SANDRINGHAM SCHOOL

MATHEMATICS DEPARTMENT

Introduction to A Level Further Maths

SUMMER WORK

A Level Mathematics

Thank you for choosing to study A Level Further Mathematics in the Sixth Form at Sandringham School.

The Mathematics Department is committed to ensuring that you make good progress throughout your A level course. In order that you make the best possible start to the course, we have prepared a booklet of key topics you need to master before September.

The Task

You will need to have a good knowledge of the topics detailed in this booklet before you commence your course in September. Note that this expected knowledge level is for both the topics included in this booklet and the topics included within the A Level Mathematics booklet.

You should have met all the topics before at GCSE.
For each topic:

1. Follow the first link to the Maths Genie website and watch the video, making clear and concise notes.

2. Complete all the questions on the worksheets attached (note there may be additional questions on the website which are optional).

3. Follow the second link to the solutions. You must mark your work and make corrections where necessary.

4. Complete the checklist in this booklet, assessing your own confidence level. This is to be handed in with your work.

We will assess you early in the course to check how well you understand these topics, as well as all topics in the A Level Mathematics Summer Work. It is therefore important that you have complete all questions and fill in the self-assessment page.

We hope that you will use this introduction to give you a good start to your A level work in Further Mathematics and that it will help you further enjoy and benefit from the course.

Sandringham School

Course Description

Course Title: **Further Mathematics**
Examination Board: **Edexcel (Pearson)**

Textbooks
You will be given access to the Pearson Edexcel textbooks online at the beginning of the **course.**

Resources

We are using the excellent website www.mathsgenie.co.uk for tutorial clips, questions and solutions for the summer work. Note that copies of the worksheets are included in this document. Sometimes there are more questions on the worksheet on the website than included here. Any additional questions on the website are optional, the summer work is to complete the questions included here.

LINKS TO VIDEOS, QUESTIONS AND SOLUTIONS

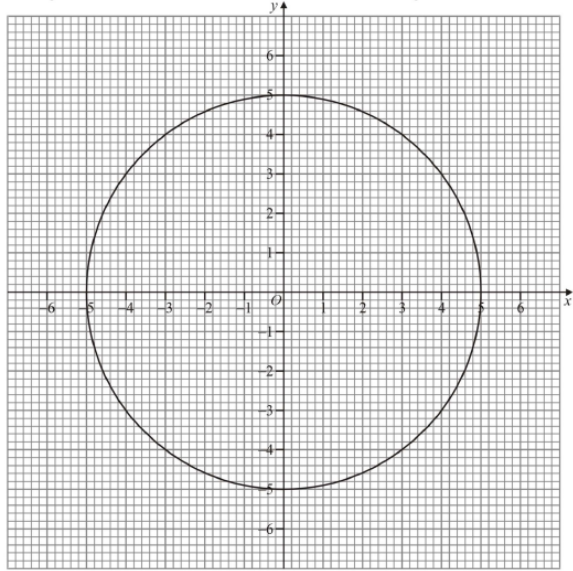**Linear and Circular Geometry, and equations of tangents**
VIDEO LINK
https://www.mathsgenie.co.uk/equation-of-tangent.html

WORKSHEET

Mathsgenie.co.uk	Please do not write on this sheet	Mathsgenie.co.uk

1

A is the point (0, 1)
B is the point (10, 6)

The equation of the straight line through A and B is $y = \frac{1}{2}x + 1$

a) Write down the equation of another straight line parallel to $y = \frac{1}{2}x + 1$

(1)

b) Write down the equation of another straight line that passes through the point (0, 1)

(1)

c) Find the equation of the line perpendicular to AB passing through B.

(3)

2 A straight line, L, passes through the point with coordinates (4, 7) and is perpendicular to the line with equation y = 2x + 3.

Find an equation of the straight line L.

(3)

3 A straight line passes through the points (0, 5) and (3, 17).
Find the equation of the straight line.

(3)

4 Show that line 3y = 4x - 14 is perpendicular to line 4y = -3x + 48.

(4)

5 Here are the equations of 5 straight lines.

P: $y = 2x + 5$
Q: $y = -2x + 5$
R: $y = x + 5$
S: $y = -\frac{1}{2}x + 6$
T: $y = \frac{1}{2}x + 1$

a) Write down the letter of the line that is parallel to $y = x + 6$

(1)

b) Write down the letter of the line that is perpendicular to y = 2x – 1

(1)

Grade 9	Perpendicular lines and the equation of a Tangent	

Mathsgenie.co.uk	Please do not write on this sheet	Mathsgenie.co.uk

6 The point A has the coordinates (2,5) The point B has the coordinates (6,7)

  a) Find the mid point of AB

    (2)

  b) Find the gradient of the line that passes through AB

    (2)

  c) Find the equation of the perpendicular bisector to AB

    (3)

7 A circle C has centre (2,5)

  The point A (11, 8) lies on the circumference of the circle

  Find the equation of the tangent to the circle at A

    (5)

8 A circle has the equation $x^2 + y^2 = 5$

  a) Write down the centre of the circle

    (1)

  b) Write down the exact length of the radius of the circle

    (1)

  P is the point (1,2) on the circle $x^2 + y^2 = 5$

  c) Work out the equation of the tangent to the circle at P

    (4)

9 The diagram shows a circle of radius 5 cm, centre the origin.

Find the equation of the tangent to the circle at (3,4)

    (5)

Grade 9	Perpendicular lines and the equation of a Tangent	

LINK TO SOLUTIONS

https://www.mathsgenie.co.uk/resources/perpendicularlinesans.pdf

Functions

VIDEO LINK

https://www.mathsgenie.co.uk/functions.html

WORSHEET

mathsgenie.co.uk	Please do not write on this sheet	mathsgenie.co.uk

1   Given that $f(x) = x - 4$ find:

     (a) $f(5)$ (1)

     (b) $f(3)$ (1)

     (Total for Question 1 is 2 marks)

2   Given that $g(x) = 2x^2 - 10$ find:

     (a) $g(2)$ (1)

     (b) $g(-2)$ (1)

     (c)   Solve: $g(x) = 8$ (3)

     (Total for Question 2 is 5 marks)

3   Given that $f(x) = 3x - 5$ find:

     (a) $f(3)$ (1)

     (b) $f(-2)$ (1)

     (c)   Solve $f(x) = 1$ (2)

     (Total for Question 3 is 4 marks)

4   Given that $f(x) = x^2 - 3$ find:

     (a) $f(10)$ (1)

     (b) $f(-1)$ (1)

     (c)   Solve: $f^{-1}(x) = 8$ (2)

     (Total for Question 4 is 4 marks)

5   Given that $f(x) = 2x - 4$ and $g(x) = 3x + 5$

     (a)   Find $gf(3)$ (2)

     (b)   Work out an expression for $f^{-1}(x)$ (2)

     (c)   Solve $f(x) = g(x)$ (2)

     (Total for Question 5 is 6 marks)

6   Given that $f(x) = 3x + 1$ and $g(x) = x^2$

     (a)   Find $fg(x)$ (2)

     (b)   Work out an expression for $gf(x)$ (2)

     (c)   Solve $fg(x) = gf(x)$ (3)

     (Total for Question 6 is 7 marks)

7   Given that $f(x) = x^2 - 17$ and $g(x) = x + 3$

     (a)   Work out an expression for $g^{-1}(x)$ (2)

     (b)   Work out an expression for $f^{-1}(x)$ (2)

     (c)   Solve $f^{-1}(x) = g^{-1}(x)$ (4)

     (Total for Question 7 is 8 marks)

8   The function f is defined such that $f(x) = x^2 - 1$

     (a)   Find an expression for $f(x - 2)$ (2)

     (b)   Hence solve: $f(x - 2) = 0$ (2)

     (Total for Question 8 is 4 marks)

9   The function f is defined such that $f(x) = 4x - 1$

     (a)   Find $f^{-1}(x)$ (2)

     The function g is defined such that $g(x) = kx^2$ where k is a constant

     (b)   Given that $fg(2) = 12$ (2)
     Work out the value of k.

     (Total for Question 9 is 4 marks)

LINK TO SOLUTIONS

https://www.mathsgenie.co.uk/resources/7-functionsans.pdf

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Algebraic fractions

VIDEO LINK

https://www.mathsgenie.co.uk/algebraic-fractions.html

WORKSHEET

mathsgenie.co.uk	Please do not write on this sheet	mathsgenie.co.uk

1 Simplify fully $\dfrac{x^2 + 5x}{x^2 + 7x + 10}$

(2 marks)

2 Simplify fully $\dfrac{x^2 - x - 12}{x^2 - 9x + 20}$

(2 marks)

3 Simplify fully $\dfrac{3x^2 + 9x}{x^2 - 9}$

(2 marks)

4 Simplify fully $\dfrac{x + 4}{x^2 - 16}$

(2 marks)

5 Write $\dfrac{3x^2 + 11x - 4}{x^2 + 3x - 4}$ in the form $\dfrac{ax + b}{x + c}$ where a, b, and c are integers.

(3 marks)

6 Write $\dfrac{x^2 + 7x - 18}{2x^2 - x - 6}$ in the form $\dfrac{x + a}{bx + c}$ where a, b, and c are integers.

(3 marks)

7 Simplify fully $\dfrac{3x + 6}{x - 4} \div \dfrac{2x^2 + 9x + 10}{x^2 - 4x}$

(3 marks)

8 Simplify fully $\dfrac{2x - 2}{x + 5} \div \dfrac{x^2 - 4x + 3}{2x^2 + 13x + 15}$

(3 marks)

9 Solve $\dfrac{8}{x + 3} + \dfrac{3}{x + 8} = 1$

(4 marks)

10 Solve $\dfrac{8}{3x - 2} + \dfrac{6}{x + 1} = 2$

(4 marks)

11 Solve $\dfrac{2}{5 - x} + \dfrac{3}{x + 7} = 1$

(4 marks)

12 Solve $\dfrac{7}{x + 1} - \dfrac{4}{3x - 2} = 1$

(4 marks)

13 Given that $\quad 2x + 1 : x + 2 \ = \ x + 8 : 3x - 4$

Find the possible values of x.

(4 marks)

14 Given that $\quad x - 1 : 2x - 3 \ = \ x + 2 : 3x - 2$

Find the possible values of x.

(4 marks)

15 Given that $\quad x + 9 : 5x - 1 \ = \ x + 7 : 2x - 3$

Find the possible values of x.

(4 marks)

16 Given that $\quad 5 - 3x : 9 - x \ = \ 3x + 7 : 4 - x$

Find the possible values of x.

(4 marks)

LINK TO SOLUTIONS

https://www.mathsgenie.co.uk/resources/7-algebraic-fractionsans.pdf

Algebraic Proof
VIDEO LINK
https://www.mathsgenie.co.uk/proof.html

WORKSHEET

mathsgenie.co.uk	Please do not write on this sheet	mathsgenie.co.uk

1   Prove algebraically that the sum of any two consecutive integers is always an odd number.

(2 marks)

2   Prove algebraically that the sum of any three consecutive even integers is always a multiple of 6.

(2 marks)

3   Prove that $(3n + 1)^2 - (3n - 1)^2$ is always a multiple of 12, for all positive integer values of n.

(2 marks)

4 n is an integer.
Prove algebraically that the sum of $n(n + 1)$ and $n + 1$ is always a square number.

(2 marks)

5   Prove that $(2n + 3)^2 - (2n - 3)^2$ is always a multiple of 12, for all positive integer values of n.

(2 marks)

6 n is an integer.
Prove algebraically that the sum of $(n + 2)(n + 1)$ and $n + 2$ is always a square number.

(2 marks)

7   Prove that the sum of 3 consecutive odd numbers is always a multiple of 3.

(2 marks)

8   Prove that the sum of 3 consecutive even numbers is always a multiple of 6.

(2 marks)

9   Prove algebraically that the sum of the squares of any 2 even positive integers is always a multiple of 4.

(2 marks)

10   Prove algebraically that the sum of the squares of any 2 odd positive integers is always even.

(2 marks)

11   Prove that the sum of the squares of any two consecutive integers is always an odd number.

(3 marks)

12   Prove that the sum of the squares of two consecutive odd numbers is always 2 more than a multiple of 8

(2 marks)

13   Prove that the difference between the squares of any 2 consecutive integers is equal to the sum of these integers.

(3 marks)

14   Prove algebraically that the sums of the squares of any 2 consecutive even number is always 4 more than a multiple of 8.

(3 marks)

LINK TO SOLUTIONS

https://www.mathsgenie.co.uk/resources/9-proofans.pdf
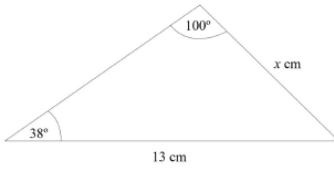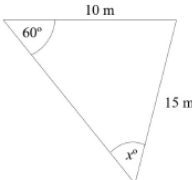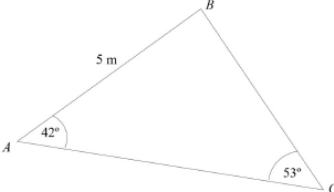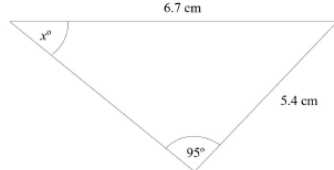
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Non-right angled trigonometry
VIDEO LINKS
https://www.mathsgenie.co.uk/sine-rule.html
https://www.mathsgenie.co.uk/cosine-rule.html
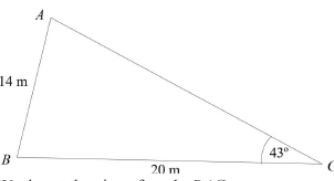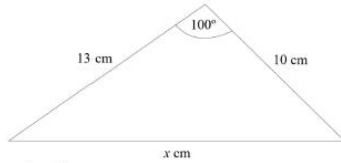https://www.mathsgenie.co.uk/area-of-any-triangle.html
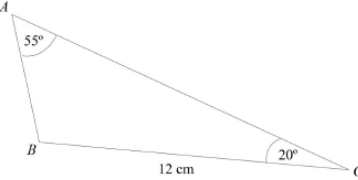
WORKSHEETS

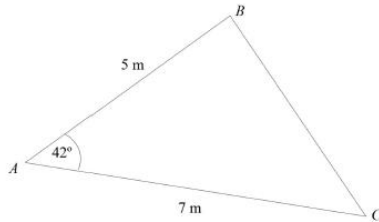| Mathsgenie.co.uk	Please do not write on this sheet	Mathsgenie.co.uk

1.

Work out the value of x.
Give your answer to 1 decimal place. **(3 marks)**

2.

Work out the length of BC.
Give your answer to 3 significant figures. **(3 marks)**

3.

Work out the value of x.
Give your answer to 3 significant figures. **(3 marks)**

4.

Work out the size of angle
Give your answer to 3 significant figures. **(3 marks)**

5.
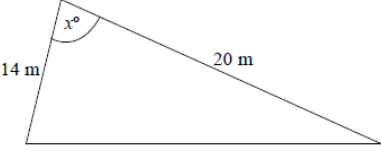
Work out the length of AC.
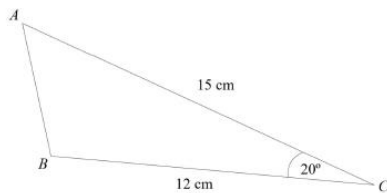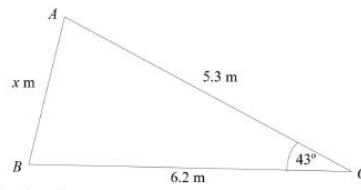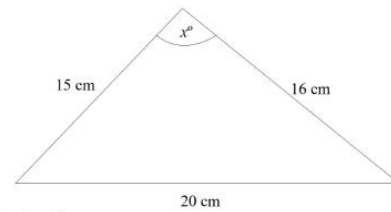Give your answer to 1 decimal place. **(3 marks)**

6.

Work out the size of angle BAC.
Give your answer to 3 significant figures. **(3 marks)**

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1

100°

13 cm   10 cm

x cm

Work out the value of *x*.
Give your answer to 1 decimal place.   **(3 marks)**

2

B

5 m

42°

A

7 m

C

Work out the length of BC
Give your answer to 3 significant figures   **(3 marks)**

3

A

15 cm

B

12 cm   20°   C

Work out the length of AB
Give your answer to 1 decimal place   **(3 marks)**

4

A

x m   5.3 m

B   43°   C

6.2 m
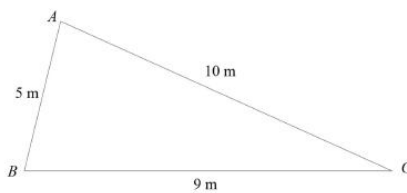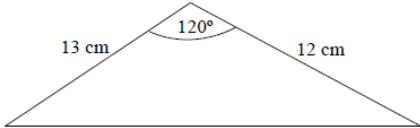
Work out the value of *x*.
Give your answer to 3 significant figures   **(3 marks)**

5

x°

15 cm   16 cm

20 cm

Work out the value of *x*.
Give your answer to 3 significant figures   **(3 marks)**

6

A

5 m   10 m

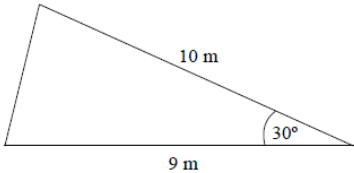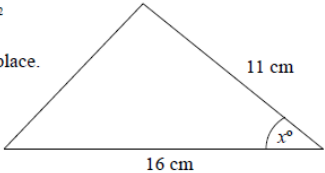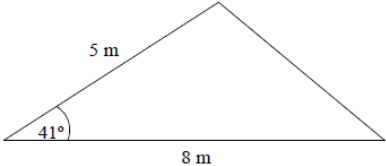B   9 m   C

Work out the size of angle *ABC*
Give your answer to the nearest degree   **(3 marks)**

Grade 7	Cosine Rule	

1

13 cm   120°   12 cm

Work out the area of the triangle.
Give your answer to 1 decimal place.

(2 marks)

2

5 m

41°

8 m

Work out the area of the triangle.
Give your answer to 3 significant figures.

(2 marks)

3

100°

15 cm   16 cm

Work out the area of the triangle.
Give your answer to 3 significant figures.

(2 marks)

4

10 m

30°

9 m

Work out the area of the triangle.

(2 marks)

5   The area of the triangle is 70cm^2
Work out the value of x.
Give your answer to 1 decimal place.

11 cm

16 cm

$x°$

(3 marks)

6

$x°$

14 m   20 m

The area of the triangle is 100m^2
Work out the value of x.
Give your answer to 3 significant figures.

(3 marks)

| Grade 7 | Area of any Triangle | Grade 7 |

LINK TO SOLUTIONS

https://www.mathsgenie.co.uk/resources/7-sine-ruleans.pdf
https://www.mathsgenie.co.uk/resources/7-cosine-ruleans.pdf
https://www.mathsgenie.co.uk/resources/7-area-of-any-triangleans.pdf

Trigonometric Graphs
Just watch the video clip to make sure you understand the basics and can sketch the three main graphs. Questions on the website are optional.

https://www.mathsgenie.co.uk/harder-graphs.html

As you work through these topics you should make a note on this checklist of where you needed help. If you are still unsure about a topic, tick the final column.

Please do not just pretend you are ok with these topics if you are struggling! We are here to help! We will put on extra sessions to help you sort out these problems early on in the course.

EXERCISE CHECK LIST

TOPIC	Exercise Completed	I was fine on this exercise	I got help on this exercise and now it's ok	I still have a problem with this topic
Linear and Circular Geometry				
Functions				
Algebraic Fractions				
Algebraic Proof				
Non-right angled triangles: Sine Rule Cosine Rule Area of a general triangle				
Trigonometric Graphs				