D= Declarative know

YEAR 10 ROUTE B HAND BOOK 2021-2022

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

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AUTUMN TERM

YEAR 10 B		NUMBER (year 9/ year 10 foundation content Standard from etc)	PROBABILITY		DATA- Cumulative frequency and histograms.		GEOMETRY perimeter area and volume	MOCK INCLUDING PREP	GEOMETRY perimeter area and volume

SPRING TERM

ALGEBRA - recap algebra from year 9quadratics			Circle theorems		Circle theorems

SUMMER TERM

TRANSFORMATIONS		TRANSFORMATIONS CONSTRUCTIONS/ LOCI / BEARINGS		QUADRATICS		QUADRATICS

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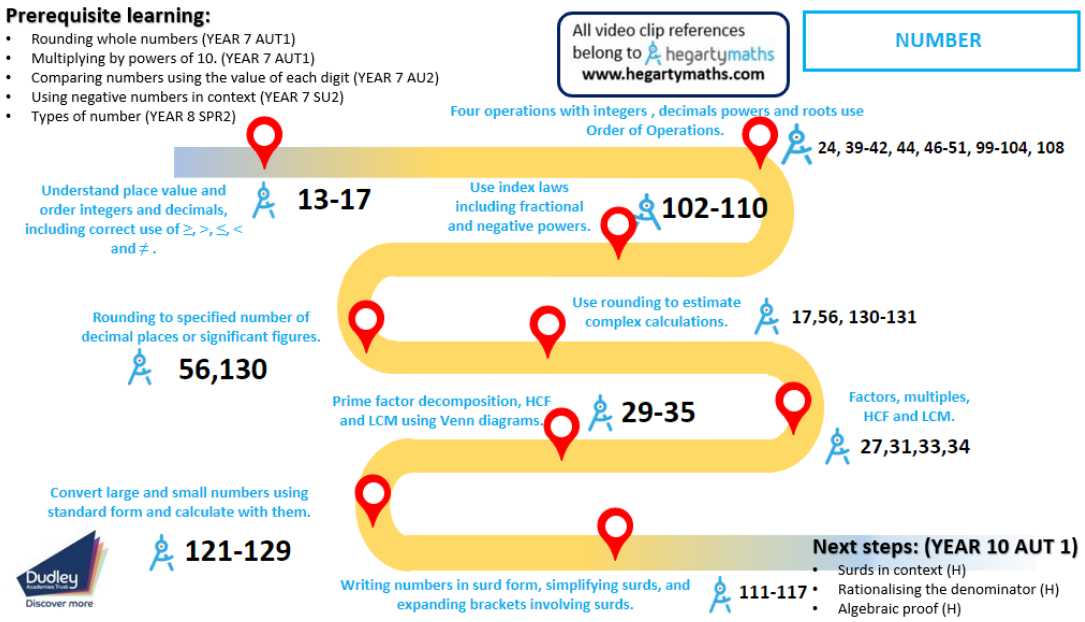
YEAR 10 NUMBER from year 9 ROUTE B

Objectives

1c	Round to a specified number of decimal places or significant figures. (D/P)
	Estimate answers to one or two step calculations, including use of rounding numbers (D/P)
1d	Add, subtract, multiply and divide positive integers and decimals, including calculations involving money and inverse operations. Problem solving with decimals (D/P)
1e	Add, subtract, multiply and divide negative number (in context, eg. temperature, overdraft) (D/P)
1f	Apply order of operations (D/P)
1h	Find square and cube roots (D/P)
1i	Recognise powers of 2,3,4 and 5 (D)
1g	Use and understand positive indices and roots (D/P)
1f (H)	Use index laws for positive and negative powers (D/P/C)
1g (H)	Use index laws, including use of zero, fractional and negative powers (D/P)

SMAP



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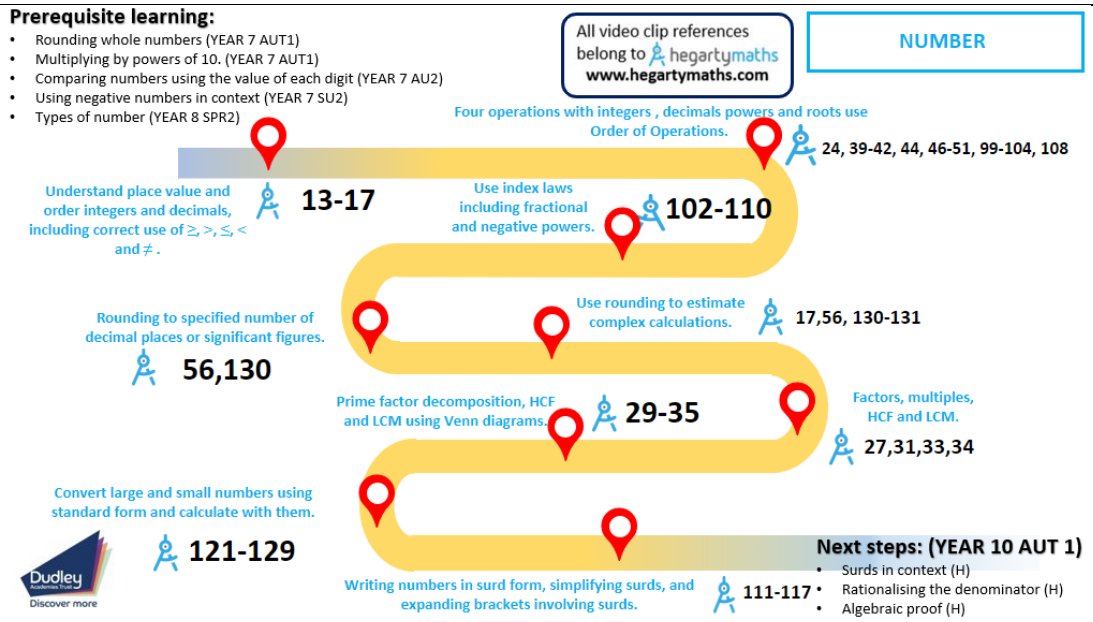
1h (H)	Find the value of calculations using indices including fractional powers (D/P)
1i	Find the prime factor decomposition of positive integers – write as a product using index notation; (D/P)
1m	Carry out prime factor decomposition and apply this to HCF and LCM using Venn diagrams. (D/P/C)
1k (H)	Convert large and small numbers into standard form and vice versa; Add, subtract, multiply and divide numbers in standard form (D/P/C)
1l (H)	Write a number in surd form Simplifying surds Expand surds in brackets DO NOT including rationalising the denominator (D/P/C)
1j (H)	Find positive powers of positive and negative integers and fractions. Find roots of positive and negative integers (D/P)



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Essential Language Integer, Factor, Negative, Product, Multiples, Prime	
power, index, roots, BIDMAS, estimate, digit, decimal, operation, even, odd,	
prime factorisation, root, indices, significant figures, reciprocal, standard form, base 10, irrational, surds	
PREQUISITE AND GREAER DEPTH EXEMPLIFICATION • **Rounding whole numbers.** • **Types of number.** • **Multiplying by powers of 10.** • **Comparing numbers using the value of each digit.** • **Using negative numbers in context.** Convince me that 8 is not prime. Given 5 digits, what are the largest or smallest answers when subtracting a two-digit number from a three-digit number? Given 2.6 × 15.8 = 41.08 What is 26 × 0.158? What is 4108 ÷ 26 Prove that the square root of 45 lies between 6 and 7. Work out the value of n in $40 = 5 \times 2^n$.	**COMMON MISCONCEPTIONS:** Stress the importance of knowing the multiplication tables to aid fluency. Students may write statements such as 150 – 210 = 60. Significant figures and decimal place rounding are often confused. Some students may think 35 877 = 36 to two significant figures. The order of operations is often not applied correctly when squaring negative numbers, and many calculators will reinforce this misconception. 10^3, for example, is interpreted as 10 × 3. Many students think 1 is a prime number. Particular emphasis should be made on the definition of 'product' as multiplication as many students get confused and think it relates to addition. Significant figure and decimal place rounding are often confused. Some pupils may think 35 934 = 36 to two significant figures. The order of operations is often not applied correctly when squaring negative numbers, and many calculators will reinforce this misconception. Remind students that 1 is not a prime number with clear reasoning. Particular emphasis should be made on the definition of "product" as multiplication, as many students get confused and think it relates to addition. Remind students that a surd is an irrational number – when simplifying you must be able to recall square numbers fluently.
OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:	**MASTERY PEDAGOGY** **RESOURCES TO SUPPORT LEARNING:**

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Phil states 3.44 × 10 = 34.4 and Chris states 3.44 × 10 = 34.40. Who is correct? Problems involving shopping for multiple items, such as: Rob purchases a magazine costing £2.10, a newspaper costing 82p and two bars of chocolate. He pays with a £10 note and gets £5.40 change. Work out the cost of one bar of chocolate When estimating, students should be able to justify whether the answer will be an overestimate or underestimate Which two digit number is special because adding the sum of its digits to the product of its digits gives me my original number? Sharon says 108 is a prime number. Is she correct? Questions that require multiple layers of operations such as: Pam writes down one multiple of 9 and two different factors of 40. She then adds together her three numbers. Her answer is greater than 20 but less than 30. Find three numbers that Jan could have written down	Negative numbers in real life can be modelled by interpreting scales on thermometers using F and C. Money/coins Pupils need to know how to enter negative numbers into their calculator. Use the language of 'negative' number and not minus number to avoid confusion with calculations. **TRANSFERABLE SKILLS- Content in other context** **SCIENCE** EDEXCEL SCIENCE VERSION - We don't do EDEXCEL but might be useful https://qualifications.pearson.com/content/dam/pdf/GCSE/Science/2016/teaching-and-learning-materials/Guide-to-Maths-for-Scientists.pdf Pages 41-42, 54-59 AQA Science- https://filestore.aqa.org.uk/resources/science/AQA-MATHS-IN-SCIENCE-FACTSHEET-PTT.PDF Pages 3, 9-11 https://www.stem.org.uk/triplescience/maths AQA - first link TEACHER TRAINING IN SCIENCE https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464/planning-resources **GEOGRAPHY** EDEXCEL GEOGRAPHY LINK- https://qualifications.pearson.com/content/dam/pdf/GCSE/Geography-A/2016/teaching-and-learning-materials/Edexcel-2016-GCSE-Geography-A-B-Maths-for-Geographers.pdf **Pages 36-41**

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YEAR 10 PROBABILITY ROUTE B

Objectives

10a	Write probabilities using fractions, percentages or decimals **(D/P/C)**
10b	Understand and use experimental and theoretical measures of probability, including relative frequency to include outcomes using dice, spinners, coins, etc **(D/P)**
10c	Estimate the number of times an event will occur, given the probability and the number of trials **(D/P)**
10d	Find the probability of successive events, such as several throws of a single dice **(D)**
10e	List all outcomes for single events, and combined events, systematically **(D/P)**
10f	Draw sample space diagrams and use them for adding simple probabilities **(D/P/C)**
10g	Know that the sum of the probabilities of all outcomes is 1 **(D)**
10h	Use 1 – p as the probability of an event not occurring where p is the probability of the event occurring**(D/P/C)**
10i	Work out probabilities from Venn diagrams to represent real-life situations and also 'abstract' sets of numbers/values **(D/P/C)**
10j	Use union and intersection notation **(D)**
10k	Find a missing probability from a list or two-way table, including algebraic terms **(D/P)**
10l	Understand conditional probabilities and decide if two events are independent **(D/P/C)**
10m	Draw a probability tree diagram based on given information, and use this to find probability and expected number of outcome **(D/P)**
10n	Understand selection with or without replacement **(D/P/C)**

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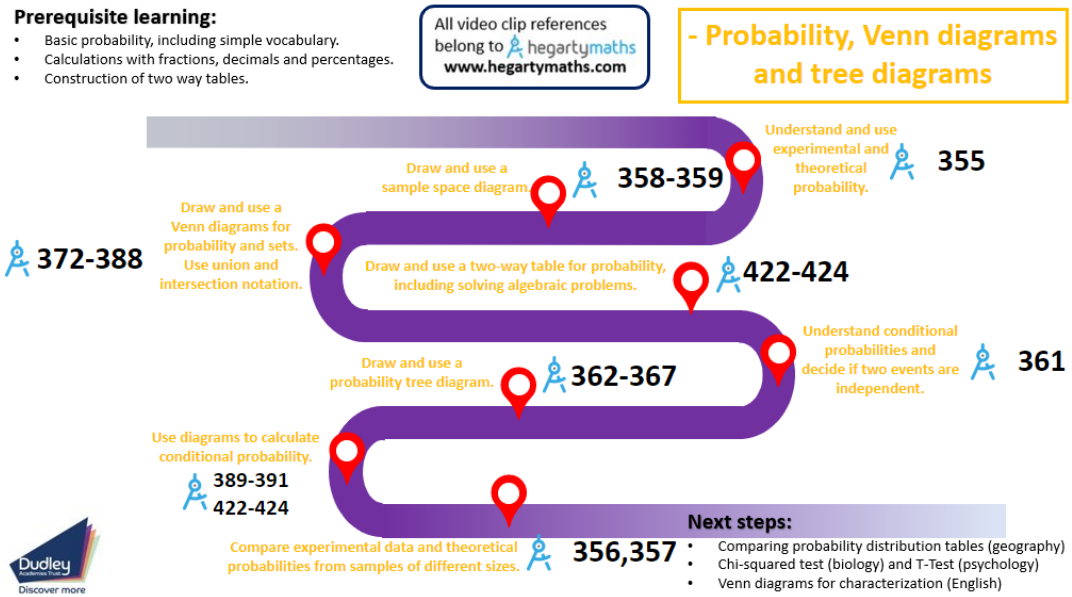

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10o	Calculate the probability of independent and dependent combined events **(D/P/C)**	
10p	Use a two-way table to calculate conditional probability **(D/P/C)**	
10q	Use a tree diagram to calculate conditional probability **(D/P/C)**	
10r	Use a Venn diagram to calculate conditional probability **(D/P/C)**	
10s	Compare experimental data and theoretical probabilities **(D/P/C)**	
10t	Compare relative frequencies from samples of different sizes **(D/P/C)**	

Essential Language:

Probability, outcomes, fairness, experimental, replacement, sample

Conditional

mutually exclusive, tree diagrams, sample space, theoretical, relative frequency, Venn diagram,

PREQUISITE AND GREAER DEPTH EXEMPLIFICATION	**COMMON MISCONCEPTIONS:**
• **Basic probability, including simple vocabulary.** • **Calculations with fractions, decimals and percentages.** • **Construction of two way tables.**	Probability without replacement is best illustrated visually and by initially working out probability 'with' replacement. Not using fractions or decimals when working with probability trees.

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OPPORTUNITIES FOR REASONING/PROBLEM SOLVING:	MASTERY PEDAGOGY
Students should be given the opportunity to justify the probability of events happening or not happening in real-life and abstract contexts. If the probability of outcomes are x, 2x, 4x, 3x, calculate x. Draw a Venn diagram of students studying French, German or both, and then calculate the probability that a student studies French given that they also study German.	**RESOURCES TO SUPPORT LEARNING:** **TRANSFERABLE SKILLS- Content in other context** **SCIENCE** EDEXCEL SCIENCE VERSION - We don't do EDEXCEL but might be useful https://qualifications.pearson.com/content/dam/pdf/GCSE/Science/2016/teaching-and-learning-materials/Guide-to-Maths-for-Scientists.pdf **Page 36** AQA Science- https://filestore.aqa.org.uk/resources/science/AQA-MATHS-IN-SCIENCE-FACTSHEET-PTT.PDF https://www.stem.org.uk/triplescience/maths AQA - first link TEACHER TRAINING IN SCIENCE https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464/planning-resources **GEOGRAPHY** EDEXCEL GEOGRAPHY LINK- https://qualifications.pearson.com/content/dam/pdf/GCSE/Geography-A/2016/teaching-and-learning-materials/Edexcel-2016-GCSE-Geography-A-B-Maths-for-Geographers.pdf

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YEAR 10 DATA HANDLING ROUTE B

Objectives

14a	Specify the problem and plan: decide what data to collect and what analysis is needed understand primary and secondary data sources consider fairness **(D)**
14b	Understand what is meant by a sample and a population **(D)**
14c	Understand how different sample sizes may affect the reliability of conclusions drawn **(D/P)**
14d	Identify possible sources of bias and plan to minimise it **(D/P)**
14e	Write questions to eliminate bias, and understand how the timing and location of a survey can ensure a sample is representative **(D/P)**
14f	Use statistics found in all graphs/charts in this unit to describe a population **(D/P/C)**
14h	Know the appropriate uses of cumulative frequency diagrams **(D)**
14i	**Construct and interpret cumulative frequency tables (P/C)**
14j	**Construct and interpret cumulative frequency graphs/diagrams and from the graph:** **estimate frequency greater/less than a given value** **find the median and quartile values and interquartile range (D/P/C)**
14k	**Compare the mean and range of two distributions, or median and interquartile range, as appropriate (D/P/C)**
14l	**Interpret box plots to find median, quartiles, range and interquartile range and draw conclusions (D/P)**

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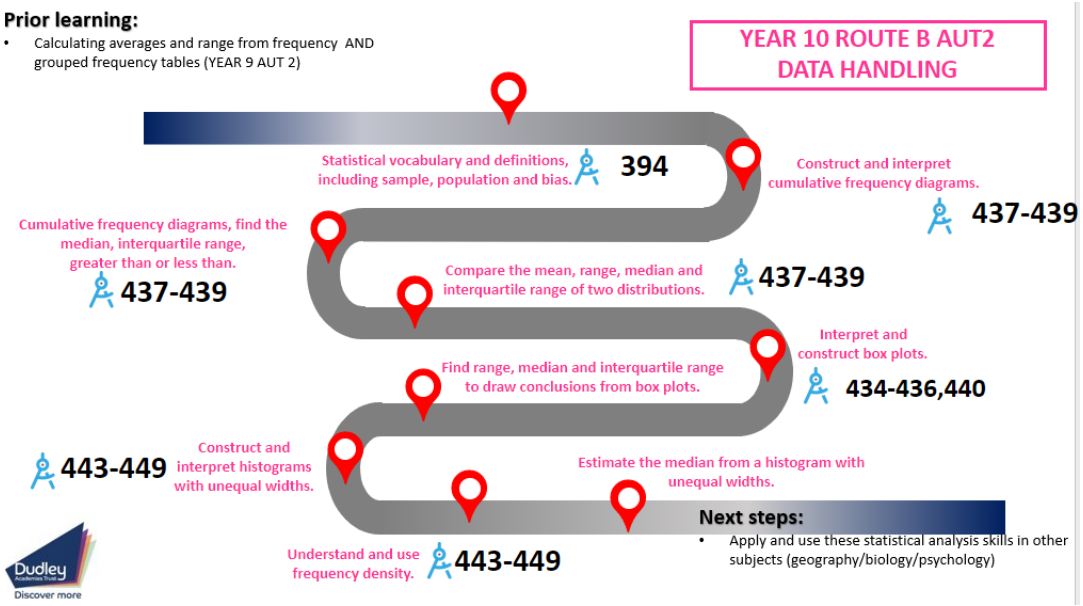

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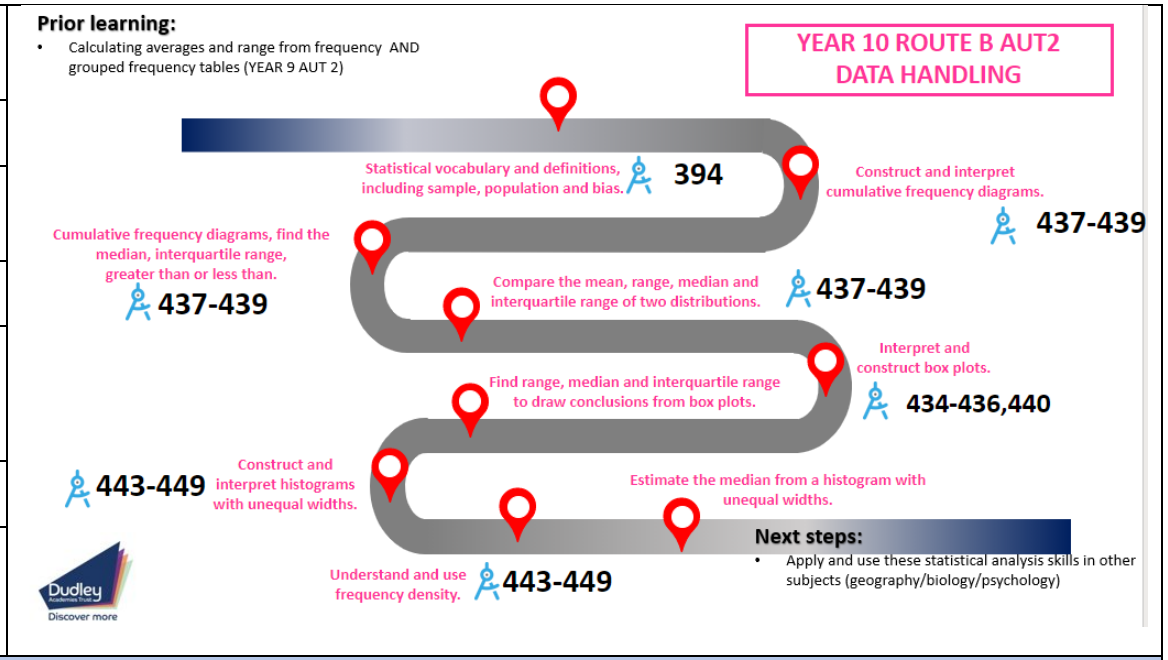
14m	**Produce box plots from raw data and when given quartiles, median and identify any outliers (D/P/C)**
14n	Know the appropriate uses of histograms **(D)**
14o	**Construct and interpret histograms from class intervals with unequal width (D/P/C)**
14p	**Use and understand frequency density (D/P/C)**
14q	**From histograms:** **complete a grouped frequency table** understand and define frequency density (D/P/C)
14r	Estimate the mean from a histogram **(D/P/C)**
14s	**Estimate the median from a histogram with unequal class widths or any other information from a histogram, such as the number of people in a given interval. (D/P/C)**



Essential Language:

random, comparison, frequency, averages, sample, interpret

population, fraction, decimal, percentage, bias, mean, median, mode, range,

stratified sample, cumulative frequency, box plot, histogram, frequency density, lower quartile, upper quartile, interquartile range, spread, outlier

PREQUISITE AND GREAER DEPTH EXEMPLIFICATION	COMMON MISCONCEPTIONS:
Calculating averages and range from frequency tables. **Reading scales on different axes.** **Plotting coordinates in the first quadrant.**	Labelling axes incorrectly in terms of the scales, and also using 'Frequency' instead of 'Frequency Density' or 'Cumulative Frequency'. Students often confuse the methods involved with cumulative frequency, estimating the mean and histograms when dealing with data tables.

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As an extension, use the formula for identifying an outlier, (i.e. if data point is below LQ – 1.5 × IQR or above UQ + 1.5 × IQR, it is an outlier). Get them to identify outliers in the data, and give bounds for data.	
OPPORTUNITIES FOR REASONING/PROBLEM SOLVING: When using a sample of a population to solve contextual problem, students should be able to justify why the sample may not be representative the whole population. Interpret two or more data sets from box plots and relate the key measures in the context of the data. Given the size of a sample and its box plot calculate the proportion above/below a specified value. Explain why a sample may not be representative of a whole population. Carry out their own statistical investigation and justify how sources of bias have been eliminated. Construct cumulative frequency graphs, box plots and histograms from frequency tables. Compare two data sets and justify their comparisons based on measures extracted from their diagrams where appropriate in terms of the context of the data.	**MASTERY PEDAGOGY** **RESOURCES TO SUPPORT LEARNING:** **TRANSFERABLE SKILLS- Content in other context** **SCIENCE** EDEXCEL SCIENCE VERSION - We don't do EDEXCEL but might be useful https://qualifications.pearson.com/content/dam/pdf/GCSE/Science/2016/teaching-and-learning-materials/Guide-to-Maths-for-Scientists.pdf Pages 3 -18 AQA Science- https://filestore.aqa.org.uk/resources/science/AQA-MATHS-IN-SCIENCE-FACTSHEET-PTT.PDF Pages 8, 10, 12 https://www.stem.org.uk/triplescience/maths AQA - first link TEACHER TRAINING IN SCIENCE https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464/planning-resources **GEOGRAPHY** EDEXCEL GEOGRAPHY LINK- https://qualifications.pearson.com/content/dam/pdf/GCSE/Geography-A/2016/teaching-and-learning-materials/Edexcel-2016-GCSE-Geography-A-B-Maths-for-Geographers.pdf **Pages 4-16, 42-49**

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YEAR 10 PERIMETER, AREA and VOLUME ROUTE B

Objectives

7a	Recall and use the formulae for the area of a triangle, rectangle, trapezium and parallelogram using a variety of metric measures **(D)**
7b	**Calculate the area of compound shapes made from triangles, rectangles, trapezia and parallelograms using a variety of metric measures (D/P)**
7c	**Find the perimeter of a rectangle, trapezium and parallelogram using a variety of metric measures (D/P)**
7d	**Calculate the perimeter of compound shapes made from triangles and rectangles (D/P)**
7e	Estimate area and perimeter by rounding measurements to 1 significant figure to check reasonableness of answers **(D/P)**
7f	**Recall the definition of a circle and name and draw parts of a circle (D)**
7g	**Use $\pi \approx 3.142$ or use the π button on a calculator (D)**
7h	**Recall and use formulae for the circumference of a circle and the area enclosed by a circle (using circumference = $2\pi r = \pi d$ and area of a circle = πr^2) using a variety of metric measures (D/P)**
7i	**Find radius or diameter, given area or circumference of circles in a variety of metric measures (P/C)**
7j	**Calculate perimeters and areas of composite shapes made from circles and parts of circles (including semicircles, quarter-circles, combinations of these and also incorporating other polygons) (D/P/C)**
7k	**Calculate arc lengths, angles and areas of sectors of circles (D/P/C)**
7l	Give answers to an appropriate degree of accuracy or in terms of π **(D/P/C)**

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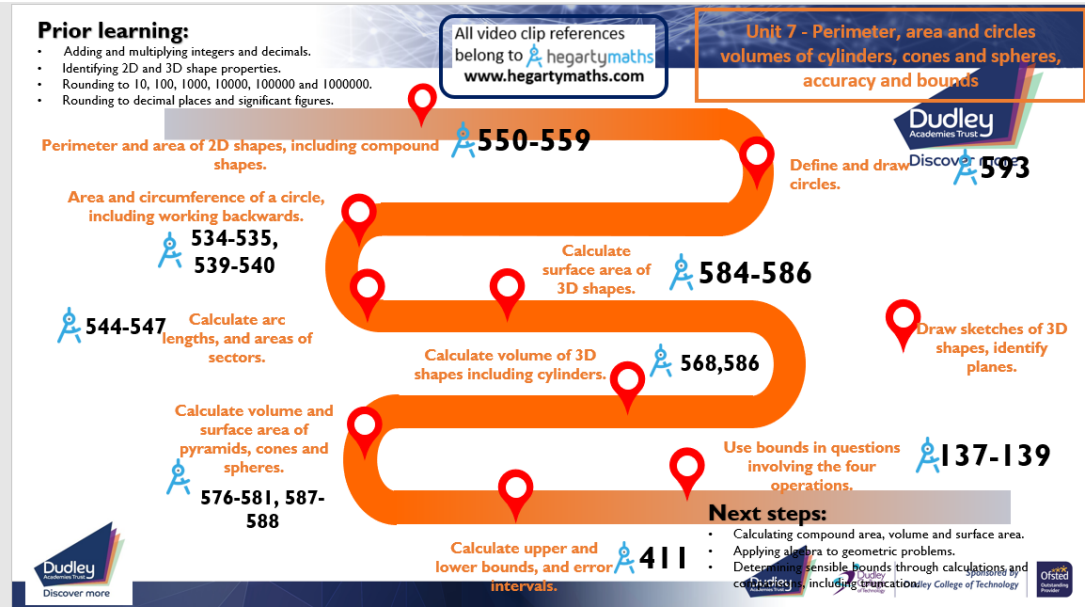

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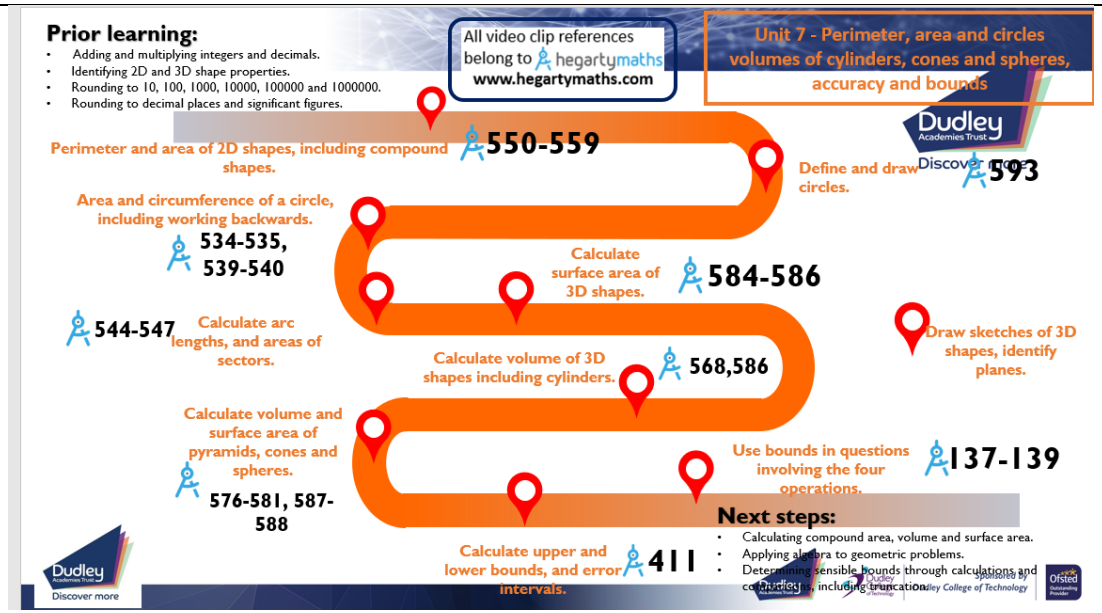
7m	**Form equations involving more complex shapes and solve these equations (D/P)**
7n	**Find the surface area of prisms using the formulae for triangles and rectangles, and other (simple) shapes with and without a diagram (D/P/C)**
7o	**Draw sketches of 3D solids (D)**
7p	Identify planes of symmetry of 3D solids, and sketch planes of symmetry **(D/P/C)**
7q	**Recall and use the formula for the volume of a cuboid or prism made from composite 3D solids using a variety of metric measures (D/P/C)**
7r	Convert between metric volume measures **(D/P)**
7s	Convert between metric measures of volume and capacity, e.g. 1 ml = 1 cm^3 **(D/P)**
7t	**Use volume to solve problems (D/P/C)**
7u	Estimating surface area, perimeter and volume by rounding measurements to 1 significant figure to check reasonableness of answers **(D/P)**
7v	**Find the volume and surface area of a cylinder (D/P)**
7w	**Recall and use the formula for volume of pyramid (D/P)**
7x	**Find the surface area of a pyramid (D/P)**
7y	**Use the formulae for volume and surface area of spheres and cones (D/P)**
7z	**Solve problems involving more complex shapes and solids, including segments of circles and frustums of cones (D/P/C)**



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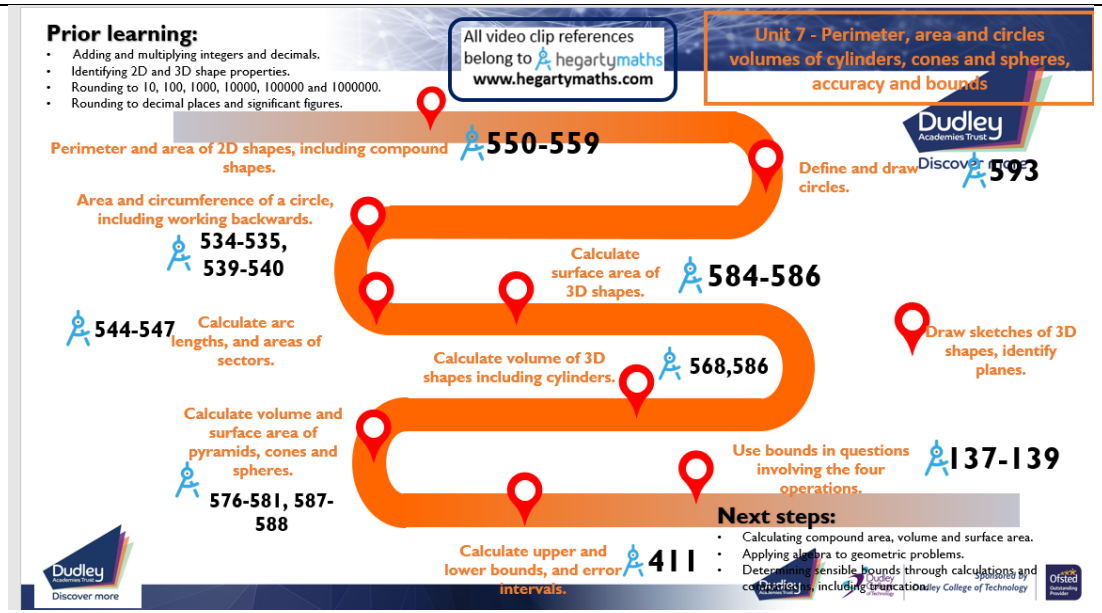
7aa	**Find the surface area and volumes of compound solids constructed from cubes, cuboids, cones, pyramids, spheres, hemispheres, cylinders, giving answers to an appropriate degree of accuracy or in terms of π (D/P/C)**	
7ab	**Calculate the upper and lowers bounds of numbers given to varying degrees of accuracy (D/P)**	
7ac	**Calculate the upper and lower bounds of an expression involving the four operations (D/P)**	
7ad	**Find the upper and lower bounds in real-life situations using measurements given to appropriate degrees of accuracy (D/P)**	
7ae	**Find the upper and lower bounds of calculations involving perimeters, areas and volumes of 2D and 3D shapes (D/P/C)**	
7af	**Calculate the upper and lower bounds of calculations, particularly when working with measurements (D/P/C)**	
7ag	**Use inequality notation to specify an error interval due to truncation or rounding (D/P/C)**	

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Essential Language polygon, area, perimeter, formula, measurement, prism	
compound, circumference, radius, diameter, composite, sphere, cone, capacity, Triangle, rectangle, area, perimeter, formula, length, width, measurement, cuboid, volume, symmetry, edge, face, circle,	
parallelogram, trapezium, polygon, nets, isometric, vertices, segment, arc, sector, cylinder, pi, hemisphere, segment, frustum, bounds, accuracy, surface area	
PREQUISITE AND GREAER DEPTH EXEMPLIFICATION • **Perimeter of triangles, quadrilaterals and polygons.** • **Area of 2D shapes and volume of 3D prisms.** • **Awareness and use of π on the calculator.**	**COMMON MISCONCEPTIONS:** Students often get the concepts of area and perimeter confused. Shapes involving missing lengths of sides often result in incorrect answers. Diameter and radius are often confused, and recollection of area and circumference of circles involves incorrect radius or diameter. Students often get the concepts of surface area and volume confused Students readily accept the rounding for lower bounds, but take some convincing in relation to upper bounds.
OPPORTUNITIES FOR REASONING/PROBLEM SOLVING: Using compound shapes or combinations of polygons that require students to subsequently interpret their result in a real-life context. Know the impact of estimating their answers and whether it is an overestimate or underestimate in relation to a given context. Multi-step problems, including the requirement to form and solve equations, provide links with other areas of mathematics. Combinations of 3D forms such as a cone and a sphere where the radius has to be calculated given the total height.	**MASTERY PEDAGOGY** **RESOURCES TO SUPPORT LEARNING:** Students should use 'half a unit above' and 'half a unit below' to find upper and lower bounds. Encourage use a number line when introducing the concept. **TRANSFERABLE SKILLS- Content in other context** **SCIENCE** EDEXCEL SCIENCE VERSION - We don't do EDEXCEL but might be useful https://qualifications.pearson.com/content/dam/pdf/GCSE/Science/2016/teaching-and-learning-materials/Guide-to-Maths-for-Scientists.pdf **Pages 44-53**

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This sub-unit provides many opportunities for students to evaluate their answers and provide counter-arguments in mathematical and real-life contexts, in addition to requiring them to understand the implications of rounding their answers. Calculate the area and/or perimeter of shapes with different units of measurement. Understand that answers in terms of π are more accurate. Calculate the perimeters and/or areas of circles, semicircles and quarter-circles given the radius or diameter and vice versa. Given dimensions of a rectangle and a pictorial representation of it when folded, work out the dimensions of the new shape. Work out the length given the area of the cross-section and volume of a cuboid. Understand that answers in terms of π are more accurate. Given two solids with the same volume and the dimensions of one, write and solve an equation in terms of π to find the dimensions of the other, e.g. a sphere is melted down to make ball bearings of a given radius, how many will it make? Round 16,000 people to the nearest 1000. Round 1100 g to 1 significant figure. Work out the upper and lower bounds of a formula where all terms are given to 1 decimal place. Be able to justify that measurements to the nearest whole unit may be inaccurate by up to one half in either direction.	AQA Science- https://filestore.aqa.org.uk/resources/science/AQA-MATHS-IN-SCIENCE-FACTSHEET-PTT.PDF Page 13 https://www.stem.org.uk/triplescience/maths AQA - first link TEACHER TRAINING IN SCIENCE https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464/planning-resources **GEOGRAPHY** EDEXCEL GEOGRAPHY LINK- https://qualifications.pearson.com/content/dam/pdf/GCSE/Geography-A/2016/teaching-and-learning-materials/Edexcel-2016-GCSE-Geography-A-B-Maths-for-Geographers.pdf **Pages 29-35**

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YEAR 10 ALGBERA & QUADRATICS ROUTE B (RECAP)

Objectives

2e	Use index notation and the index laws when multiplying or dividing algebraic terms; **(D/P/C)**
2f	Substitute positive and negative numbers into simple expressions **(D/P/C)**
2i	Factorise into a single bracket by taking out common factors (including powers) **(D/P/C)**
2d	Expand and simplify expressions with single and two brackets. Work up to expansion of triple brackets, including negatives e.g $(2x - y)(3x – 5)$ and $(5x – 3)^2$ and $(2x + 6)(3x – 4)(x – 5)$ **(D/P/C)**
2f	Find the difference of 2 squares and factorise quadratic expressions up to including expressions with a co-efficient **(D/P/C)**
2h	Rearrange formula, including cases where the subject is on both sides **(D/P/C)**
2i	Substitute into functions f(x) and work out composite functions fg(x) using correct notation. Find the inverse of a function **(D/P/C)**
2j	Calculate terms in linear sequences using the nth term. Find the nth term of a sequence. Include Fibonacci. **(D/P/C)**
2k	Calculate terms in quadratic sequences and find the nth term of a quadratic sequence. **(D/P/C)**
16a	Define a 'quadratic' expression and know the difference between an identity, expression, equation

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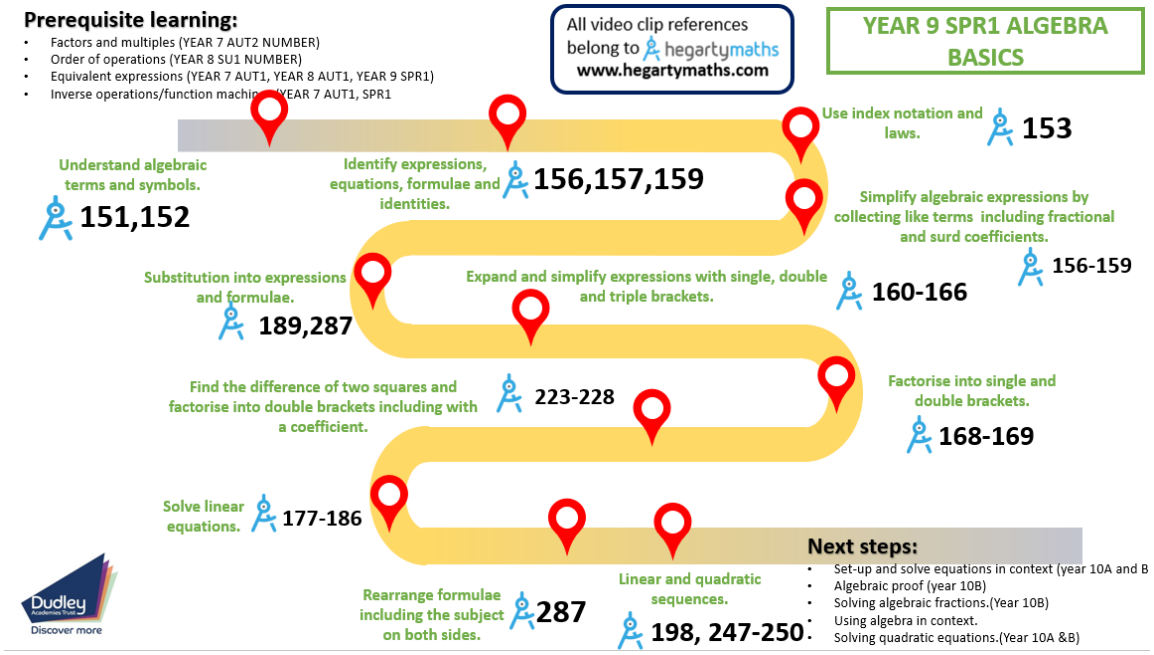

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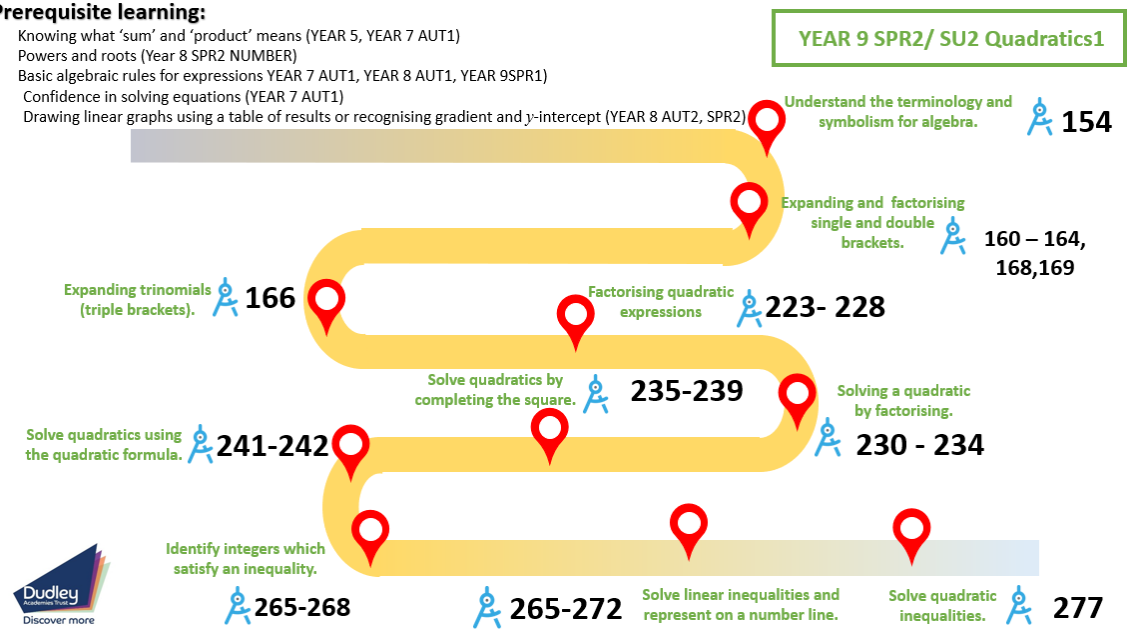
	and formula. Understand the not equal (≠) to symbol Recap from unit 2 **(D/P/C)**
16b	Recap expansion of x(x+3) etc **(D/P/C)**
16c/d	Expansion of double brackets **(D/P/C)**
16e	Square a linear expression, e.g. $(x + 1)^2$; **(D/P/C)**
16f	Factorise a linear expression **(D/P/C)**
16g	Factorise quadratic expressions of the form $x^2 + bx + c$ including those that need rearranging **(D/P/C)**
16h	Factorise a quadratic expression $x^2 – a^2$ using the difference of two squares; **(D/P/C)**
16i	Solve quadratic equations by factorising; **(D/P/C)**
16j	Generate points and plot graphs of simple quadratic functions, **(D/P/C)**
16k	Identify the line of symmetry of a quadratic graph; **(D/P/C)**
16l	Solve quadratic equations in the form $x^2 + bx + c = 0$ graphically **(D/P/C)**
16m	Identify and interpret roots, intercepts and turning points of quadratic graphs. **(D/P/C)**
9a	Recap factorising quadratic expressions in the form $ax^2 + bx + c$, including equations that need rearranging
9b	Solve quadratics by completing the square

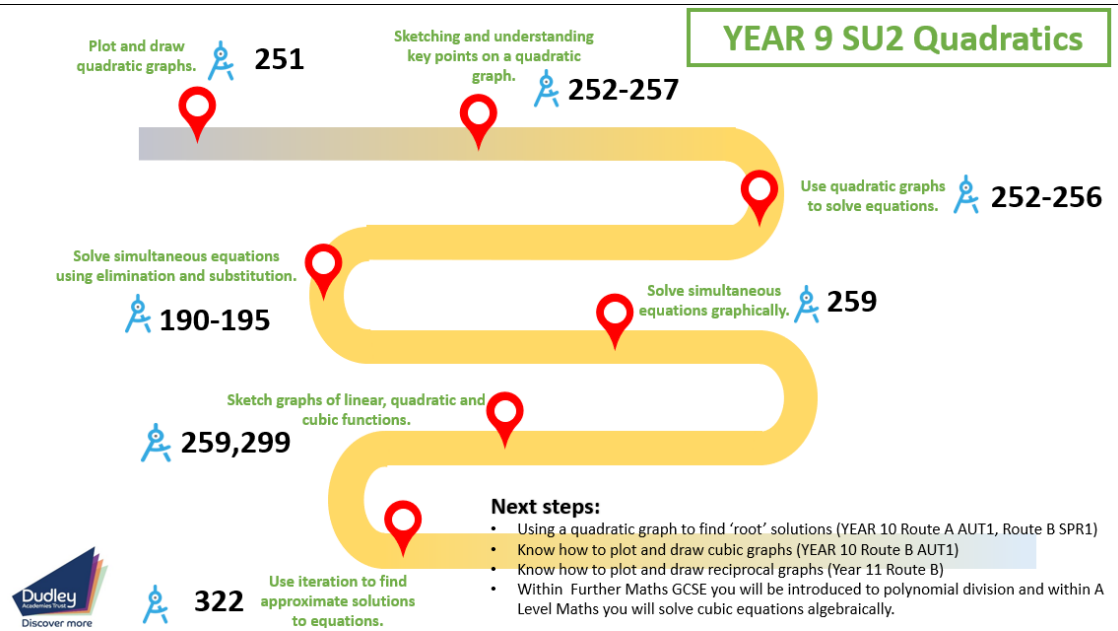
Prerequisite learning:

- Knowing what 'sum' and 'product' means (YEAR 5, YEAR 7 AUT1)
- Powers and roots (Year 8 SPR2 NUMBER)
- Basic algebraic rules for expressions YEAR 7 AUT1, YEAR 8 AUT1, YEAR 9SPR1)
- Confidence in solving equations (YEAR 7 AUT1)
- Drawing linear graphs using a table of results or recognising gradient and y-intercept (YEAR 8 AUT2, SPR2)



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

9c	Solve quadratic equations by using the quadratic formula
9d	Write down whole number values that satisfy an inequality and use the correct notation to show inclusive and exclusive inequalities.
9e	Solve linear inequalities with one unknown and unknowns on both sides and represent the solution set on a number line
9f	Solve simultaneous equations using elimination and substitution, including when both need multiplying
9g	Solve simultaneous equations when one is a quadratic
9h	Understand how to solve $x^2 + y^2 = r^2$
9i	Use iteration to find approximate solutions to equations for quadratic, cubic and higher.



Essential Language

Simplify, expand, substitute, solve, equation, estimate

formula, identity, terms, integer, fractional, index, Sketch, graphical, algebraic., function, solve, factorise, simplify, expression, graph, curve, factor, bracket, solution, root, linear, simultaneous, rearrange, function, circle, index, graph, bracket, solution,

factorise, Quadratic, cubic, function, factorising, simultaneous equation, coefficient, Quadratic, solution, root, linear, inequality, completing the square, factorise, surd, sets, union, intersection

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

PREQUISITE AND GREAER DEPTH EXEMPLIFICATION	COMMON MISCONCEPTIONS:
• **Factors and multiples.** • **Equivalent expressions** • **Inverse operations/function machines** • **Order of operations (BIDMAS).**	Any poor number skills involving negatives and times tables will become evident. $3(x + 4) = 3x + 4$. The convention of not writing a coefficient with a single value, i.e. x instead of 1x, may cause confusion. Some students may think that it is always true that a = 1, b = 2, c = 3 If a = 2 sometimes students interpret 3a as 32. Making mistakes with negatives, including the squaring of negative numbers. When expanding two linear expressions, poor number skills involving negatives and times tables will become evident. Hierarchy of operations applied in the wrong order when changing the subject of a formula.
• **Squared numbers, including integers and decimals.** • **Basic algebraic rules for expressions.** • **Knowing what 'sum' and 'product' means.** • **Confidence in solving equations.** • **Drawing linear graphs using a table of results or recognising gradient and *y*-intercept**	$a^0 = 0$. Students believe that 3xy and 5yx are different "types of term" and cannot be "collected" when simplifying expressions. Not using brackets with negative numbers on a calculator. Not writing down all the digits on the display. Students struggle to relate the position of the term to "n".
Argue mathematically that $2(x + 5) = 2x + 10$ Given a sequence, 'which is the 1st term greater than 50?	x terms are sometimes be 'collected' with x^2. Squaring negative numbers can be a problem. When squaring a linear expression, students may only square the two terms in the bracket. Emphasise the need to rewrite the expression as two brackets and then to expand. Missing out the negative sign when writing negative intercepts. It is important that students check for this mistake. Students often confuse being asked to factorise and being asked to solve. When estimating values from a graph, it is important that students understand it is an 'estimate' It is important to stress that when expanding quadratics, the x terms are also collected together. Quadratics involving negatives sometimes cause numerical errors. Using the formula involving negatives can result in incorrect answers. If students are using calculators for the quadratic formula, they can come to rely on them and miss the fact that some solutions can be left in surd form.

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

	When solving inequalities students often state their final answer as a number quantity, and exclude the inequality or change it to =. Some students believe that –6 is greater than –3. Solutions can be written as final answers in surd form. Students may not have a secure understanding of the fact that a square always has two roots. A brief class discussion can help. Students may not be clear about which set includes the value in question and which one doesn't, e.g. the difference between > 4 and ≥ 4. Some students may exchange an inequality sign for an equals sign when solving inequalities, then forget to change it back. Discourage students from changing the sign. .
OPPORTUNITIES FOR REASONING/PROBLEM SOLVING: Forming expressions and forming and solving equations using area andd perimeter of 2D shapes.Evaluate statements about whether or not specific numbers or patterns are in a sequence and justify the reasons. Be able to solve problems involving sequences from real-life situations, such as: • 1 grain of rice on first square, 2 grains on second, 4 grains on third, etc (geometric progression), or person saves £10 one week, £20 the next, £30 the next, etc; • What is the amount of money after x months saving the same amount, or the height of tree that grows 6 m per year; Visual proof of the difference of two squares.	**MASTERY PEDAGOGY** **RESOURCES TO SUPPORT LEARNING:** **TRANSFERABLE SKILLS- Content in other context** **SCIENCE** EDEXCEL SCIENCE VERSION - We don't do EDEXCEL but might be useful https://qualifications.pearson.com/content/dam/pdf/GCSE/Science/2016/teaching-and-learning-materials/Guide-to-Maths-for-Scientists.pdf **Pages 37-40** AQA Science- https://filestore.aqa.org.uk/resources/science/AQA-MATHS-IN-SCIENCE-FACTSHEET-PTT.PDF Page 4 https://www.stem.org.uk/triplescience/maths Algebra | STEM AQA - first link TEACHER TRAINING IN SCIENCE https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464/planning-resources

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Matching graphs with their respective functions. Match equations to their graphs and to real-life scenarios. "Show that"-type questions will allow students to show a logical and clear chain of reasoning. Problems that require students to set up and solve a pair of simultaneous equations in a real-life context, such as 2 adult tickets and 1 child ticket cost £28, and 1 adult ticket and 3 child tickets cost £34. How much does 1 adult ticket cost? Problems that require student to justify why certain values in a solution can be ignored.	**GEOGRAPHY** EDEXCEL GEOGRAPHY LINK- https://qualifications.pearson.com/content/dam/pdf/GCSE/Geography-A/2016/teaching-and-learning-materials/Edexcel-2016-GCSE-Geography-A-B-Maths-for-Geographers.pdf

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YEAR 10 CIRCLES ROUTE B

Objectives

16a	Recall the definition of a circle and identify (name) and draw parts of a circle, including sector, tangent, chord, segment **(D)**
16b	**Prove and use the facts that:** • **the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference** • **the angle in a semicircle is a right angle** • **the perpendicular from the centre of a circle to a chord bisects the chord** • **angles in the same segment are equal** • **alternate segment theorem** • **opposite angles of a cyclic quadrilateral sum to 180° (D/P)**
16c	**Understand and use the fact that the tangent at any point on a circle is perpendicular to the radius at that point (D)**
16d	**Find and give reasons for missing angles on diagrams using:** • **circle theorems** • **isosceles triangles (radius properties) in circles** • **the fact that the angle between a tangent and radius is 90°** • **the fact that tangents from an external point are equal in length (D/P)**
16e	**Select and apply construction techniques and understanding of loci to draw graphs based on circles and perpendiculars of lines (D/P/C)**
16f	**Find the equation of a tangent to a circle at a given point, by:** • **finding the gradient of the radius that meets the circle at that point (circles all centre the origin)** • **finding the gradient of the tangent perpendicular to it using the given point (D/P/C)**
16g	**Recognise and construct the graph of a circle using $x^2 + y^2 = r^2$ for radius r centred at the origin of coordinates. (D/P/C)**

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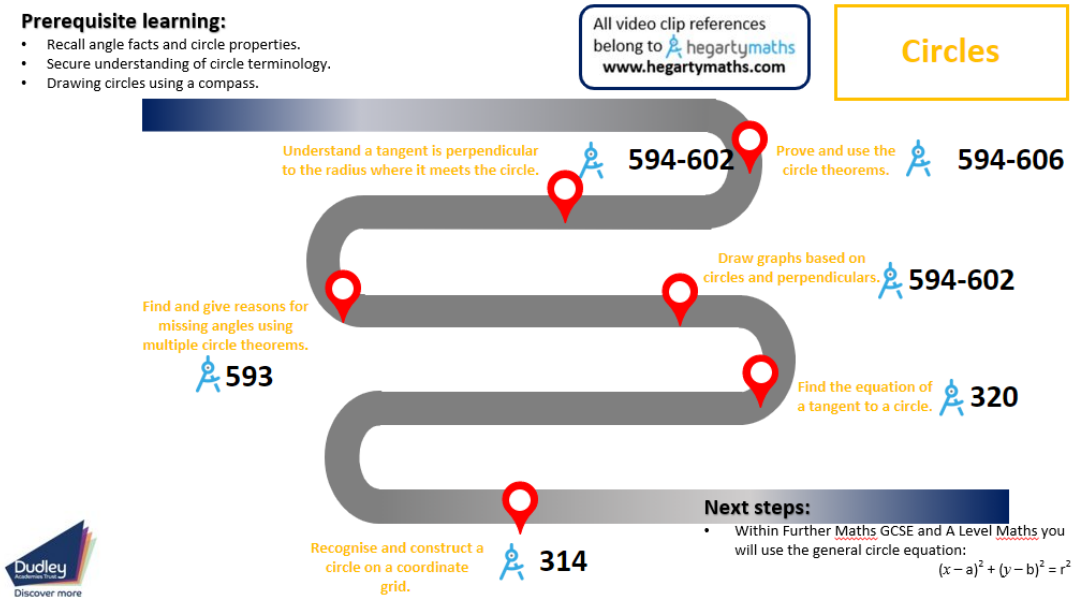

D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language circle, coordinate, equation, substitution, angles, degrees,	
Radius, circumference, diameter, gradient, isosceles, triangle, centre,	
tangent, perpendicular, reciprocal, chord, cyclic quadrilateral, alternate, segment, semicircle, arc, theorem	
PREQUISITE AND GREAER DEPTH EXEMPLIFICATION • **Recall angle facts and circle properties.** • **Secure understanding of circle terminology.** • **Drawing circles using a compass.**	**COMMON MISCONCEPTIONS:** • Much of the confusion arises from mixing up the diameter and the radius. • Students find it difficult working with negative reciprocals of fractions and negative fractions.
OPPORTUNITIES FOR REASONING/PROBLEM SOLVING: Problems that involve a clear chain of reasoning and provide counter-arguments to statements. Can be linked to other areas of mathematics by incorporating trigonometry and Pythagoras' Theorem. Justify if a straight-line graph would pass through a circle drawn on a coordinate grid. Justify clearly missing angles on diagrams using the various circle theorems. Find the gradient of a radius of a circle drawn on a coordinate grid and relate this to the gradient of the tangent. Justify the relationship between the gradient of a tangent and the radius. Produce an equation of a line given a gradient and a coordinate.	**MASTERY PEDAGOGY** **RESOURCES TO SUPPORT LEARNING:** **TRANSFERABLE SKILLS- Content in other context** **SCIENCE** EDEXCEL SCIENCE VERSION - We don't do EDEXCEL but might be useful https://qualifications.pearson.com/content/dam/pdf/GCSE/Science/2016/teaching-and-learning-materials/Guide-to-Maths-for-Scientists.pdf AQA Science- https://filestore.aqa.org.uk/resources/science/AQA-MATHS-IN-SCIENCE-FACTSHEET-PTT.PDF https://www.stem.org.uk/triplescience/maths AQA - first link TEACHER TRAINING IN SCIENCE https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464/planning-resources **GEOGRAPHY** EDEXCEL GEOGRAPHY LINK- https://qualifications.pearson.com/content/dam/pdf/GCSE/Geography-A/2016/teaching-and-learning-materials/Edexcel-2016-GCSE-Geography-A-B-Maths-for-Geographers.pdf

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YEAR 10 TRANSFORMATIONS (ROUTE B)

Objectives

8a	Distinguish properties that are preserved under particular transformations **(D)**
8b	**Recognise and describe rotations – know that that they are specified by a centre and an angle (D/P)**
8c	**Rotate 2D shapes using the origin or any other point (not necessarily on a coordinate grid) (D/P)**
8d	Identify the equation of a line of symmetry **(D/P)**
8e	**Recognise and describe reflections on a coordinate grid – know to include the mirror line as a simple algebraic equation, $x = a$, $y = a$, $y = x$, $y = -x$ and lines not parallel to the axes (D/P)**
8f	**Reflect 2D shapes using specified mirror lines including lines parallel to the axes and also $y = x$ and $y = -x$; (D/P)**
8g	**Recognise and describe single translations using column vectors on a coordinate grid (D/P)**
8h	**Translate a given shape by a vector (D/P)**
8i	Understand the effect of one translation followed by another, in terms of column vectors (to introduce vectors in a concrete way) **(D/P/C)**
8j	Enlarge a shape on a grid without a centre specified **(D/P)**
8k	**Describe and transform 2D shapes using enlargements by a positive integer, positive fractional, and negative scale factor (D/P)**

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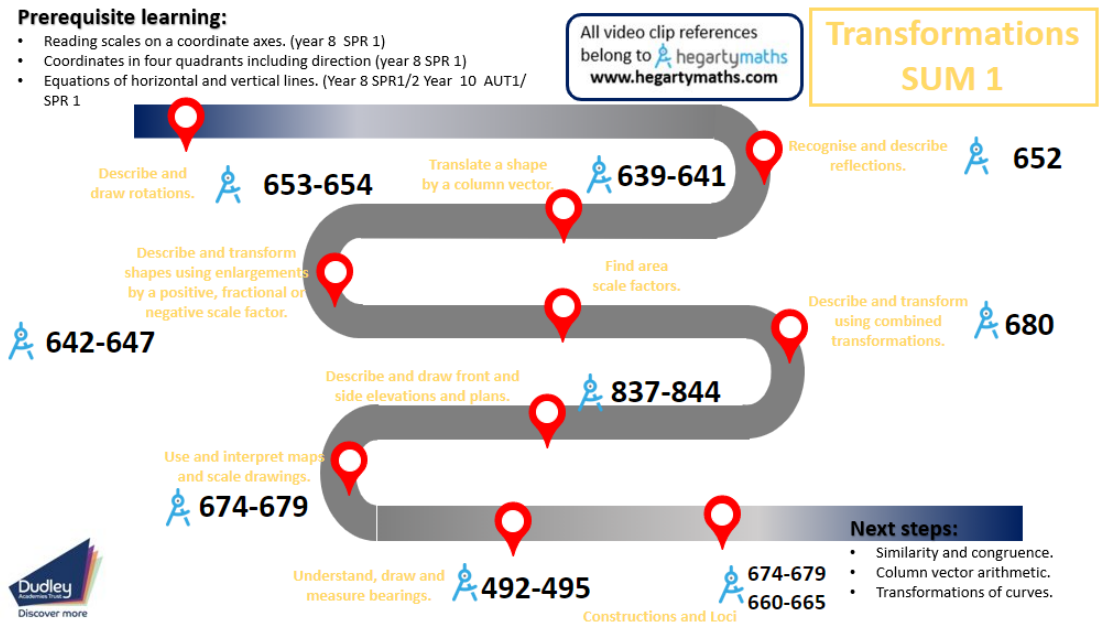
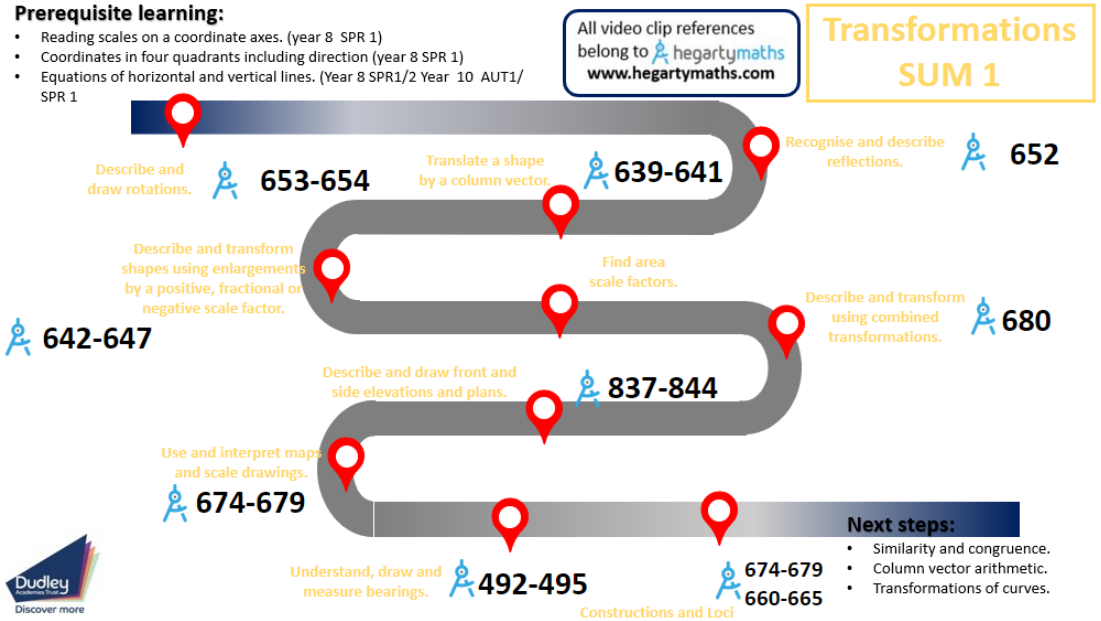


D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

8l	Know that an enlargement on a grid is specified by a centre and a scale factor **(D)**
8m	Identify the scale factor of an enlargement of a shape **(P)**
8n	**Enlarge a given shape using a given centre as the centre of enlargement by counting distances from centre, and find the centre of enlargement by drawing (D/P)**
8o	**Find areas after enlargement and compare with before enlargement, to deduce multiplicative relationship (area scale factor); given the areas of two shapes, one an enlargement of the other, find the scale factor of the enlargement (whole number values only) (D/P/C)**
8p	Use congruence to show that translations, rotations and reflections preserve length and angle, so that any figure is congruent to its image under any of these transformations **(D/P/C)**
8q	**Describe and transform 2D shapes using combined rotations, reflections, translations, or enlargements (D/P/C)**
8r	Describe the changes and invariance achieved by combinations of rotations, reflections and translations. **(D/P)**
8s	**Understand and draw front and side elevations and plans of shapes made from simple solids (D/P)**
8t	**Given the front and side elevations and the plan of a solid, draw a sketch of the 3D solid (D/P)**
8u	**Use and interpret maps and scale drawings, using a variety of scales and units (D/P)**
8v	**Read and construct scale drawings, drawing lines and shapes to scale (D/P/C)**



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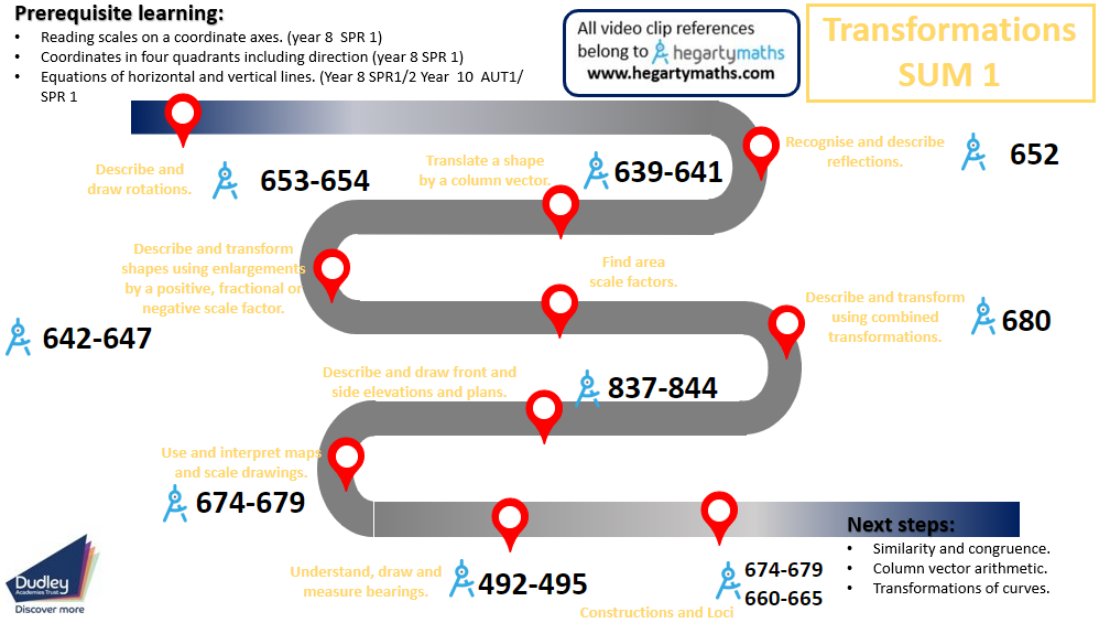
8w	Estimate lengths using a scale diagram **(D/P/C)**
8x	**Understand, draw and measure bearings (D/P)**
8y	Calculate bearings and solve bearings problems, including on scaled maps, and find/mark and measure bearings **(D/P/C)**
8z	**Use the standard ruler and compass constructions:** ➢ **bisect a given angle** ➢ **construct a perpendicular to a given line from/at a given point** ➢ **construct angles of 90°, 45°** ➢ **perpendicular bisector of a line segment (D/P/C)**
8aa	• **Construct:** ➢ **a region bounded by a circle and an intersecting line** ➢ **a given distance from a point and a given distance from a line** ➢ **equal distances from two points or two line segments** ➢ **regions which may be defined by 'nearer to' or 'greater than' (D/P/C)**
8ab	**Find and describe regions satisfying a combination of loci, including in 3D (D/P)**
8ac	Use constructions to solve loci problems including with bearings **(D/P/C)**
8ad	Know that the perpendicular distance from a point to a line is the shortest distance to the line **(D)**



D= Declarative knowledge, P= Procedural knowledge, C= Contextual knowledge

Essential Language centre, angle, direction, describe, similar, single,	
mirror line, combinations, compasses, protractor, distance	
Rotation, reflection, translation, transformation, enlargement, scale factor, vector, centre of enlargement, congruence, corresponding, constructions, bisector, bisect, line segment, perpendicular, loci, bearing	
PREQUISITE AND GREAER DEPTH EXEMPLIFICATION • **Reading scales on a coordinate axes.** • **Coordinates in four quadrants including direction.** • **Equations of horizontal and vertical lines.**	**COMMON MISCONCEPTIONS:** **Students often use the term 'transformation' when describing transformations instead of the required information.** Lines parallel to the coordinate axes often get confused. Correct use of a protractor may be an issue. Emphasise the need to describe the transformations fully, and if asked to describe a 'single' transformation students should not include two types. Find the centre of rotation, by trial and error and by using tracing paper. Include centres on or inside shapes. Drawings should be done in pencil. **Construction lines should not be erased.**
OPPORTUNITIES FOR REASONING/PROBLEM SOLVING: Students should be given the opportunity to explore the effect of reflecting in two parallel mirror lines and combining transformations. Interpret a given plan and side view of a 3D form to be able to produce a sketch of the form.	**MASTERY PEDAGOGY** **RESOURCES TO SUPPORT LEARNING:** **TRANSFERABLE SKILLS- Content in other context** **SCIENCE**

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Problems involving combinations of bearings and loci can provide a rich opportunity to link with other areas of mathematics and allow students to justify their findings Recognise similar shapes because they have equal corresponding angles and/or sides scaled up in same ratio. Understand that translations are specified by a distance and direction (using a vector). Recognise that enlargements preserve angle but not length. Understand that distances and angles are preserved under rotations, reflections and translations so that any shape is congruent to its image. Understand that similar shapes are enlargements of each other and angles are preserved. Able to read and construct scale drawings. When given the bearing of a point A from point B, can work out the bearing of B from A. Know that scale diagrams, including bearings and maps, are 'similar' to the real-life examples. Able to sketch the locus of point on a vertex of a rotating shape as it moves along a line, of a point on the circumference and at the centre of a wheel.	EDEXCEL SCIENCE VERSION - We don't do EDEXCEL but might be useful https://qualifications.pearson.com/content/dam/pdf/GCSE/Science/2016/teaching-and-learning-materials/Guide-to-Maths-for-Scientists.pdf AQA Science- https://filestore.aqa.org.uk/resources/science/AQA-MATHS-IN-SCIENCE-FACTSHEET-PTT.PDF https://www.stem.org.uk/triplescience/maths AQA - first link TEACHER TRAINING IN SCIENCE https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464/planning-resources **GEOGRAPHY** EDEXCEL GEOGRAPHY LINK- https://qualifications.pearson.com/content/dam/pdf/GCSE/Geography-A/2016/teaching-and-learning-materials/Edexcel-2016-GCSE-Geography-A-B-Maths-for-Geographers.pdf

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YEAR 1O EQUATIONS and GRAPHS ROUTE B Quadratics

Objectives

15a	Sketch a graph of a quadratic function, by factorising or by using the formula, identifying roots, *y*-intercept and turning point by completing the square **(D/P)**
15b	Be able to identify from a graph if a quadratic equation has any real roots **(D/P/C)**
15c	**Find approximate solutions to quadratic equations using a graph (D/P/C)**
15d	**Expand the product of more than two linear expressions (D/P)**
15e	Sketch a graph of a quadratic function and a linear function, identifying intersection points **(D/P/C)**
15f	Sketch graphs of simple cubic functions, given as three linear expressions **(D/P/C)**
15g	**Solve simultaneous equations graphically:** ➢ **find approximate solutions to simultaneous equations formed from one linear function and one quadratic function using a graphical approach** ➢ **find graphically the intersection points of a given straight line with a circle** ➢ **solve simultaneous equations representing a real-life situation graphically, and interpret the solution in the context of the problem (D/P/C)**
15h	**Solve quadratic inequalities in one variable, by factorising and sketching the graph to find critical values (D/P/C)**
15i	**Represent the solution set for inequalities using set notation,**

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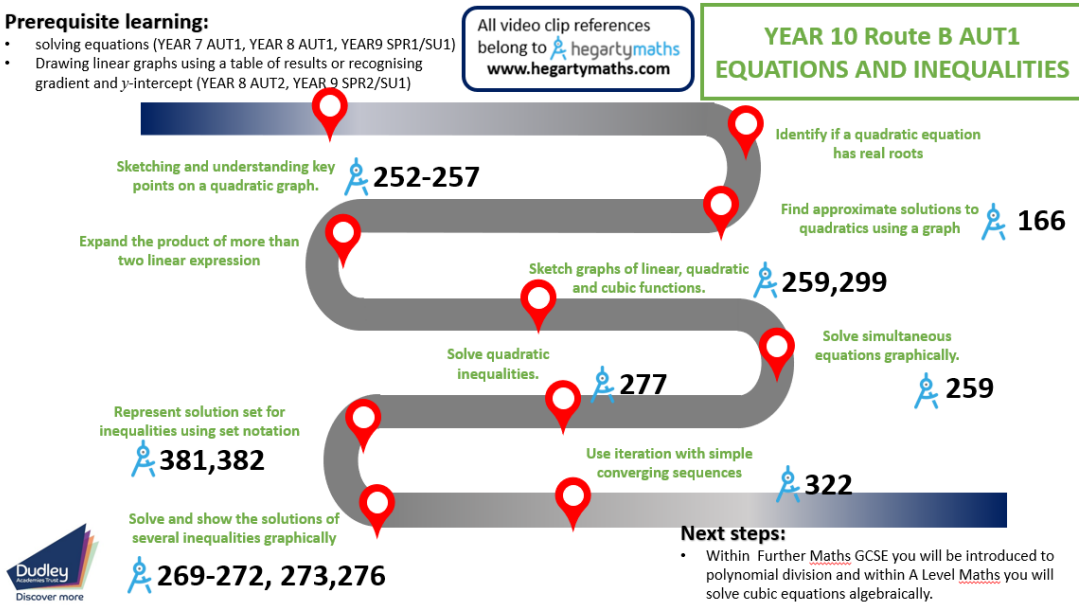

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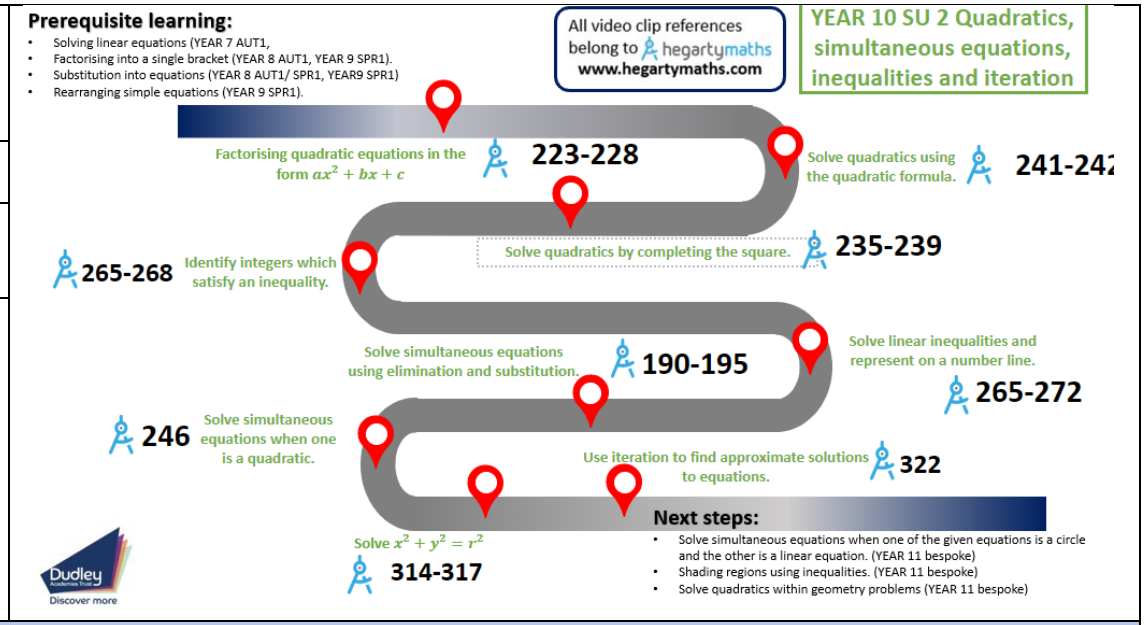
	i.e. curly brackets and 'is an element of' notation for problems identifying the solutions to two different inequalities, show this as the intersection of the two solution sets, i.e. solution of $x^2 - 3x - 10 < 0$ as $\{x: -3 < x < 5\}$ (D/P/C)	
15j	**Solve linear inequalities in two variables graphically (D/P/C)**	
15k	Show the solution set of several inequalities in two variables on a graph **(D/P/C)**	
15l	**Use iteration with simple converging sequences (D/P)**	

Essential Language

Sketch, estimate, graph, function, linear, factorise

graphical, algebraic. inequalities

quadratic, cubic, factorising, simultaneous equation, iteration

PREQUISITE AND GREAER DEPTH EXEMPLIFICATION	**COMMON MISCONCEPTIONS:**
• **Confidence in solving equations.** • **Drawing linear graphs using a table of results or recognising gradient and *y*-intercept.** • **Effective use of calculator**	When estimating values from a graph, it is important that students understand it is an 'estimate'. It is important to stress that when expanding quadratics, the *x* terms are also collected together.

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	Quadratics involving negatives sometimes cause numerical errors.
OPPORTUNITIES FOR REASONING/PROBLEM SOLVING: Match equations to their graphs and to real-life scenarios. "Show that"-type questions will allow students to show a logical and clear chain of reasoning. Expand $x(x – 1)(x + 2)$. Expand $(x – 1)^3$. Expand $(x + 1)(x + 2)(x – 1)$. Sketch $y = (x + 1)2(x – 2)$. Interpret a pair of simultaneous equations as a pair of straight lines and their solution as the point of intersection. Be able to state the solution set of $x^2 – 3x – 10 < 0$ as $\{x: x < -3\}$ $\{x: x > 5\}$.	**MASTERY PEDAGOGY** **RESOURCES TO SUPPORT LEARNING:** **TRANSFERABLE SKILLS- Content in other context** **SCIENCE** EDEXCEL SCIENCE VERSION - We don't do EDEXCEL but might be useful https://qualifications.pearson.com/content/dam/pdf/GCSE/Science/2016/teaching-and-learning-materials/Guide-to-Maths-for-Scientists.pdf AQA Science- https://filestore.aqa.org.uk/resources/science/AQA-MATHS-IN-SCIENCE-FACTSHEET-PTT.PDF https://www.stem.org.uk/triplescience/maths AQA - first link TEACHER TRAINING IN SCIENCE https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464/planning-resources **GEOGRAPHY** EDEXCEL GEOGRAPHY LINK- https://qualifications.pearson.com/content/dam/pdf/GCSE/Geography-A/2016/teaching-and-learning-materials/Edexcel-2016-GCSE-Geography-A-B-Maths-for-Geographers.pdf

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