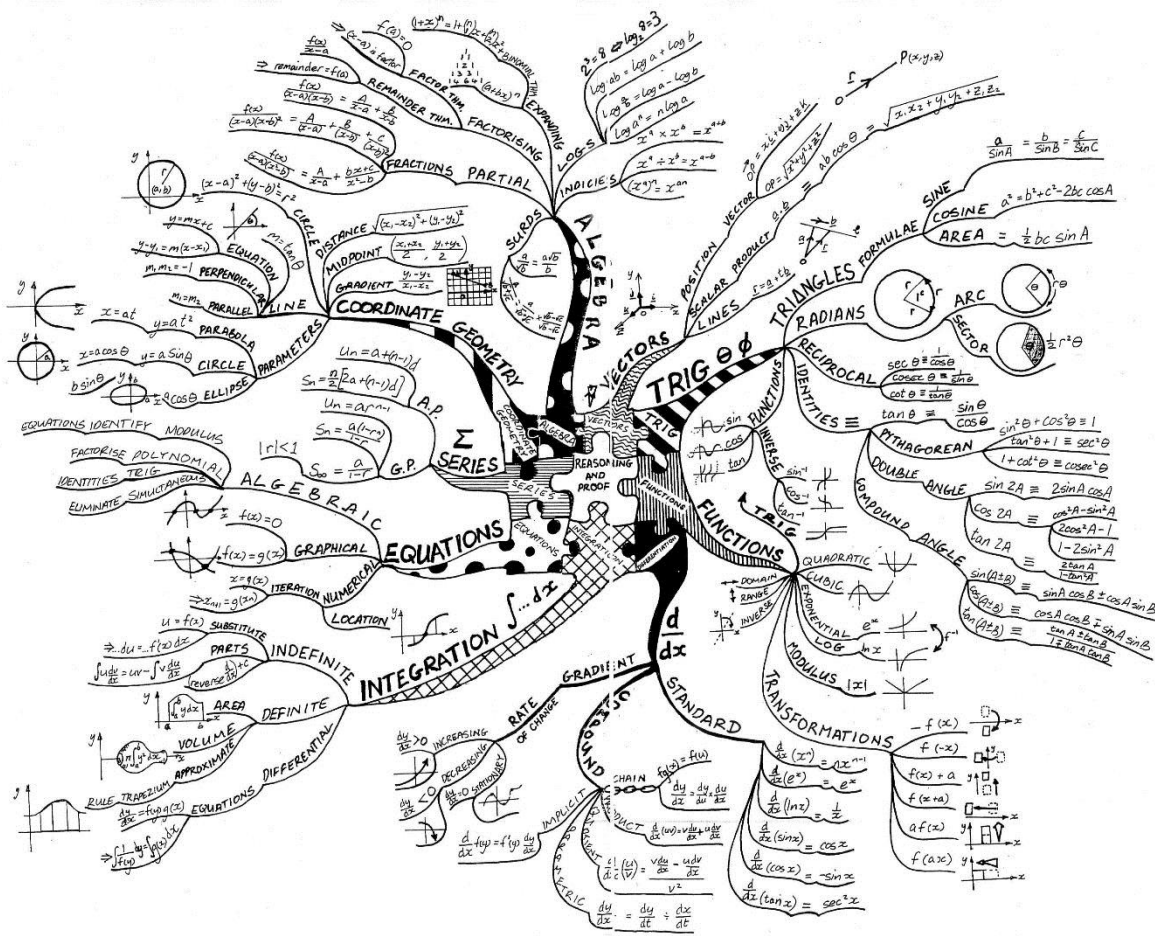


# A Level Mathematics

## Summer Work



Information regarding the Maths A level can be found on the AQA website:

<http://www.aqa.org.uk/subjects/mathematics/as-and-a-level/mathematics-7357>

There are three tasks for you to complete in preparation for your Maths A level.

Task One – Questions

Task Two – Formulae to learn

Task Three - Equipment

## Task One

You need to be confident answering the following questions in order to be able to achieve success in your Maths A level from the beginning! You need to make sure you show full workings and correct notation for each question.

To help you with these questions you can use MathsWatch or MyMaths (your logins will still work until the end of the summer). You could also purchase a 'Head Start to A-Level Maths' book which contains all these topics: [Link to head start book](#).

### Types of Number and Fractions

1. Which of the following are integers?

4      - 3.5      0.3       $\frac{4}{5}$       8.99      - 10      205      0

2. Which of the following values are rational, and which are irrational?

5.9       $\pi$        $\sqrt{7}$        $\frac{1}{5}$       - 6       $\sqrt{4}$       13.978      2.1

3. Evaluate the following without using a calculator, giving your answers in their lowest terms. Give any answers larger than 1 as improper fractions.

- a)  $\frac{2}{9} \times \frac{3}{5}$   
b)  $\frac{1}{6} \div \frac{2}{3}$   
c)  $\frac{1}{12} + \frac{5}{6}$   
d)  $\frac{8}{5} - \frac{1}{7}$

### Indices, Multiplying Out Brackets and Factorising

4. Simplify the following:

- a)  $x^7 \times x^2$   
b)  $10y^3 \div 5y$   
c)  $m^0$   
d)  $(2n^3)^5$

5. Write  $5^{-2}$  as a fraction.

6. Evaluate the following without using a calculator:

- a)  $\left(\frac{3}{4}\right)^2$   
b)  $16^{\frac{1}{2}}$   
c)  $8^{\frac{2}{3}}$   
d)  $36^{-\frac{1}{2}}$

7. Multiply out the brackets and simplify your answers where possible.

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

8. Factorise the following:

- a)  $5x + 20$
- b)  $3a + 12b$
- c)  $x^2 - 4$
- d)  $9x^2 - 36$
- e)  $x^2 - 5$

### Surds

9. Simplify the following:

- a)  $\sqrt{3} \times \sqrt{2}$
- b)  $(\sqrt{5})^2$
- c)  $\frac{\sqrt{30}}{\sqrt{5}}$
- d)  $\sqrt{12} + 2\sqrt{3}$
- e)  $(1 + \sqrt{7})^2$

10. Rationalise the denominators of the following:

- a)  $\frac{3}{\sqrt{2}}$
- b)  $\frac{\sqrt{5}}{2\sqrt{2}}$
- c)  $\frac{2}{3+\sqrt{6}}$
- d)  $\frac{\sqrt{2}}{1-\sqrt{5}}$

### Solving Equations and Rearranging Formulae

11. Solve the following:

- a)  $5x - 2 = 8$
- b)  $3(x - 6) = 2(x - 4)$
- c)  $\frac{x+2}{3} + \frac{2x}{5} = x + 2$
- d)  $2x(x + 1) = 2x + 18$

12. Make  $x$  the subject of the following formulae:

- a)  $y = mx + c$
- b)  $y = \frac{3x+2}{5}$
- c)  $y = 2x^2z + 1$
- d)  $y = \frac{3x+1}{x-2}$

## Quadratic Equations

13. Solve the following by factorising:

a)  $x^2 - 3x + 2 = 0$

b)  $x^2 + 6x + 5 = 0$

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

d)  $3x^2 - 13x = -12$

14. Solve the following using the quadratic formula. Give your answers to two decimal places.

a)  $x^2 + 2x - 10 = 0$

b)  $2x^2 - 5x - 1 = 0$

15. Solve the following by completing the square. Give your answers as surds.

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

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

16. Complete the square for  $x^2 + 6x + 8$ . Hence sketch the graph of  $y = x^2 + 6x + 8$ , labelling the turning point and intercepts with the  $x$ -axis.

## Algebraic Fractions, Inequalities and Simultaneous Equations

17. Simplify the following:

a)  $\frac{15a^3b^3}{5a^2b}$

b)  $\frac{2x^2y}{(4xy)^2}$

c)  $\frac{x^2-16}{x^2-x-20}$

18. Simplify the following:

a)  $\frac{9b^2}{a} \times \frac{2a^2}{3b}$

b)  $\frac{2(x-1)^2}{15} \times \frac{10}{4x-4}$

c)  $\frac{3x^2-21x}{x+2} \div \frac{x(x+7)}{9x+18}$

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

19. Solve the following inequalities:

a)  $7x + 5 \leq 2x$

b)  $2(10 - x) > 4$

c)  $2x^2 + 3 < 21$

d)  $4x^2 - 9 \geq 7$

e)  $x^2 - 4x + 10 \geq 2x + 5$

20. Draw a set of axes with the  $x$ -axis from -2 to 3 and the  $y$ -axis from 0 to 6.

Show on these axes the region that satisfies the following inequalities:

$$y > 3x - 1, \quad y < x + 3 \quad \text{and} \quad y \geq \frac{x}{5} + 2$$

21. Solve the following simultaneous equations:

a)  $2x + y = 2$   
 $x - 3y = 8$

b)  $3x - 2y = 1$   
 $5x - 3y = 7$

c)  $y = x^2 + 3$   
 $y - 2x = 18$

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

### Proof and Functions

22. Prove that the sum of any three consecutive odd numbers is a multiple of 3.

23. Mia says, "for any integers  $x$  and  $y$ ,  $xy > y$ ". Prove that Mia is wrong.

24.  $f(x) = \frac{x+5}{3}$  and  $g(x) = x - 3$ .

- a) Evaluate  $f(4)$
- b) Find  $fg(x)$
- c) Find  $f^{-1}(x)$

### Straight Lines and Quadratic Graphs

25. Give the gradient and  $y$ -intercept of the line  $x + 2y = 4$

26. Point A has coordinates (5,2) and point B has coordinates (2,-4).

- a) Find the equation of the line passing through points A and B.
- b) Find the exact length of line AB.

27. Line A has equation  $y = 2x + 5$ .

- a) Find the equation of the line parallel to line A which passes through (3,2).
- b) Find the equation of the line perpendicular to line A which passes through (2,1).

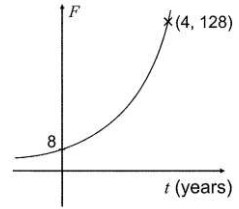
28. Sketch the graph of  $y = x^2 - 8x + 15$ . Label the graph with the coordinates of the turning point and the points where the graph crosses the axes.

### Harder graphs and Graph Transformations

29. Sketch the following graphs:

- a)  $y = x^3$
- b)  $y = \frac{1}{x}$
- c)  $y = -\frac{1}{x}$

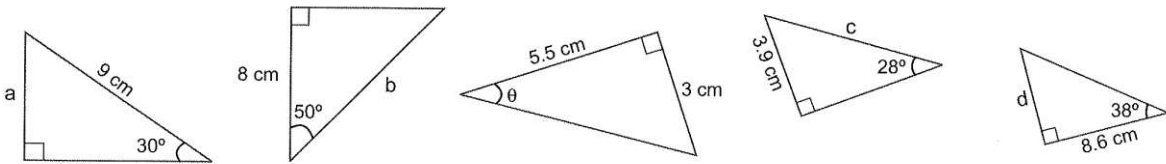
30. The graph on the right shows how the number of fish ( $F$ ) living in a river changes over time. The equation of the graph is  $F = mn^t$  where  $t$  is the number of years and  $m$  and  $n$  are positive constants. Find the values of  $m$  and  $n$ .



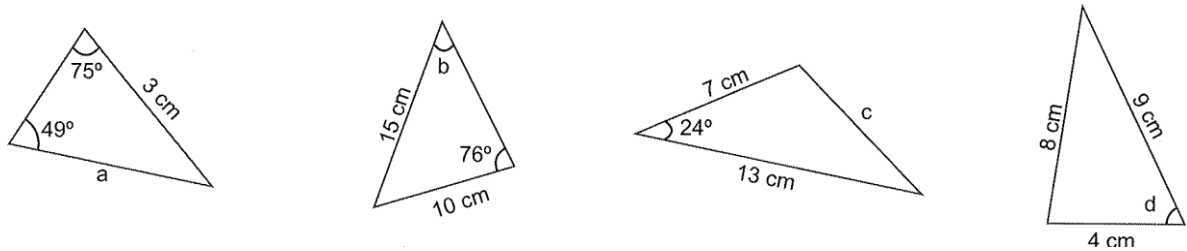
31. Find the equation of the tangent to  $x^2 + y^2 = 25$  at the point  $(3,4)$ . Give your answer in the form  $ax + by + c = 0$ .
32.  $f(x) = x^2$ . For parts a) to c) below, sketch the graphs of  $y = f(x)$  and the given transformation.
- $y = f(x) + 3$
  - $y = f(x + 3)$
  - $y = -f(x)$

### Trigonometry and Vectors

33. Find the unknowns in each of these triangles. Give your answers to 1 decimal place.



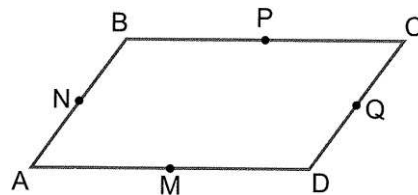
34. Find the unknowns in each of these triangles. Give your answers to 1 decimal place.



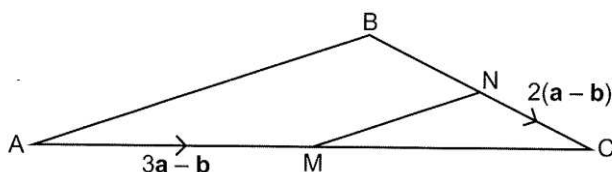
35.  $ABCD$  is the parallelogram shown on the right.  $M, N, P$  and  $Q$  are the midpoints of the sides.  $\vec{AB} = \mathbf{a}$  and  $\vec{BC} = \mathbf{b}$ .

Find the following vectors in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

- $\vec{AC}$
- $\vec{DQ}$
- $\vec{CM}$
- $\vec{QP}$
- $\vec{MB}$
- $\vec{PA}$



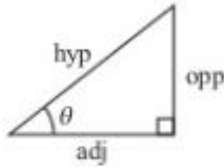
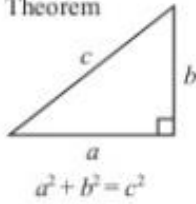
36. The diagram shows triangle  $ABC$ .  $M$  is the midpoint of  $\vec{AC}$  and  $N$  is the midpoint of  $\vec{BC}$ .  $\vec{AM} = 3\mathbf{a} - \mathbf{b}$  and  $\vec{NC} = 2(\mathbf{a} - \mathbf{b})$ . Show that  $\vec{AB}$  and  $\vec{MN}$  are parallel.



**Task Two**

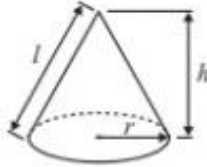
Make sure you know and can use the following formulae:

Pythagoras' Theorem



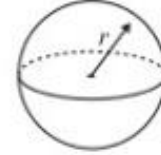
Volume of cone =  $\frac{1}{3} \pi r^2 h$

Curved surface area of cone =  $\pi r l$



Volume of sphere =  $\frac{4}{3} \pi r^3$

Surface area of sphere =  $4 \pi r^2$



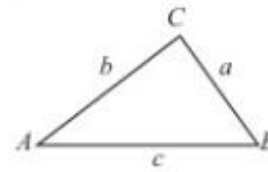
adj = hyp  $\times$  cos  $\theta$   
opp = hyp  $\times$  sin  $\theta$   
opp = adj  $\times$  tan  $\theta$

or  $\sin \theta = \frac{\text{opp}}{\text{hyp}}$

$\cos \theta = \frac{\text{adj}}{\text{hyp}}$

$\tan \theta = \frac{\text{opp}}{\text{adj}}$

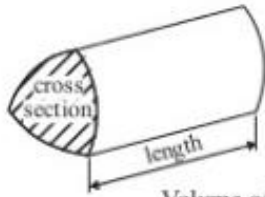
In any triangle ABC



Sine rule:  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule:  $a^2 = b^2 + c^2 - 2bc \cos A$

Area of triangle =  $\frac{1}{2} ab \sin C$



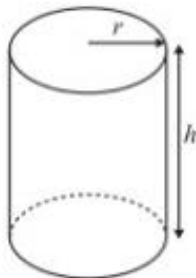
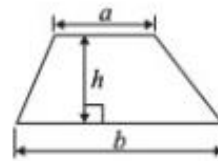
Volume of prism = area of cross section  $\times$  length



Circumference of circle =  $2 \pi r$

Area of circle =  $\pi r^2$

Area of a trapezium =  $\frac{1}{2} (a + b) h$



Volume of cylinder =  $\pi r^2 h$

Curved surface area of cylinder =  $2 \pi r h$

The Quadratic Equation  
The solutions of  $ax^2 + bx + c = 0$ ,  
where  $a \neq 0$ , are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

### Task Three

#### Equipment

For your Maths work you will need:

- A scientific calculator – for the new A level, you will need a scientific calculator that does a number of functions. The one we recommend is the CASIO fx-991EX CLASSWIZ .



The Maths A level content includes the following:

#### *Use of technology*

*The use of technology, in particular mathematical and statistical graphing tools and spreadsheets, must permeate the study of AS and A level mathematics. Calculators used must include the following features:*

- *an iterative function*
- *the ability to compute summary statistics and access probabilities from standard statistical distributions*

- Folders

You need to ensure you keep all your notes and work organised. You will need a folder (at least one!) to keep all your work together, with dividers to separate the work into sections.



- Paper

Class work and home work will be completed on A4 paper (lined or squared it's your choice). You will need to bring your own paper for lessons.

- Pens, pencils, ruler, ...

Ensure you have the standard equipment for work with you for all lessons.

