# Teacher Delivery Guide Pure Mathematics: 1.02 Algebra and Functions

| **OCR Ref.** | **Subject Content** | **Stage 1 learners should…** | **Stage 2 learners additionally should…** | **DfE Ref.** |
| --- | --- | --- | --- | --- |
| **1.02 Algebra and Functions** |
| 1.02a | Indices | a) Understand and be able to use the laws of indices for all rational exponents.*Includes negative and zero indices.**Problems may involve the application of more than one of the following laws:*. |  | MB1 |
| 1.02b | Surds | b) Be able to use and manipulate surds, including rationalising the denominator.*Learners should understand and use the equivalence of surd and index notation.* |  | MB2 |
| 1.02c | Simultaneous equations | c) Be able to solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation.*The equations may contain brackets and/or fractions.**e.g.* *and*  *and*  |   | MB4 |
| 1.02d1.02e1.02f | Quadratic functions | d) Be able to work with quadratic functions and their graphs, and the discriminant (*D* or) of a quadratic function, including the conditions for real and repeated roots. *i.e. Use the conditions:**1.  real distinct roots**2.  repeated roots**3.  roots are not real**to determine the number and nature of the roots of a quadratic equation and relate the results to a graph of the quadratic function.*e) Be able to complete the square of the quadratic polynomial .*e.g. Writing* *in the form in order to find the line of symmetry , the turning point  and to determine the nature of the roots of the equation for example  has no real roots because* .f) Be able to solve quadratic equations including quadratic equations in a function of the unknown.*e.g. ,  or* |  | MB3 |
| 1.02g1.02h1.02i | Inequalities | g) Be able to solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions.*e.g. , .*[*Quadratic equations with complex roots are excluded*.]h) Be able to express solutions through correct use of ‘and’ and ‘or’, or through set notation. *Familiarity is expected with the correct use of set notation for intervals, e.g.* ,,,,.*Familiarity is expected with interval notation, e.g.*,  *and* .i) Be able to represent linear and quadratic inequalities such as  and  graphically. |   | MB5 |
| 1.02j1.02k | Polynomials |  j) Be able to manipulate polynomials algebraically.*Includes expanding brackets, collecting like terms, factorising, simple algebraic division and use of the factor theorem.**Learners should be familiar with the terms “quadratic”, “cubic” and “parabola”.* *Learners should be familiar with the factor theorem as:* *1.  is a factor of* ;*2.  is a factor of* .*They should be able to use the factor theorem to find a linear factor of a polynomial normally of degree* . *They may also be required to find factors of a polynomial, using any valid method, e.g. by inspection.* | k) Be able to simplify rational expressions.*Includes factorising and cancelling, and algebraic division by linear expressions.**e.g. Rational expressions may be of the form* *or* *.**Learners should be able to divide a polynomial of degree  by a linear polynomial of the form , identify the quotient and remainder and solve equations of degree .* *The use of the factor theorem and algebraic division may be required.* | MB6 |
| 1.02l | The modulus function |  | l) Understand and be able to use the modulus function, including the notation , and use relations such as  and  in the course of solving equations and inequalities. e.g. solve . | MB7 |
| 1.02m1.02s1.02n1.02t1.02o1.02p1.02q1.02r | Curve sketching | m) Understand and be able to use graphs of functions.*The difference between plotting and sketching a curve should be known. See section 2b.*n) Be able to sketch curves defined by simple equations including polynomials. *e.g. Familiarity is expected with sketching a polynomial of degree  in factorised form, including repeated roots.**Sketches may require the determination of stationary points and, where applicable, distinguishing between them.*o) Be able to sketch curves defined by  and  (including their vertical and horizontal asymptotes).p) Be able to interpret the algebraic solution of equations graphically.q) Be able to use intersection points of graphs to solve equations.*Intersection points may be between two curves one or more of which may be a polynomial, a trigonometric, an exponential or a reciprocal graph*.r) Understand and be able to use proportional relationships and their graphs. *i.e. Understand and use different proportional relationships and relate them to linear, reciprocal or other graphs of variation.* | s) Be able to sketch the graph of the modulus of a linear function involving a single modulus sign. *i.e. Given the graph of  sketch the graph of* .[*Graphs of the modulus of other functions are excluded.*]t) Be able to solve graphically simple equations and inequalities involving the modulus function.  | MB7 |
| 1.02u1.02v | Functions | *Within Stage 1, learners should understand and be able to apply functions and function notation in an informal sense in the context of the factor theorem (1.02j), transformations of graphs (1.02w), differentiation (Section 1.07) and the Fundamental Theorem of Calculus (1.08a).* | u) Understand and be able to use the definition of a function. *The vocabulary and associated notation is expected**i.e. the terms many-one, one-many, one-one, mapping, image, range, domain*.*Includes knowing that a function is a mapping from the domain to the range such that for each* *x in the domain, there is a unique y in the range with . The range is the set of all possible values of ; learners are expected to use set notation where appropriate.*v) Understand and be able to use inverse functions and their graphs, and composite functions. Know the condition for the inverse function to exist and be able to find the inverse of a function either graphically, by reflection in the line , or algebraically.*The vocabulary and associated notation is expected**e.g. , ,* . | MB8OT1.1OT1.4 |
| 1.02w1.02x | Graph transformations | w) Understand the effect of simple transformations on the graph of  including sketching associated graphs, describing transformations and finding relevant equations: ,*,* and , for any real *a*.*Only single transformations will be requested.* *Translations may be specified by a two-dimensional column vector*. | x) Understand the effect of combinations of transformations on the graph of  including sketching associated graphs, describing transformations and finding relevant equations.*The transformations may be combinations of**,*, *and* *, for any real* *a, and any function defined in the Stage 1 or Stage 2 content.* | MB9 |
| 1.02y | Partial fractions |   | y) Be able to decompose rational functions into partial fractions (denominators not more complicated than squared linear terms and with no more than 3 terms, numerators constant or linear).*i.e. The denominator is no more complicated than  or  and the numerator is either a constant or linear term.* *Learners should be able to use partial fractions with the binomial expansion to find the power series for an algebraic fraction or as part of solving an integration problem.* | MB10 |
| 1.02z | Models in context |   | z) Be able to use functions in modelling.*Includes consideration of modelling assumptions, limitations and refinements of models, and comparing models.*  | MB11 |

# Thinking Conceptually

**General approaches:**

Prior to working with the subject content of this section of the specification, it is essential that learners have gained a thorough understanding of a number of topics at GCSE level such as the four rules of number including the priority of operations, signed numbers, fractions, algebra including substitution, bracket expansion, simplification of terms and factorisation, products, factors, index notation, graphs and transformations.

Learners’ understanding should be deepened by a hands-on approach to this subject as they tend to struggle with the algebra involved.

**Common misconceptions or difficulties learners may have:**

Learners make many mistakes when using indices. Their weaknesses lie primarily in negative and fractional indices but also a common mistake is to wrongly think that. A common misconception is thinking that if the power is negative, the result must be negative.

Also misconceptions concerning negative numbers lead to errors in using the laws of indices as learners wrongly think that two negatives always make a positive when adding / subtracting negative numbers.

A common misconception when using surds is to think that  and many learners find the concept  very challenging.

Very often when learners are solving simultaneous equations, they make a minor algebraic error or a transposition error.

One common misconception when working with quadratic functions is that learners only give the positive value as the square root of a positive number. They tend to forget about the negative value being a solution as well.

Also when solving an equation such as, often they are able to factorise and get  and then just give the solution and forget about the solution.

Completing the square of a quadratic polynomial requires learners to have a high level of skills in algebra. As the foundation of algebra is basic arithmetic, many misconceptions in algebra are found to be rooted in misconceptions in arithmetic.

Learners often make mistakes when completing the square when the coefficient of  is not .

Many learners fail to realise that completing the square of a quadratic function reveals the maximum or minimum value of the function it defines.

Many learners struggle to recognise that.

Some learners might not be able to find integer solutions when solving quadratic functions and therefore conclude that no solutions exist.

Many learners find the solving of a quadratic equation very difficult but even when they do manage to solve the quadratic equation; they still do not always possess an understanding of the meaning of their solutions. Very often when learners are given quadratic word problems, they have difficulty comprehending the context and are unable to formulate the equation to be solved.

A common misconception when manipulating polynomials algebraically is failing to understand that two expressions that appear to be different can still be equivalent. Learners have difficulty recognising that the properties and operations for integers is the same as that for polynomials.

A persistent misconception when solving inequalities is expressing inequalities as equations. As many learners think that inequalities and equations require the same mathematical solution process, they treat problems involving inequalities in exactly the same manner as equations, and assume the questions require similar processes. Very often learners treat inequalities as equations and solve the equations then they simply put the sign back. Learners often forget the rule that multiplying and dividing by a negative number changes the direction of the inequality.

Also, even when learners find the solution to inequalities, they do not always possess an understanding of the meaning of their solutions.

When simplifying rational expressions, learners make errors related to their prior knowledge on common fractions. As they try to simplify the rational expressions, learners follow certain procedures without full understanding. As the learners do so, they retrieve wrong or incomplete rules that lead them to make errors. The most common errors and misconceptions learners make due to their prior knowledge on simplifying common fractions are errors to do with cancellation, partial cancellation and like terms.

Learners have a limited understanding of the relationship between graphs and functions.

Learners make many errors when sketching curves such as confusing the two axes, thinking that graphs always go through the origin and that graphs always cross both axes.

Many learners struggle to recognise the significance of the intersection of the curve with the *x*-axis with respect to the solution of the equation and with the *y*-axis for the constant term of the equation.

A common misconception involved in curve sketching is assuming that all quadratics are u shaped. Another common mistake is to ignore negative signs, e.g. thinking the y intercept of  is at 3 rather than -3.

Many learners struggle with graph transformations and try to memorise the rules instead of understanding them.

Also it is common for learners to focus on some attributes of a situation when sketching graphs and ignore others. For example, noting the existence of turning points but ignoring their relative positions or values.

Many learners fail to realise that completing the square of a quadratic function reveals the maximum or minimum value of the function it defines.

When decomposing rational functions into partial fractions, learners make errors related to their prior knowledge on common fractions and algebra. Learners follow certain procedures without full understanding which leads to errors.

# Thinking Contextually

The section on Algebra and Functions focuses upon the fundamental skills that will set learners up for topics later in the course:

**Straight Lines** – learners need to be able to solve equations graphically and this involves drawing a straight line graph.

**Circles** – learners need a good understanding of how to complete the square when finding the centre and radius of a circle.

**Binomial expressions** – learners need a good understanding of the laws of indices when expanding binomial expressions.

**Integration** – learners need a good understanding of partial fractions to be able to integrate functions using partial fractions.

Many learners fail to make connections between what they are learning and how that knowledge will be used. They struggle to understand the concepts in mathematics unless they can see the relevance to their everyday lives.

Learners will be more successful if they investigate mathematics through real life scenarios as they can see how these concepts are actually used outside of the classroom. They will then be able to discover the meaningful relationship between abstract ideas and practical applications in the real world. This in turn, will lead to greater motivation, enjoyment through discovery, improved confidence, independent thinking and better retention of skills.

# Past paper examples

[2018 H230/01](https://www.ocr.org.uk/Images/535662-question-paper-pure-mathematics-and-statistics.pdf) Q 1: Indices and surds problem set as a ‘Detailed reasoning’ question so that candidates must show mathematical argument and not just state the answer found using their calculator.

[2018 H230/01](https://www.ocr.org.uk/Images/535662-question-paper-pure-mathematics-and-statistics.pdf) Q 2: Question on quadratics set with unknown constant term in part (a) to assess candidates understanding of discriminant. In part (b) the inequality needs rearranging before calculator solve functions can be used.

[2018 H230/02](https://www.ocr.org.uk/Images/535664-question-paper-pure-mathematics-and-mechanics.pdf) Q 4: A completing the square problem in part (a), with the subsequent parts involving candidates explain important features of the quadratic curve using an appreciation of expressing the function in this form.

[2018 H240/01](https://www.ocr.org.uk/Images/535607-question-paper-pure-mathematics.pdf) Q 3: This involved rearranging and solving a disguised quadratic equation.

[2018 H240/01](https://www.ocr.org.uk/Images/535607-question-paper-pure-mathematics.pdf) Q 6: This question revolved around a cubic function, requiring candidates to use factor theorem, curve sketching, using set notation to express the solution of an inequality and a graph transformation.

[2018 H240/01](https://www.ocr.org.uk/Images/535607-question-paper-pure-mathematics.pdf) Q 9: This question investigated the domain and range of a quadratic function.

[2018 H240/02](https://www.ocr.org.uk/Images/535611-question-paper-pure-mathematics-and-statistics.pdf) Q 1: This question involved candidates demonstrating the understanding of .completing the square and discriminant.

[2018 H240/03](https://www.ocr.org.uk/Images/535617-question-paper-pure-mathematics-and-mechanics.pdf) Q 3 This was a linear inequality word problem.

[2018 H240/03](https://www.ocr.org.uk/Images/535617-question-paper-pure-mathematics-and-mechanics.pdf) Q 4 This question looked at composite functions.

# Resources

| Title | Organisation | Description | Ref |
| --- | --- | --- | --- |
| [Section Check In Algebra and Functions](http://www.ocr.org.uk/Images/386170-section-check-in-1.02-algebra-and-functions.docx) | OCR | 10 questions on Algebra and Functions section content | 1.02a – 1.02z |
| [Indices](https://revisionmaths.com/advanced-level-maths-revision/pure-maths/algebra/indices) | Revision Maths | This introductory resource covers the laws of indices.  | 1.02a |
| [Indices or Powers](http://www.mathcentre.ac.uk/resources/uploaded/mc-ty-indicespowers-2009-1.pdf) | Mathscentre | This comprehensive resource covers the laws of indices. It includes worked examples and exercises for the learners to complete along with answers. | 1.02a |
| [Advanced Laws of Indices](https://www.youtube.com/watch?v=cyLANy096j0) | Gaudianista | This video resource introduces learners to the laws of indices including fractional and negative indices. | 1.02a |
| [More Advanced Indices](https://www.youtube.com/watch?v=sbwSKpJkR2s) | The Maths Man | This excellent video resource includes worked examples using the laws of indices including fractional and negative indices.  | 1.02a |
| [Exponents in the Real World](http://passyworldofmathematics.com/exponents-in-the-real-world/) | Passy’s World of Mathematics | This informative resource looks at how exponents are used in the real world. | 1.02a |
| [Interpreting Proportional Relationship Graphs](https://www.youtube.com/watch?v=sOVk30fK9NU) | School21 | This video resource demonstrates how to use real life proportional relationships and their graphs. | 1.02a |
| [Surds and Indices](http://mei.org.uk/files/sow/01-surds-indices.pdf) | MEI | MEI curriculum notes on surds and indices | 1.02a and 1.02 b |
| [Indices and Surds](https://en.wikibooks.org/wiki/A-level_Mathematics/OCR/C1/Indices_and_Surds) | Wikibooks | This introductory resource covers the laws of indices including negative, zero and fractional indices. | 1.02a and 1.02b |
| [Lesson Element Using and manipulating Surds](http://www.ocr.org.uk/Images/308610-topic-1.02b-lesson-element-surds.doc) | OCR | 3 Learner activitiesTask 1 Card Matching equivalent surd expressionsTask 2 Card Matching equivalent fractions involving surds and rationalising the denominatorTask 3 What’s the question challenge | 1.02b |
| [Surds](https://revisionmaths.com/advanced-level-maths-revision/pure-maths/algebra/surds) | Revision Maths | This introductory resource covers the addition, subtraction, multiplication and division of surds. | 1.02b |
| [Surds](http://mathematics.laerd.com/maths/surds-intro.php) | Laerd Mathematics | This excellent interactive resource is an introduction to surds. It includes twenty questions for learners to complete along with detailed solutions.  | 1.02b |
| [Surds and Other Roots](http://www.mathcentre.ac.uk/resources/uploaded/mc-ty-surds-2009-1.pdf) | Mathscentre | This comprehensive resource covers surds and demonstrates how to simplify and rationalise expressions containing surds. It includes worked examples and exercises for the learners to complete along with answers. | 1.02b |
| [Relevance Of Surds](https://www.youtube.com/watch?v=4K5y2K83Zrc) | Maths With Jacob | This short video resource highlights some areas where surds are used in real life.  | 1.02b |
| [Surds – Application To Adding / Subtracting](https://www.youtube.com/watch?v=o1Jm6HaUWWo) | Dani Wright | This short video resource looks at a real life application of adding surds.  | 1.02b |
| [Simultaneous Equations – Linear / Quadratic](http://www.mathsteacher.com.au/year10/ch13_quadratic_graphs/10_simult_equations/simquad.htm) | Mathsteacher | This concise resource demonstrates how to solve simultaneous equations when one is linear and one is quadratic. Detailed algebraic and graphical solutions are given. | 1.02c |
| [Simultaneous Equations (Linear and Quadratic)](https://corbettmaths.com/2013/05/07/simultaneous-equations-linear-and-quadratic/) | Corbettmaths | This excellent video resource demonstrates how to solve simultaneous equations when one equation is linear and the other is a quadratic. | 1.02c |
| [Simultaneous Equations – Linear and Non-Linear](http://www.onlinemathlearning.com/simultaneous-linear-quadratic-2.html) | OnlineMaths Learning.com | This resource includes two video clips and demonstrates how to solve simultaneous equations when one is linear and one is quadratic.  | 1.02c |
| [Systems of Linear and Quadratic Equations](http://www.phschool.com/atschool/new_york/phmath07_intalg/IANYSENY06.pdf) | Learning Standards for Mathematics | This excellent comprehensive resource demonstrates how to solve simultaneous equations (when one equation is linear and one is quadratic) graphically and algebraically. It includes worked examples and exercises for the learners to attempt. | 1.02c |
| [What is a Quadratic Equation?](http://www.virtualnerd.com/algebra-1/quadratic-equations-functions/graphing-solutions/graphing-solution-definitions-examples/equation-definition) | Virtual Nerd | This video resource introduces learners to quadratic equations and the methods of solving them. | 1.02d |
| [What is the Discriminant?](http://www.virtualnerd.com/algebra-1/quadratic-equations-functions/discriminant-quadratic-formula/discriminant/discriminant-definition) | Virtual Nerd | This video resource introduces learners to the method of calculating the discriminant of a quadratic equation.  | 1.02d |
| [Quadratic Theory: The Discriminant](http://www.bbc.co.uk/bitesize/higher/maths/algebra/quadratic_theory/revision/4/) | BBC | This excellent resource introduces learners to the discriminant of quadratic equations and determines the number and nature of the roots. | 1.02d |
| [How do you find the Discriminant of a Quadratic Equation with 2 solutions?](http://www.virtualnerd.com/algebra-1/quadratic-equations-functions/discriminant-quadratic-formula/discriminant/discriminant-two-solutions-example) | Virtual Nerd | This video resource demonstrates how to calculate the discriminant of a quadratic equation. | 1.02d |
| [Discriminants and Determining the Number of Real Roots of a Quadratic Equation](https://www.mytutor.co.uk/answers/801/A-Level/Maths/Discriminants%2Band%2Bdetermining%2Bthe%2Bnumber%2Bof%2Breal%2Broots%2Bof%2Ba%2Bquadratic%2Bequation) | My tutor | This excellent short resource introduces learners to the discriminant of quadratic equations and determines the number and nature of the roots. It includes four questions for learners to attempt, along with answers. | 1.02d |
| [Examples on the Nature of Roots of a Quadratic Equation](https://www.youtube.com/watch?v=zepJRXw-3o4) | Exam Solutions | This excellent video resource demonstrates how to use the discriminant to determine the number and nature of the roots of the quadratic equation and then relates the results to a graph. | 1.02d |
| [Solving Quadratics by Factorising](https://corbettmaths.com/2013/05/03/solving-quadratics-by-factorising/) | Corbettmaths | This excellent video resource demonstrates how to solve quadratics by factorising. | 1.02d |
| [Exam Questions – Roots and Discriminant](https://www.examsolutions.net/tutorials/exam-questions-roots-and-discriminant/) | Exam Solutions | This interactive resource offers learners the opportunity to practice their understanding of quadratic equations (including the discriminant and roots) to help address some misconceptions.  | 1.02d  |
| [Solve Quadratic Equations Using Discriminants](https://www.analyzemath.com/Equations/solve-quadratic-equations-using-discriminants.html) | Free Mathematics Tutorials | This interactive resource offers learners the opportunity to practice solving quadratic equations using discriminants to help address some misconceptions. | 1.02d |
| [Examples on the Nature of Roots of a Quadratic Equation](https://www.youtube.com/watch?v=zepJRXw-3o4) | ExamSolutions | This excellent video resource demonstrates how to use the discriminant to determine the number and nature of the roots of the quadratic equation and then relates the results to a graph. |  1.02d |
| [Roots of a Quadratic Equation: Discriminant](https://www.youtube.com/watch?v=awL6Znlemoo) | Exam Solutions | This excellent video resource demonstrates how to solve quadratic equations using the quadratic formula. It then demonstrates how to use the discriminant to determine the number and nature of the roots of the quadratic equation and then relates the results to a graph. | 1.02d and 1.02f |
| [Real World Examples of Quadratic Equations](https://www.mathsisfun.com/algebra/quadratic-equation-real-world.html) | Maths is Fun | This excellent resource highlights where quadratic equations are used in the real world and then uses completing the square and the quadratic formula to solve the real life problems. It also demonstrates how to solve a real life problem graphically. | 1.02d, 1.02e and 1.02f |
| [Completing the Square Example](https://www.youtube.com/watch?v=lS0ork9JvSc) | Exam Solutions | This excellent video resource demonstrates how to complete the square of the quadratic polynomial   | 1.02e |
| [Completing The Square](http://www.mathcentre.ac.uk/resources/uploaded/mc-ty-completingsquare2-2009-1.pdf) | Mathscentre | This comprehensive resource covers completing the square. It includes worked examples and exercises for the learners to complete along with answers. | 1.02e |
| [Completing the Square](https://www.youtube.com/watch?v=FD7vZ5jt0yg) | Exam Solutions | This excellent video resource demonstrates how to complete the square of the quadratic polynomial   | 1.02e |
| [How to Complete the Square For Quadratics](https://www.youtube.com/watch?v=8oVmtQ88gt0) | Foxmaths | This excellent video resource demonstrates how to complete the square using two examples. | 1.02e |
| [Completing the Square](http://www.nuffieldfoundation.org/sites/default/files/files/FSMA%20Completing%20the%20square%20student.pdf) | Nuffield foundation | This concise resource demonstrates how to complete the square of the quadratic polynomial and highlights an application of completing the square. | 1.02e |
| [Completing The Square](http://www.mathsmutt.co.uk/files/com%20squares.htm) | Maths Mutt | This excellent resource demonstrates how to complete the square using numerous detailed examples. | 1.02e |
| [Solve A Quadratic Equation Using The Classwiz Polynomial Solver- Casio fx-991EX fx-570EX Calculator](https://www.youtube.com/watch?v=b8iO5oJuIc8) | The Calculator Guide | Short video on use of calculator to solve quadratic equation and find turning point using the polynomial solver function. | 1.02e |
| [Sketching Quadratic Graphs By Completing the Square](http://www.onlinemathlearning.com/sketch-quadratic-graph.html) | OnlineMaths Learning.com | This resource includes a number of video clips and demonstrates how to complete the square to sketch a quadratic graph, locate the maximum or minimum points and the equation of the line of symmetry. | 1.02e |
| [Solving Inequalities](http://www.mathcentre.ac.uk/resources/uploaded/mc-ty-inequalities-2009-1.pdf) | Mathscentre | This comprehensive resource introduces learners to solving inequalities. It includes worked examples and exercises for the learners to complete. | 1.02g  |
| [Solving Quadratic Inequalities](https://www.mathsisfun.com/algebra/inequality-quadratic-solving.html) | Maths is Fun | This excellent interactive resource demonstrates how to solve quadratic inequalities. It includes ten questions for the learners to complete with detailed answers. | 1.02g  |
| [Solving Inequalities](http://www.cimt.org.uk/ske/F6/Text.pdf) | CIMT | This comprehensive resource introduces learners to solving inequalities. It includes detailed worked examples and exercises for the learners to complete. | 1.02g |
| [Inequalities](https://revisionmaths.com/advanced-level-maths-revision/pure-maths/algebra/inequalities) | Revision Maths | This concise resource demonstrates how to solve linear and quadratic inequalities.  | 1.02g |
| [Inequalities](https://www.youtube.com/watch?v=jQ2NE4emOgs) | mathstutorbiz | This excellent video resource demonstrates how to solve linear and quadratic inequalities | 1.02g |
| [How do you Solve A Quadratic Inequality Algebraically?](http://www.virtualnerd.com/algebra-2/quadratics/inequalities/graphing-solving-inequalities/solve-inequality-algebraically) | Virtual Nerd | This short video resource demonstrates how to solve a quadratic inequality algebraically. | 1.02g |
| [Solving Compound Inequalities](https://www.youtube.com/watch?v=aFXo2ws-roU) | Maths Meeting | This excellent video resource demonstrates how to solve compound inequalities. It also introduces learners to expressing solutions with interval notation. | 1.02g |
| [Inequalities in Real Life](https://www.tes.com/teaching-resource/inequalities-in-real-life-6439663) | TES | This resource invites learners to solve a problem using inequalities. | 1.02g, 1.02h and 1.02i |
| [Solving Real Life Linear Inequalities](https://www.youtube.com/watch?v=rnXcIS-CD7M) | Sarah Messing | This excellent video resource demonstrates how to solve a real life problem using inequalities. | 1.02g, 1.02h and 1.02i |
| [Solving Quadratic Inequalities (Application)](https://www.youtube.com/watch?v=F76CZmNlDv4) | Myhre Math MCHS | This excellent video resource demonstrates how quadratic inequalities are used in the real world. | 1.02g, 1.02h and 1.02i |
| [Interval Notation and Linear Inequalities](https://online.math.uh.edu/Math1300-unpaid/ch1/s17/1300_Ch1_Section7.pdf) | University of Houston | This comprehensive resource gives detailed examples of how to write the solutions to linear inequalities using interval notation. | 1.02h |
| [Writing Compound Inequalities in interval notation and graphing(Part 1)](https://www.youtube.com/watch?v=QPyphMG3haI) | Maths Meeting | This excellent video resource demonstrates how to express solutions to inequalities using interval notation. | 1.02h and 1.02i |
| [Writing Compound Inequalities in interval notation and graphing(Part 2)](https://www.youtube.com/watch?v=BdIeBjdyPxs) | Maths Meeting | This excellent video resource demonstrates how to express solutions to inequalities using interval notation. | 1.02h and 1.02i |
| [Polynomials](http://mei.org.uk/files/sow/06-polynomials.pdf) | MEI | MEI curriculum notes on polynomials | 1.02j |
| [Algebra: Polynomials](http://www.a-levelmathstutor.com/polynomials.php) | A-Level Maths Tutor | This concise resource looks at polynomials and the factor theorem. | 1.02j |
| [Polynomials](https://www.youtube.com/watch?v=wkP1Gkl-gfk) | mathstutorbiz | This excellent video resource demonstrates how to add, subtract and multiply polynomials. | 1.02j |
| [The Factor Theorem](https://www.youtube.com/watch?v=6G3iAgpK4kA) | ExamSolutions | This excellent video resource introduces learners to the factor theorem. | 1.02j |
| [Polynomial Division & Equating Coefficients](https://www.youtube.com/watch?v=Gu5xF0CSJmk) | ukmathsteacher | This challenging video resource demonstrates how to divide polynomials. | 1.02j |
| [Factor and Remainder Theorem](https://www.youtube.com/watch?v=Gu5xF0CSJmk) | ukmathsteacher | This challenging video resource covers the factor and remainder theorem. | 1.02j |
| [Polynomial Division](http://www.mathtutor.ac.uk/algebra/polynomialdivision/text) | mathtutor | This comprehensive resource covers polynomial division. It includes a video tutorial, worked examples and exercises for the learners to complete.  | 1.02j |
| [Polynomials](http://www.s-cool.co.uk/a-level/maths/advanced-algebra/revise-it/polynomials) | S-cool | This concise resource looks at polynomials and the factor theorem. | 1.02j |
| [Real World Applications of Polynomial Addition/ Subtraction](https://www.youtube.com/watch?v=8k7TB8bCBaE) | Mathceratops | This video resource demonstrates how real-world problems can be solved by manipulating polynomials.  | 1.02j |
| [Factor/Remainder Theorem](https://www.geogebra.org/m/nTZksysr) | Geogebra | Uses a slider to demonstrate the factor theorem | 1.02j |
| [Algebra](http://mei.org.uk/files/sow/27-algebra.pdf) | MEI | MEI curriculum notes on algebraic fractions and rational expressions | 1.02k |
| [How to Simplify Rational Expressions](http://www.mathwarehouse.com/algebra/rational-expression/how-to-simplify-rational-expressions.php) | Mathwarehouse | This interactive resource demonstrates how to simplify rational expressions and includes worksheets for learners to attempt (along with the answers). | 1.02k |
| [Simplifying Rational Expressions Part 1](https://www.youtube.com/watch?v=yfToPZqbvu4) | Al Richards | This short video resource is the first part of a two part lesson. It demonstrates how to simplify rational expressions. | 1.02k |
| [Simplifying Rational Expressions Part 2](https://www.youtube.com/watch?v=AL6RdmKxPaE) | Al Richards | This excellent video resource is the second part of a two part lesson and continues with the simplification of rational expressions.  | 1.02k |
| [Rational Expressions](http://tutorial.math.lamar.edu/Classes/Alg/RationalExpressions.aspx) | Paul’s Online Notes | This challenging resource demonstrates how to simplify rational expressions. It includes questions for the learners to attempt along with detailed solutions. | 1.02k |
| [The Modulus Function](https://www.youtube.com/watch?v=EqXVuQ7LN2Q) | ExamSolutions | This excellent video resource introduces learners to the modulus function and how it is used with inequalities. | 1.02l and 1.02s |
| [Modulus Inequalities (1)](https://www.youtube.com/watch?v=ShwfKY0gIX0) | ExamSolutions | This excellent video resource demonstrates how to use the modulus function in the course of solving inequalities. | 1.02l and 1.02s |
| [Modulus Inequalities (2)](https://www.youtube.com/watch?v=fyVwQ17meI0) | ExamSolutions | This excellent video resource demonstrates how to solve equations involving the modulus function, algebraically and graphically. | 1.02l and 1.02s |
| [Modulus Function Graphing, Equations and Inequalities](https://www.youtube.com/watch?v=eh5HnB6Jg-s) | ukmathsteacher | This excellent lengthy video resource demonstrates how to use the modulus function including the notation. It also demonstrates how to sketch the graph of the modulus of a linear function. | 1.02l and 1.02s |
| [The Modulus Function](http://mkhometuition.co.uk/index_files/A2-12_Modulus_Function.pdf) | M.K. Home Tuition | This challenging resource demonstrates how to sketch graphs of the modulus of a function and how to solve graphically equations involving the modulus function. It includes examples with detailed solutions. | 1.02l and 1.02s |
| [Modulus Functions 01 Linear Function](https://www.geogebra.org/m/Km3YKFaM)   | Geogebra | Use the sliders to vary the gradient and y-intercept of f(x) and the show/hide tickbox to reveal the modulus function |f(x)| | 1.02l and 1.02s |
| [Absolutely!](https://undergroundmathematics.org/thinking-about-functions/absolutely) | Underground Maths | Initial set of discussion questions to introduce modulus function graph | 1.02l and 1.02s |
| [Functions](http://mei.org.uk/files/sow/24-functions.pdf) | MEI | MEI curriculum notes on functions | 1.02l, 1.02s and 1.02z |
| [Graphs of Eight Bic Types of Function](http://mathonweb.com/help_ebook/html/functions_4.htm) | mathonweb | This simple resource covers the graphs of different types of functions. |  1.02m |
| [Sketching Polynomials](https://math.usask.ca/emr/examples/grpo_eg4.html) | University of Saskatchewan | This short resource demonstrates how to sketch polynomials by using two examples. |  1.02n |
| [Sketching Polynomial Graphs](https://www.youtube.com/watch?v=pvSzcBKJvu4) | MrBgottschalk | This excellent video resource demonstrates how to sketch polynomial functions. |  1.02n |
| [Graphs of Polynomial Functions](https://www.youtube.com/watch?v=OcjD6vYD7ic) | Textbook Tactics | This excellent video resource introduces learners to sketching polynomials. |  1.02n |
| [Sketching Curves Whodunnit?](http://www.ocr.org.uk/Images/181376-sketching-curves-whodunnit-lesson-element-teacher-instructions-and-task.pdf) | OCR | This enjoyable resource invites learners to use their knowledge of sketching quadratic graphs to solve a crime. It tries to address the misconceptions involved with quadratic graphs. |  1.02n |
| [Can you find... cubic edition](https://undergroundmathematics.org/polynomials/can-you-find-cubic-edition) | Underground Maths | Investigation that encourages learners to use their knowledge of the general shape of cubic graphs and the different ways that the curve can be positions to meet specific coordinate criteria. |  1.02n |
| [How not to solve a cubic...](https://undergroundmathematics.org/polynomials/how-not-to-solve-a-cubic) | Underground Maths | Investigation to find a cubic and a quadratic that intersect at   |  1.02n |
| [Functions - Graphs](https://www.geogebra.org/m/VrkX32Uq) | Geogebra | Investigate the shape of different polynomial functions | 1.02n |
| [Sketching a Graph](https://portal.uea.ac.uk/documents/6207125/8198428/bridging%2Balgebra%2Bcalculus%2Bsketching%2Ba%2Bgraph.pdf) | University of East Anglia | This resource explains the difference between plotting and sketching a curve. It also looks at sketching curves defined by simple equations including polynomials. |  1.02o |
| [Graphs of Reciprocal Functions](http://www.onlinemathlearning.com/reciprocal-function.html) | OnlineMath Learning.com | This excellent resource demonstrates how to graph reciprocal functions and also how to get the equation of a reciprocal function when given its graph. It also includes a video resource demonstrating how to graph transformations of reciprocal functions. |  1.02o |
| [Sketching Reciprocal Graphs of the form](https://www.youtube.com/watch?v=9fpGSyFZUGM)  | ExamSolutions | This excellent video resource demonstrates how to sketch reciprocal graphs. |  1.02o |
| [Asymptotes –What are they?](https://www.youtube.com/watch?v=5Hl_WJXcR6M) | ExamSolutions | This excellent video resource introduces learners to asymptotes. |  1.02o |
| [Translating or not?](https://undergroundmathematics.org/combining-functions/translating-or-not) | Underground Maths | Investigation looking at family of curves for  and   | 1.02o |
| [Reciprocal function](https://www.geogebra.org/m/R4WRZsNs) | Geogebra | Use of sliders to investigate family of curves  including the vertical and horizontal asymptotes. | 1.02o |
| [Solving Equations by Graphing](https://www.khanacademy.org/math/algebra2/advanced-functions#solving-equations-by-graphing) | Khan Academy | This challenging resource includes text and videos and covers interpreting equations graphically and solving equations graphically. |  1.02q |
| [Points of Intersection on Graphs AS Maths](https://www.youtube.com/watch?v=tISoZtCcBIo) | Starfish Maths | This excellent video resource demonstrates how to find the points of intersection on graphs, including finding where lines, circles and curves cross.  |  1.02q |
| [Quadratic Roots and Using Graphs](https://www.tes.com/teaching-resource/introducing-quadratic-roots-and-solving-quadratic-equations-graphically-11270005) | TES | This resource includes a worksheet and offers learners the opportunity to practice their understanding of interpreting algebraic solution of equations graphically. |  1.02q |
| [Stationary points](https://www.geogebra.org/m/WyxeGtWS) | Geogebra | Learners can investigate the position of stationary points for family of curves. Links to calculated values of   and  to introduce application of calculus.  | 1.02q |
| [Picture the process i](https://undergroundmathematics.org/thinking-about-functions/picture-the-process-i) | Underground Maths | Descriptions of eight real-world processes to match with appropriate graphs. Some background science may be useful but not essential to reason through what a graph might look like. | 1.02r |
| [Modulus Inequalities](https://www.geogebra.org/m/rg9n89PN) | Geogebra | Demonstration of solving  where the value of can be varied using a slider. | 1.02t |
| [Functions](https://revisionmaths.com/advanced-level-maths-revision/pure-maths/algebra/functions) | revision maths | This excellent comprehensive resource introduces functions and their associated vocabulary and notation. It covers the domain, range, inverse and composite functions, function graphs, the modulus function and transforming graphs. It also includes a video to explain the inverse of a function. | 1.02u |
| [Introduction to Functions](http://www.mathcentre.ac.uk/resources/uploaded/mc-ty-introfns-2009-1.pdf) | mathcentre | This excellent resource defines a function, the domain and range and demonstrates how to graph functions. It includes worked examples and exercises for the learners to complete along with the answers. | 1.02u |
| [What relation are you?](https://undergroundmathematics.org/thinking-about-functions/what-relation-are-you) | Underground Maths | Introduction to the language of functions using every day situations | 1.02u |
| [Solving Equations involving The Modulus Function. Composite Functions and Examining The Range of a Function](https://www.stem.org.uk/resources/elibrary/resource/35240/solving-equations-involving-modulus-function-composite-functions) | STEM Learning | This excellent resource includes a video clip to demonstrate how to sketch the graph of the modulus of a linear function and then solve graphically simple equations using the modulus function. It also covers composite functions and the range of a function. This website does require a login, but registration is free.  | 1.02v |
| [Inverse Functions](http://www.mathcentre.ac.uk/resources/uploaded/mc-ty-inverse-2009-1.pdf) | mathcentre | This comprehensive resource demonstrates how to find the inverse of a function algebraically and graphically. It includes worked examples and exercises for the learners to complete along with answers. | 1.02v |
| [Composition of Functions](http://www.mathcentre.ac.uk/resources/uploaded/mc-ty-composite-2009-1.pdf) | mathcentre | This comprehensive resource covers composite functions. It includes worked examples and exercises for the learners to complete along with the answers. | 1.02v |
| [Inverse Functions: Introduction](https://www.youtube.com/watch?v=vgwPqKkZd_0): | ExamSolutions | This excellent video resource introduces learners to inverse functions. | 1.02v |
| [Inverse Functions – Graphical Relationship](https://www.youtube.com/watch?v=sPkH0-7y9s4) | ExamSolutions | This excellent video resource demonstrates the graphical relationship between a function and its inverse. | 1.02v |
| [Combining Functions](https://www.youtube.com/watch?v=DAGUNSLNa4s) | ExamSolutions | This excellent video resource introduces learners to composite functions. | 1.02v  |
| [Composite Functions](https://www.geogebra.org/m/P35QpbWg) | Geogebra | This worksheet will help you visually finding the domian and range of the composite functions. | 1.02v |
| [Compose!](https://undergroundmathematics.org/combining-functions/compose) | Underground Maths | Learners are challenged to identify how functions have been composed from an initial 4 defined functions and then to find the domain and range of each composite function..  | 1.02v |
| [Composing gets me nowhere](https://undergroundmathematics.org/combining-functions/composing-gets-me-nowhere) | Underground Maths | Learners are encouraged to investigate self inversing functions | 1.02v |
| [Find an Inverse and Check](https://www.youtube.com/watch?v=rIKqk-OPnKo) | Mathbyfives | video clip demonstrating finding the inverse and   | 1.02v |
| [Graphs and Transformations](https://www.slideshare.net/timschmitz/higher-maths-122-graphs-and-transformations) | In SlideShare | This excellent resource includes five slides and introduces learners to graph transformations. |  1.02w |
| [Graph Transformations](https://www.math.utah.edu/~wortman/1050-text-gt.pdf) | University of Utah | This comprehensive resource demonstrates the effects of simple transformations on graphs. It includes questions for learners to attempt. |  1.02w |
| [Transformation of Functions](https://www.youtube.com/watch?v=IFT2uznB7fM) | mathtutodvd | This excellent short video resource demonstrates the effects of simple transformations on graphs. |  1.02w |
| [Transformations of Functions 1](https://www.youtube.com/watch?v=yP_ZpQnZyU0) | MrAlnoldsMaths | This excellent video resource demonstrates the effects of simple transformations on graphs. It includes examples and solutions. |  1.02w |
| [Graph Transformation](https://brilliant.org/wiki/graph-transformation/) | brilliant.org | This excellent resource demonstrates the different type of graph transformations and includes combination of transformations. It gives examples with detailed solutions. |  1.02w and 1.02x |
| [Transformations](http://www.s-cool.co.uk/a-level/maths/functions/revise-it/transformations) | S-cool | This excellent resource demonstrates the effects of simple transformations on graphs. |  1.02x |
| [Combining Transformations](https://online.math.uh.edu/Math1330-unpaid/ch1/s13/CombTransf/Combining_Transformations_Math1330_s13.pdf) | University of Utah | This challenging resource demonstrates the effect of a combination of transformations on graphs of functions. It includes examples with detailed solutions. |  1.02x |
| [Transformations – Combination Example 1](https://www.youtube.com/watch?v=PvXPKiwjX6I) | Brian Veitch | This excellent short video resource demonstrates in a very simple way, the effect of a combination of transformations on a graph. |  1.02x |
| [Transformatoin - Combination Example 2](https://www.youtube.com/watch?v=GcIO1Z01r8o) | Brian Veitch | This excellent short video resource demonstrates in a very simple way, the effect of a combination of transformations on a graph. |  1.02x |
| [Graph Transformations](https://www.youtube.com/watch?v=0a-AjP4UdnY) | Hegartymaths | This excellent video resource demonstrates the effects of a combination of transformations on graphs. |  1.02x |
| [Graphical Transformations of Functions](http://michelenaja.faculty.mjc.edu/transformations_of_graphs/Math_90_transformations_of_graphs_of_functions.pdf) | Modesto Junior College | This excellent resource demonstrates the effect of a combination of transformations on graphs of functions. It includes examples with solutions. |  1.02x |
| [Partial Fraction Decomposition](https://www.khanacademy.org/math/algebra-home/alg-rational-expr-eq-func/alg-partial-fraction/v/partial-fraction-expansion-1) | Khan Academy | This challenging video resource introduces partial fraction decomposition. | 1.02y |
| [Partial Fractions](http://www.mathcentre.ac.uk/resources/uploaded/mc-ty-partialfractions-2009-1.pdf) | Mathscentre | This comprehensive resource demonstrates how to use partial fractions. It includes worked examples and questions for learners to attempt (along with the answers). | 1.02y |
| [Partial Fractions](https://www.mathsisfun.com/algebra/partial-fractions.html) | Maths is Fun | This excellent interactive resource demonstrates how to decompose rational functions into partial fractions. It includes ten questions for the learners to complete with detailed answers. | 1.02y |
| [Using Partial Fractions with the Binomial Expansion](https://www.examsolutions.net/tutorials/using-partial-fractions-with-the-binomial-expansion/) | Exam Solutions | This excellent video resource demonstrates how to express a fraction in partial fractions before using the binomial expansion. | 1.02y |
| [Modelling with Function Combination](https://www.khanacademy.org/math/algebra2/manipulating-functions/combining-and-composing-modeling-functions/v/modeling-with-combined-functions) | Khan Academy | This excellent interactive resource looks at how functions are used in modelling. | 1.02z |
| [Modelling the Real World with Families of Functions](http://study.com/academy/lesson/modeling-the-real-world-with-families-of-functions.html) | Study.com | This resource demonstrates how functions are used in modelling. | 1.02z |
| [Modelling and Solving Problems with Polynomial Functions](https://www.youtube.com/watch?v=zC0zbH-Tkc8) | ctkleduc | This excellent video resource demonstrates how to solve real life problems with polynomial functions. | 1.02z |
| [Absolute-Value Function in a Real Life Situation](https://www.youtube.com/watch?v=aeUBcSJ01aA) | Maria Ena Rosales | This animated video resource demonstrates how the absolute value function is used in real life.  | 1.02z |
| [Real Life Applications of Absolute Value](https://www.youtube.com/watch?v=qQ2Kh__DC40) | Paul Schick | This excellent video resource demonstrates how the modulus function can be used to solve real life problems. | 1.02z |
| [Using Functions in Real Life](https://www.youtube.com/watch?v=Jz16ZRioUgs) | Mindset Learn | This excellent video resource looks at functions and how they can be used in real life. | 1.02z |
| [Finding Inverse Functions (Applications)](https://www.youtube.com/watch?v=w_dz47LeUiI) | Myhre Math MCHS | This video resource demonstrates how inverse functions are used in the real world. | 1.02z |

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