

A-Level Maths: What do you need to know and what will you learn?

The following booklet provides most of the knowledge you are expected to have from GCSE maths that you will need in A-Level.

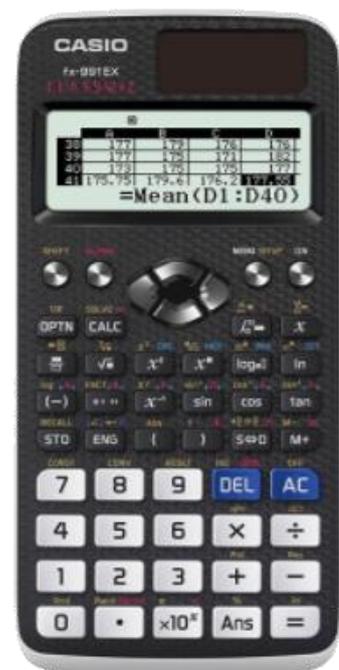
The first section entitled “Before you start...” has topics and example questions which you will have covered in GCSE Maths and provides the foundation to springboard your successful achievement in A-Level.

Also included are links to MyMaths lessons which you can use to provide a refresher on those topics. You may have your own revision sources that you may like to use, either websites or booklets that you have used in the past.

The last section, entitled “Mathematical formulae and identities” has some of the formula that you will learn during the two-years of the course. Other formula that you will need will be provided in a formula booklet made available to you when you sit the exam.

Remember that you will also need a calculator for the course. We recommend the Casio FX-991EX model available online and in good stockists and we will order these for you shortly

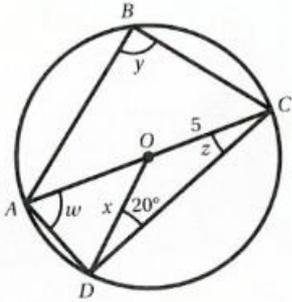
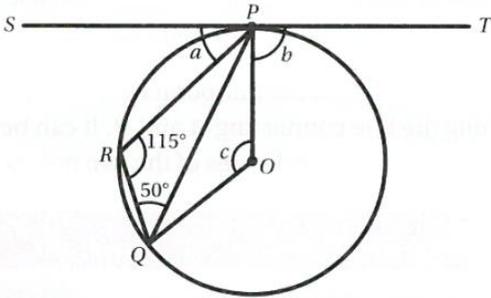
If you have any questions, please e-mail Angela aegan@kgv.ac.uk with your query.

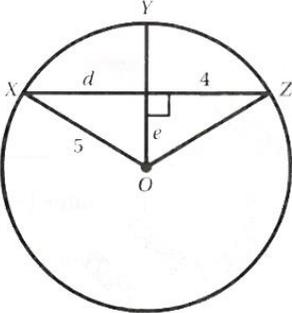
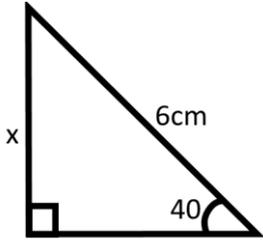
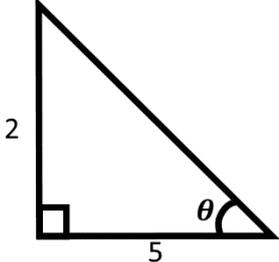


Before you start...

Things you are expected to know from GCSE Maths

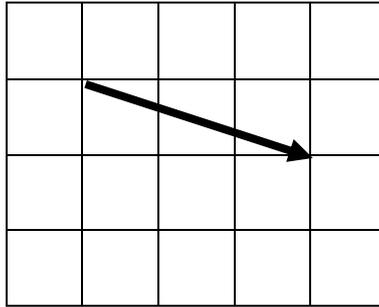
You should know the definition of a square root function	1. Write down the value of $\sqrt{9}$	https://app.mymaths.co.uk/156-resource/surds-1
You should be able to manipulate algebraic expressions	2. Factorise $4x^2 - 1$	https://app.mymaths.co.uk/174-resource/factorising-quadratics-1
You should know basic angle facts	3. a) What is the sum of the angles in a triangle? b) What is the sum of the exterior angles of any polygon?	https://app.mymaths.co.uk/256-resource/angle-sums https://app.mymaths.co.uk/259-resource/interior-exterior-angles
You should know the definition of rational and irrational numbers	4. Which of these numbers are irrational? $\pi, 0.3, 0.5, \sqrt{2}$	https://app.mymaths.co.uk/156-resource/surds-1
You should be able to work with function notation	5. If $f(x) = 2x^2 - 3$, find $f(3)$.	https://app.mymaths.co.uk/1779-resource/functions-1
You should be able to evaluate expressions involving powers, including working with the order of operations	6. Evaluate a) 3×2^3 b) 2×3^2 c) $3 - 4 \times (-2)^3$	https://app.mymaths.co.uk/203-resource/order-of-operations
You should be able to evaluate expressions involving roots	7. Evaluate $\sqrt[3]{27}$	https://app.mymaths.co.uk/154-resource/indices-3
You should be able to work with the laws of indices	8. Simplify: a) $(x^2)^3$ b) $x^2 \times x^5$ c) $\frac{x^{10}}{x^5}$ d) $(2x^3)^4$ e) $x^4 \times x^7$ f) $\frac{x^{12}}{x^3}$	https://app.mymaths.co.uk/153-resource/indices-1
You should be able to work with negative, fractional and zero indices	9. a) Write $\frac{3x}{x^3}$ in the form ax^b b) Write $\frac{1}{\sqrt[3]{x^2}}$ in the form x^d	https://app.mymaths.co.uk/1785-resource/indices-2 https://app.mymaths.co.uk/154-resource/indices-3
You should be able to multiply out two brackets	10. Expand a) $(1 + x)(2 - y)$ b) $(3x + 1)(2x - 3)$ c) $(2x + 1)(x - 3)$ d) $(2x + 3)^2$	https://app.mymaths.co.uk/172-resource/brackets
You should be able to factorise quadratic expressions	11. Factorise $x^2 - 8x + 15$	https://app.mymaths.co.uk/174-resource/factorising-quadratics-1
You should be able to recognise and use the factorisation of the difference of two squares	12. Expand $(2a + b)(2a - b)$	https://app.mymaths.co.uk/172-resource/brackets

<p>You should be able to solve quadratic equations by factorising</p>	<p>13. Solve these equations.</p> <p>a) $x^2 + x - 20 = 0$ b) $2x^2 + 15x - 8 = 0$ c) $5x^2 - 3x = 0$ d) $4x^2 - 9 = 0$</p>	<p>https://app.mymaths.co.uk/1784-resource/quadratic-equations-1</p>
<p>You should be able to use the formula to solve quadratic equations</p>	<p>14. Solve these equations</p> <p>a) $x^2 - 4x + 2 = 0$ b) $2x^2 - 10x - 5 = 0$ c) $x^2 + 4x + 2 = 0$</p>	<p>https://app.mymaths.co.uk/194-resource/quadratic-formula</p>
<p>You should be able to solve linear inequalities</p>	<p>15. Solve this inequality</p> <p>a) $x - 1 > 2x + 5$ b) $3x + 1 > 13$</p>	<p>https://app.mymaths.co.uk/232-resource/inequations</p>
<p>You should be able to solve simple linear simultaneous equations by elimination</p>	<p>16. Solve these simultaneous equations</p> <p>a) $x + 2y = 5$ and $3x + 4y = 11$ b) $3x - 2y = 13$ and $x + 3y = -3$</p>	<p>https://app.mymaths.co.uk/197-resource/simultaneous-equations-2</p>
<p>You should be able to find the equation of a straight line in the form $y = mx + c$</p>	<p>17. Find the equation of a straight line:</p> <p>a) With gradient 2 and y-intercept $(0, -1)$ b) With gradient -2 and passing through the point with coordinates $(2, 5)$ c) Passing through the points with coordinates $(1, 3)$ and $(3, 9)$</p>	<p>https://app.mymaths.co.uk/3270-resource/equation-of-a-line-3</p>
<p>You should be able to use the fact that parallel lines have the same gradient</p>	<p>18. A straight line passes through the points $(0, 1)$ and $(4, p)$ and is parallel to the line with equation $y = 3x + 4$. Find the value of p.</p>	<p>https://app.mymaths.co.uk/3270-resource/equation-of-a-line-3</p>
<p>You should be able to use properties of tangents and chords of circles:</p> <ul style="list-style-type: none"> the angle in a semi-circle is a right-angle a tangent to the circle is perpendicular to the radius at the point of contact the radius perpendicular to the chord bisects the chord 	<p>19. Find the values of the angles and lengths marked with letters giving reasons for your answers.</p> <p>a)</p>  <p>b)</p> 	<p>https://app.mymaths.co.uk/273-resource/circle-theorems</p>

	<p>c)</p> 	
<p>You should be able to work with expressions involving exponents</p>	<p>20. Answer 'true' or 'false'</p> <p>a) $2 \times 3^2 = 36$</p> <p>b) When $x = 25$, $4x^{\frac{1}{2}} = 10$</p> <p>c) $(2 \times 3)^7 = 2^7 \times 3^7$</p> <p>d) $\frac{1}{2x^3} = 2^{-3} \times x^{-3}$</p>	<p>https://app.mymaths.co.uk/1785-resource/indices-2</p> <p>https://app.mymaths.co.uk/154-resource/indices-3</p>
<p>You should be able to evaluate fractional and negative exponents</p>	<p>21. Evaluate, without using a calculator</p> <p>a) $27^{\frac{4}{3}}$</p> <p>b) $9^{-\frac{3}{2}}$</p>	<p>https://app.mymaths.co.uk/1785-resource/indices-2</p> <p>https://app.mymaths.co.uk/154-resource/indices-3</p>
<p>You should be able to solve equations involving fractions</p>	<p>22. Solve this equation:</p> $\frac{x+1}{2x-3} = 2$	<p>https://app.mymaths.co.uk/1735-resource/equations-5-fractions</p>
<p>You should be able to work with equations of straight lines</p>	<p>23. What is the gradient of $3y + 2x = 5$?</p>	<p>https://app.mymaths.co.uk/221-resource/equation-of-a-line-2</p>
<p>You should be able to use trigonometry in right-angled triangles to find unknown lengths</p>	<p>24. Find the value of x in the diagram</p> 	<p>https://app.mymaths.co.uk/322-resource/trig-missing-sides</p>
<p>You should be able to use trigonometry in right-angled triangles to find unknown angles</p>	<p>25. Find the value of θ in the diagram</p> 	<p>https://app.mymaths.co.uk/321-resource/trig-missing-angles</p>
<p>You should be able to use Pythagoras' theorem in a right-angled triangle</p>	<p>26. The length of the two shorter sides of a right-angled triangle are 5 cm and 12 cm. Find the length of the hypotenuse.</p>	<p>https://app.mymaths.co.uk/300-resource/pythagoras-theorem</p>
<p>You should be able to use three-figure bearings</p>	<p>27. Point A is on a bearing of 290° from B. Find the bearing of B from A.</p>	<p>https://app.mymaths.co.uk/255-resource/bearings</p>

You should be able to represent vectors on a grid and write them as column vectors

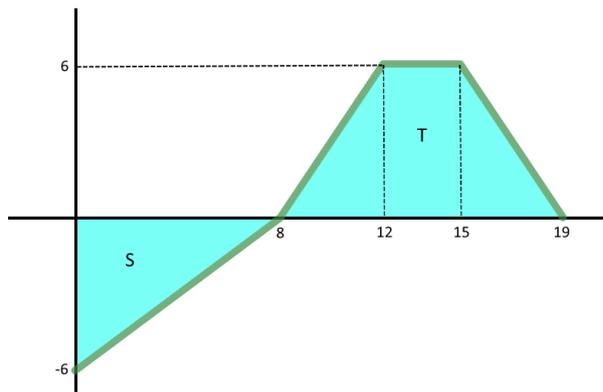
28. Write this as a column vector



<https://app.mymaths.co.uk/332-resource/vectors-1>

You should be able to find areas of triangles and trapeziums

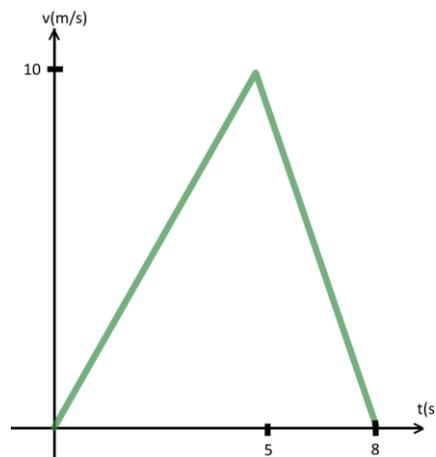
29. Find the areas of the shaded regions marked S and T



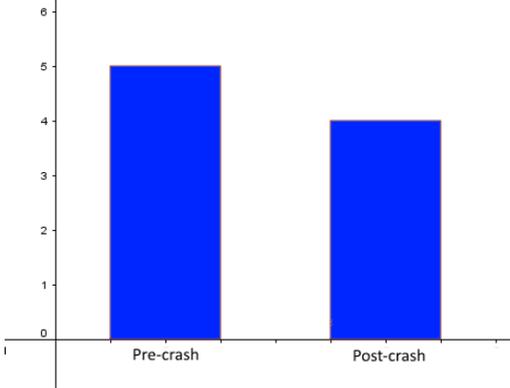
<https://app.mymaths.co.uk/268-resource/area-of-a-triangle>
<https://app.mymaths.co.uk/271-resource/area-of-a-trapezium>

You should be able to interpret displacement-time and velocity-time graphs

30. Use this velocity-time graph to find:
a) The acceleration of the object during the first 5 seconds
b) The distance travelled during the whole 8 seconds



<https://app.mymaths.co.uk/869-resource/kinematics-graphs>

Interpret basic statistical diagrams such as pie charts and bar charts	<p>31. Find the percentage decrease in the stock price after the crash in this bar chart</p> 	<p>https://app.mymaths.co.uk/351-resource/frequency-tables-and-bar-charts https://app.mymaths.co.uk/145-resource/change-as-a-percentage</p>
Be able to calculate the mean, median and mode of a set of data	<p>32. Find the mean, median and mode of: 1,1,4,5,9,10</p>	<p>https://app.mymaths.co.uk/366-resource/mean-and-mode https://app.mymaths.co.uk/367-resource/median-and-range</p>
Be able to calculate the range and interquartile range of a set of data	<p>33. Find the range and interquartile range of: 12,15,18,18,19,16,14,20,12</p>	<p>https://app.mymaths.co.uk/367-resource/median-and-range https://app.mymaths.co.uk/506-resource/interquartile-range</p>
You should be able to list all possible outcomes (sample space) of a single event or a combination of two events	<p>34. A five-sided spinner has the numbers 1 to 5 written on it, and a four-sided spinner has the letters A to D on it. What is the probability of getting an A and a 3 when the two spinners are spun together?</p>	<p>https://app.mymaths.co.uk/379-resource/listing-outcomes</p>
You should be able to use tree diagrams to record probabilities of successive events and to calculate probabilities of combined events	<p>35. A bag containing 7 red and 3 yellow sweets. A sweet is taken out of the bag and eaten. This is repeated 3 times. Find the probability that three red sweets are picked.</p>	<p>https://app.mymaths.co.uk/3263-resource/dependent-events</p>

Mathematical formulae and identities

Students must use the following formulae and identities for AS and A-level Mathematics, without these formulae and identities being provided, either in these forms or in equivalent forms. These formulae and identities may only be provided where they are the starting point for a proof or as a result to be proved.

Not all of these formulae may be familiar to you now, but as you progress through the two-year course you will learn how to use and apply them.

Pure Mathematics	
Quadratic Equations	$ax^2 + bx + c = 0$ has roots $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Laws of indices	$a^x a^y \equiv a^{x+y}$ $a^x \div a^y \equiv a^{x-y}$ $(a^x) a^y \equiv a^{xy}$

Laws of logarithms	$x = a^n \leftrightarrow n = \log_a x$ for $a > 0$ and $x > 0$ $\log_a x + \log_a y \equiv \log_a(xy)$ $\log_a x - \log_a y \equiv \log_a\left(\frac{x}{y}\right)$ $k \log_a x \equiv \log_a(x^k)$
Coordinate geometry	<p>A straight line, gradient m passing through (x_1, y_1) has equation $y - y_1 = m(x - x_1)$</p> <p>Straight lines with gradients m_1 and m_2 are perpendicular when $m_1 m_2 = -1$</p> <p>A circle with centre (a, b) and radius r has equation $(x - a)^2 + (y - b)^2 = r^2$</p>
Sequences	<p>General term of an arithmetic progression: $u_n = a + (n - 1)d$</p> <p>General term of a geometric progression: $u_n = ar^{n-1}$</p>
Trigonometry	<p>In the triangle ABC:</p> <p>sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$</p> <p>cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$</p> <p>area: $\frac{1}{2}ab \sin C$</p> <p>$\cos^2 A + \sin^2 A \equiv 1$ $\sec^2 A \equiv 1 + \tan^2 A$ $\operatorname{cosec}^2 A \equiv 1 + \cot^2 A$</p> <p>$\sin 2A \equiv 2 \sin A \cos A$ $\cos 2A \equiv \cos^2 A - \sin^2 A$ $\tan 2A \equiv \frac{2 \tan A}{1 - \tan^2 A}$</p>
Mensuration	<p>Circumference (C) and area (A) of a circle, radius r and diameter d. $C = 2\pi r = \pi d$ $A = \pi r^2$</p> <p>Pythagoras' Theorem: In any right-angled triangle, where a, b and c are the lengths of the sides and c is the hypotenuse: $c^2 = a^2 + b^2$</p> <p>Area of a trapezium: $\frac{1}{2}(a + b)h$ where a and b are the lengths of the parallel sides and h is their perpendicular separation</p> <p>Volume of a prism = area of cross section \times length</p> <p>For a circle of radius r, where an angle at the centre of θ radians subtends an arc of length s and encloses an associated sector of area A: $s = r\theta$ $A = \frac{1}{2}r^2\theta$</p>

Calculus and differential equations	Differentiation	
	Function	Derivative
	x^n	nx^{n-1}
	$\sin kx$	$k \cos kx$
	$\cos kx$	$-k \sin kx$
	e^{kx}	ke^{kx}
	$\ln x$	$\frac{1}{x}$
	$f(x) + g(x)$	$f'(x) + g'(x)$
	$f(x)g(x)$	$f'(x)g(x) + f(x)g'(x)$
	$f(g(x))$	$f'(g(x))g'(x)$
	Integration	
	Function	Integral
	x^n	$\frac{1}{n+1}x^{n+1} + c, n \neq -1$
	$\cos kx$	$\frac{1}{k} \sin kx + c$
	$\sin kx$	$-\frac{1}{k} \cos kx + c$
	e^{kx}	$\frac{1}{k} e^{kx} + c$
	$\frac{1}{x}$	$\ln x + c, x \neq 0$
	$f'(x) + g'(x)$	$f(x) + g(x) + c$
$f'(g(x))g'(x)$	$f(g(x)) + c$	
Area under a curve = $\int_a^b y dx$ ($y \geq 0$)		
Vectors	$ x\mathbf{i} + y\mathbf{j} + z\mathbf{k} = \sqrt{x^2 + y^2 + z^2}$	
Mechanics		
Forces and equilibrium	Weight = mass \times g Friction: $F \leq \mu r$ Newton's second law in the form: $F = ma$	
Kinematics	For motion in a straight line with variable acceleration: $v = \frac{dr}{dt}$ $a = \frac{dv}{dt} = \frac{d^2r}{dt^2}$ $r = \int v dt$ $v = \int a dt$	
Statistics		
The mean of a set of data	$\bar{x} = \frac{\sum x}{n} = \frac{\sum fx}{\sum f}$	
The standard Normal variable	$Z = \frac{X-\mu}{\sigma}$ where $X \sim N(\mu, \sigma^2)$	