - 4}$

Solving quadratic equations by factorisation

Practice

1   Solve

   a $6x^2 + 4x = 0$ **b** $28x^2 - 21x = 0$

   c $x^2 + 7x + 10 = 0$ **d** $x^2 - 5x + 6 = 0$

   e $x^2 - 3x - 4 = 0$ **f** $x^2 + 3x - 10 = 0$

   g $x^2 - 10x + 24 = 0$ **h** $x^2 - 36 = 0$

   i $x^2 + 3x - 28 = 0$ **j** $x^2 - 6x + 9 = 0$

   k $2x^2 - 7x - 4 = 0$ **l** $3x^2 - 13x - 10 = 0$

2   Solve

   a $x^2 - 3x = 10$ **b** $x^2 - 3 = 2x$

   c $x^2 + 5x = 24$ **d** $x^2 - 42 = x$

   e $x(x + 2) = 2x + 25$ **f** $x^2 - 30 = 3x - 2$

   g $x(3x + 1) = x^2 + 15$ **h** $3x(x - 1) = 2(x + 1)$

Hint
Get all terms onto one side of the

Completing the square

Practice

1   Write the following quadratic expressions in the form $(x + p)^2 + q$

   a $x^2 + 4x + 3$ **b** $x^2 - 10x - 3$

   c $x^2 - 8x$ **d** $x^2 + 6x$

   e $x^2 - 2x + 7$ **f** $x^2 + 3x - 2$

2   Write the following quadratic expressions in the form $p(x + q)^2 + r$

   a $2x^2 - 8x - 16$ **b** $4x^2 - 8x - 16$

   c $3x^2 + 12x - 9$ **d** $2x^2 + 6x - 8$

3   Complete the square.

   a $2x^2 + 3x + 6$ **b** $3x^2 - 2x$

   c $5x^2 + 3x$ **d** $3x^2 + 5x + 3$

Extend

4   Write $(25x^2 + 30x + 12)$ in the form $(ax + b)^2 + c$.

Solving quadratic equations by completing the square

Practice

3 Solve by completing the square.

  a $x^2 - 4x - 3 = 0$ **b** $x^2 - 10x + 4 = 0$

  c $x^2 + 8x - 5 = 0$ **d** $x^2 - 2x - 6 = 0$

  e $2x^2 + 8x - 5 = 0$ **f** $5x^2 + 3x - 4 = 0$

4 Solve by completing the square.

  a $(x - 4)(x + 2) = 5$

  b $2x^2 + 6x - 7 = 0$

  c $x^2 - 5x + 3 = 0$

> **Hint**
>
> Get all terms onto one side of the

Solving quadratic equations by using the formula

Practice

5 Solve, giving your solutions in surd form.

  a $3x^2 + 6x + 2 = 0$ **b** $2x^2 - 4x - 7 = 0$

6 Solve the equation $x^2 - 7x + 2 = 0$

  Give your solutions in the form $\dfrac{a \pm \sqrt{b}}{c}$, where a, b and c are integers.

7 Solve $10x^2 + 3x + 3 = 5$

  Give your solution in surd form.

> **Hint**
>
> Get all terms onto one side of the equation.

Extend

8 Choose an appropriate method to solve each quadratic equation, giving your answer in surd form when necessary.

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

  b $10 = (x + 1)^2$

  c $x(3x - 1) = 10$

Solving linear simultaneous equations using the elimination method

Practice

Solve these simultaneous equations.

1 $4x + y = 8$

   $x + y = 5$

2 $3x + y = 7$

   $3x + 2y = 5$

3 $4x + y = 3$

   $3x - y = 11$

4 $3x + 4y = 7$

   $x - 4y = 5$

5 $2x + y = 11$

   $x - 3y = 9$

6 $2x + 3y = 11$

   $3x + 2y = 4$

Solving linear simultaneous equations using the substitution method

Practice

Solve these simultaneous equations.

7 $y = x - 4$

   $2x + 5y = 43$

8 $y = 2x - 3$

   $5x - 3y = 11$

9 $2y = 4x + 5$

   $9x + 5y = 22$

10 $2x = y - 2$

   $8x - 5y = -11$

11 $3x + 4y = 8$

   $2x - y = -13$

12 $3y = 4x - 7$

   $2y = 3x - 4$

13 $3x = y - 1$

   $2y - 2x = 3$

14 $3x + 2y + 1 = 0$

   $4y = 8 - x$

Extend

15 Solve the simultaneous equations $3x + 5y - 20 = 0$ and $2(x + y) = \dfrac{3(y - x)}{4}$.

Solving linear and quadratic simultaneous equations

Practice

Solve these simultaneous equations.

1 $y = 2x + 1$
$x^2 + y^2 = 10$

2 $y = 6 - x$
$x^2 + y^2 = 20$

3 $y = x - 3$
$x^2 + y^2 = 5$

4 $y = 9 - 2x$
$x^2 + y^2 = 17$

5 $y = 3x - 5$
$y = x^2 - 2x + 1$

6 $y = x - 5$
$y = x^2 - 5x - 12$

7 $y = x + 5$
$x^2 + y^2 = 25$

8 $y = 2x - 1$
$x^2 + xy = 24$

9 $y = 2x$
$y^2 - xy = 8$

10 $2x + y = 11$
$xy = 15$

Extend

11 $x - y = 1$
$x^2 + y^2 = 3$

12 $y - x = 2$
$x^2 + xy = 3$

Linear inequalities

Practice

1   Solve these inequalities.

    a $4x > 16$ **b** $5x - 7 \leq 3$ **c** $1 \geq 3x + 4$

    d $5 - 2x < 12$ **e** $\dfrac{x}{2} \geq 5$ **f** $8 < 3 - \dfrac{x}{3}$

2   Solve these inequalities.

    a $\dfrac{x}{5} < -4$ **b** $10 \geq 2x + 3$ **c** $7 - 3x > -5$

3   Solve

    a $2 - 4x \geq 18$ **b** $3 \leq 7x + 10 < 45$ **c** $6 - 2x \geq 4$

    d $4x + 17 < 2 - x$ **e** $4 - 5x < -3x$ **f** $-4x \geq 24$

4   Solve these inequalities.

    a $3t + 1 < t + 6$ **b** $2(3n - 1) \geq n + 5$

5   Solve.

    a $3(2 - x) > 2(4 - x) + 4$ **b** $5(4 - x) > 3(5 - x) + 2$

Extend

6   Find the set of values of x for which $2x + 1 > 11$ and $4x - 2 > 16 - 2x$.

Quadratic inequalities

Practice

1   Find the set of values of x for which $(x + 7)(x - 4) \leq 0$

2   Find the set of values of x for which $x^2 - 4x - 12 \geq 0$

3   Find the set of values of x for which $2x^2 - 7x + 3 < 0$

4   Find the set of values of x for which $4x^2 + 4x - 3 > 0$

5   Find the set of values of x for which $12 + x - x^2 \geq 0$

Extend

Find the set of values which satisfy the following inequalities.

6   $x^2 + x \leq 6$

7   $x(2x - 9) < -10$

8   $6x^2 \geq 15 + x$