Maths – Year 9

Knowledge Organisers

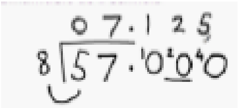
9.01 – 9.18

Links: Mathematical proof, number theory, if/then functions in Computing.

Place value and number properties – Key Vocabulary		
1	Integers	Whole numbers such as -2, -1, 0, 1, 2, 3…..
2	Even numbers	Numbers which can be divided by 2. All numbers ending in 0, 2, 4, 6, 8 are even.
3	Odd numbers	Numbers which cannot be divided by 2 without a remainder. All numbers that end in 1, 3, 5, 7, 9 are odd numbers.
4	Negative numbers	All numbers less than 0 are negative numbers such as -1, -10, -35
5	Decimal numbers	Numbers which go beyond the decimal point and may contain tenths, hundredths, thousandths etc.
6	>	Is greater than sign. Means that whatever is on the left of the sign is greater than what is on the right e.g. 5 > 2.
7	<	Is less than sign. Means that whatever is on the left of the sign is less than what is on the right e.g. 7 < 10.
8	≥	Is greater than or equal to sign. Means that whatever is on the left of the sign is greater than or equal to what is on the right e.g. 8 ≥ 8.
9	≤	Is less than or equal to sign. Means that whatever is on the left of the sign is less than or equal to what is on the right of the sign e.g. 10 ≤ 10.
10	≠	Is not equal sign. Means that whatever is on the right of the sign is not equal to what is on the left of the sign e.g. 4 ≠ 9.
Place value and number properties - Skills		
11	Positive x/÷ Positive = Positive	10 x 2 = 20
12	Positive x/÷ Negative = Negative	40 ÷ - 4 = -10
13	Negative x/÷ Positive = Negative	– 60 ÷ 5 = -12
14	Negative x/÷ Negative = Positive	– 3 x – 5 = 15
15	Adding a minus is a subtraction	10 + - 4 = 6
16	Subtracting a positive is a subtraction	20 - + 5 = 15
17	Double subtraction becomes an addition	30 - - 10 = 40
18	Even + Even = Even	10 + 20 = 30
19	Even + Odd = Odd	6 + 3 = 9
20	Odd + Odd = Even	11 + 13 = 24
21	Even x Even = Even	6 x 10 = 60
22	Odd x Odd = Odd	5 x 3 = 15
23	Even x Odd = Even	2 x 13 = 130

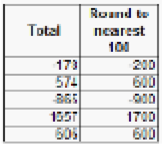
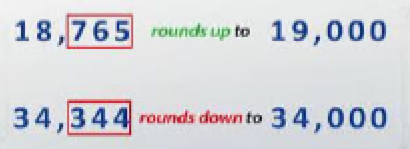
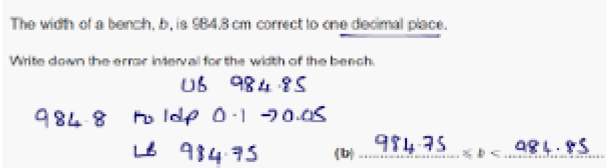
Y9 Maths Knowledge Organiser – Unit 9.02

Links: fundamental to all Maths and many Science, Business and Computing problems.

Four rules (decimals) – Key Vocabulary		
1	Decimal numbers	Numbers which go beyond the decimal point and may contain tenths, hundredths, thousandths etc.
2	Decimal point	A **point** (small dot) used to separate the whole number part from the fractional part of a number. Example: in the number 36.9 the **point** separates the 36 (the whole number part) from the 9 (the fractional part, which really means 9 tenths).
3	Integer	A whole number.
4	Evaluate	To calculate the value of
5	Dividend	The number being divided
6	Divisor	The number doing the dividing
7	Fraction	A number that represents a part of a whole. It consists of a numerator and a denominator.
8	Equivalent fraction	A fraction with different numerators and denominators that represent the same value or proportion of the whole.
9	Recurring decimal	A number which keeps repeating forever after the decimal point. A recurring decimal is represented by placing a dot above the number or numbers that repeat. All recurring decimals can be represented as fractions.
10	BIDMAS	The order in which calculations are solved (operations)
Four rules (decimals) - Skills		
11	Adding decimals	Line the decimal points up and add the columns 0.867 + 0.113 0.970 1
12	Subtracting decimals	Line the decimal points up and subtract the columns 
13	Multiplying decimals	Remove the decimal points, carry out the calculation and then count the same number of places back in the answer as there are numbers behind the decimal point in the question. 0.2 x .0.5 2 x 5 = 10 0.2 x 0.5 = 0.10
14	Dividing a decimal by an integer	Make sure the decimal point stays in the same place in the answer as it is in the dividend 
15	Dividing a decimal by a decimal	Make the divider a whole number by multiplying by 10 or 100 or 1000, do the same to the dividend and carry out the division as normal.
16	BIDMAS	Brackets, Indices, Division, Multiplication, Addition, Subtraction

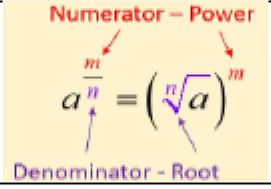
Y9 Maths Knowledge Organiser – Unit 9.03

Links: Accuracy, upper and lower bounds, problems with unknown quantities.

Rounding and estimation – Key Vocabulary		
1	Rounding	To alter (a number) to one less exact but more convenient for calculations. "we'll round the weight up to the nearest kilo".
2	Estimation	A rough calculation of the value, number, quantity, or extent of something.
3	Significant figure	Each of the digits of a number that are used to express it to the required degree of accuracy, starting from the first non-zero digit.
4	One step calculation	A calculation that involves only one step to get to the answer
5	Two step calculation	A calculation that involves two steps to get to the answer
7	Error interval	An error interval is the range of values that a number could have taken before being rounded .They are usually written as a range using inequalities, with a lower bound and an upper bound.
8	Accuracy	The degree to which the result of a measurement or calculation, conforms to the correct value or a standard.
9	Limits of accuracy	When a number is rounded, there is a group of measurements that the original number may be between called the limits of accuracy.
10	Upper bound	The biggest number that could be rounded to a specific number
11	Lower bound	The smallest number that could be rounded to a specific number
Rounding and estimation - Skills		
12	Rounding to the nearest 10	738 → 740 If the digit in the ones place is: 5 or higher, round the tens place up 4 or lower, leave the tens place as is. Digits in the other places don't matter 293 → 290
13	Rounding to the nearest 100 and 1000	 Total | Round to nearest 100 173 | 200 574 | 600 865 | 900 1657 | 1700 606 | 600  18,765 rounds up to 19,000 34,344 rounds down to 34,000
14	Estimation and bounds	 The width of a bench, *b*, is 984.8 cm correct to one decimal place. Write down the error interval for the width of the bench. UB 984.85 984.8 to 1dp 0.1 → 0.05 LB 984.75 (b) 984.75 ≤ *b* < 984.85
15	Rounding to 1 decimal place	 To round 7.63 to 1 decimal place 7.63 3 is less than 5 (half way) so round down 7.63 rounded to 1 decimal place is 7.6 To round 16.79 to 1 decimal place 16.79 9 is greater than 5 (half way) so round up 16.79 rounded to 1 decimal place is 16.8

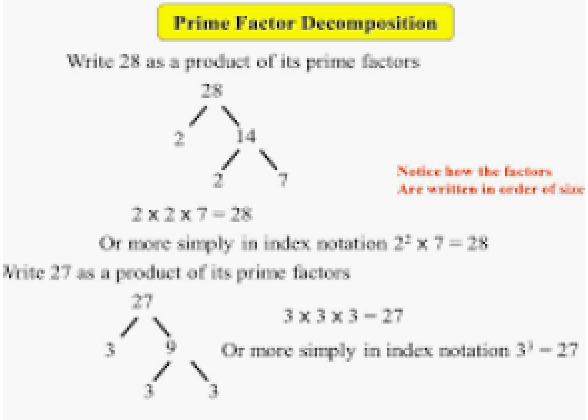
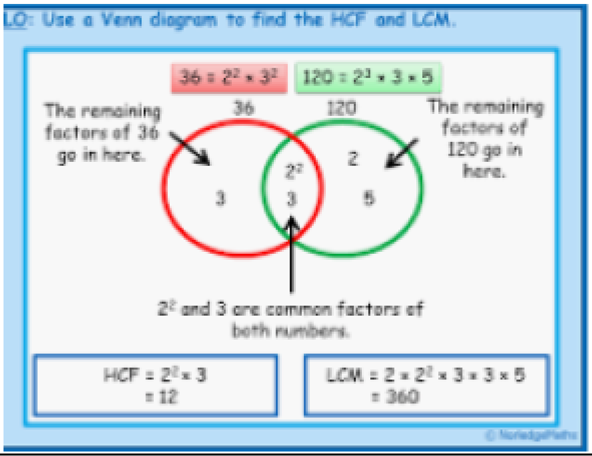
Y9 Maths Knowledge Organiser – Unit 9.04

Links: Compound interest and rates of change. Population growth and decay. Standard form.

Indices, powers and roots – Key Vocabulary		
1	Indices and powers	An index number is a number which is raised to a power. The power, also known as the index, tells you how many times you have to multiply the number by itself.
2	Roots	The root of a number x is another number, which when multiplied by itself a given number of times, equals x. For example the second root of 9 is 3, because 3x3 = 9. The second root is usually called the square root. The third root is usually called the cube root.
3	$\sqrt{}$	The square root of the number (can be positive or negative)
4	Reciprocal	An expression or function so related to another that their product is unity; the quantity obtained by dividing the number one by a given quantity.
5	Index Laws	The rules for simplifying expressions involving powers of the same base number.
7	x^2	The number 2 is the index / power
8	Fractional indices	The denominator of the fraction is the root of the number or letter, and the numerator of the fraction is the power to raise the answer to.
9	Estimating a root	When a number is rounded, there is a group of measurements that the original number may be between called the limits of accuracy.
10	$\sqrt[3]{X}$	A cubed root. The number 3 is the index.
Indices, powers and roots - Skills		
11	Estimating a root	What is square root of 20? You can start out by noting that since √16 = 4 and √25 = 5, then √20 must be between 4 and 5.
12	2^2	2 x 2 = 4
13	2^3	2 x 2 x 2 = 8
14	2^4	2 x 2 x 2 x 2 = 16
15	2^5	2 x 2 x 2 x 2 x 2 = 32
16	Index Laws	The rules: $a^m \times a^n = a^{m+n}$ $a^m \div a^n = a^{m-n}$ $(a^m)^n = a^{m \times n}$
17	Reciprocal of 8	$\frac{1}{8}$
18	$\sqrt{49}$	As 7 x 7 = 49, the square root of 49 must be 7.
19	$\sqrt[3]{27}$	As 3 x 3 x 3 = 27, the cubed root of 27 must be 3.
20	To calculate with fractional indices	 $a^{\frac{m}{n}} = \left(\sqrt[n]{a}\right)^m$ *Examples:* $8^{\frac{1}{3}} = \sqrt[3]{8} = 2$ $25^{\frac{3}{2}} = \left(\sqrt[2]{25}\right)^3 = 5^3 = 125$

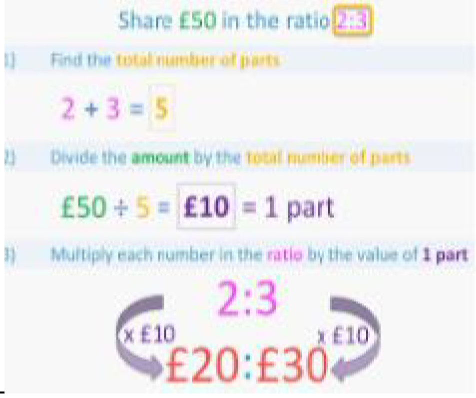
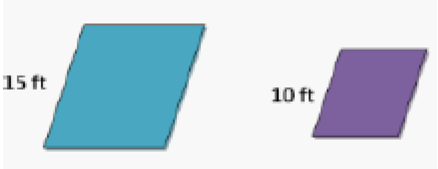
Y9 Maths Knowledge Organiser – Unit 9.05

Links: Factorising, sequences, divisibility of numbers and formal proof of these at A-Level.

Factors, multiples and primes – Key Vocabulary		
1	Factors	Factors are whole numbers that are multiplied together to produce another number.
2	Multiples	Numbers that may be divided by another a certain number of times without a remainder.
3	Prime numbers	A prime number is a whole number greater than 1 whose only factors are 1 and itself.
4	Prime factor decomposition	Prime factor decomposition of a number means writing it as a product of prime factors.
5	LCM	The lowest common multiple of two integers a and b, is the smallest positive integer that is divisible by both a and b.
6	HCF	The highest common factor of two integers is the largest whole number that divides both numbers without leaving a remainder. For example, the HCF of 16 and 24 is 8.
Factors, multiples and primes - Skills		
7	Factors of 24	1,2,3,4,6,8,12,24 You can divide 24 by all these numbers without a remainder.
8	Multiples of 12	12, 24, 36, 48, 60………… (1x12 = 12, 2x12 =24, 3x12 = 36, 4x12 = 48, 5x12 = 60)
9	Prime numbers	2,3,5,7,11,13,17,19 All these numbers have only 2 factors, 1 and itself
10	Prime factor decomposition	
11	LCM & HCF	

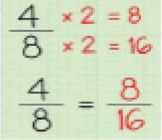
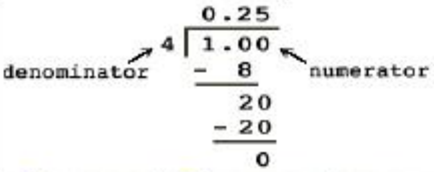
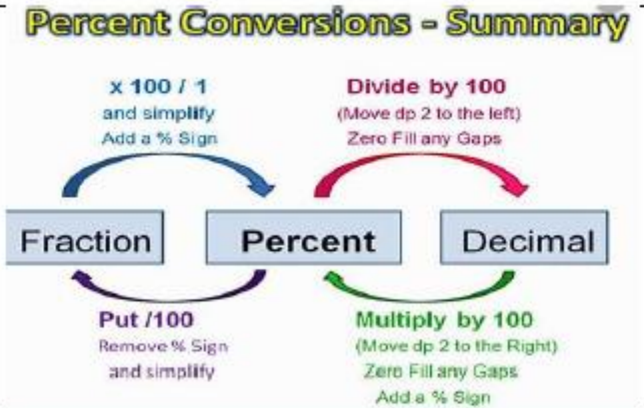
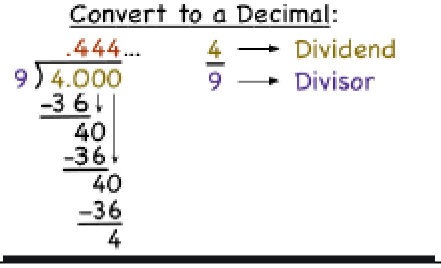
Y9 Maths Knowledge Organiser – Unit 9.06

Links: compound measures, gradients, recipe questions.

Ratio – Key Vocabulary		
1	Ratio	A ratio is a relationship between two numbers indicating how many times the first number contains the second.
2	Simplifying	To make something less complicated and therefore easier to do or understand
3	Scale factors	A scale factor is a number which scales, or multiplies, some quantity.
4	Compare	Estimate, measure, or note the similarity or dissimilarity between a set of values.
5	1:n	A way of showing the value in a ratio of 1 part of the other value.
Ratio - Skills		
6	Writing ratios in the form 1:n	To write a ratio in the form 1: n, divide both sides by the left-hand number. For example, with the ratio 4 : 10 you would divide both sides by 4, giving the equivalent ratio 1 : 2.5
7	Putting numbers into ratio notation and simplifying	For example, if a bowl of fruit contains eight oranges and six lemons, then the ratio of oranges to lemons is eight to six (that is, 8:6, which is equivalent to the ratio 4:3).
8	Dividing a quantity in a given ratio	 Share £50 in the ratio 2:3 1) Find the total number of parts 2 + 3 = 5 2) Divide the amount by the total number of parts £50 ÷ 5 = £10 = 1 part 3) Multiply each number in the ratio by the value of 1 part 2:3 x £10 x £10 £20:£30
9	Writing a ratio as a fraction	In a bag there are 3 red buttons, 4 green buttons and 2 yellow buttons. R : G : Y 3 : 4 : 2 3 + 4 + 2 = 9 R = 3/9 = 1/3 G = 4/9 Y = 2/9
10	Using scale factors in ratio	In two similar geometric figures, the ratio of their corresponding sides is called the scale factor. To find the scale factor, locate two corresponding sides, one on each figure. Write the ratio of one length to the other to find the scale factor from one figure to the other.  The scale factor between the parallelograms is 15:10 or 3:2.

Y9 Maths Knowledge Organiser – Unit 9.07

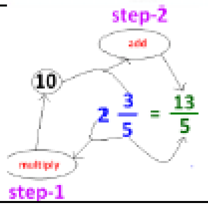
Links: Mathematical proof, number theory, if/then functions in Computing.

Fractions, decimals and percentages – Key Vocabulary		
1	Fraction	Fractions are a way of showing numbers that are parts of a whole.
2	Decimals	A decimal is a way of writing a number that is not whole. Decimal numbers are 'in between' numbers. For example, 10.4 is in between the numbers 10 and 11. It is more than 10, but less than 11.
3	Percentages	A percent is a ratio whose second term is 100. Percent means parts per hundred. The word comes from the Latin phrase per centum, which means per hundred. In mathematics, we use the symbol % for percent.
4	Equivalent fractions	Equivalent fractions can be defined as fractions with different numerators and denominators that represent the same value or proportion of the whole.
5	Converting	To change the form, character, or function of something.
6	Ascending	To put numbers in order, place them from lowest (first) to highest (last).
7	Descending	To put numbers in order, place them from highest (first) to lowest (last).
8	Recurring decimals	A recurring decimal is a number which keeps repeating forever after the decimal point. Denoted by a dot placed above the numbers that repeat e.g 1.3333333333333 = 1.3
Fractions, decimals and percentages - Skills		
9	Equivalent fractions	 Multiply or divide both numerator and denominator by the same number to find and equivalent fraction.
10	Converting fractions to decimals	
11	Converting fractions, percentages and decimals	
12	Converting fractions to recurring decimals	

Y9Maths Knowledge Organiser – Unit 9.08

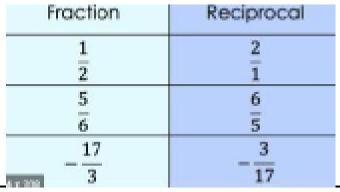
Links: Mathematical proof, number theory, if/then functions in Computing.

<table>
<tr><th colspan="3">Fractions– Key Vocabulary</th></tr>
<tr><td>1</td><td>Fractions</td><td>Fractions are a way of showing numbers that are parts of a whole.</td></tr>
<tr><td>2</td><td>Mixed numbers</td><td>A mixed number is a combination of a whole number and a fraction. For example, if you have two whole apples and one half apple, you could describe this as 2 + ¹/2 apples, or 2¹/2 apples.</td></tr>
<tr><td>3</td><td>Simplify / cancelling fractions</td><td>In order to simplify a fraction there must be a number that will divide evenly into both the numerator and denominator so it can be reduced.</td></tr>
<tr><td>4</td><td>Improper or top heavy fractions</td><td>An Improper Fraction has a top number larger than (or equal to) the bottom number.</td></tr>
<tr><td>5</td><td>Ratio</td><td>A ratio is a relationship between two numbers indicating how many times the first number contains the second. For example, if a bowl of fruit contains eight oranges and six lemons, then the ratio of oranges to lemons is eight to six (that is, 8:6, which is equivalent to the ratio 4:3).</td></tr>
<tr><td>6</td><td>Reciprocal</td><td>The reciprocal of a number is 1 divided by that number. So, for example, the reciprocal of 3 is 1 divided by 3, which is 1/3. A reciprocal is also a number taken to the power of -1. So, 1/8 is the same as 8 to the power of -1.</td></tr>
<tr><td>7</td><td>Integer</td><td>An integer (pronounced IN-tuh-jer) is a whole number (not a fractional number) that can be positive, negative, or zero. Examples of integers are: -5, 1, 5, 8, 97, and 3,043.</td></tr>
<tr><td>8</td><td>Decimal</td><td>A decimal number is often used to mean a number that uses a decimal point followed by digits that show a value smaller than one.</td></tr>
<tr><th colspan="3">Fractions - Skills</th></tr>
<tr><td>9</td><td>Adding and subtracting fractions with different denominators</td><td>You need the fractions to have the same denominators to add and subtract. To do this you can put them into equivalent fractions.

$$\frac{3}{4} + \frac{1}{3} = \frac{3 \times 3}{4 \times 3} + \frac{1 \times 4}{3 \times 4}$$
$$= \frac{9}{12} + \frac{4}{12}$$
$$= \frac{13}{12} = 1\frac{1}{12}$$</td></tr>
<tr><td>10</td><td>Converting from mixed numbers to improper fractions</td><td>
</td></tr>
<tr><td>11</td><td>Fraction of an amount</td><td>To work out the fraction of an amount, divide by the denominator and multiply by the numerator

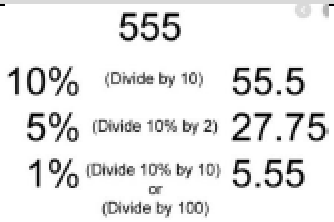
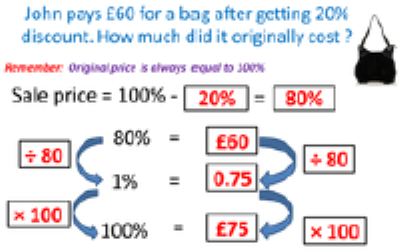
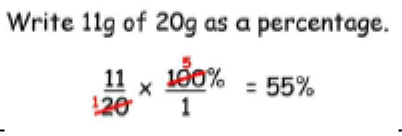
E.g
$\frac{3}{5}$ of 15 = 9

because 15 ÷ 5 = 3
3 x 3 = 9</td></tr>
<tr><td>12</td><td>Reciprocal of a fraction</td><td>The reciprocal of a fractions is 1 over the fractions, which flips it


<table>
<tr><th>Fraction</th><th>Reciprocal</th></tr>
<tr><td>$\frac{1}{2}$</td><td>$\frac{2}{1}$</td></tr>
<tr><td>$\frac{5}{6}$</td><td>$\frac{6}{5}$</td></tr>
<tr><td>$-\frac{17}{3}$</td><td>$-\frac{3}{17}$</td></tr>
</table></td></tr>
</table>

Y9Maths Knowledge Organiser – Unit 9.09

Links: Mathematical proof, number theory, if/then functions in Computing.

Percentages– Key Vocabulary		
1	Percentages	In mathematics, a percentage is a number or ratio expressed as a fraction of 100. It is often denoted using the percent sign, "%".
2	Percentage increase and decrease	To increase or decrease an amount by a percentage, first calculate the percentage of the amount and then either add this answer on to increase the quantity, or subtract this answer to decrease the quantity.
3	Reverse percentages	Reverse percentages are used when the percentage and the final number is given, and the original number needs to be found.
4	VAT	The letters VAT stand for Value Added Tax. This is a tax added on to the price of lots of the things that you can buy. Most shops include VAT in their prices. So the price you see on the label is the total of what you pay.
5	Profit	Profit is the surplus left from revenue after paying all costs. Profit is found by deducting total costs from revenue. In short: profit = total revenue - total costs.
6	Loss	A loss is made when the revenue from sales is not enough to cover all the costs of a business.
7	Income tax	Income tax is defined as money the government takes out of your earnings in order to pay for government operations and programs.
8	Simple interest	Simple interest is the amount paid by someone who borrows a certain amount of money or interest earned in savings. It is associated with percent, rate and the length of time, for which the amount of money is borrowed or saved.
Percentages		
9	Percentage of an amount	 555 10% (Divide by 10) 55.5 5% (Divide 10% by 2) 27.75 1% (Divide 10% by 10) or (Divide by 100) 5.55
10	Percentage increases and decreases	To increase £120 by 20%, work our 20% of £120 = £24 then add on to the original £120 + £24 = £144 To decrease £140 by 30%, work out 30% of £140 = £42, then subtract from the original £120 - £42 = £78
11	Reverse percentages	Step 1) Get the percentage of the original number. If the percentage is an increase then add it to 100, if it is a decrease then subtract it from 100. Step 2) Multiply the final number by 100.  John pays £60 for a bag after getting 20% discount. How much did it originally cost ? Remember: Original price is always equal to 100% Sale price = 100% - 20% = 80% 80% = £60 1% = 0.75 100% = £75
12	Express one quantity as a percentage of another	 Write 11g of 20g as a percentage. $\frac{11}{{}^{1}\cancel{20}} \times \frac{\overset{5}{\cancel{100}}\%}{1} = 55\%$

Y9 Maths Knowledge Organiser – Unit 9.11

Links: All algebraic work.

Notation– Key Vocabulary		
1	Identity	An identity is an equality that holds true regardless of the values chosen for its variables. They are used in simplifying or rearranging algebra expressions. By definition, the two sides of an identity are interchangeable, so we can replace one with the other at any time.
2	Algebraic notation	The most obvious feature of algebra is the use of special notation. Symbols, called variables, are used to represent numbers. Variables are usually letters such as x, y, z or a and b. Special symbols such as "=" and " " are used to denote relationships (equality and less-than-or equal).
3	Coefficients	The coefficients are the numbers that multiply the variables or letters. Thus in 5x, 5 is the coefficient of x. They can also be fractions.
4	Expression	An algebraic expression is an expression built up from integer constants, variables, and operations. For example, $3x^2 – 2xy + c$ is an algebraic expression.
5	Equation	An equation says that two things are equal. It will have an equals sign "=" like this. An example of an equation is : $x + 2 = 6$
6	Formulae	A formula is a fact or rule that uses mathematical symbols. It will usually have: an equals sign (=) two or more variables (x, y, etc) that stand in for values we don't know yet.
7	Inequalities	An inequality says that two values are not equal. $a \neq b$ says that a is not equal to b. There are other special symbols that show in what way things are not equal. $a < b$ says that a is less than b. $a > b$ says that a is greater than b
8	Terms	A term is either a single number or a variable, or numbers and variables multiplied together.
9	Sum	Sum in general means to add all positive real and rational numbers when algebraic sum include the sign (+ or -) of the numbers in consideration
10	Product	A product is the result of multiplying, or an expression that identifies factors to be multiplied.

Notation - Skills		
11	a x b	ab
12	y + y + y or 3 x y	3y
13	a x a	a^2
14	a x a x a	a^3
15	a x a x b	a^2b
16	a ÷ b	$\frac{a}{b}$
17	y(f + g)	Expanding this brackets means multiplying everything in the bracket by what is outside the bracket $y(f + g) = fy + gy$

Y9 Maths Knowledge Organiser – Unit 9.12

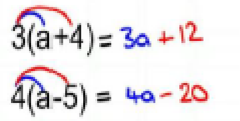
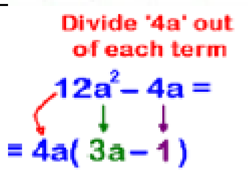
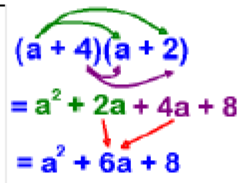
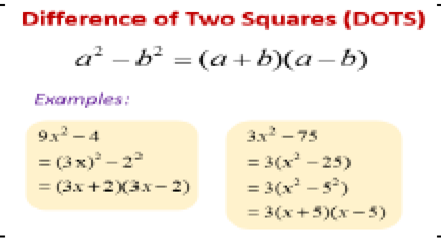
Links: All algebraic work.

Simplifying and index laws– Key Vocabulary		
1	Like terms	Like terms are terms that contain the same variables raised to the same power. Only the numerical coefficients are different. In an expression, only like terms can be combined.
2	Collecting like terms	We can combine like terms to shorten and simplify algebraic expressions, so we can work with them more easily. This is called collecting like terms.
3	Laws of indices	$a^m \times a^n = a^{m+n}$ First Index Law $(a^m)^n = a^{mn}$ Second Index Law $\frac{a^m}{a^n} = a^{m-n}$ Third Index Law $a^{-m} = \frac{1}{a^m}$ $a^0 = 1$ $a^{\frac{1}{n}} = \sqrt[n]{a}$
4	Simplifying	By "simplifying" an algebraic expression, we mean writing it in the most compact or efficient manner, without changing the value of the expression. This mainly involves collecting like terms, which means that we add together anything that can be added together.
5	Cancelling	The operation of cancelling out common factors in both the numerator and the denominator is called Cancellation.
Simplifying and index laws - Skills		
6	2a x 3b	6ab
7	3b^2 x 2b^3	6b$^{2+3=5}$
8	y^0	1
9	7^0	1
10	$\frac{g^7}{g^5}$	g$^{7-5=2}$
11	(d^2)^4	D$^{2\times4=8}$
12	16$^{1/2}$	$\sqrt{16} = 4$
13	t^{-2}	$\frac{1}{t^2}$
14	Multiplying and cancelling algebraic terms	$\frac{12x^2}{5y^3} \cdot \frac{20y^4}{6x^3} = \frac{240x^2y^4}{30x^3y^3}$ Multiply. $= \frac{\overset{8}{\cancel{240}}\ \overset{1}{\cancel{x^2}}\ \overset{y}{\cancel{y^4}}}{\underset{1}{\cancel{30}}\ \underset{x}{\cancel{x^3}}\ \underset{1}{\cancel{y^3}}}$ Cancel. $= \frac{8y}{x}$

Y9 Maths Knowledge Organiser – Unit 9.13

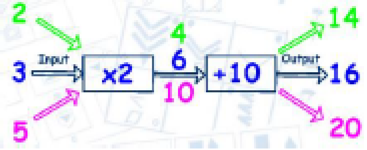
Links: All algebraic work.

Expanding and factorising– Key Vocabulary		
1	**Expanding brackets**	To expand a bracket means to multiply each term in the bracket by the expression outside the bracket. Expanding brackets involves using the skills of simplifying algebra.
2	**Brackets**	Brackets are symbols used in pairs to group things together.
3	**Expanding double brackets**	For an expression of the form (a + b)(c + d), the expanded version is ac + ad + bc + bd, in other words everything in the first bracket should be multiplied by everything in the second.
4	**Factorising**	Factorising is the reverse of expanding brackets. This is an important way of solving quadratic equations. The first step of factorising an expression is to 'take out' any common factors which the terms have.
5	**Factorising double brackets**	Factorising is the reverse of expanding brackets, so it is, for example, putting $2x^2 + x - 3$ into the form $(2x + 3)(x - 1)$.
6	**Quadratics**	A quadratic equation is in the form: $ax^2 + bx + c = 0$. Quadratic Equations can be factored.
7	**Difference of two squares**	The difference of two squares means one squared term subtract another squared term.

Expanding and factorising - Skills		
8	**Expanding a single bracket**	 $3(a+4) = 3a + 12$ $4(a-5) = 4a - 20$
9	**Factorising single brackets**	 Divide '4a' out of each term $12a^2 - 4a =$ $= 4a(3a - 1)$
10	**Expanding double brackets**	 $(a + 4)(a + 2)$ $= a^2 + 2a + 4a + 8$ $= a^2 + 6a + 8$
11	**Factorising quadratics**	 $x^2 - 8x + 15 = 0$ 2 numbers multiply to give you +15 and when you add them give you -8 ? 5 x 3 = 15 but 5 + 3 = +8 1 x 15 = 15 but 1 + 15 = 16 -1 x -15 = 15 but -1 + -15 = -16 -5 x -3 = 15 AND -5 + -3 = -8 So (x-5) and (x-3) are the factors
12	**Difference of two squares**	 Difference of Two Squares (DOTS) $a^2 - b^2 = (a + b)(a - b)$ Examples: $9x^2 - 4$ $= (3x)^2 - 2^2$ $= (3x + 2)(3x - 2)$ $3x^2 - 75$ $= 3(x^2 - 25)$ $= 3(x^2 - 5^2)$ $= 3(x + 5)(x - 5)$

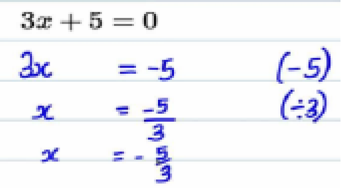
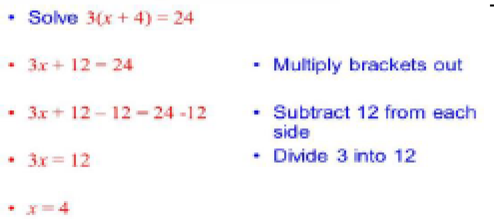
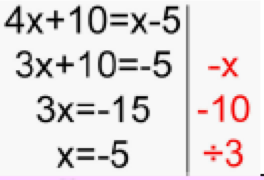
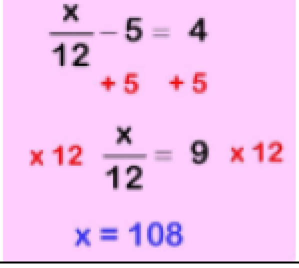
Y9 Maths Knowledge Organiser – Unit 9.14

Links: All algebraic work.

Expressions and substitution– Key Vocabulary		
1	**Functions**	An algebraic function is an equation that allows one to input a domain, or x-value and perform mathematical calculations to get an output, which is the range, or y-value, that is specific for that particular x-value. There is a one in/one out relationship between the domain and range.
2	**Input and output**	Both the input and output of a function are variables, which means that they change. You can choose the input variables yourself, but the output variables are always determined by the rule established by the function.
3	**Expressions**	An algebraic expression is an expression built up from integer constants, variables, and operations. For example, $3x^2 - 2xy + c$ is an algebraic expression.
4	**Formulae**	A formula is a fact or rule that uses mathematical symbols. It will usually have: an equals sign (=) two or more variables (x, y, etc) that stand in for values we don't know yet.
5	**Substitution**	Substitution in maths means replacing one mathematical entity by another of equal value.
6	**Scientific formulae**	In science, a formula is a concise way of expressing information symbolically, as in a mathematical formula or a chemical formula. The informal use of the term formula in science refers to the general construct of a relationship between given quantities.
7	**Equation**	An equation says that two things are equal. It will have an equals sign "=" like this. An example of an equation is : $x + 2 = 6$
8	**Identity**	An identity is an equality that holds true regardless of the values chosen for its variables. They are used in simplifying or rearranging algebra expressions. By definition, the two sides of an identity are interchangeable, so we can replace one with the other at any time.
9	**Derive**	To derive a formula means to deduce, obtain, or prove the formula from a set of already-known or already-established principles or observations.
Expressions and substitution - Skills		
10	**Function machine showing inputs and outputs**	
11	**Substitution into an expression**	$a = 2$ $b = 3$ $2a + b$ $4 + 3 = 7$
12	**Substitution into a scientific formula**	$E=MC^2$ When M = 3 and C = 2 $E = 3 \times 2^2$ $E = 3 \times 4 = 12$
13	**The difference between and identity and an equation.**	An identity is an equation that is true for all values of the variables. For example: $(x+y)^2 = x^2+2xy+y^2$ The above equation is true for all possible values of x and y, so it is called an identity. An identity is true for any value of the variable, but an equation is not. For example the equation $3x = 12$ is true only when x=4, so it is an equation, but not an identity. In fact, when we see an equation like that, we are usually trying to solve it. That is, find the single value of x that makes the equation true.

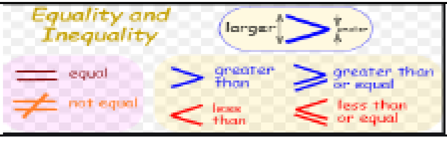
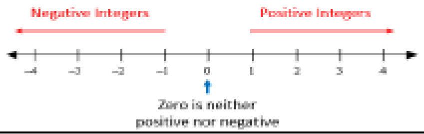
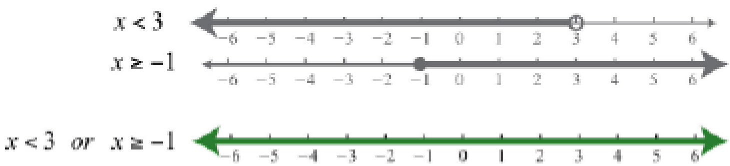
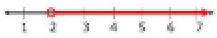
Y9Maths Knowledge Organiser – Unit 9.15

Links: forming and solving equations, quadratic equations, geometry problems with angles.

Linear Equations - Vocabulary		
1	**Solve**	To find an answer to, explanation for, or means of effectively dealing with a mathematical question or problem.
2	**Linear functions**	A function that is able to be represented by a straight line on a graph and has only one dimension (unknown).
3	**Linear equations**	An equation between two variables that gives a straight line when plotted on a graph.
4	**Brackets**	Each of a pair of marks ( ) [ ] { } ( ) used to enclose words or figures so as to separate them from the context. They can be used to separate terms in algebraic calculations.
5	**Fractional**	Relating to or expressed as a fraction, especially a fraction less than one in mathematical terms.
6	**Coefficients**	A numerical or constant quantity placed before and multiplying the variable in an algebraic expression (e.g. *4* in $4x^y$).
7	**Substitution**	To substitute values into a formula means to replace the letters used with their corresponding values. When all but one letter in the formula are replaced with numbers, the value of the remaining letter can be evaluated. Order of operations must be observed at all times.
8	**Formula**	A formula is a mathematical rule or relationship that uses letters to represent amounts which can be changed – these are called variables. For example, the formula of a triangle. The plural of formula is formulae or formulas.
Linear Equations - Skills		
9	**Solving linear equations**	 $3x + 5 = 0$ $3x = -5$ (-5) $x = \frac{-5}{3}$ $(\div 3)$ $x = -\frac{5}{3}$
10	**Solving linear with brackets and coefficients**	 • Solve $3(x + 4) = 24$ • $3x + 12 = 24$ • Multiply brackets out • $3x + 12 - 12 = 24 - 12$ • Subtract 12 from each side • $3x = 12$ • Divide 3 into 12 • $x = 4$
11	**Solving linear equations with the same unknown on both sides**	 4x+10=x-5 3x+10=-5 -x 3x=-15 -10 x=-5 ÷3
12	**Solving linear equation involving fractions**	 $\frac{x}{12} - 5 = 4$ +5 +5 x 12 $\frac{x}{12} = 9$ x 12 x = 108

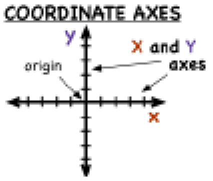
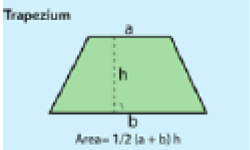
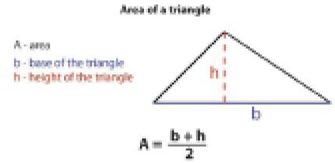
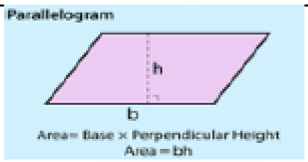
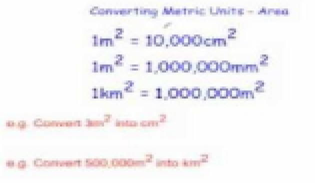
Y9Maths Knowledge Organiser – Unit 9.16

Links: regions, business problems maximising profit and loss.

Linear Inequalities - Vocabulary		
1	**Inequality**	An inequality says that two values are not equal. a ≠ b says that a is not equal to b. There are other special symbols that show in what way things are not equal. a < b says that a is less than b. a > b says that a is greater than b.
2	**Linear inequality**	In mathematics a linear inequality is an inequality which involves a linear function. A linear inequality contains one of the symbols of inequality. It shows the data which is not equal in graph form.
3	**Inequality signs**	
4	**Variables**	A symbol for a number we don't know yet. It is usually a letter like x or y. Example: in x + 2 = 6, x is the variable.
5	**Number line**	
6	**Solution sets**	A solution set is the set of values which satisfy a given inequality. It means, each and every value in the solution set will satisfy the inequality and no other value will satisfy the inequality.
7	**Interpret solutions**	A solution to inequalities is a range of numbers that, when plugged in for the variable, make the inequality true. We can interpret solutions to multi-step linear equations and inequalities abstractly as points and intervals on a number line.
Linear Inequalities - Skills		
8	**Solving linear inequalities with one variable**	Problem: $2x-5<1$ Solution: $2x-5+5<1+5$ $2x<6$ $\frac{2x}{2}<\frac{6}{2}$ $x<3$
9	**Inequality solution sets on a number line**	
10	**Solving linear inequalities when dividing by a negative coefficient of the variable**	$-3x+5\leq -16$ $-5 \quad -5$ Subtract $-3x\leq -21$ $\frac{-3x}{-3}\geq\frac{-21}{-3}$ Divide by -3, reverse inequality $x\geq 7$
11	**Two step inequality with solution shown on number line**	**$5x+2>12$** $5x+2>12$ $-2 \quad -2$ Subtract 2 from both sides. $5x \quad >10$ $\frac{5x}{5}>\frac{10}{5}$ Divide both sides by 5. $x>2$ 

Y9Maths Knowledge Organiser – Unit 9.17

Links: Functional mathematics with area and perimeter, unit conversions. Volume and surface area.

Perimeter, Area and Measures - Vocabulary		
1	Perimeter	A perimeter is a path that encompasses/surrounds a two-dimensional shape. The term may be used either for the path, or its length—in one dimension. It can be thought of as the length of the outline of a shape.
2	2D shapes	In geometry, a two-dimensional shape can be defined as a flat plane figure or a shape that has two dimensions – length and width.
3	Metric area measures	The common metric measurements for area are square centimetres, square metres and hectare (10,000 square meters). Areas of glass panes are measured in square centimetres. Building and floor areas are measured in square meters.
4	Coordinate axis	
5	Area	In geometry, the area can be defined as the space occupied by a flat shape or the surface of an object.
6	Range	The area of variation between upper and lower limits on a particular scale.
7	Trapezia	A quadrilateral with one pair of sides parallel.
8	Triangle	A triangle is a polygon with three edges and three vertices. It is one of the basic shapes in geometry.
9	Parallelogram	A parallelogram is a quadrilateral with opposite sides parallel (and therefore opposite angles equal). A quadrilateral with equal sides is called a rhombus, and a parallelogram whose angles are all right angles is called a rectangle.
Perimeter, Area and Measures - Skills		
10	Area of trapezia	
11	Area of a triangle	
12	Area of a parellelogram	
13	Conversion between metric area measurements	Converting Metric Units - Area $1m^2 = 10,000cm^2$ $1m^2 = 1,000,000mm^2$ $1km^2 = 1,000,000m^2$ e.g. Convert $3m^2$ into cm^2 e.g. Convert $500,000m^2$ into km^2

Y9Maths Knowledge Organiser – Unit 9.18

Links: Engineering, trigonometry with sin, cos and tan ratios.

Pythagoras - Vocabulary		
1	**Pythagoras Theorem**	For any right triangle with sides, a and b and hypotenuse h, the square of the hypotenuse is equal to the sum of the squares of the other two sides
2	**Right angled triangle**	A right-angled triangle is a triangle in which one angle is a right angle (that is, a 90-degree angle). The relation between the sides and angles of a right-angles triangle is the basis for trigonometry.
3	**Hypotenuse**	A hypotenuse is the longest side of a right triangle. It's the side that is opposite to the right angle (90°).
4	**Surds**	Surds are numbers left in square root form that are used when detailed accuracy is required in a calculation. They are numbers which, when written in decimal form, would go on forever, for example √3.
5	**Squaring a number**	The square of a number is that number times itself e.g. $3^2 = 3 \times 3 = 9$
6	**Square root**	The square root of a number is the inverse operation of squaring that number. e.g.$\sqrt{9} = 3$
7	**Line segment**	In geometry, a line segment is a part of a line that is bounded by two distinct end points, and contains every point on the line between its end points.
8	**Coordinates**	Coordinates are a set of values that show an exact position. On graphs it is usually a pair of numbers: the first number shows the distance along, and the second number shows the distance up or down.
Pythagoras - Skills		
9	**Pythagoras Theorem – finding the hypotenuse**	Begin by identifying the hypotenuse, then label the other sides 'a' and 'b', substitute values then work out the left hand side. Square root to 'undo' the squaring operation.
10	**Pythagoras Theorem – finding one of the shorter sides using the hypotenuse**	confidence to rearrange the formulae. Label the sides and write the formula and substitute as before. Subtract the number from the left hand side to leave X^2 then, square root to 'undo' the squaring operation as before.