Brockenhurst College

Getting Ahead – Pre-course Work

#ThinkBrock

A-level Maths

The maths team are delighted that you have chosen to study maths at Brock!

To ensure a smooth start to the year, we would like you to refresh some of the GCSE maths content, which is particularly important for the A-level. Please go through the attached material, completing the exercises at the bottom of each page on lined paper. The solutions are on the last page. You will have a short test in your first week to ensure this material is secured.

In preparation for the start of your course, you may want to order your textbook and calculator now. Note that if you benefit from a student bursary, you can claim for both items.

We will be using the **textbook** *A Level Mathematics for AQA Student Book 1* (ISBN 978-1-316-64422-5) in the lessons and at home. We will provide textbooks for your use in the lessons. We will also give you a code allowing access to an online version of the book (including some extra resources). In our experience, you are more successful learning with a paper copy of the book, so we strongly recommend you purchase your own copy. We discourage you from using your phone as the display is too small and you will miss valuable information.

You will also need to buy an A-level **calculator**. We strongly recommend the Numworks graphical calculator (the Casio CG-50 and CG-100 are suitable if you already have one). You have the opportunity to buy the Numworks calculator at a discounted price of £79.99 directly through the company (see instructions below, leaving the class blank). Please order the calculator **before the 14th September** to ensure a prompt delivery.

We are looking forward to working with you over the next two years and grow your mathematical understanding.

Kind regards,

Audrey Harwood
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Brockenhurst College
NumWorks Graphing Calculator discount link

We are providing a link to purchase NumWorks calculators at a discounted rate. To participate, please scan the QR code:

https://my.numworks.com/group_orders/1gzwwhd-1

Deadline: September 14, 2026

FRACTIONS

- **Adding & subtracting fractions**

→ Both fractions need to have the same denominator.

Ex: $\frac{5}{6} + \frac{1}{4} = \frac{5 \times 2}{6 \times 2} + \frac{1 \times 3}{4 \times 3}$ The smallest common denominator is 12, so multiply the top & bottom of the first fraction by 2 & by 4 for the 2nd fraction.

$= \frac{10}{12} + \frac{3}{12} = \frac{10+3}{12} = \frac{13}{12}$.

Ex: $\frac{3}{x+1} - \frac{2x}{x-5} = \frac{3(x-5)}{(x+1)(x-5)} - \frac{2x(x+1)}{(x-5)(x+1)}$

$= \frac{3x-15}{(x+1)(x-5)} - \frac{2x^2+2x}{(x-5)(x+1)} = \frac{3x-15-(2x^2+2x)}{(x+1)(x-5)} = \frac{-2x^2+x-15}{(x+1)(x-5)}$

- **Multiplying fractions**

→ Multiply tops & bottoms separately.

Ex: $\frac{2}{3} \times \frac{7}{8} = \frac{2 \times 7}{3 \times 8} = \frac{14}{24} = \frac{7}{12}$

but it is helpful to simplify before multiplying: $\frac{2}{3} \times \frac{7}{8} = \frac{\cancel{2}^{1} \times 7}{3 \times \cancel{8}^{4}} = \frac{7}{3 \times 4} = \frac{7}{12}$.

Ex: $\frac{x(x+1)}{(x+2)^2} \times \frac{(x+2)}{x} = \frac{\cancel{x}(x+1)\cancel{(x+2)}}{(x+2)^{\cancel{2}} \cancel{x}} = \frac{x+1}{x+2}$.

- **Dividing fractions**

→ Multiply by the reciprocal.

Ex: $\frac{14}{3} \div \frac{7}{9} = \frac{14}{3} \times \frac{9}{7} = \frac{\cancel{14}^{2} \times 9^{3}}{3 \times \cancel{7}} = 6$.

Ex: $\frac{1}{1/2} = 1 \div \frac{1}{2} = 1 \times \frac{2}{1} = 2$.

- **Exercises**: Calculate or simplify:

a) $\frac{7}{12} - \frac{3}{4}$ b) $\frac{11}{13} \div \frac{33}{26}$ c) $\frac{1}{1/3}$

d) $\frac{x+1}{3} + \frac{2x-4}{15}$ e) $\frac{(a+3)(a-2)}{a+5} \times \frac{(a+5)^2}{a+3}$ f) $\frac{(x+1)^2}{x-1} \times \frac{x^2-1}{(x+1)^3}$

g) $\frac{t+1}{t-1} \div \frac{2}{t-1}$ h) $\frac{5x}{2x+1} - \frac{3}{x-4}$ i) $\frac{x(x-3)}{2} \times \frac{2x^2-4x}{x^2}$

INDICES

- $x^3 = x \times x \times x$

$x^3 \times x^2 = (x \times x \times x) \times (x \times x) = x^{3+2} = x^5$ So: $x^p x^q = x^{p+q}$

$(x^3)^2 = x^3 \times x^3 = (x \times x \times x) \times (x \times x \times x) = x^{3 \times 2} = x^6$ So: $(x^p)^q = x^{pq}$

$x^3 \div x^5 = \begin{cases} x^{3-5} = x^{-2} \\ \frac{x^3}{x^5} = \frac{x \times x \times x}{x \times x \times x \times x \times x} = \frac{1}{x \times x} = \frac{1}{x^2} \end{cases}$ $\therefore x^{-2} = \frac{1}{x^2}$

So: $\frac{x^p}{x^q} = x^{p-q}$ and $x^{-p} = \frac{1}{x^p}$

$x = \begin{cases} x^1 = x^{\frac{1}{2}+\frac{1}{2}} = x^{\frac{1}{2}} \times x^{\frac{1}{2}} \\ \sqrt{x}\sqrt{x} \end{cases}$ $\therefore x^{\frac{1}{2}} = \sqrt{x}$ So $x^{\frac{1}{p}} = \sqrt[p]{x}$

Ex: $\frac{\sqrt[3]{x}}{x^2} = \frac{x^{\frac{1}{3}}}{x^2} = x^{\frac{1}{3}-2} = x^{-\frac{5}{3}}$

- Exercises:

Simplify:

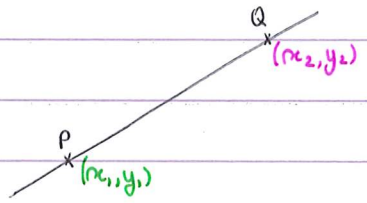
a) $(3\sqrt[3]{a})^6$ b) $\frac{1}{x^{-2}}$ c) $\frac{x^3}{\sqrt{x}}$

d) $\sqrt{t}\ \sqrt[3]{t}$ e) $a^4(a^2 - a^{-2})$ f) $\frac{81\sqrt{a}\,b^2}{9\,a^2 b}$

Solve:

g) $x^2 = 9$ h) $x^3 = 27$ i) $\sqrt{x} = 4$

Straight line.



Gradient of the line PQ : $\frac{\text{difference in } y}{\text{difference in } x}$:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

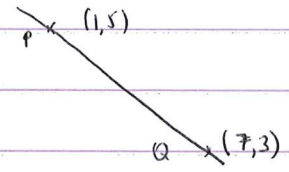
Equation of the line PQ : $y - y_1 = m(x - x_1)$

In the A-level, this form is more useful than $y = mx + c$.

Midpoint of the segment PQ : $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

(the midpoint is the middle, so you are averaging the x-coordinates of P and Q, and then the y-coordinates)

Ex.:



Gradient $m = \frac{3-5}{7-1} = \frac{-2}{6} = \frac{-1}{3}$

Equation of the line : $y - 5 = \frac{-1}{3}(x - 1)$ $\Leftrightarrow y = \frac{-1}{3}x + \frac{16}{3}$

gradient — y-intercept

Midpoint of PQ : $\left(\frac{1+7}{2}, \frac{5+3}{2}\right) = (4, 4)$

- Exercises :

a) Find the equation of the line passing through $(-3, 2)$ and with gradient 5.

b) Find the equation of the line going through $(-2, -5)$ and $(3, 7)$.

c) Find the gradient and y-intercept of the line with equation $2y - x = 5$

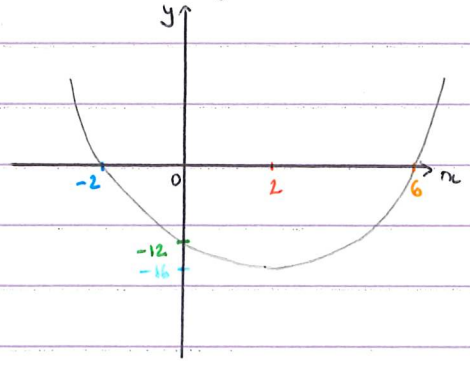
d) Find the midpoint of the segment $(-2, -5)$, $(3, 7)$.

QUADRATIC GRAPHS

By looking carefully at the equation of a function, we can learn a lot about its graph.

Ex.: $y = x^2 - 4x - 12$

- In this expanded form, the sign of the coefficient of x^2 gives the orientation of the graph.
  Here, it is positive, so the graph is $\cup$.
- The expanded form also shows us the y-intercept, i.e. where the graph crosses the y-axis:
  At $x=0$, $y = -12$, so $(0, -12)$ is the y-intercept.
- By rearranging the equation, we can find more about the graph.
- Factorising: $y = (x+2)(x-6)$
  (find 2 numbers that add to give -4 and that multiply to give -12)
  This form shows the x-intercepts, i.e. where the graph crosses the x-axis:
  At $y=0$, $x+2=0 \Rightarrow x=-2$
  or $x-6=0 \Rightarrow x=6$
  So $(-2,0)$ and $(6,0)$ are the x-intercepts.
- Completing the square: $y = (x-2)^2 - 4 - 12 \iff y = (x-2)^2 - 16$
  (-2: half the coefficient of x in the original equation; -4: adjust as we added an extra term in the square: $(x-2)^2 = x^2 - 4x + 4$)
  This form shows us the turning point, a minimum here: $(+2, -16)$
- We can now draw the graph:



Exercises: Carry on a similar analysis and draw the graphs of the following functions:

a) $y = -3x^2 + 12x$

b) $y = (x-1)(x-3)$

c) $y = 4 - (x-3)^2$

QUADRATIC EQUATIONS

There are 2 main methods to solve quadratic equations:

- Factorisation

Ex: $x^2 + 2x - 15 = 0$

→ Find 2 numbers that add to give 2 and that multiply to give -15 : -3 and 5

$\Leftrightarrow (x-3)(x+5) = 0$

$\Leftrightarrow x - 3 = 0$ or $x + 5 = 0$

$\Leftrightarrow x = +3$ or -5

- Quadratic formula

The solutions to $ax^2 + bx + c = 0$ are $\boxed{x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}}$

You will need to remember this as it is not on the A-level formula sheet!

Ex: $x^2 + 2x - 15 = 0$

$\Rightarrow x = \frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times (-15)}}{2 \times 1} = \frac{-2 \pm \sqrt{4 + 60}}{2} = \frac{-2 \pm 8}{2} = 3$ or -5.

Note that if $b^2 - 4ac = 0$, you have a double solution: $x = \frac{-b}{2a}$;

and if $b^2 - 4ac < 0$, you do not have any real solutions as you cannot take the square root of a negative number.

- Exercises

Solve, by factorisation & quadratic formula:

a) $x^2 - 9x + 14 = 0$

b) $6x - 2x^2 = 0$

c) $x^2 - 16 = 0$

Determine how many real solutions these equations have:

d) $3x^2 + 2x + 5 = 0$

e) $3x^2 + 2x - 5 = 0$

f) $4x - x^2 - 4 = 0$.

SOLUTIONS

Fractions

a) $-1/6$ b) $2/3$ c) 3

d) $\frac{7x+1}{15}$ e) $(a-2)(a+5)$ f) 1

g) $\frac{t+1}{2}$ h) $\frac{5x^2-26x-3}{(2x+1)(x-4)}$ i) $(x-3)(x-2)$

Indices

a) $729a^2$ b) x^2 c) $x^{5/2}$

d) $t^{5/6}$ e) $a^6 - a^2$ f) $\frac{ab}{a^{3/2}} = a^{-3/2}b$.

g) $x = 3$ or -3 h) $x = 3$ i) $x = 16$.

Straight line

a) $y - 2 = 5(x+3)$ or $y = 5x + 17$

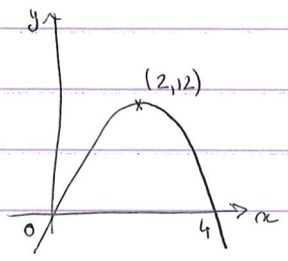
b) $y + 5 = \frac{12}{5}(x+2)$ or $12x - 5y = 1$

c) Gradient $= 1/2$ y-intercept $= 5/2$.

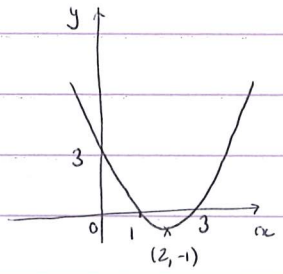
d) $(1/2, 1)$.

Quadratic graphs

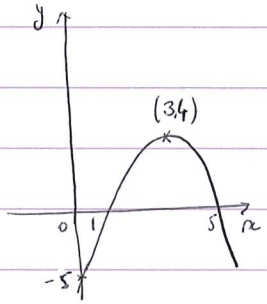
a)



b)



c)



Quadratic equations

a) $x = 2$ or 7 b) $x = 0$ or 3 c) $x = -4$ or 4

d) no real solution e) 2 real solutions f) 1 double solution.