

MATERIAL TAUGHT IN MATHEMATICS

FORM 3 TO FORM 4

2007-2008

1. Powers and Roots

- Use index laws to simplify and evaluate numerical expressions involving integer, fractional negative powers

(Evaluate $\sqrt[3]{8^2}$, $625^{-\frac{1}{2}}$, $\left(\frac{1}{25}\right)^{\frac{3}{2}}$)

- Substitute positive and negative numbers into expressions and formulae with quadratic and/or cubic terms
- Recognise the relationship between fractional powers and roots
- Understand the meaning of surds
- Manipulating surds, including rationalising the denominator where the denominator is a pure surd

(Express in the form $a\sqrt{2}$: $\sqrt{18} + 3\sqrt{2}$, $\frac{2}{\sqrt{8}}$)

Simplify $(3 + 5\sqrt{2})^2$)

2. Use of symbols

- Use index notation involving fractional powers

(Simplify $(64t^3)^{\frac{2}{3}}$, $\frac{a^{\frac{1}{2}} \times a^{\frac{3}{4}}}{a^{\frac{1}{3}}}$)

- Convert recurring decimals into fractions

$(0.\dot{3} = \frac{1}{3}$, $0.2333... = \frac{21}{90}$)

3. Algebraic Manipulation Quadratic Equations

- Factorisation (common factor, difference of two squares, grouping(simple))
- Understand the concept of a quadratic expression
- Factorise quadratic expressions ($x^2 + 12x - 45$, $6x^2 - 5x - 4$)
- Add, subtract, multiply and divide algebraic fractions
- Factorise and simplify ($\frac{x^2 - 4x}{x^2 - x - 12}$)
- Solve quadratic equations by factorisation
($2x^2 - 3x + 1 = 0$, $x(3x - 2) = 5$, $(x - 2)(2x + 3) = 0$)
- Solve quadratic equations by using the **quadratic formula**
- Form and solve quadratic equations from data given in a context

4. Simultaneous Equations

- Simultaneous linear equations (REVISION)
- Solve simultaneous equations in two unknowns, one equation being linear and the other equation being quadratic ($y = 2x - 11$ and $x^2 + y^2 = 25$ or $y - 11x = -2$ and $y = 5x^2$)

5. Graphs

- Straight lines: gradient, y-intercept, parallel lines (REVISION FORM 2)
- Draw and interpret straight line conversion graphs (to include currency conversion graphs)

- Understand the concept of a gradient of a straight line (use a triangle)
(A ramp rises 15m over a horizontal distance of 60m, therefore the gradient of the ramp is $15/60 = 0.25$)
- Determine the coordinates of the midpoint of a line segment given the coordinates of the two end points
- Complete tables
- Plot and draw graphs with equations:
 $y = Ax^3 + Bx^2 + Cx + D$ in which
 - i) the constants are integers and some could be zero
 - ii) the letters x and y can be replaced with any other two letters

$$(y = x^3, y = 3x^3 - 2x^2 + 5x - 4, y = 2x^3 - 6x + 2, \\ V = 60w(60 - w))$$

or

$$y = Ax^3 + Bx^2 + Cx + D + \frac{E}{x} + \frac{F}{x^2} \text{ in which}$$

- i) the constants are numerical and at least three of them are zero
- ii) the letters x and y can be replaced with any other two letters

$$(y = \frac{1}{x} \quad x \neq 0, y = 2x^2 + 3x + \frac{1}{x} \quad x \neq 0,$$

$$y = \frac{1}{x}(3x^2 - 5) \quad x \neq 0, W = \frac{5}{d^2} \quad d \neq 0)$$

- Find the gradients of non-linear graphs by drawing a tangent

- Find the intersection points of two graphs, one linear (y_1) and one non-linear (y_2), and recognise that the solutions correspond to the solutions of $y_2 - y_1 = 0$
(the x-values of the intersection of the two graphs
 $y = 2x + 1$, $y = x^2 + 3x - 2$ are the solutions of
 $x^2 + x - 3 = 0$

Similarly, the x-values of the intersection of the two graphs $y = 5$, $y = x^3 - 3x^2 + 7$ are the solutions of $x^3 - 3x^2 + 2 = 0$)

- Interpret information presented in a range of linear and non-linear graphs (to include real-life situations, speed/time and distance/time graphs)

6. Inequalities

- Inequalities and regions (REVISION FORM 2)
- Solve quadratic inequalities in one unknown and represent the solution set on a number line
($x^2 \geq 25$, $4x^2 > 25$, $(2x - 1)(x - 1) < 0$)

7. Ratio and Proportion

- Use ratio notation including reduction to its simplest form and its various links to fraction notation
(Expressing in the form 1 : n)
- If one of the two quantities in a given ratio is known, find the other, including the use of the unitary method
- Divide a quantity in a given ratio into 2 or 3 parts
(Share £416 in the ratio 5 : 3)

- Use the process of proportionality to evaluate unknown quantities
- Calculate an unknown quantity from quantities that vary in direct proportion
(s varies directly as t. Find the missing value in a table)
- Solve word problems about ratio and proportion
(including maps and scale diagrams)
- Set up problems involving direct or inverse proportion and relate algebraic solutions to graphical representation of the equations

(to include only the following: $y \propto x$, $y \propto \frac{1}{x}$, $y \propto x^2$,
 $y \propto \frac{1}{x^2}$, $y \propto x^3$, $y \propto \sqrt{x}$)

8. Sequences

- Generate terms of a sequence using term-to term and position-to-term definitions of the sequence
(including odd, even, squares, multiples and powers)
- Find subsequent terms of an integer sequence
(1, 2, 4, 8,..... 5, 9, 13, 17,.....)
- Describe the terms of a sequence in words
- Use linear expressions to describe the nth term of an arithmetic sequence
(1,3, 5,7,9,..... nth term = $2n - 1$)

9. Symmetry

- Recognise line and rotational symmetry
- Identify any lines of symmetry and the order of rotational symmetry of a given two-dimensional figure
(name a quadrilateral with no lines of symmetry and order of rotational symmetry 2)
- Draw lines of symmetry

10. Circle Properties

- Recognise the term cyclic quadrilateral
- Recognise the terms tangent, arc, sector and segment of a circle
- Understand and use angle properties of the circle including
 - i) angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the remaining part of the circumference
 - ii) angle subtended at the circumference by a diameter is 90°
 - iii) angles in the same segment are equal
 - iv) the sum of the opposite angles of a cyclic quadrilateral is 180°
 - v) the alternate segment theorem
- Understand chord and tangent properties of circles
 - i) two tangents from a point to a circle are equal in length
 - ii) tangents are perpendicular to the radius at the point of contact
 - iii) the line from the centre of a circle which is perpendicular to a chord, bisects the chord (and the converse)
- Understand and use the internal and external intersecting chord properties
- Provide reasons, using standard geometrical statements to support numerical values for angles obtained in any geometrical context involving circles

11. Similarity

- Understand congruence as meaning the same shape and size
- Understand and use the geometrical properties that similar figures have corresponding lengths in the same ratio and their corresponding angles are equal
- Use similarity to find lengths of sides
- Understand that areas of similar figures are in the ratio of the square of corresponding sides
- Understand that volumes of similar figures are in the ratio of the cube of corresponding sides
- Use areas and volumes of similar figures in solving problems

12. Set Language and Notation

- Understand sets defined in algebraic terms
- Understand and use subsets
(if A is a subset of B, then $A \subset B$)
- Understand and use the complement of a set
- Understand the definition of a set of numbers
- Use the set notation \cup , \cap , \in and \notin
- Understand the concept of the Universal Set, the Null Set and the Empty set and the symbols for these sets
- Use Venn diagrams to represent sets and the number of elements in sets
- Define sets of numbers by describing
($\{$ first four odd numbers $\}$, $\{x : x \text{ is a factor of } 12 \}$
or by listing $\{1,3,5,7 \}$

- Use the notation $n(A)$ for the number of elements in the set (use the notation A')
- Use sets in practical situations
- Inequality notation $\{x : 2 \leq x \leq 5\}$ may be used

13. Trigonometry

- Trigonometric ratios form angles up to 180°
- Understand and use angles of elevation and depression. Bearings.
- Understand and use the sine and cosine rules for any triangle
- Use Pythagoras theorem in 3 dimensions
- Understand and use the formula $\frac{1}{2}bc \sin A$ for the area of a triangle
- Apply trigonometrical methods to solve problems in 3 dimensions including finding the angle between a line and a plane (not the angle between two planes)

REVISION: FORMS 1 and 2

- Integers, Decimals, Fractions
- Prime factors (LCM, HCF)
- Directed numbers
- Simplify and expand expressions and fractions
- Solve linear equations (verbal problems)
- Angles and Triangles
- Pythagoras theorem
- Area and Volume
- Trigonometry (understand and use sine, cosine and tangent of acute angles to determine lengths and angles of right-angled triangle, solve problems including bearings, use angles of elevation and depression)
- Percentages and Ratio
- Inequalities (solve simple linear inequalities and represent the solution set on a number line)
- Inequalities and regions
- Changing the subject
- Standard form
- Indices and Powers (laws of indices)
- Use of a calculator
- Straight lines (gradient, y-intercept, parallel lines)
- Simultaneous equations
- Powers and Roots