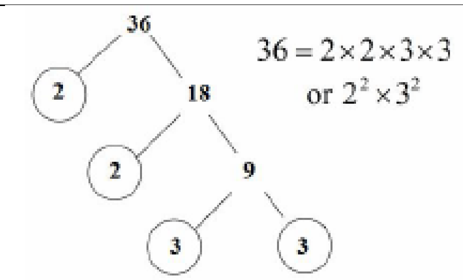
	MATHS – YEAR 11 Higher Tier			RAG
	Whole year:			
1.	**Integer**	A **whole number** that can be positive, negative or zero.	$-3, 0, 92$	
2.	**Factor**	A number that **divides exactly** into another number without a remainder. It is useful to write factors in pairs.	The factors of 18 are: $1, 2, 3, 6, 9, 18$ The factor pairs of 18 are: $1, 18$ $2, 9$ $3, 6$	
3.	**Multiple**	The result of multiplying a number by an integer. The **times tables** of a number.	The first five multiples of 7 are: $7, 14, 21, 28, 35$	
4.	**Highest Common Factor (HCF)**	The **biggest** number that **divides exactly** into two or more numbers.	The HCF of 6 and 9 is 3 because it is the biggest number that divides into 6 and 9 exactly.	
5.	**Lowest Common Multiple (LCM)**	The **smallest** number that is in the **times tables** of each of the numbers given.	The LCM of 3, 4 and 5 is 60 because it is the smallest number in the 3, 4 and 5 times tables.	
6.	**Prime Number**	A number that has exactly two factors: one and itself.	The first ten prime numbers are: 2, 3, 5, 7, 11, 13, 17, 19, 23 and 29	
7.	**Prime Factor**	A factor which is a prime number.	The prime factors of 18 are: 2 ,3	
8.	**Product of Prime Factors**	Finding out which **prime numbers multiply** together to make the **original** number. se a **prime factor tree.** Also known as 'prime factorisation'.		
9.	**Recurring**	A decimal number that has **digits that repeat forever**. The part that repeats is usually shown by placing a dot above the digit that repeats, or dots over the first and last digit of the repeating pattern.	$\frac{1}{3} = 0.333\ldots = 0.\dot{3}$ $\frac{1}{7} = 0.142857142857\ldots$ $= 0.\dot{1}4285\dot{7}$ $\frac{77}{600} = 0.128333\ldots = 0.128\dot{3}$	

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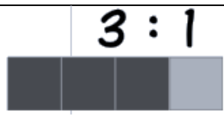
10.	**Rational number**	A number of the form $\frac{p}{q}$, where p **and** q **are integers** and $q \neq 0$.	$\frac{4}{9}, 6, -\frac{1}{3}, \sqrt{25}$ are examples of rational numbers.	
11.	**Irrational number**	A number that cannot be written in the form $\frac{p}{q}$, where p **and** q **are integers** and $q \neq 0$.	$\pi, \sqrt{2}$ are examples of an irrational numbers.	
12.	**Surd**	The **irrational number** that is a **root of a positive integer,** whose value cannot be determined exactly. Surds have **infinite non-recurring decimals.**	$\sqrt{2}$ is a surd because it is a root which cannot be determined exactly. $\sqrt{2} = 1.41421356\ldots$ which never repeats.	
13.	**Ratio**	Ratio compares the size of **one part** to **another part.** Written using the ':' symbol.		
14.	**Proportion**	Proportion compares the size of **one part** to the size of the **whole.** Usually written as a fraction.	In a class with 13 boys and 9 girls, the proportion of boys is $\frac{13}{22}$ and the proportion of girls is $\frac{9}{22}$	
15.	**Simplifying Ratios**	**Divide** all parts of the ratio by a **common factor.**	5 : 10 = 1 : 2 (divide both by 5) 14 : 21 = 2 : 3 (divide both by 7)	
16.	**Ratios in the form $1 : n$ or $n : 1$**	**Divide** both parts of the ratio by one of the numbers to make **one part equal 1.**	5 : 7 = 1 : $\frac{7}{5}$ in the form 1 : n 5 : 7 = $\frac{5}{7}$: 1 in the form n : 1	
17.	**Sharing in a Ratio**	**1. Add** the total parts of the ratio. **2. Divide** the amount to be shared by this value to find the value of one part. **3. Multiply** this value by each part of the ratio. Use only if you **know the total.**	Share £60 in the ratio 3 : 2 : 1. 3 + 2 + 1 = 6 60 ÷ 6 = 10 3 x 10 = 30, 2 x 10 = 20, 1 x 10 = 10 £30 : £20 : £10	

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18.	**Proportional Reasoning**	Comparing two things using **multiplicative reasoning** and applying this to a new situation. Identify one multiplicative link and use this to find missing quantities.	**7 bunches of flowers contain 42 flowers. How many flowers are in 1 bunch?** ÷7 7 bunches 42 flowers 1 bunch 6 flowers	
19.	**Unitary Method**	Finding the **value of a single unit** and then finding the necessary value by **multiplying** the single unit value.	3 cakes require 450g of sugar to make. Find how much sugar is needed to make 5 cakes. 3 cakes = 450g So 1 cake = 150g (÷ by 3) So 5 cakes = 750 g (x by 5)	
20.	**Ratio already shared**	Find what **one part** of the ratio is worth using the **unitary method.**	Money was shared in the ratio 3:2:5 between Ann, Bob and Cat. Given that Bob had £16, found out the total amount of money shared. £16 = 2 parts So £8 = 1 part 3 + 2 + 5 = 10 parts, so 8 x 10 = £80	
21.	**Best Buys**	Find the **unit cost** by **dividing** the **price by the quantity.** The **lowest** number is the best value.	8 cakes for £1.28 → 16p each (÷by 8) 13 cakes for £2.05 → 15.8p each (÷by 13) Pack of 13 cakes is best value.	
22.	**Percentage Change**	$\frac{\boldsymbol{Difference}}{\boldsymbol{Original}} \times \mathbf{100\%}$	A games console is bought for £200 and sold for £250. % change = $\frac{50}{200} \times 100 = 25\%$	

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23.	**Fractions to Decimals**	**Divide the numerator by the denominator** using the bus stop method.	$\frac{3}{8} = 3 \div 8 = 0.375$	
24.	**Decimals to Fractions**	**Write as a fraction** over 10, 100 or 1000 and simplify.	$0.36 = \frac{36}{100} = \frac{9}{25}$	
25.	**Percentages to Decimals**	**Divide by 100.**	$8\% = 8 \div 100 = 0.08$	
26.	**Decimals to Percentages**	**Multiply by 100.**	$0.4 = 0.4 \times 100\% = 40\%$	
27.	**Fractions to Percentages**	Percentage is just a fraction out of 100. **Make the denominator 100 using equivalent fractions.** When the denominator doesn't go in to 100, use a calculator and **multiply the fraction by 100**.	$\frac{3}{25} = \frac{12}{100} = 12\%$ $\frac{9}{17} \times 100 = 52.9\%$	
28.	**Percentages to Fractions**	Percentage is just a fraction out of 100. **Write the percentage over 100** and simplify.	$14\% = \frac{14}{100} = \frac{7}{50}$	
29.	**Increase or Decrease by a Percentage**	Non-calculator: **Find the percentage** and **add** or **subtract** it from the **original** amount. Calculator: Find the **percentage multiplier** and multiply.	<u>Increase 500 by 20% (Non Calc):</u> 10% of 500 = 50 so 20% of 500 = 100 500 + 100 = 600 <u>Decrease 800 by 17% (Calc):</u> 100%-17%=83% 83% ÷ 100 = 0.83 0.83 x 800 = 664	
30.	**Percentage Multiplier**	The **number** you **multiply** a quantity by to **increase or decrease** it by a **percentage**.	The multiplier for increasing by 12% is 1.12 The multiplier for decreasing by 12% is 0.88 The multiplier for increasing by 100% is 2.	
31.	**Reverse Percentage**	Find the **correct percentage given in the question**, then work backwards to **find 100%.** Look out for words like '**before**' or '**original**'.	A jumper was priced at £48.60 after a 10% reduction. Find its original price. 100% - 10% = 90%, 90% = £48.60 1% = £0.54 100% = £54	

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32.	Simple Interest	Interest calculated as a **percentage of the original** amount.	£1000 invested for 3 years at 10% simple interest. 10% of £1000 = £100 Interest = $3 \times £100 = £300$	
33.	Exponential Growth	When we **multiply** a number **repeatedly** by the **same number** ($\neq 1$), resulting in the number **increasing by the same proportion** each time. The original amount can grow very quickly in exponential growth.	$1, 2, 4, 8, 16, 32, 64, 128 \ldots$ is an example of exponential growth, because the numbers are being multiplied by 2 each time.	
34.	Exponential Decay	When we **multiply** a number **repeatedly** by the **same number** ($\mathbf{0 < x < 1}$), resulting in the number **decreasing by the same proportion** each time. The original amount can decrease very quickly in exponential decay.	$1000, 200, 40, 8 \ldots$ is an example of exponential decay, because the numbers are being multiplied by $\frac{1}{5}$ each time.	
35.	Compound Interest	Interest paid on the **original amount and the accumulated interest**.	A bank pays 5% compound interest a year. Bob invests £3000. How much will he have after 7 years. $3000 \times 1.05^7 = £4221.30$	
36.	Fraction	A mathematical expression representing the **division** of one integer by another. Fractions are written as **two numbers separated by a horizontal line.**	$\frac{2}{7}$ is a 'proper' fraction. $\frac{9}{4}$ is an 'improper' or 'top-heavy' fraction.	
37.	Numerator	The **top** number of a fraction.	In the fraction $\frac{3}{5}$, 3 is the numerator.	

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38.	**Denominator**	The **bottom** number of a fraction.	In the fraction $\frac{3}{5}$, 5 is the denominator.	
39.	**Unit Fraction**	A fraction where the **numerator is one** and the denominator is a positive integer.	$\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ $etc.$ are examples of unit fractions.	
40.	**Reciprocal**	The reciprocal of a number is **1 divided by the number.** The reciprocal of x is $\frac{1}{x}$ **When we multiply a number by its reciprocal we get 1.** This is called the 'multiplicative inverse'.	The reciprocal of 5 is $\frac{1}{5}$ The reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$, because $$\frac{2}{3} \times \frac{3}{2} = 1$$	
41.	**Mixed Number**	A number formed of both an **integer part** and a **fraction part.**	$3\frac{2}{5}$ is an example of a mixed number.	
42.	**Simplifying Fractions**	**Divide the numerator and denominator by the highest common factor.**	$$\frac{20}{45} = \frac{4}{9}$$	
43.	**Equivalent Fractions**	Fractions which represent the **same value.**	$$\frac{2}{5} = \frac{4}{10} = \frac{20}{50} = \frac{60}{150}\ etc.$$	
44.	**Comparing Fractions**	To compare fractions, they each need to be rewritten so that they have a **common denominator.** **Ascending** means **smallest to biggest.** **Descending** means **biggest to smallest.**	Put in to ascending order : $\frac{3}{4}, \frac{2}{3}, \frac{5}{6}, \frac{1}{2}$. Equivalent: $\frac{9}{12}, \frac{8}{12}, \frac{10}{12}, \frac{6}{12}$ Correct order: $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{5}{6}$	
45.	**Fraction of an Amount**	**Divide** by the **bottom**, **times** by the **top.**	Find $\frac{2}{5}$ of £60 $$60 \div 5 = 12$$ $$12 \times 2 = 24$$	

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46.	**Adding or Subtracting Fractions**	Find the **LCM of the denominators** to find a common denominator. Use equivalent fractions to change each fraction to the **common denominator**. Then just **add or subtract the numerators** and keep the **denominator the same.**	$\frac{2}{3}+\frac{4}{5}$ Multiples of 3: 3, 6, 9, 12, **15**.. Multiples of 5: 5, 10, **15**.. LCM of 3 and 5 = 15 $\frac{2}{3}=\frac{10}{15}$ $\frac{4}{5}=\frac{12}{15}$ $\frac{10}{15}+\frac{12}{15}=\frac{22}{15}=1\frac{7}{15}$	
47.	**Multiplying Fractions**	**Multiply** the **numerators** together and **multiply** the **denominators** together.	$\frac{3}{8}\times\frac{2}{9}=\frac{6}{72}=\frac{1}{12}$	
48.	**Dividing Fractions**	**'Keep it, Flip it, Change it - KFC'** Keep the first fraction the same. Flip the second fraction upside down. Change the divide to a multiply. Multiply by the reciprocal of the second fraction.	$\frac{3}{4}\div\frac{5}{6}=\frac{3}{4}\times\frac{6}{5}=\frac{18}{20}=\frac{9}{10}$	
49.	**Rounding**	To make a number simpler but keep its value close to what it was. If the **digit to the right** of the rounding digit is **less than 5, round down**. If the **digit to the right** of the rounding digit is **5 or more, round up**.	74 rounded to the nearest ten is 70, because 74 is closer to 70 than 80. 152,879 rounded to the nearest thousand is 153,000.	

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50.	**Decimal Place**	The **position** of a digit to the **right of a decimal point**.	In the number 0.372, the 7 is in the second decimal place. 0.372 rounded to two decimal places is 0.37, because the 2 tells us to round down. Careful with money - don't write £27.4, instead write £27.40	
51.	**Significant Figure**	The significant figures of a number are the digits which **carry meaning** (ie. are significant) to the size of the number. The **first significant figure** of a number **cannot be zero**. In a number with a decimal, trailing zeros are not significant.	In the number 0.00821, the first significant figure is the 8. In the number 2.740, the 0 is not a significant figure. 0.00821 rounded to 2 significant figures is 0.0082. 19357 rounded to 3 significant figures is 19400. We need to include the two zeros at the end to keep the digits in the same place value columns.	
52.	**Truncation**	A method of approximating a decimal number by **dropping all decimal places** past a certain point **without rounding**.	3.14159265… can be truncated to 3.1415 (note that if it had been rounded, it would become 3.1416).	
53.	**Error Interval**	A **range of values** that a number could have taken before being rounded or truncated. An error interval is written using inequalities, with a **lower bound** and an **upper bound**. Note that the lower bound inequality can be 'equal to', but the upper bound cannot be 'equal to'.	0.6 has been rounded to 1 decimal place. The error interval is: $0.55 \leq x < 0.65$ The lower bound is 0.55 The upper bound is 0.65	

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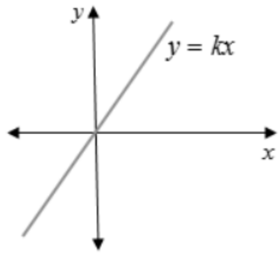
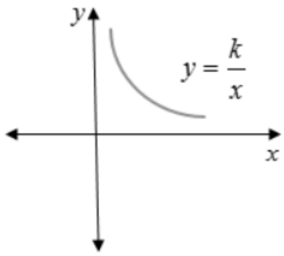
54.	**Estimate**	To find something **close to the correct answer**.	An estimate for the height of a man is 1.8 metres.	
55.	**Approximation**	When using approximations to estimate the solution to a calculation, **round each number in the calculation to 1 significant figure**. $\approx$ means ‘approximately equal to’	$\frac{348+692}{0.526} \approx \frac{300+700}{0.5} = 2000$ ‘Note that dividing by 0.5 is the same as multiplying by 2’	
56.	**Direct Proportion**	If two quantities are in direct proportion, **as one increases**, the **other increases** by the **same percentage**. If y is directly proportional to x, this can be written as $\boldsymbol{y} \propto \boldsymbol{x}$ An equation of the form $\boldsymbol{y = kx}$ represents direct proportion, where k **is the constant of proportionality**.		
57.	**Inverse Proportion**	If two quantities are inversely proportional, **the product of the two quantities always remains constant**, this means if **one quantity doubles** then the other **quantity will halve**. If y is inversely proportional to x, this can be written as $\boldsymbol{y} \propto \boldsymbol{\frac{1}{x}}$ An equation of the form $\boldsymbol{y = \frac{k}{x}}$ represents inverse proportion.		
58.	**Using proportionality formulae**	**Direct: y = kx** or **y** $\propto$ **x** **Inverse: y =** $\frac{k}{x}$ or **y** $\propto \frac{1}{x}$ 1. **Solve to find k** using the pair of values in the question. 2. **Rewrite the equation** using the k you have just found. 3. **Substitute the other given value** from the question in to the equation to **find the missing value.**	p is directly proportional to q. When p = 12, q = 4. Find p when q = 20. 1. p = kq 12 = k x 4 so k = 3 2. p = 3q 3. p = 3 x 20 = 60, so p = 60	

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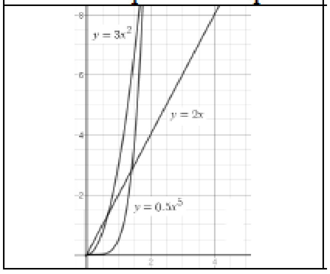
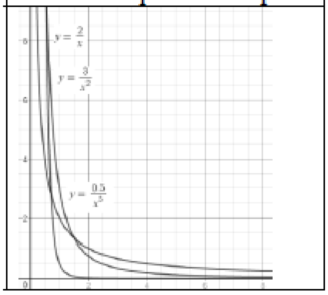
59.	**Direct Proportion with powers**	Graphs showing **direct proportion** can be written in the form $\boldsymbol{y = kx^n}$ Direct proportion graphs will always start at the origin.	Direct Proportion Graphs 	
60.	**Inverse Proportion with powers**	Graphs showing inverse proportion can be written in the form $\boldsymbol{y = \frac{k}{x^n}}$. Inverse proportion graphs will never start at the origin.	Inverse Proportion Graphs 	
61.	**Square Number**	The number you get when you **multiply a number by itself.** *Technically these are called 'perfect square numbers' if you go on to study Maths post-16 you will learn more about this.*	**1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225…** $9^2 = 9 \times 9 = 81$	
62.	**Square Root**	The **number you multiply by itself** to get another number. The reverse process of squaring a number.	$\sqrt{36} = 6$ because $6 \times 6 = 36$	
63.	**Solutions to $\boldsymbol{x^2 =}$ ….**	**Equations** involving **squares** have **two solutions**, one **positive** and one **negative**.	Solve $x^2 = 25$ $x = 5 \text{ or } x = -5$ This can also be written as $x = \pm 5$	
64.	**Cube Number**	The number you get when you **multiply a number by itself and itself again.**	1, 8, 27, 64, 125… $2^3 = 2 \times 2 \times 2 = 8$	

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65.	**Cube Root**	The **number you multiply by itself and itself again** to get another number. The reverse process of cubing a number.	$\sqrt[3]{125} = 5$ because $5 \times 5 \times 5 = 125$	
66.	**Powers of…**	The powers of a number are that **number raised to various powers.**	The powers of 3 are: $3^1 = 3$ $3^2 = 9$ $3^3 = 27$ $3^4 = 81$ etc.	
67.	**Multiplication Index Law**	When **multiplying** with the same base (number or letter), **add the powers.** $\boldsymbol{a^m \times a^n = a^{m+n}}$	$7^5 \times 7^3 = 7^8$ $a^{12} \times a = a^{13}$ $4x^5 \times 2x^8 = 8x^{13}$	
68.	**Division Index Law**	When **dividing** with the same base (number or letter), **subtract the powers.** $\boldsymbol{a^m \div a^n = a^{m-n}}$	$15^7 \div 15^4 = 15^3$ $x^9 \div x^2 = x^7$ $20a^{11} \div 5a^3 = 4a^8$	
69.	**Brackets Index Laws**	When raising a power to another power, multiply the powers together. $\boldsymbol{(a^m)^n = a^{mn}}$	$(y^2)^5 = y^{10}$ $(6^3)^4 = 6^{12}$ $(5x^6)^3 = 125x^{18}$	
70.	**Notable Powers**	$\boldsymbol{p = p^1}$ $\boldsymbol{p^0 = 1}$ $\boldsymbol{0^p = 0, when\ p \neq 0}$	$99999^0 = 1$	
71.	**Negative Powers**	A negative power performs the reciprocal. $\boldsymbol{a^{-m} = \frac{1}{a^m}}$	$3^{-2} = \frac{1}{3^2} = \frac{1}{9}$	

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72.	**Fractional Powers**	The denominator of a fractional power acts as a 'root'. The numerator of a fractional power acts as a normal power. $a^{\frac{m}{n}} = \left(\sqrt[n]{a}\right)^m$	$27^{\frac{2}{3}} = \left(\sqrt[3]{27}\right)^2 = 3^2 = 9$ $\left(\frac{25}{16}\right)^{\frac{3}{2}} = \left(\frac{\sqrt{25}}{\sqrt{16}}\right)^3 = \left(\frac{5}{4}\right)^3 = \frac{125}{64}$	
73.	**Surd**	The **irrational number** that is a **root of a positive integer,** whose value cannot be determined exactly. Surds have **infinite non-recurring decimals.**	$\sqrt{2}$ is a surd because it is a root which cannot be determined exactly. $\sqrt{2} = 1.41421356\ldots$ which never repeats.	
74.	**Rules of Surds**	$\sqrt{ab} = \sqrt{a} \times \sqrt{b}$ $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ $a\sqrt{c} \pm b\sqrt{c} = (a \pm b)\sqrt{c}$ $\sqrt{a} \times \sqrt{a} = a$	$\sqrt{48} = \sqrt{16} \times \sqrt{3} = 4\sqrt{3}$ $\sqrt{\frac{25}{36}} = \frac{\sqrt{25}}{\sqrt{36}} = \frac{5}{6}$ $2\sqrt{5} + 7\sqrt{5} = 9\sqrt{5}$ $\sqrt{7} \times \sqrt{7} = 7$	

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75.	**Rationalise a Denominator**	The process of rewriting a fraction so that the **denominator contains only rational numbers.**	$\frac{\sqrt{3}}{\sqrt{2}} = \frac{\sqrt{3}\times\sqrt{2}}{\sqrt{2}\times\sqrt{2}} = \frac{\sqrt{6}}{2}$ $\frac{6}{3+\sqrt{7}} = \frac{6(3-\sqrt{7})}{(3+\sqrt{7})(3-\sqrt{7})}$ $= \frac{18-6\sqrt{7}}{9-7}$ $= \frac{18-6\sqrt{7}}{2}$ $= 9-3\sqrt{7}$	
76.	**Standard Form**	$\boldsymbol{A \times 10^{b}}$ $where\ \boldsymbol{1 \leq A < 10},$ $\boldsymbol{b = integer}$	8400 = 8.4 x 10^3 0.00036 = 3.6 x 10^{-4}	
77.	**Multiplying or Dividing with Standard Form**	Multiply: **Multiply the numbers** and **add the powers.** Divide: **Divide the numbers** and **subtract the powers.**	$(1.2\times10^3)\times(4\times10^6)$ $= 8.8\times10^9$ $(4.5\times10^5)\div(3\times10^2)$ $= 1.5\times10^3$	
78.	**Adding or Subtracting with Standard Form**	**Convert** in to **ordinary** numbers, **calculate** and then **convert back** in to standard form.	$2.7\times10^4 + 4.6\times10^3$ $= 27000 + 4600 = 31600$ $= 3.16\times10^4$	
79.	**Expression**	A mathematical statement written using symbols, numbers or letters.	3x + 2 or $5y^2$	
80.	**Equation**	A statement showing that two expressions are equal.	2y - 17 = 15	
81.	**Identity**	An equation that is true for all values of the variables. An identity uses the symbol: $\equiv$	2x ≡ x + x	
82.	**Formula**	Shows the relationship between two or more variables.	Area of a rectangle = length x width or A= LxW	
83.	**Expand**	To expand a bracket, multiply each term in the bracket by the expression outside the bracket.	$3(x+7) = 3x+21$	

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84.	**Factorise**	The reverse of expanding. Factorising is writing an expression as a product of terms by 'taking out' a common factor.	$6x - 15 = 3(2x - 5)$, where 3 is the common factor.	
85.	**Solve a linear equation**	To find the answer/value of something. Use inverse operations on both sides of the equation (balancing method) until you find the value for the letter.	Solve $2x - 3 = 7$ Add 3 on both sides $2x = 10$ Divide by 2 on both sides $x = 5$	
86.	**Inverse**	Opposite	The inverse of addition is subtraction. The inverse of multiplication is division. The inverse of cubing is cube rooting. The inverse of sine is sine^{-1}.	
87.	**Substitution**	Replace letters with numbers. Be careful of $5x^2$. You need to square first, then multiply by 5.	$a = 3, b = 2 \; and \; c = 5.$ Find: 1. $2a = 2 \times 3 = 6$ 2. $3a - 2b = 3 \times 3 - 2 \times 2 = 5$ 3. $7b^2 - 5 = 7 \times 2^2 - 5 = 23$	
88.	**Rearranging Formulae**	Use inverse operations on both sides of the formula (balancing method) until you find the expression for the letter.	Make x the subject of $y = \frac{2x-1}{z}$ Multiply both sides by z $yz = 2x - 1$ Add 1 to both sides $yz + 1 = 2x$ Divide by 2 on both sides $\frac{yz + 1}{2} = x$ We now have x as the subject.	

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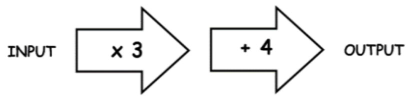
89.	**Writing Formulae**	Substitute letters for words in the question.	Bob charges £3 per window and a £5 call out charge. $C = 3N + 5$ Where N=number of windows and C=cost.	
90.	**Function Machine**	Takes an input value, performs some operations and produces an output value.		
91.	**Function**	A relationship between two sets of values.	$f(x) = 3x^2 - 5$ 'For any input value, square the term, then multiply by 3, then subtract 5'.	
92.	**Function notation**	$f(x)$ x is the input value $f(x)$ is the output value.	$f(x) = 3x + 11$ Suppose the input value is $x = 5$ The output value is $f(5) = 3 \times 5 + 11 = 26$	
93.	**Inverse function**	$f^{-1}(x)$ A function that performs the opposite process of the original function. 1. Write the function as $y = f(x)$ 2. Rearrange to make x the subject. 3. Replace the y with x and the x with $f^{-1}(x)$	$f(x) = (1 - 2x)^5$. Find the inverse. $y = (1 - 2x)^5$ $\sqrt[5]{y} = 1 - 2x$ $1 - \sqrt[5]{y} = 2x$ $\frac{1-\sqrt[5]{y}}{2} = x$ $f^{-1}(x) = \frac{1-\sqrt[5]{x}}{2}$	

	Whole year:			RAG
94.	**Composite function**	A combination of two or more functions to create a new function. $fg(x)$ is the composite function that substitutes the function $g(x)$ into the function $f(x)$. $fg(x)$ means 'do g first, then f' $gf(x)$ means 'do f first, then g'	$f(x) = 5x - 3,\ g(x) = \frac{1}{2}x + 1$ What is $fg(4)$? $g(4) = \frac{1}{2} \times 4 + 1 = 3$ $f(3) = 5 \times 3 - 3 = 12 = fg(4)$ What is $fg(x)$? $fg(x) = 5\left(\frac{1}{2}x + 1\right) - 3 = \frac{5}{2}x + 2$	
95.	**Iteration**	The act of repeating a process over and over again, often with the aim of approximating a desired result more closely. Recursive Notation: $x_{n+1} = \sqrt{3x_n + 6}$	$x_1 = 4$ $x_2 = \sqrt{3 \times 4 + 6} = 4.242640 \ldots$ $x_3 = \sqrt{3 \times 4.242640 \ldots + 6}$ $= 4.357576 \ldots$	
96.	**Iterative Method**	To create an iterative formula, rearrange an equation with more than one x term to make one of the x terms the subject. You will be given the first value to substitute in, often called $\boldsymbol{x_1}$. Keep substituting in your previous answer until your answers are the same to a certain degree of accuracy. This is called converging to a limit. Use the 'ANS' button on your calculator to keep substituting in the previous answer.	Use an iterative formula to find the positive root of $x^2 - 3x - 6 = 0$ to 3 decimal places. $x_1 = 4$ Answer: $x^2 = 3x + 6$ $x = \sqrt{3x + 6}$ So $x_{n+1} = \sqrt{3x_n + 6}$ $x_1 = 4$ $x_2 = \sqrt{3 \times 4 + 6} = 4.242640 \ldots$ $x_3 = \sqrt{3 \times 4.242640 \ldots + 6}$ $= 4.357576 \ldots$ Keep repeating… $x_7 = 4.372068.. = 4.372\ (3dp)$ $x_8 = 4.372208 \ldots = 4.372\ (3dp)$ So answer is $x = 4.372\ (3dp)$	

	MATHS – YEAR 11 Higher Tier			RAG
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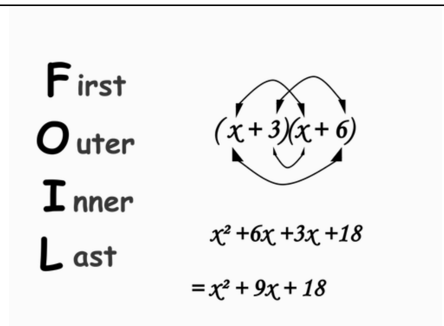
97.	**Simplifying Expressions**	Collect 'like terms'. Be careful with negatives. x^2 and x are not like terms.	$2x + 3y + 4x - 5y + 3$ $= 6x - 2y + 3$ $3x + 4 - x^2 + 2x - 1$ $= 5x - x^2 + 3$	
98.	**x times x**	The answer is x^2 not $2x$.	Squaring is multiplying by itself, not by 2.	
99.	**$p \times p \times p$**	The answer is p^3 not $3p$.	If p = 2, then p^3 = 2x2x2=8, not 2x3 = 6	
100.	**$p + p + p$**	The answer is 3p not p^3.	If p = 2, then 2+2+2 = 6, not $2^3 = 8$	
101.	**Quadratic**	A quadratic expression is of the form $ax^2 + bx + c$ where a, b and c are numbers, $a \neq 0$.	Examples of quadratic expressions: x^2 $8x^2 - 3x + 7$ Examples of non-quadratic expressions: $2x^3 - 5x^2$ $9x - 1$	
102.	**Factorising Quadratics**	When a quadratic expression is in the form $x^2 + bx + c$ find the two numbers that add to give b and multiply to give c.	$x^2 + 7x + 10 = (x + 5)(x + 2)$ (because 5 and 2 add to give 7 and multiply to give 10) $x^2 + 2x - 8 = (x + 4)(x - 2)$ (because +4 and -2 add to give +2 and multiply to give -8)	
103.	**Difference of 2 Squares**	An expression of the form $a^2 - b^2$ can be factorised to give $(a + b)(a - b)$.	$x^2 - 25 = (x + 5)(x - 5)$ $16x^2 - 81 = (4x + 9)(4x - 9)$	
104.	**Expanding double brackets**	When you expand double brackets use the FOIL method to make sure you don't forget any of the terms!	 	

MATHS – YEAR 11 Higher Tier				RAG
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105	**Solving Quadratics** $(\boldsymbol{ax^2 = b})$	Isolate the x^2 term and square root both sides. Remember there will be a positive and a negative solution.	$2x^2 = 98$ $x^2 = 49$ $x = \pm 7$	
106	**Solving Quadratics** $(\boldsymbol{ax^2 + bx = 0})$	Factorise and then solve = 0.	$x^2 - 3x = 0$ $x(x-3) = 0$ $x = 0 \; or \; x = 3$	
107	**Solving Quadratics by Factorising** $(\boldsymbol{a = 1})$	Factorise the quadratic in the usual way. Solve = 0 Make sure the equation = 0 before factorising.	Solve $x^2 + 3x - 10 = 0$ Factorise: $(x+5)(x-2) = 0$ $x = -5 \; or \; x = 2$	
108	**Factorising Quadratics when** $\boldsymbol{a \neq 1}$	When a quadratic is in the form $ax^2 + bx + c$ 1. Multiply a by c = ac 2. Find two numbers that add to give b and multiply to give ac. 3. Re-write the quadratic, replacing bx with the two numbers you found. 4. Factorise in pairs - you should get the same bracket twice 5. Write your two brackets - one will be the repeated bracket, the other will be made of the factors outside each of the two brackets.	Factorise $6x^2 + 5x - 4$ 1. $6 \times -4 = -24$ 2. Two numbers that add to give +5 and multiply to give -24 are +8 and -3 3. $6x^2 + 8x - 3x - 4$ 4. Factorise in pairs: $2x(3x+4) - 1(3x+4)$ 5. Answer = $(3x+4)(2x-1)$	

		MATHS – YEAR 11 Higher Tier		RAG
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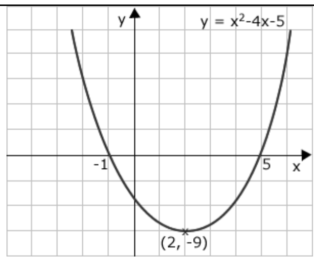
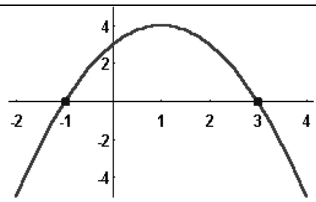
109	**Solving Quadratics by Factorising** $(\boldsymbol{a} \neq \mathbf{1})$	Factorise the quadratic in the usual way. Solve = 0 Make sure the equation = 0 before factorising.	Solve $2x^2 + 7x - 4 = 0$ Factorise: $(2x-1)(x+4) = 0$ $x = \frac{1}{2}\ or\ x = -4$	
110	**Quadratic Graph**	A 'U-shaped' curve called a parabola. The equation is of the form $y = ax^2 + bx + c$, where a, b and c are numbers, $a \neq 0$. If $a < 0$, the parabola is upside down.		
111	**Roots of a Quadratic**	A root is a solution. The roots of a quadratic are the x-intercepts of the quadratic graph.		
112	**Turning Point of a Quadratic**	A turning point is the point where a quadratic turns. On a positive parabola, the turning point is called a minimum. On a negative parabola, the turning point is called a maximum.		
113	**Completing the Square (when $\boldsymbol{a} = \mathbf{1}$)**	A quadratic in the form $x^2 + bx + c$ can be written in the form $(x+p)^2 + q$ 1. Write a set of brackets with x in and half the value of b. 2. Square the bracket. 3. Subtract $\left(\frac{b}{2}\right)^2$ and add c. 4. Simplify the expression. This helps you find the maximum or minimum of a quadratic graph.	Complete the square of $y = x^2 - 6x + 2$ Answer: $(x-3)^2 - 3^2 + 2$ $= (x-3)^2 - 7$ The minimum value of this expression occurs when $(x-3)^2 = 0$, which occurs when $x = 3$ When $x = 3$, $y = 0 - 7 = -7$ Minimum point = $(3, -7)$	

	MATHS – YEAR 11 Higher Tier			RAG
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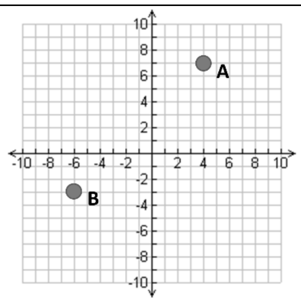
114	**Completing the Square (when $a \neq 1$)**	A quadratic in the form $ax^2 + bx + c$ can be written in the form $p(x+q)^2 + r$. Use the same method as above, but factorise out a at the start.	Complete the square of $4x^2 + 8x - 3$ Answer: $4[x^2 + 2x] - 3$ $= 4[(x+1)^2 - 1^2] - 3$ $= 4(x+1)^2 - 4 - 3$ $= 4(x+1)^2 - 7$	
115	**Solving Quadratics by Completing the Square**	Complete the square in the usual way and use inverse operations to solve.	Solve $x^2 + 8x + 1 = 0$ Answer: $(x+4)^2 - 4^2 + 1 = 0$ $(x+4)^2 - 15 = 0$ $(x+4)^2 = 15$ $(x+4) = \pm\sqrt{15}$ $x = -4 \pm \sqrt{15}$	
116	**Solving Quadratics using the Quadratic Formula**	A quadratic in the form $ax^2 + bx + c = 0$ can be solved using the formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ Use the formula if the quadratic does not factorise easily.	Solve $3x^2 + x - 5 = 0$ Answer: $a = 3, b = 1, c = -5$ $x = \frac{-1 \pm \sqrt{1^2 - 4 \times 3 \times -5}}{2 \times 3}$ $x = \frac{-1 \pm \sqrt{61}}{6}$ $x = 1.14 \ or - 1.47 \ (2 \ d.p.)$	
117	**Coordinates**	Written in pairs. The first term is the x-coordinate (movement across). The second term is the y-coordinate (movement up or down).	 A: (4,7) B: (-6,-3)	

<table>
<tr><th colspan="4">MATHS – YEAR 11
Higher Tier</th><th>RAG</th></tr>
<tr><td></td><td colspan="3">Whole year:</td><td></td></tr>
<tr><td>118</td><td>Midpoint of a Line</td><td>Method 1: add the x coordinates and divide by 2, add the y coordinates and divide by 2.

Method 2: Sketch the line and find the values half way between the two x and two y values.</td><td>Find the midpoint between (2,1) and (6,9)

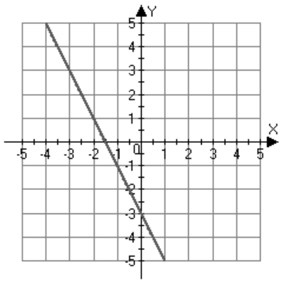
$\frac{2+6}{2} = 4$ and $\frac{1+9}{2} = 5$

So, the midpoint is (4,5)</td><td></td></tr>
<tr><td>119</td><td>Linear Graph</td><td>Straight line graph.

The general equation of a linear graph is

$$y = mx + c$$

where m is the gradient and c is the y-intercept.

The equation of a linear graph can contain an x-term, a y-term and a number.</td><td>
Example:

Other examples:

$x = y$

$y = 4$

$x = -2$

$y = 2x - 7$

$y + x = 10$

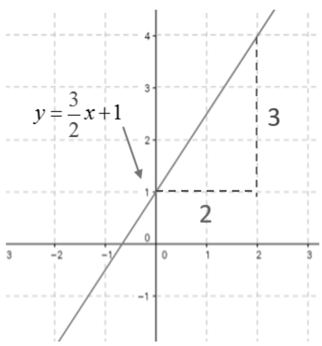
$2y - 4x = 12$</td><td></td></tr>
<tr><td>120</td><td>Plotting Linear Graphs</td><td>Method 1: Table of Values

Construct a table of values to calculate coordinates.

Method 2: Gradient-Intercept Method (use when the equation is in the form $y = mx + c$)

1. Plots the y-intercept

2. Using the gradient, plot a second point.

3. Draw a line through the two points plotted.</td><td><table><tr><td>x</td><td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>y= x +3</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr></table>
</td><td></td></tr>
</table>

	MATHS – YEAR 11 **Higher Tier**			**RAG**
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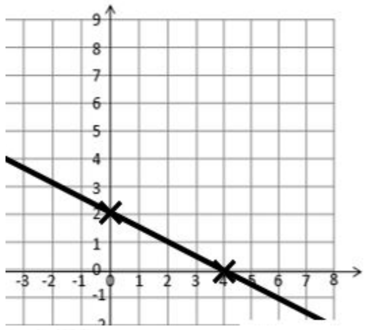
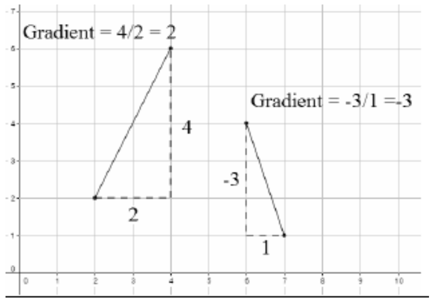
	Plotting Linear Graphs	Method 3: Cover-Up Method (use when the equation is in the form $ax + by = c$) 1. Cover the x term and solve the resulting equation. Plot this on the $x - axis$. 2. Cover the y term and solve the resulting equation. Plot this on the $y - axis$. 3. Draw a line through the two points plotted.	 $2x + 4y = 8$	
121	**Gradient**	The gradient of a line is how steep it is. Gradient = $\frac{Change\ in\ y}{Change\ in\ x} = \frac{Rise}{Run}$ The gradient can be positive (sloping upwards) or negative (sloping downwards)	 	
122	**Finding the Equation of a Line given a point and a gradient**	Substitute in the gradient (m) and point (x,y) in to the equation $y = mx + c$ and solve for c.	Find the equation of the line with gradient 4 passing through (2,7). $y = mx + c$ $7 = 4 \times 2 + c$ $c = -1$ $y = 4x - 1$	

	Whole year:			RAG
123	**Finding the Equation of a Line given two points**	Use the two points to calculate the gradient. Then repeat the method above using the gradient and either of the points.	Find the equation of the line passing through (6,11) and (2,3) $m = \frac{11-3}{6-2} = 2$ $y = mx + c$ $11 = 2 \times 6 + c$ $c = -1$ $y = 2x - 1$	
124	**Parallel Lines**	If two lines are parallel, they will have the same gradient. The value of m will be the same for both lines.	Are the lines $y = 3x - 1$ and $2y - 6x + 10 = 0$ parallel? Answer: Rearrange the second equation in to the form $y = mx + c$ $2y - 6x + 10 = 0 \rightarrow y = 3x - 5$ Since the two gradients are equal (3), the lines are parallel.	
125	**Perpendicular Lines**	If two lines are perpendicular, the product of their gradients will always equal -1. The gradient of one line will be the negative reciprocal of the gradient of the other line. You may need to rearrange equations of lines to compare gradients (they need to be in the form $y = mx + c$)	Find the equation of the line perpendicular to $y = 3x + 2$ which passes through (6,5) Answer: As they are perpendicular, the gradient of the new line will be $-\frac{1}{3}$ as this is the negative reciprocal of 3. $y = mx + c$ $5 = -\frac{1}{3} \times 6 + c$ $c = 7$ $y = -\frac{1}{3}x + 7$ Or $3x + x - 7 = 0$	

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126	**Linear Sequence**	A number pattern with a common difference.	2, 5, 8, 11… is a linear sequence	
127	**Term**	Each value in a sequence is called a term.	In the sequence 2, 5, 8, 11…, 8 is the third term of the sequence.	
128	**Term-to-term rule**	A rule which allows you to find the next term in a sequence if you know the previous term.	First term is 2. Term-to-term rule is 'add 3' Sequence is: 2, 5, 8, 11…	
129	**nth term**	A rule which allows you to calculate the term that is in the nth position of the sequence. Also known as the 'position-to-term' rule. n refers to the position of a term in a sequence.	nth term is $3n - 1$ The 100th term is $3 \times 100 - 1 = 299$	
130	**Finding the nth term of a linear sequence**	1. Find the difference. 2. Multiply that by n. 3. Substitute $n = 1$ to find out what number you need to add or subtract to get the first number in the sequence.	Find the nth term of: 3, 7, 11, 15… 1. Difference is +4 2. Start with $4n$ 3. $4 \times 1 = 4$, so we need to subtract 1 to get 3. nth term = $4n - 1$	
131	**Fibonacci type sequences**	A sequence where the next number is found by adding up the previous two terms	The Fibonacci sequence is: $1,1,2,3,5,8,13,21,34 \ldots$ An example of a Fibonacci-type sequence is: $4, 7, 11, 18, 29 \ldots$	

	MATHS – YEAR 11 Higher Tier			RAG
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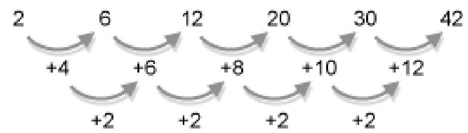
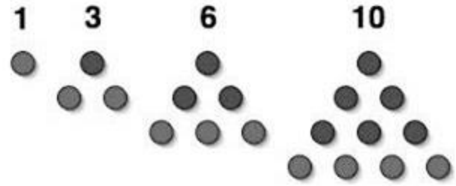
132	**Geometric Sequence**	A sequence of numbers where each term is found by multiplying the previous one by a number called the common ratio, r.	An example of a geometric sequence is: $2, 10, 50, 250 \ldots$ The common ratio is 5 Another example of a geometric sequence is: $81, -27, 9, -3, 1 \ldots$ The common ratio is $-\frac{1}{3}$	
133	**Quadratic Sequence**	A sequence of numbers where the second difference is constant. A quadratic sequence will have a n^2 term.		
134	**Triangular numbers**	The sequence which comes from a pattern of dots that form a triangle. $1, 3, 6, 10, 15, 21 \ldots$		
135	**Inequality**	An inequality says that two values are not equal. $a \neq b$ means that a is not equal to b.	$7 \neq 3$ $x \neq 0$	
136	**Inequality symbols**	$x > 2$ means x is greater than 2 $x < 3$ means x is less than 3 $x \geq 1$ means x is greater than or equal to 1 $x \leq 6$ means x is less than or equal to 6	State the integers that satisfy $-2 < x \leq 4.$ -1, 0, 1, 2, 3, 4	

MATHS – YEAR 11 Higher Tier				RAG
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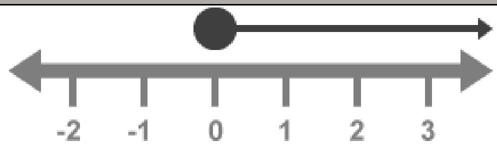
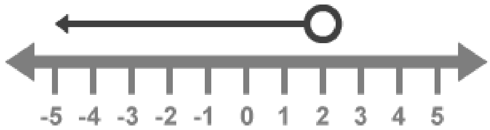
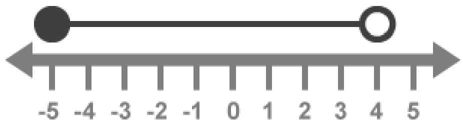
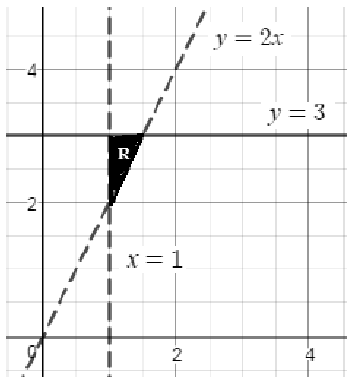
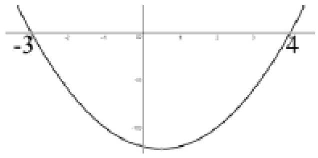
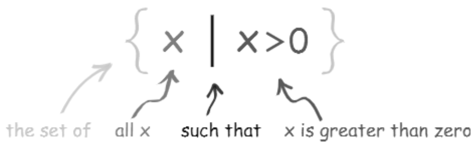
137	**Inequalities on a Number Line**	Inequalities can be shown on a number line. Open circles are used for numbers that are less than or greater than $(< or >)$ Closed circles are used for numbers that are less than or equal or greater than or equal $(\leq or \geq)$	 $x \geq 0$  $x < 2$  $-5 \leq x < 4$	
138	**Graphical Inequalities**	Inequalities can be represented on a coordinate grid. If the inequality is strict $(x > 2)$ then use a dotted line. If the inequality is not strict $(x \leq 6)$ then use a solid line. Shade the region which satisfies all the inequalities.	Shade the region that satisfies: $y > 2x, x > 1$ and $y \leq 3$ 	

				RAG
	Whole year:			
139	**Quadratic Inequalities**	Sketch the quadratic graph of the inequality. If the expression is $> or \geq$ then the answer will be above the x-axis. If the expression is $< or \leq$ then the answer will be below the x-axis. Look carefully at the inequality symbol in the question. Look carefully if the quadratic is a positive or negative parabola.	Solve the inequality $x^2 - x - 12 < 0$ Sketch the quadratic:  The required region is below the x-axis, so the final answer is: $-3 < x < 4$ If the question had been > 0, the answer would have been: $x < -3 \; or \; x > 4$	
140	**Set Notation**	A set is a collection of things, usually numbers, denoted with brackets { } $\{x \mid x \geq 7\}$ means 'the set of all x's, such that x is greater than or equal to 7' The 'x' can be replaced by any letter. Some people use ':' instead of '|'	$\{3, 6, 9\}$ is a set.  $\{x : \; -2 \leq x < 5\}$	
141	**Simultaneous Equations**	A set of two or more equations, each involving two or more variables (letters). The solutions to simultaneous equations satisfy both/all of the equations.	$2x + y = 7$ $3x - y = 8$ $x = 3$ $y = 1$	
142	**Variable**	A symbol, usually a letter, which represents a number which is usually unknown.	In the equation $x + 2 = 5$, x is the variable.	

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143	**Coefficient**	A number used to multiply a variable. It is the number that comes before/in front of a letter.	6z 6 is the coefficient z is the variable	
144	**Solving Simultaneous Equations (by Elimination)**	1. Balance the coefficients of one of the variables. 2. Eliminate this variable by adding or subtracting the equations (Same Sign Subtract, Different Sign Add) 3. Solve the linear equation you get using the other variable. 4. Substitute the value you found back into one of the previous equations. 5. Solve the equation you get. 6. Check that the two values you get satisfy both of the original equations.	$5x + 2y = 9$ $10x + 3y = 16$ Multiply the first equation by 2. $10x + 4y = 18$ $10x + 3y = 16$ Same Sign Subtract (+10x on both) $y = 2$ Substitute $y = 2$ in to equation. $5x + 2 \times 2 = 9$ $5x + 4 = 9$ $5x = 5$ $x = 1$ Solution: $x = 1, y = 2$	
145	**Solving Simultaneous Equations (by Substitution)**	1. Rearrange one of the equations into the form $y = \ldots$ or $x = \ldots$ 2. Substitute the right-hand side of the rearranged equation into the other equation. 3. Expand and solve this equation. 4. Substitute the value into the $y = \ldots$ or $x = \ldots$ equation. 5. Check that the two values you get satisfy both of the original equations.	$y - 2x = 3$ $3x + 4y = 1$ Rearrange: $y - 2x = 3 \rightarrow y = 2x + 3$ Substitute: $3x + 4(2x + 3) = 1$ Solve: $3x + 8x + 12 = 1$ $11x = -11$ $x = -1$ Substitute: $y = 2 \times -1 + 3$ $y = 1$ Solution: $x = -1, y = 1$	

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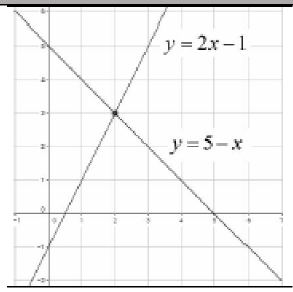
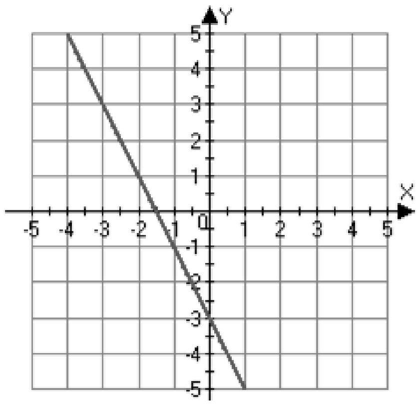
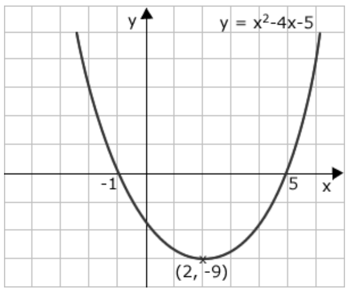
146.	**Solving Simultaneous Equations** **(Graphically)**	Draw the graphs of the two equations. The solutions will be where the lines meet. The solution can be written as a coordinate.	 $y = 5 - x$ and $y = 2x - 1$. They meet at the point with coordinates (2,3) so the answer is $x = 2$ and $y = 3$	
147.	**Linear Graph**	Straight line graph. The equation of a linear graph can contain an x-term, a y-term and a number. Examples: $x = y$ $y = 4$ $x = -2$ $y = 2x - 7$ $y + x = 10$ $2y - 4x = 12$	Example: 	
148.	**Quadratic Graph**	A 'U-shaped' curve called a parabola. The equation is of the form $y = ax^2 + bx + c$, where a, b and c are numbers, $a \neq 0$. If $a < 0$, the parabola is upside down.		

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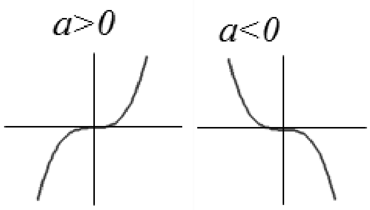
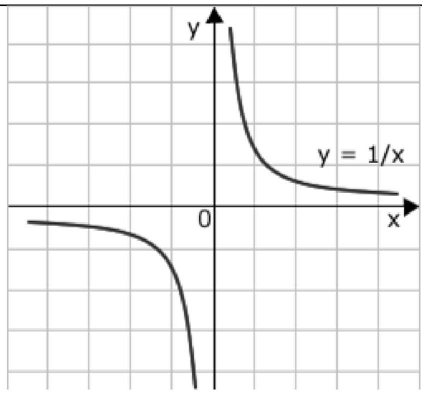
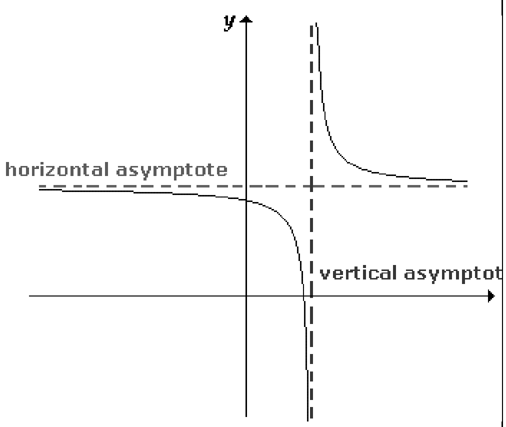
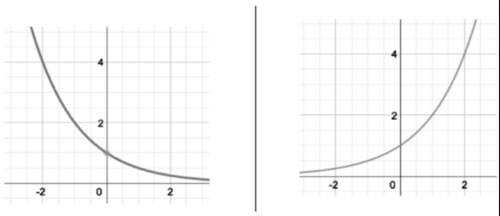
149	**Cubic Graph**	The equation is of the form $y = ax^3 + k$, where k is an number. If $a > 0$, the curve is increasing. If $a < 0$, the curve is decreasing.		
150	**Reciprocal Graph**	The equation is of the form $y = \frac{A}{x}$, where A is a number and $x \neq 0$. The graph has asymptotes on the x-axis and y-axis.		
151	**Asymptote**	A straight line that a graph approaches but never touches.		
152	**Exponential Graph**	The equation is of the form $y = a^x$, where a is a number called the base. If $a > 1$ the graph increases. If $0 < a < 1$, the graph decreases. The graph has an asymptote which is the x-axis.		

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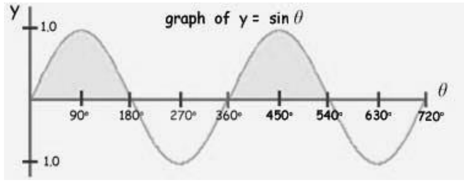
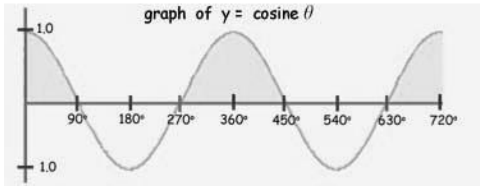
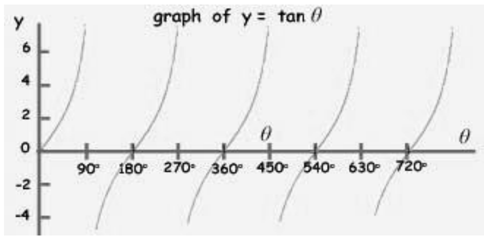
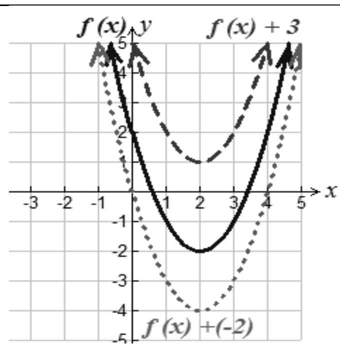
153	$y = \sin x$	Key Coordinates: $(0,0),(90,1),(180,0),(270,-1),($ y is never more than 1 or less than -1. Pattern repeats every 360°.		
154	$y = \cos x$	Key Coordinates: $(0,1),(90,0),(180,-1),$ $(270,0),(360,1)$ y is never more than 1 or less than -1. Pattern repeats every 360°.		
155	$y = \tan x$	Key Coordinates: $(0,0),(45,1),(135,-1),(180,0),$ $(225,1),(315,-1),(360,0)$ Asymptotes at $x = 90$ and $x = 270$ Pattern repeats every 360°.		
156	$f(x) + a$	Vertical translation up a units. $\binom{0}{a}$		

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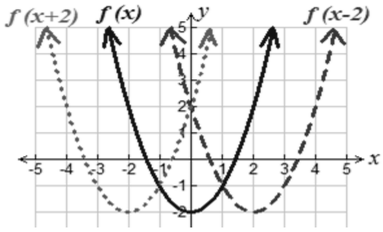
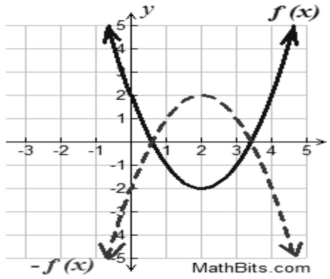
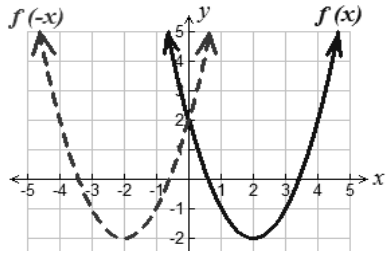
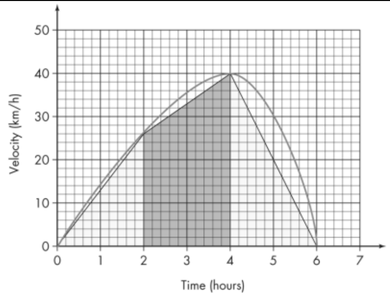
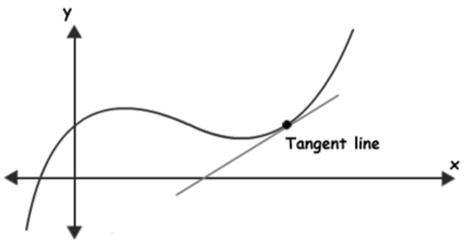
157	$\boldsymbol{f(x+a)}$	Horizontal translation left a units. $\begin{pmatrix} -a \\ 0 \end{pmatrix}$		
158	$\boldsymbol{-f(x)}$	Reflection over the x-axis.		
159	$\boldsymbol{f(-x)}$	Reflection over the y-axis.		
160	**Area Under a Curve**	To find the area under a curve, split it up into simpler shapes – such as rectangles, triangles and trapeziums – that approximate the area.		
161	**Tangent to a Curve**	A straight line that touches a curve at exactly one point.		

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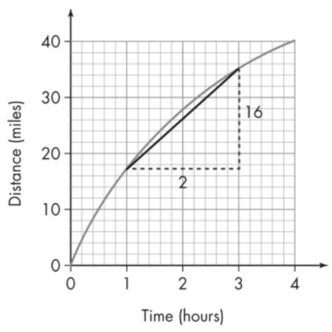
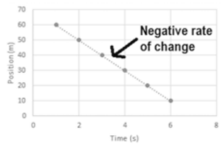
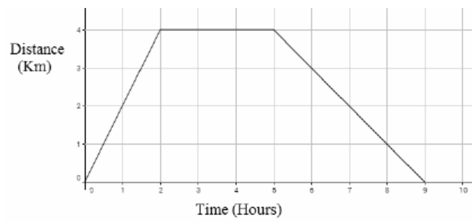
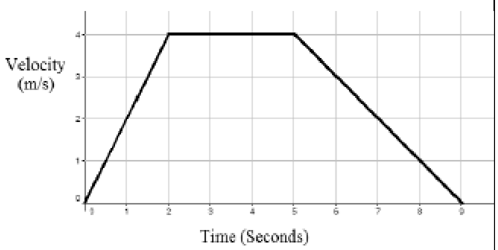
162	**Gradient of a Curve**	The gradient of a curve at a point is the same as the gradient of the tangent at that point. 1. Draw a tangent carefully at the point. 2. Make a right-angled triangle. 3. Use the measurements on the axes to calculate the rise and run (change in y and change in x) 4. Calculate the gradient.	 $Gradient = \frac{Change\ in\ y}{Change\ in\ x}$ $= \frac{16}{2} = 8$	
163	**Rate of Change**	The rate of change at a particular instant in time is represented by the gradient of the tangent to the curve at that point.		
164	**Distance-Time Graphs**	You can find the speed from the gradient of the line (Distance ÷ Time) The steeper the line, the quicker the speed. A horizontal line means the object is not moving (stationary).		
165	**Velocity-Time Graphs**	You can find the acceleration from the gradient of the line (Change in Velocity ÷ Time) The steeper the line, the quicker the acceleration. A horizontal line represents no acceleration, meaning a constant velocity. The area under the graph is the distance.		

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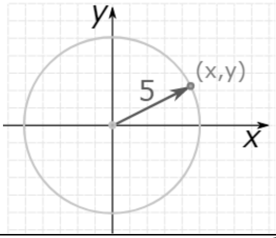
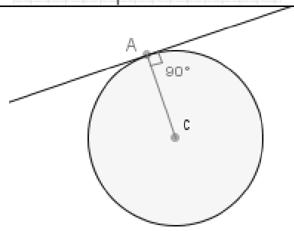
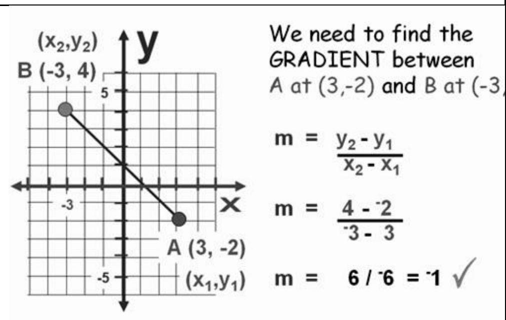
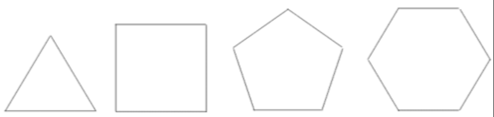
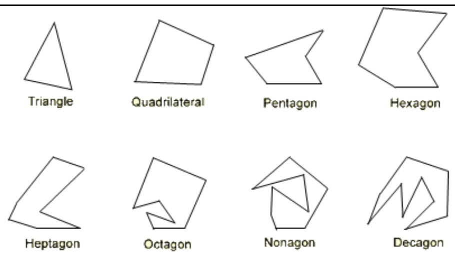
166	**Equation of a Circle**	The equation of a circle, centre (0,0), radius r, is: $x^2 + y^2 = r^2$	 $x^2 + y^2 = 25$	
167	**Tangent**	A straight line that touches a circle at exactly one point, never entering the circle's interior. A radius is perpendicular to a tangent at the point of contact.		
168	**Gradient**	Gradient is another word for slope. $G = \frac{Rise}{Run} = \frac{Change\ in\ y}{Change\ in\ x} = \frac{y_2 - y_1}{x_2 - x_1}$		
169	**Polygon**	A 2D shape with only straight edges.	Rectangle, Hexagon, Decagon, Kite etc.	
170	**Regular**	A shape is regular if all the sides and all the angles are equal.	Some examples: 	
171	**Names of Polygons**	3-sided = Triangle 4-sided = Quadrilateral 5-sided = Pentagon 6-sided = Hexagon 7-sided = Heptagon 8-sided = Octagon 9-sided = Nonagon 10-sided = Decagon		

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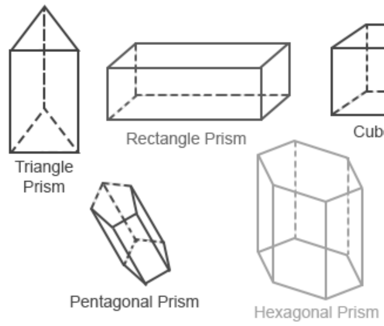
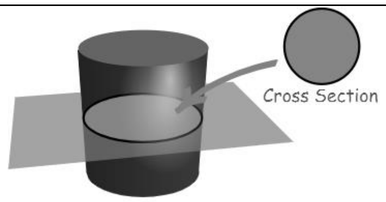
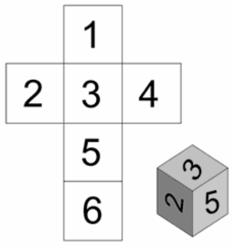
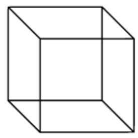
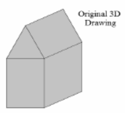
172	**Prism**	A prism is a 3D shape whose cross section is the same throughout.		
173	**Cross Section**	The cross section is the shape that continues all the way through the prism.		
174	**Net**	A pattern that you can cut and fold to make a model of a 3D shape.		
175	**Properties of Solids**	Faces = flat surfaces Edges = sides/lengths Vertices = corners	A cube has 6 faces, 12 edges and 8 vertices. 	
176	**Plans and Elevations**	This takes 3D drawings and produces 2D drawings. Plan View: from above Side Elevation: from the side Front Elevation: from the front	 	

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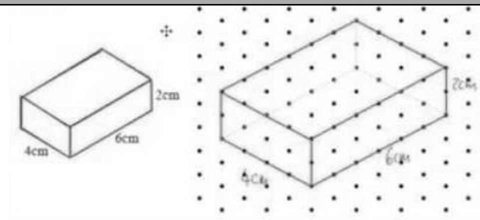
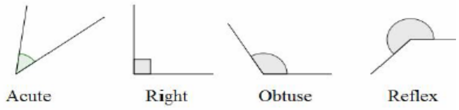
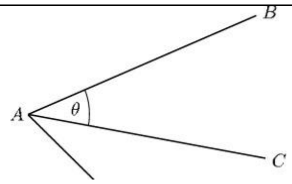
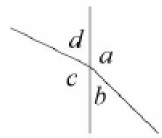
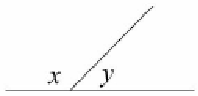
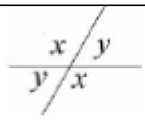
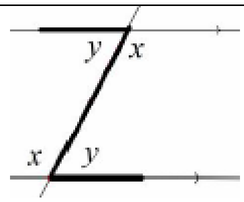
177	**Isometric Drawing**	A method for visually representing 3D objects in 2D.		
178	**Types of Angles**	Acute angles are less than 90°. Right angles are exactly 90°. Obtuse angles are greater than 90° but less than 180°. Reflex angles are greater than 180° but less than 360°.		
179	**Angle Notation**	Can use one lower-case letters, eg. θ or x Can use three upper-case letters, eg. BAC		
180	**Angles at a Point**	Angles around a point add up to 360°.	 $a+b+c+d=360^o$	
181	**Angles on a Straight Line**	Angles around a point on a straight line add up to 180°.	 $x+y=180^o$	
182	**Opposite Angles**	Vertically opposite angles are equal.		
183	**Alternate Angles**	Alternate angles are equal. They look like Z angles, but never say this in the exam.		

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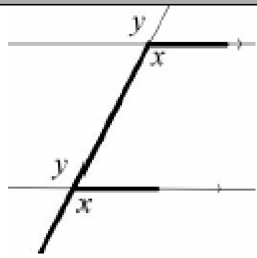
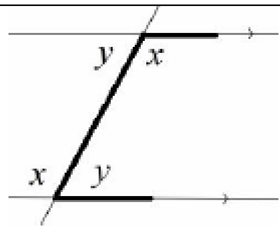
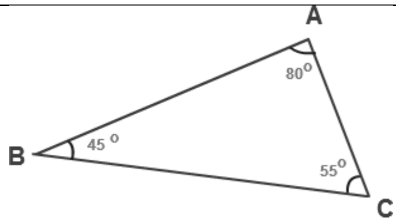
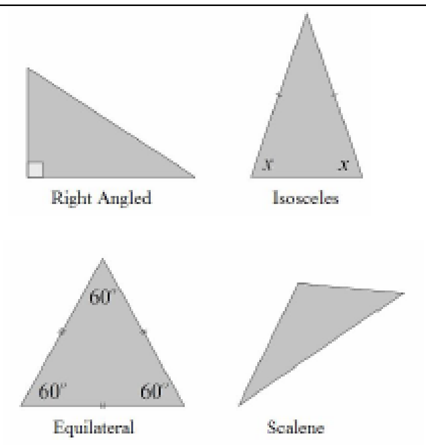
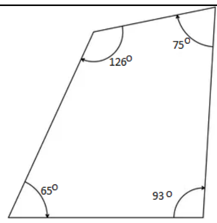
184	**Corresponding Angles**	Corresponding angles are equal. They look like F angles, but never say this in the exam.		
185	**Co-Interior Angles**	Co-Interior angles add up to 180°. They look like C angles, but never say this in the exam.		
186	**Angles in a Triangle**	Angles in a triangle add up to 180°.		
187	**Types of Triangles**	Right Angle Triangles have a 90° angle in. Isosceles Triangles have 2 equal sides and 2 equal base angles. Equilateral Triangles have 3 equal sides and 3 equal angles (60°). Scalene Triangles have different sides and different angles. Base angles in an isosceles triangle are equal.		
188	**Angles in a Quadrilateral**	Angles in a quadrilateral add up to 360°.		
189	**Sum of Interior Angles**	$(n-2) \times 180$ where n is the number of sides.	Sum of Interior Angles in a Decagon = $(10-2) \times 180 = 1440°$	

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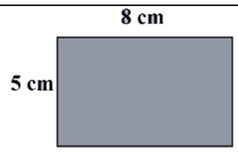
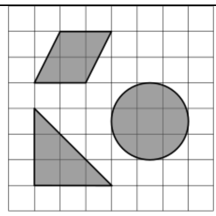
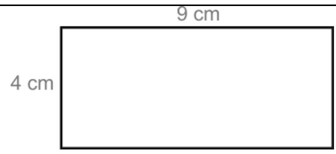
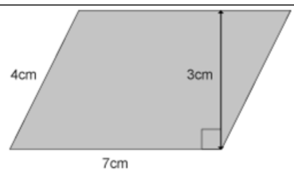
190	**Size of Interior Angle in a Regular Polygon**	$\frac{(n-2)\times 180}{n}$ You can also use the formula: $180 - Size\ of\ Exterior\ Angle$	Size of Interior Angle in a Regular Pentagon = $\frac{(5-2)\times 180}{5} = 108°$	
191	**Size of Exterior Angle in a Regular Polygon**	$\frac{360}{n}$ You can also use the formula: $180 - Size\ of\ Interior\ Angle$	Size of Exterior Angle in a Regular Octagon = $\frac{360}{8} = 45°$	
192	**Perimeter**	The total distance around the outside of a shape. Units include: mm, cm, m etc.	 $P = 8+5+8+5 = 26cm$	
193	**Area**	The amount of space inside a shape. Units include: mm^2, cm^2, m^2		
194	**Area of a Rectangle**	Length x Width	 $A = 36cm^2$	
195	**Area of a Parallelogram**	Base x Perpendicular Height Not the slanted height.	 $A = 21cm^2$	

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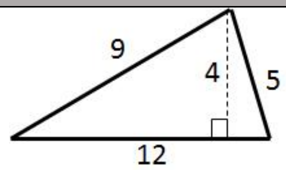
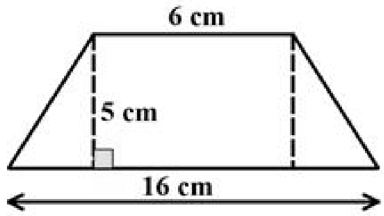
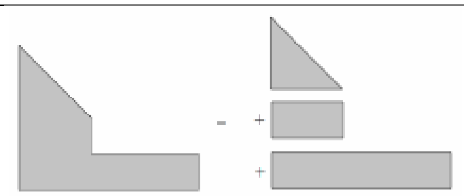
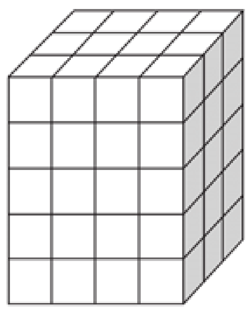
196	**Area of a Triangle**	Base x Height ÷ 2	 $A = 24cm^2$	
197	**Area of a Trapezium**	$\frac{(a+b)}{2} \times h$ "Half the sum of the parallel side, times the height between them. That is how you calculate the area of a trapezium"	 (a = 6, b = 16, h = 5) $A = 55cm^2$	
198	**Compound Shape**	A shape made up of a combination of other shapes put together		
199	**Surface Area**	The total area of the surface of a three-dimensional object.	The surface area of a cube is the area of all 6 faces added together.	
200	**Volume**	Volume is a measure of the amount of space inside a solid shape. Units: mm^3, cm^3, m^3 etc.		

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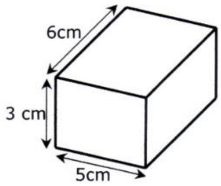
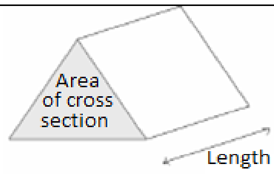
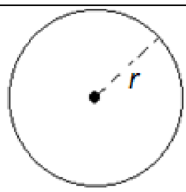
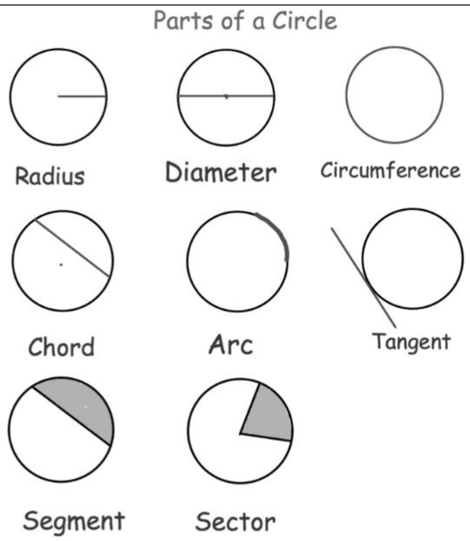
201	**Volume of a Cube/Cuboid**	$\boldsymbol{V = Area\ of\ Cross\ Section \times Length}$ Volume = area of cross-section x length Volume = 5 x 3 x length Volume = 15 x 6 = 90 cm^2		
202	**Volume of a Prism**	$\boldsymbol{V = Area\ of\ Cross\ Section \times Length}$ $\boldsymbol{V = A \times L}$		
203	**Circle**	A circle is the locus of all points equidistant from a central point.		
204	**Parts of a Circle**	Radius – the distance from the centre of a circle to the edge Diameter – the total distance across the width of a circle through the centre. Circumference – the total distance around the outside of a circle Chord – a straight line whose end points lie on a circle Tangent – a straight line which touches a circle at exactly one point Arc – a part of the circumference of a circle Sector – the region of a circle enclosed by two radii and their intercepted arc Segment – the region bounded by a chord and the arc created by the chord		

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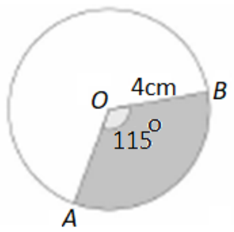
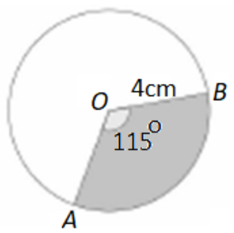
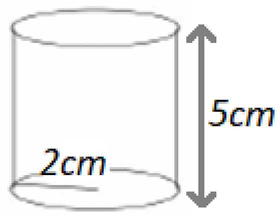
205	**Area of a Circle**	$\boldsymbol{A = \pi r^2}$ which means 'pi x radius squared'.	If the radius was 5cm, then: $A = \pi \times 5^2 = 78.5cm^2$	
206	**Circumference of a Circle**	$\boldsymbol{C = \pi d}$ which means 'pi x diameter'	If the radius was 5cm, then: $C = \pi \times 10 = 31.4cm$	
207	**π ('pi')**	Pi is the circumference of a circle divided by the diameter. $\boldsymbol{\pi \approx 3.14}$		
208	**Arc Length of a Sector**	The arc length is part of the circumference. Take the angle given as a fraction over 360° and multiply by the circumference.	Arc Length = $\frac{115}{360} \times \pi \times 8 =$ $8.03cm$ 	
209	**Area of a Sector**	The area of a sector is part of the total area. Take the angle given as a fraction over 360° and multiply by the area.	Area = $\frac{115}{360} \times \pi \times 4^2 = 16.1cm^2$ 	
210	**Volume of a Cylinder**	$\boldsymbol{V = \pi r^2 h}$	 $V = \pi(4)(5)$ $= 62.8cm^3$	

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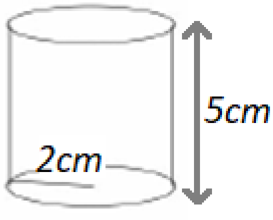
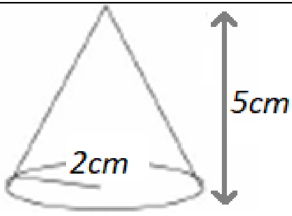
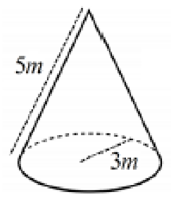
211	**Surface Area of a Cylinder**	Curved Surface Area = $\boldsymbol{\pi dh}$ or $\boldsymbol{2\pi rh}$ Total SA = $\boldsymbol{2\pi r^2 + \pi dh}$ or $\boldsymbol{2\pi r^2 + 2\pi rh}$	 $Total\ SA = 2\pi(2)^2 + \pi(4)(5) = 28\pi$	
212	**Volume of a Cone**	$\boldsymbol{V = \frac{1}{3}\pi r^2 h}$ *This formula will be given to you in the exam.*	 $V = \frac{1}{3}\pi(4)(5)$ $= 20.9cm^3$	
213	**Surface Area of a Cone**	*This formula will be given to you in the exam:* Curved Surface Area = $\boldsymbol{\pi rl}$ where $l = slant\ height$ *This formula will **NOT** be given to you in the exam:* Total SA = $\boldsymbol{\pi rl + \pi r^2}$ You may need to use Pythagoras' Theorem to find the slant height	 $Total\ SA = \pi(3)(5) + \pi(3)^2$ $= 24\pi$	
214	**Surface Area of a Sphere**	$This\ formula\ will\ be\ given\ to\ yo$ $\boldsymbol{SA = 4\pi r^2}$ Look out for hemispheres - halve the SA of a sphere and add on a circle (πr^2)	Find the surface area of a sphere with radius 3cm. $SA = 4\pi(3)^2 = 36\pi cm^2$	

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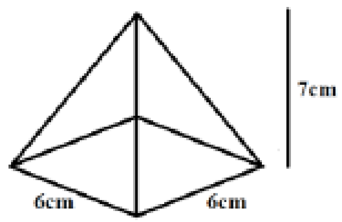
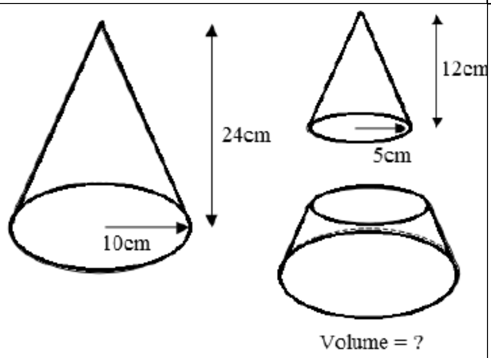
215	**Volume of a Pyramid**	$\boldsymbol{Volume = \frac{1}{3}Bh}$ where B = area of the base *This formula will __NOT__ be given to you in the exam*	 $V = \frac{1}{3} \times 6 \times 6 \times 7 = 84cm^3$	
216	**Volume of a Sphere**	$This\ formula\ will\ be\ given\ to\ you\ in\ the\ exam:$ $\boldsymbol{V = \frac{4}{3}\pi r^3}$ Look out for hemispheres - just halve the volume of a sphere.	Find the volume of a sphere with diameter 10cm. $V = \frac{4}{3}\pi(5)^3 = \frac{500\pi}{3}cm^3$	
217	**Frustums**	A frustum is a solid (usually a cone or pyramid) with the top removed. Find the volume of the whole shape, then take away the volume of the small cone/pyramid removed at the top.	 $V = \frac{1}{3}\pi(10)^2(24) - \frac{1}{3}\pi(5)^2(12)$ $= 700\pi cm^3$	
218	**Metric System for Length**	A system of measures based on: - the metre for length Length: mm, cm, m, km	$1 kilometres = 1000\ metres$ $1\ metre = 100\ centimetres$ $1\ centimetre = 10\ millimetres$	
219	**Metric System for Mass**	A system of measures based on: - the kilogram for mass Mass: mg, g, kg, tonne	$1\ tonne = 1000\ kilograms$ $1\ kilogram = 1000\ grams$ $1\ gram = 1000\ milligrams$	

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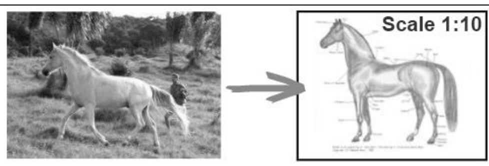
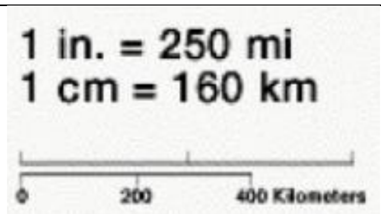
220	**Metric System for Volume**	A system of measures based on: - the litre for volume Volume: ml, cl, l	$1\ litre = 1000\ millilitres$ $1\ centilitre = 10\ millilitres$ $1\ litre = 100\ centilitre$	
221	**Imperial System**	A system of weights and measures originally developed in England, usually based on human quantities Length: inch, foot, yard, miles Mass: lb, ounce, stone Volume: pint, gallon	$1lb = 16\ ounces$ $1\ foot = 12\ inches$ $1\ gallon = 8\ pints$	
222	**Metric and Imperial Units**	Use the unitary method to convert between metric and imperial units.	$5\ miles \approx 8\ kilometres$ $1\ gallon \approx 4.5\ litres$ $2.2\ pounds \approx 1\ kilogram$ $1\ inch = 2.5\ centimetres$	
223	**Scale**	The ratio of the length in a model to the length of the real thing.	 Real Horse *1500 mm high* *2000 mm long* Drawn Horse *150 mm high* *200 mm long*	
224	**Scale (Map)**	The ratio of a distance on the map to the actual distance in real life.		

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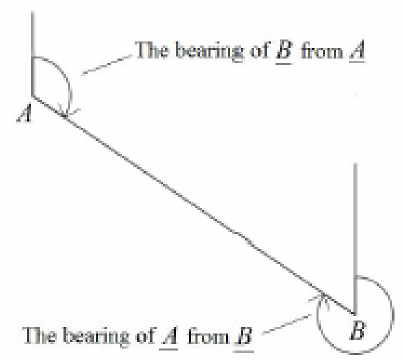
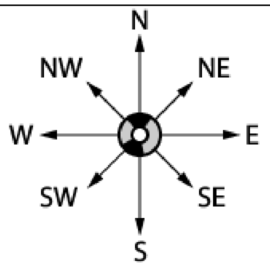
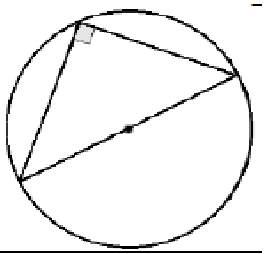
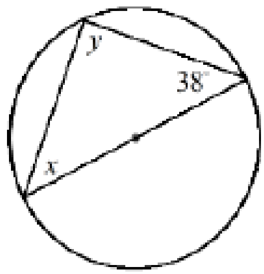
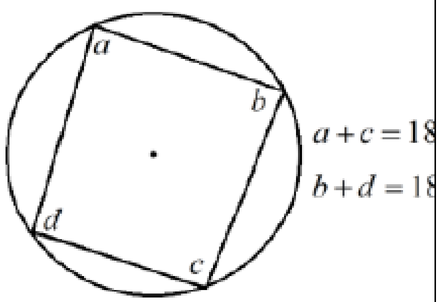
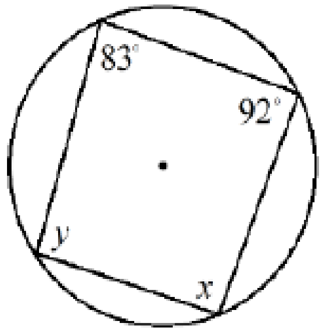
225	**Bearings**	1. Measure from North (draw a North line) 2. Measure clockwise 3. Your answer must have 3 digits (eg. 047°) Look out for where the bearing is measured from.		
226	**Compass Directions**	You can use an acronym such as 'Never Eat Shredded Wheat' to remember the order of the compass directions in a clockwise direction. Bearings: $NE = 045°, W = 270° \ etc.$		
227	**Circle Theorem 1**	Angles in a semi-circle have a right angle at the circumference. 	 $y = 90°$ $x = 180 - 90 - 38 = 52°$	
228	**Circle Theorem 2**	Opposite angles in a cyclic quadrilateral add up to 180°. 	 $x = 180 - 83 = 97°$ $y = 180 - 92 = 88°$	

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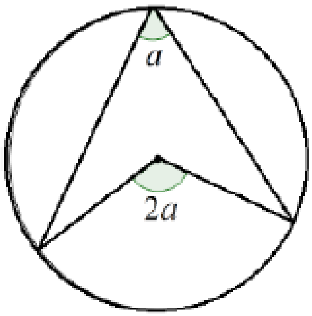
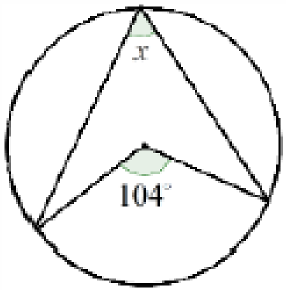
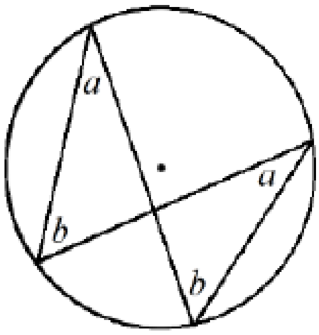
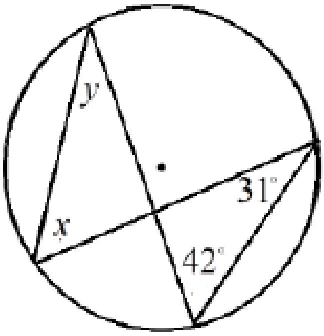
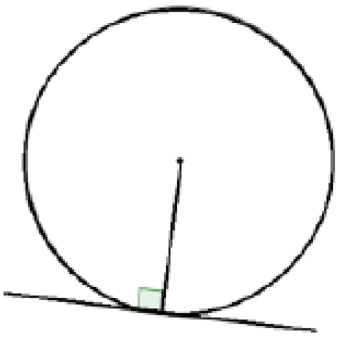
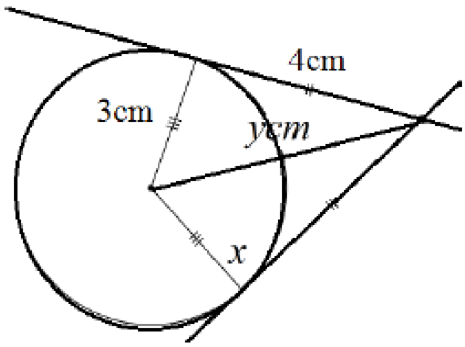
229	**Circle Theorem 3**	The angle at the centre is twice the angle at the circumference. 	 $x = 104 \div 2 = 52°$	
230	**Circle Theorem 4**	Angles in the same segment are equal. 	 $x = 42°$ $y = 31°$	
231	**Circle Theorem 5**	A tangent is perpendicular to the radius at the point of contact. 	 $y = 5cm$ (Pythagoras' Theorem)	

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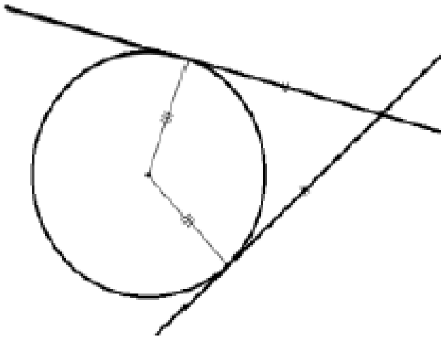
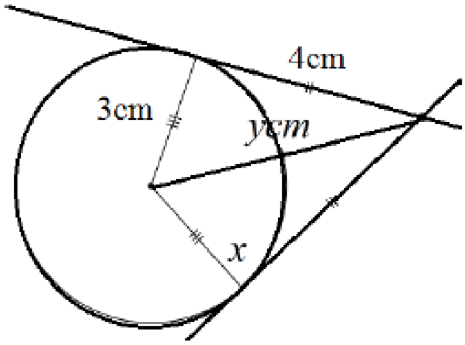
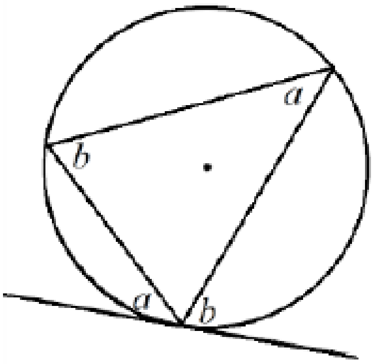
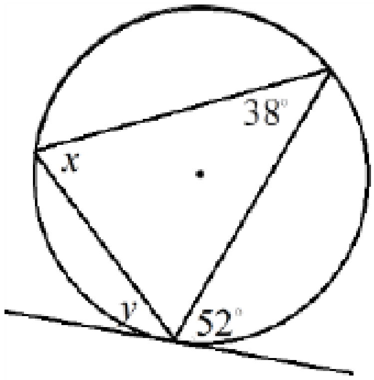
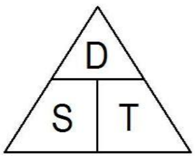
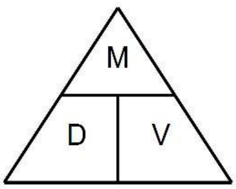
232	**Circle Theorem 6**	Tangents from an external point at equal in length. 	 $x = 90°$	
233	**Circle Theorem 7**	Alternate Segment Theorem 	 $x = 52°,\quad y = 38°$	
234	**Speed, Distance, Time**	Speed = Distance ÷ Time Distance = Speed x Time Time = Distance ÷ Speed  Remember the correct units.	Speed = 4mph Time = 2 hours Find the Distance. $D = S \times T = 4 \times 2 = 8\,miles$	
235	**Density, Mass, Volume**	Density = Mass ÷ Volume Mass = Density x Volume Volume = Mass ÷ Density 	Density = 8kg/m^3 Mass = 2000g Find the Volume. $V = M \div D = 2 \div 8 = 0.25m^3$ Remember the correct units.	

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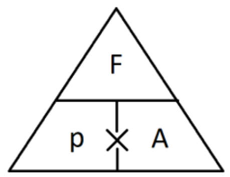
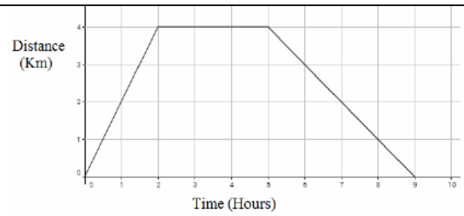
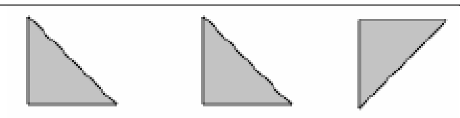
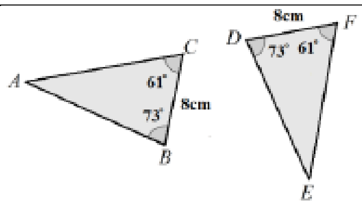
236	**Pressure, Force, Area**	Pressure = Force ÷ Area Force = Pressure x Area Area = Force ÷ Pressure  Remember the correct units.	Pressure = 10 Pascals Area = 6cm^2 Find the Force $F = P \times A = 10 \times 6 = 60\ N$	
237	**Distance-Time Graphs**	You can find the speed from the gradient of the line (Distance ÷ Time) The steeper the line, the quicker the speed. A horizontal line means the object is not moving (stationary).		
238	**Congruent Shapes**	Shapes are congruent if they are identical - same shape and same size. Shapes can be rotated or reflected but still be congruent.		
239	**Congruent Triangles**	4 ways of proving that two triangles are congruent: 1. SSS (Side, Side, Side) 2. RHS (Right angle, Hypotenuse, Side) 3. SAS (Side, Angle, Side) 4. ASA (Angle, Side, Angle) or AAS ASS does not prove congruency.	 $BC = DF$ $\angle ABC = \angle EDF$ $\angle ACB = \angle EFD$ $\therefore$ The two triangles are congruent by AAS.	

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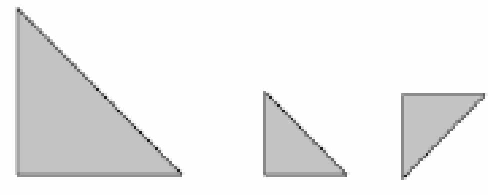
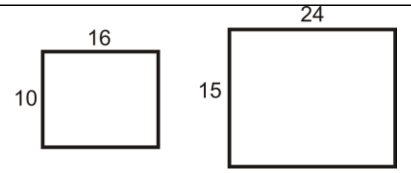
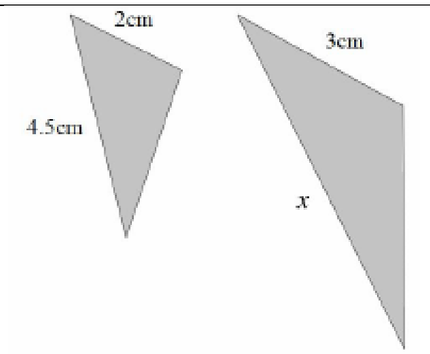
240	**Similar Shapes**	Shapes are similar if they are the same shape but different sizes. The proportion of the matching sides must be the same, meaning the ratios of corresponding sides are all equal.		
241	**Scale Factor**	The ratio of corresponding sides of two similar shapes. To find a scale factor, divide a length on one shape by the corresponding length on a similar shape.	 Scale Factor = $15 \div 10 = 1.5$	
242	**Finding missing lengths in similar shapes**	1. Find the scale factor. 2. Multiply or divide the corresponding side to find a missing length. If you are finding a missing length on the larger shape you will need to multiply by the scale factor. If you are finding a missing length on the smaller shape you will need to divide by the scale factor.	 Scale Factor = $3 \div 2 = 1.5$ $x = 4.5 \times 1.5 = 6.75cm$	
243	**Similar Triangles**	To show that two triangles are similar, show that: 1. The three sides are in the same proportion 2. Two sides are in the same proportion, and their included angle is the same 3. The three angles are equal		

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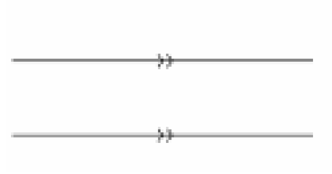
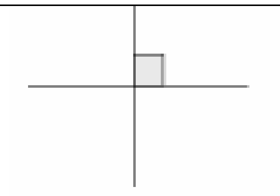
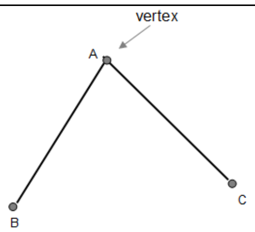
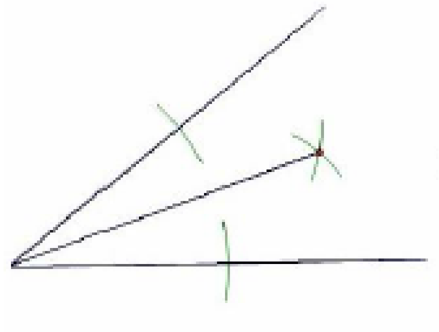
244	**Parallel**	Parallel lines never meet.		
245	**Perpendicular**	Perpendicular lines are at right angles. There is a 90° angle between them.		
246	**Vertex**	A corner or a point where two lines meet.		
247	**Angle Bisector**	Angle Bisector: Cuts the angle in half. 1. Place the sharp end of a pair of compasses on the vertex. 2. Draw an arc, marking a point on each line. 3. Without changing the compass put the compass on each point and mark a centre point where two arcs cross over. 4. Use a ruler to draw a line through the vertex and centre point.	 Angle Bisector 	

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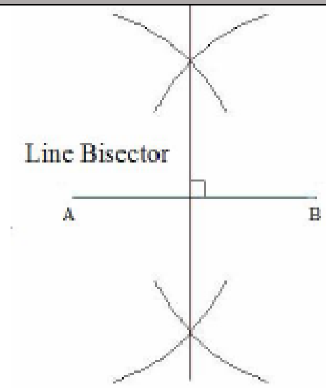
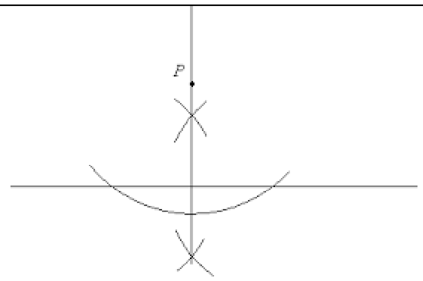
248	**Perpendicular Bisector**	Perpendicular Bisector: Cuts a line in half and at right angles. 1. Put the sharp point of a pair of compasses on A. 2. Open the compass over half way on the line. 3. Draw an arc above and below the line. 4. Without changing the compass, repeat from point B. 5. Draw a straight line through the two intersecting arcs.	 	
249	**Perpendicular from an External Point**	The perpendicular distance from a point to a line is the shortest distance to that line. 1. Put the sharp point of a pair of compasses on the point. 2. Draw an arc that crosses the line twice. 3. Place the sharp point of the compass on one of these points, open over half way and draw an arc above and below the line. 4. Repeat from the other point on the line. 5. Draw a straight line through the two intersecting arcs.	 	

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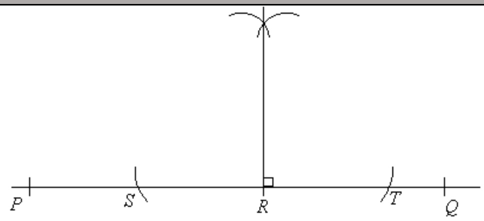
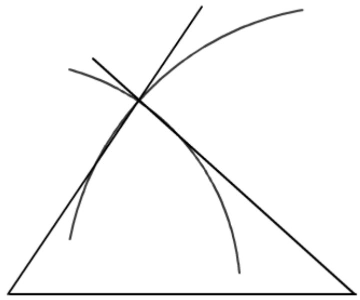
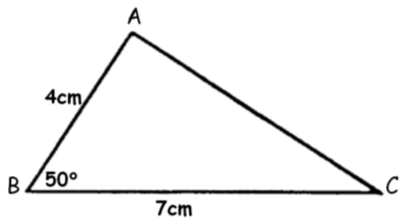
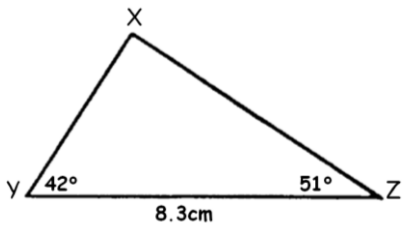
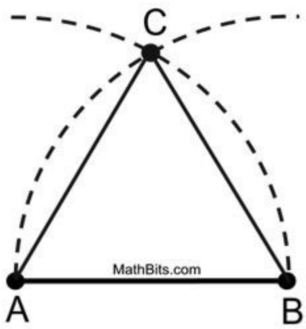
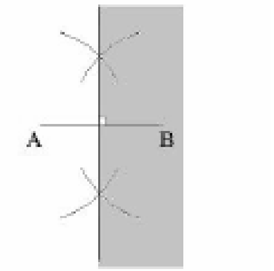
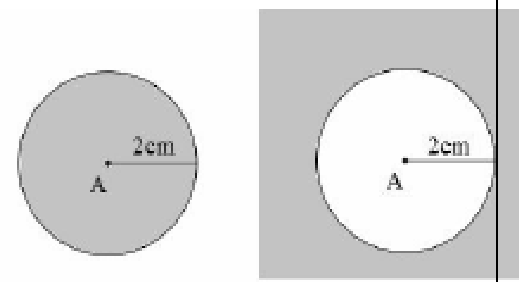
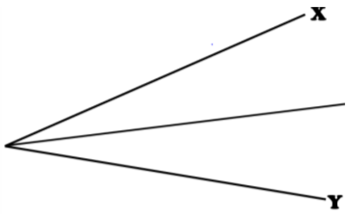
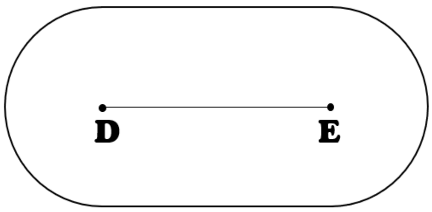
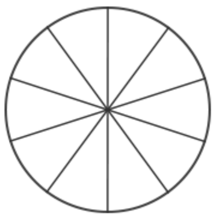
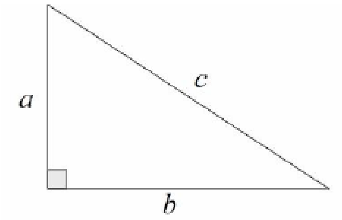
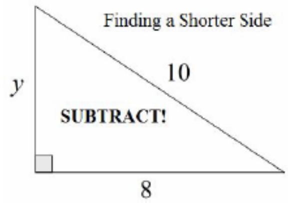
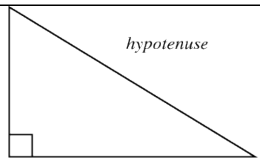
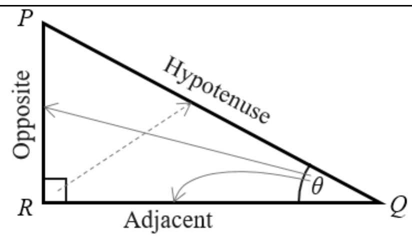
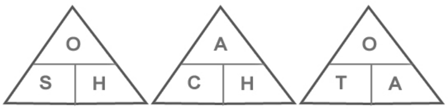
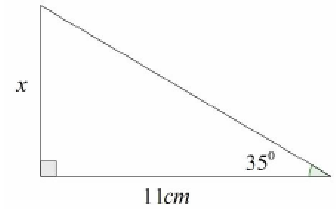
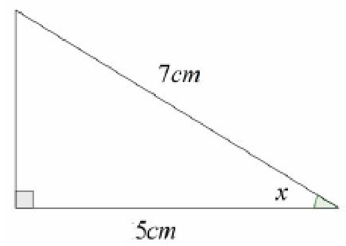
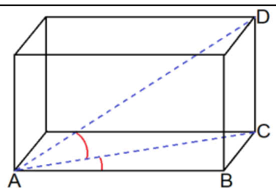
	Whole year:			
250	**Perpendicular from a Point on a Line**	Given line PQ and point R on the line: 1. Put the sharp point of a pair of compasses on point R. 2. Draw two arcs either side of the point of equal width (giving points S and T) 3. Place the compass on point S, open over halfway and draw an arc above the line. 4. Repeat from the other arc on the line (point T). 5. Draw a straight line from the intersecting arcs to the original point on the line.	 	
251	**Constructing Triangles (Side, Side, Side)**	1. Draw the base of the triangle using a ruler. 2. Open a pair of compasses to the width of one side of the triangle. 3. Place the point on one end of the line and draw an arc. 4. Repeat for the other side of the triangle at the other end of the line. 5. Using a ruler, draw lines connecting the ends of the base of the triangle to the point where the arcs intersect.		

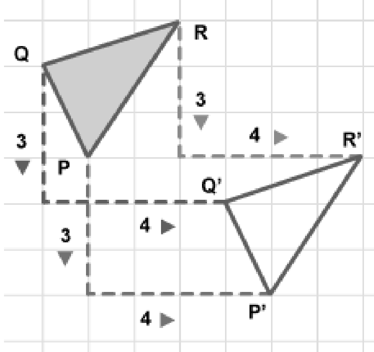
	MATHS – YEAR 11 Higher Tier			RAG
	Whole year:			
252	**Constructing Triangles (Side, Angle, Side)**	1. Draw the base of the triangle using a ruler. 2. Measure the angle required using a protractor and mark this angle. 3. Remove the protractor and draw a line of the exact length required in line with the angle mark drawn. 4. Connect the end of this line to the other end of the base of the triangle.		
253	**Constructing Triangles (Angle, Side, Angle)**	1. Draw the base of the triangle using a ruler. 2. Measure one of the angles required using a protractor and mark this angle. 3. Draw a straight line through this point from the same point on the base of the triangle. 4. Repeat this for the other angle on the other end of the base of the triangle.		
254	**Constructing an Equilateral Triangle (also makes a 60° angle)**	1. Draw the base of the triangle using a ruler. 2. Open the pair of compasses to the exact length of the side of the triangle. 3. Place the sharp point on one end of the line and draw an arc. 4. Repeat this from the other end of the line. 5. Using a ruler, draw lines connecting the ends of the base of the triangle to the point where the arcs intersect.		

MATHS – YEAR 11 Higher Tier				RAG
	Whole year:			
255	**Loci and Regions**	A locus is a path of points that follow a rule. For the locus of points closer to B than A, create a perpendicular bisector between A and B and shade the side closer to B. For the locus of points equidistant from A, use a compass to draw a circle, centre A. For the locus of points equidistant to line X and line Y, create an angle bisector. For the locus of points a set distance from a line, create two semi-circles at either end joined by two parallel lines.	 Points Closer to B than A  Points less than 2cm from A Points more than 2cm from A  	
256	**Equidistant**	A point is equidistant from a set of objects if the distances between that point and each of the objects is the same.		

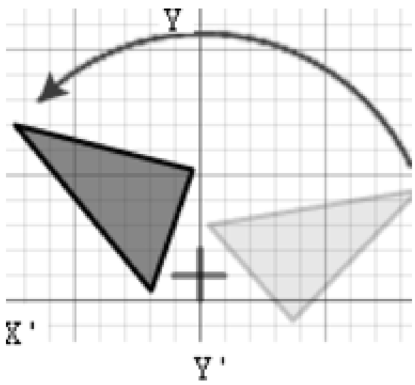
MATHS – YEAR 11 **Higher Tier**				**RAG**
	Whole year:			
257.	**Pythagoras' Theorem**	For any right angled triangle: $$a^2 + b^2 = c^2$$  Used to find missing lengths. a and b are the shorter sides, c is the hypotenuse (longest side).	 $a = y,\ b = 8,\ c = 10$ $a^2 = c^2 - b^2$ $y^2 = 100 - 64$ $y^2 = 36$ $y = 6$	
258.	**3D Pythagoras' Theorem**	Find missing lengths by identifying right angled triangles. You will often have to find a missing length you are not asked for before finding the missing length you are asked for.	Can a pencil that is 20cm long fit in a pencil tin with dimensions 12cm, 13cm and 9cm? The pencil tin is in the shape of a cuboid. Hypotenuse of the base = $\sqrt{12^2 + 13^2} = 17.7$ Diagonal of cuboid = $\sqrt{17.7^2 + 9^2} = 19.8cm$ No, the pencil cannot fit.	
259.	**Trigonometry**	The study of triangles.		
260.	**Hypotenuse**	The longest side of a right-angled triangle. Is always opposite the right angle.		
261.	**Adjacent**	Next to		

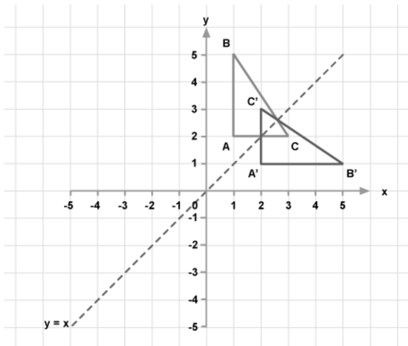
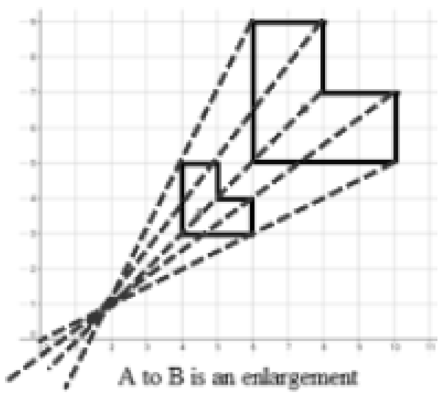
	MATHS – YEAR 11 **Higher Tier**			**RAG**
	Whole year:			
262	**Trigonometric Formulae**	Use SOHCAHTOA. $\sin\theta = \frac{O}{H}$ $\cos\theta = \frac{A}{H}$ $\tan\theta = \frac{O}{A}$  When finding a missing angle, use the 'inverse' trigonometric function by pressing the 'shift' button on the calculator.	 Use 'Opposite' and 'Adjacent', so use 'tan' $\tan 35 = \frac{x}{11}$ $x = 11\tan 35 = 7.70cm$  Use 'Adjacent' and 'Hypotenuse', so use 'cos' $\cos x = \frac{5}{7}$ $x = cos^{-1}\left(\frac{5}{7}\right) = 44.4°$	
263	**3D Trigonometry**	Find missing lengths by identifying right angled triangles. You will often have to find a missing length you are not asked for before finding the missing length you are asked for.		

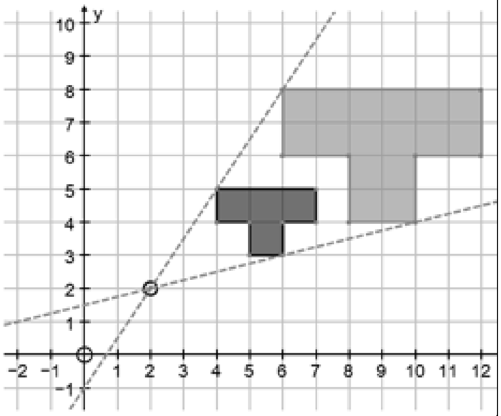
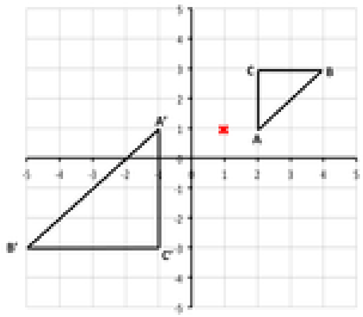
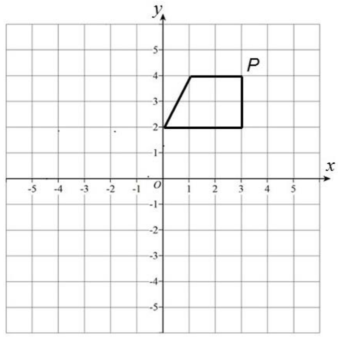
<table>
<tr><th colspan="4">MATHS – YEAR 11
Higher Tier</th><th>RAG</th></tr>
<tr><th></th><th colspan="3">Whole year:</th><th></th></tr>
<tr><td>264</td><td>Exact trig values</td><td colspan="2">
<table>
<tr><th></th><th>0°</th><th>30°</th><th>45°</th><th>60°</th><th>90°</th></tr>
<tr><td>sin θ</td><td>$\frac{\sqrt{0}}{2}$</td><td>$\frac{\sqrt{1}}{2}$</td><td>$\frac{\sqrt{2}}{2}$</td><td>$\frac{\sqrt{3}}{2}$</td><td>$\frac{\sqrt{4}}{2}$</td></tr>
<tr><td>cos θ</td><td>$\frac{\sqrt{4}}{2}$</td><td>$\frac{\sqrt{3}}{2}$</td><td>$\frac{\sqrt{2}}{2}$</td><td>$\frac{\sqrt{1}}{2}$</td><td>$\frac{\sqrt{0}}{2}$</td></tr>
<tr><td>tan θ</td><td>0</td><td>$\frac{\sqrt{3}}{3}$</td><td>1</td><td>$\sqrt{3}$</td><td>$\pm\infty$</td></tr>
</table>
</td><td></td></tr>
<tr><td>265</td><td>Translation</td><td>Translate means to move a shape.

The shape does not change size or orientation.</td><td>
</td><td></td></tr>
<tr><td>266</td><td>Column Vector</td><td>In a column vector, the top number moves left (-) or right (+) and the bottom number moves up (+) or down (-)</td><td>$\begin{pmatrix}2\\3\end{pmatrix}$ means ‘2 right, 3 up’

$\begin{pmatrix}-1\\-5\end{pmatrix}$ means ‘1 left, 5 down’</td><td></td></tr>
<tr><td>267</td><td>Rotation</td><td>The size does not change, but the shape is turned around a point.

Use tracing paper.</td><td>Rotate Shape A 90° anti-clockwise about (0,1)

</td><td></td></tr>
</table>

MATHS – YEAR 11 **Higher Tier**				**RAG**
	Whole year:			
268	**Reflection**	The size does not change, but the shape is 'flipped' like in a mirror. Line $x = ?$ is a vertical line. Line $y = ?$ is a horizontal line. Line $y = x$ is a diagonal line.	Reflect shape C in the line $y = x$  	
269	**Enlargement**	The shape will get bigger or smaller. Multiply each side by the scale factor.	Scale Factor = 3 means '3 times larger = multiply by 3' Scale Factor = ½ means 'half the size = divide by 2'	
270	**Finding the Centre of Enlargement**	Draw straight lines through corresponding corners of the two shapes. The centre of enlargement is the point where all the lines cross over. Be careful with negative enlargements as the corresponding corners will be the other way around.	 A to B is an enlargement SF 2 about the point (2,1)	
271	**Describing Transformations**	Give the following information when describing each transformation: Look at the number of marks in the question for a hint of how many pieces of information are needed. If you are asked to describe a 'transformation', you need to say the name of the type of transformation as well as the other details.	- Translation, Vector - Rotation, Direction, Angle, Centre - Reflection, Equation of mirror line - Enlargement, Scale factor, Centre of enlargement	

MATHS – YEAR 11 Higher Tier				RAG
	Whole year:			
272	**Fractional Scale Factor Enlargements**	A fractional enlargement makes a shape smaller.		
273	**Negative Scale Factor Enlargements**	Negative enlargements will look like they have been rotated. $SF = -2$ will be rotated, and also twice as big.	Enlarge ABC by scale factor -2, centre (1,1) 	
274	**Invariance**	A point, line or shape is invariant if it does not change/move when a transformation is performed. An invariant point 'does not vary'.	If shape P is reflected in the $y-axis$, then exactly one vertex is invariant. 	
275	**Hypothesis**	A hypothesis is a statement that might be true or false but you haven't got enough evidence to support it either way YET. A hypothesis must be testable.	For example: Children who go to bed earlier score higher on their class tests	

MATHS – YEAR 11 Higher Tier				RAG
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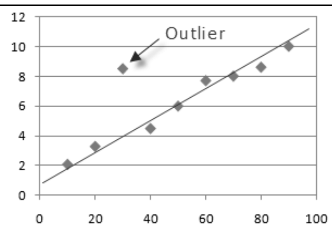
276	**Data Cycle**	The data Cycle has five parts to it: 1. Planning 2. Collecting Data 3. Processing and Representing data 4. Interpreting results Communicating results clearly and evaluating methods		
277	**Constraints**	During the planning phase you should consider the constraints of your investigation: • Time • Cost • Convenience • Ethical issues Confidentiality	For example, people might not want to answer personal questions about their age or where they live.	
278	**Primary**	Data which you have collected yourself	For example, you do a survey on your classmates about their favourite food	
279	**Secondary**	Data which someone else has collected	For example, you use census data to investigate national trends in salaries	
280	**Quantitative**	Numerical data	For example, how many siblings you have or how tall you are	
281	**Qualitative**	Descriptive data (using words not numbers)	For example, your favourite food	
282	**Discrete**	Numerical (quantitative) data which can be counted	For example, how many siblings you have	
283	**Continuous**	Numerical (quantitative) data which can be measured	For example, your mass or height	

<table>
<tr><th colspan="4">MATHS – YEAR 11
Higher Tier</th><th>RAG</th></tr>
<tr><td></td><td colspan="3">Whole year:</td><td></td></tr>
<tr><td>284</td><td>Grouped data</td><td>Data that has been bundled in to categories.

Seen in grouped frequency tables, histograms, cumulative frequency etc.</td><td><table><tr><th>Foot length, l, (cm)</th><th>Number of children</th></tr><tr><td>$10 \leqslant l < 12$</td><td>5</td></tr><tr><td>$12 \leqslant l < 17$</td><td>53</td></tr></table></td><td></td></tr>
<tr><td>285</td><td>Population</td><td>The whole group you are interested in</td><td>e.g. the population of the UK</td><td></td></tr>
<tr><td>286</td><td>Sample</td><td>A group selected from the population</td><td>e.g. the students in our school</td><td></td></tr>
<tr><td>287</td><td>Biased sample</td><td>A sample that does not properly represent the population</td><td></td><td></td></tr>
<tr><td>288</td><td>Random Sample</td><td>A sample where each member of the population has an equal chance of being selected for the sample</td><td></td><td></td></tr>
<tr><td>289</td><td>Mean</td><td>Add up the values and divide by how many values there are.</td><td>The mean of 3, 4, 7, 6, 0, 4, 6 is
$$\frac{3+4+7+6+0+4+6}{7}=5$$</td><td></td></tr>
<tr><td>290</td><td>Mean from a Table</td><td>1. Find the midpoints (if necessary)
2. Multiply Frequency by values or midpoints
3. Add up these values
4. Divide this total by the Total Frequency

If grouped data is used, the answer will be an estimate.</td><td><table><tr><th>Height in cm</th><th>Frequency</th><th>Midpoint</th><th>F × M</th></tr><tr><td>$0 < h \leq 10$</td><td>8</td><td>5</td><td>8×5=40</td></tr><tr><td>$10 < h \leq 30$</td><td>10</td><td>20</td><td>10×20=200</td></tr><tr><td>$30 < h \leq 40$</td><td>6</td><td>35</td><td>6×35=210</td></tr><tr><td>Total</td><td>24</td><td>Ignore!</td><td>450</td></tr></table>
Estimated Mean height: 450 ÷ 24 = 18.75cm</td><td></td></tr>
</table>

				RAG
	Whole year:			
291	**Median Value**	The middle value. Put the data in order and find the middle one. If there are two middle values, find the number half way between them by adding them together and dividing by 2.	Find the median of: 4, 5, 2, 3, 6, 7, 6 Ordered: 2, 3, 4, 5, 6, 6, 7 Median = 5	
292	**Median from a Table**	Use the formula $\frac{(n+1)}{2}$ to find the position of the median. n is the total frequency.	If the total frequency is 15, the median will be the $\left(\frac{15+1}{2}\right) = 8th$ position	
293	**Mode /Modal Value**	Most frequent/common. Can have more than one mode (called bi-modal or multi-modal) or no mode (if all values appear once)	Find the mode: 4, 5, 2, 3, 6, 4, 7, 8, 4 Mode = 4	
294	**Range**	Highest value subtract the Smallest value Range is a 'measure of spread'. The smaller the range the more consistent the data.	Find the range: 3, 31, 26, 102, 37, 97. Range = 102-3 = 99	
295	**Outlier**	A value that 'lies outside' most of the other values in a set of data. An outlier is much smaller or much larger than the other values in a set of data.		
296	**Lower Quartile**	Divides the bottom half of the data into two halves. LQ = $Q_1 = \frac{(n+1)}{4} th$ value	Find the lower quartile of: 2, 3, 4, 5, 6, 6, 7 $Q_1 = \frac{(7+1)}{4} = 2nd$ value → 3	

<table>
<tr><th colspan="4">MATHS – YEAR 11
Higher Tier</th><th>RAG</th></tr>
<tr><td></td><td colspan="3">Whole year:</td><td></td></tr>
<tr><td>297</td><td>Lower Quartile</td><td>Divides the top half of the data into two halves.

UQ = $Q_3 = \frac{3(n+1)}{4} th$ value</td><td>Find the upper quartile of: 2, 3, 4, 5, 6, 6, 7

$Q_3 = \frac{3(7+1)}{4} = 6th$ value → 6</td><td></td></tr>
<tr><td>298</td><td>Interquartile Range</td><td>The difference between the upper quartile and lower quartile.

$$IQR = Q_3 - Q_1$$
The smaller the interquartile range, the more consistent the data.</td><td>Find the IQR of: 2, 3, 4, 5, 6, 6, 7

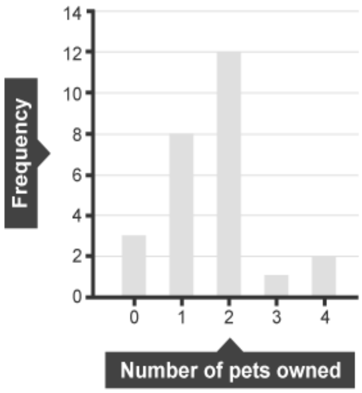
$$IQR = Q_3 - Q_1 = 6 - 3 = 3$$</td><td></td></tr>
<tr><td>299</td><td>Frequency Table</td><td>A record of how often each value in a set of data occurs.</td><td><table>
<tr><th>Number of marks</th><th>Tally marks</th><th>Frequency</th></tr>
<tr><td>1</td><td>~~||||~~ ||</td><td>7</td></tr>
<tr><td>2</td><td>~~||||~~</td><td>5</td></tr>
<tr><td>3</td><td>~~||||~~ |</td><td>6</td></tr>
<tr><td>4</td><td>~~||||~~</td><td>5</td></tr>
<tr><td>5</td><td>|||</td><td>3</td></tr>
<tr><td>Total</td><td></td><td>26</td></tr>
</table></td><td></td></tr>
<tr><td>300</td><td>Bar Chart</td><td>Represents data as vertical blocks.

$x - axis$ shows the type of data

$y - axis$ shows the frequency for each type of data

Each bar should be the same width

There should be gaps between each bar

Remember to label each axis.</td><td>
</td><td></td></tr>
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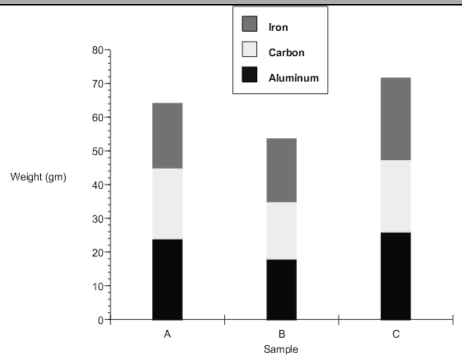
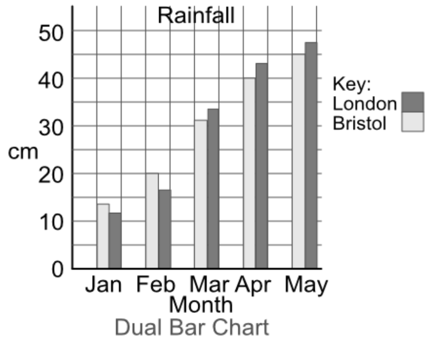
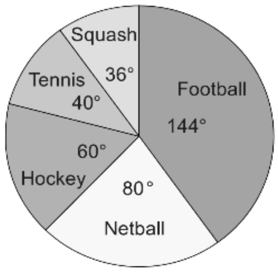
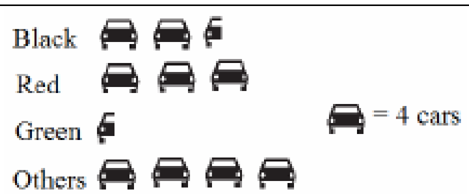
<tr><th colspan="4">MATHS – YEAR 11
Higher Tier</th><th>RAG</th></tr>
<tr><td></td><td colspan="3">Whole year:</td><td></td></tr>
<tr><td>301</td><td>Types of Bar Chart</td><td>Compound/Composite Bar Charts show data stacked on top of each other.

Comparative/Dual Bar Charts show data side by side.</td><td>


</td><td></td></tr>
<tr><td>302</td><td>Pie Chart</td><td>Used for showing how data breaks down into its constituent parts.

When drawing a pie chart, divide 360° by the total frequency. This will tell you how many degrees to use for the frequency of each category.

Remember to label the category that each sector in the pie chart represents.</td><td>
</td><td></td></tr>
<tr><td>303</td><td>Pictogram</td><td>Uses pictures or symbols to show the value of the data.

A pictogram must have a key.</td><td>
</td><td></td></tr>
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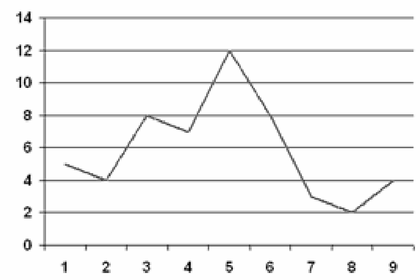
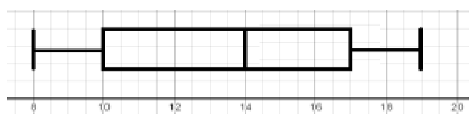
<tr><th colspan="4">MATHS – YEAR 11
Higher Tier</th><th>RAG</th></tr>
<tr><td></td><td colspan="3">Whole year:</td><td></td></tr>
<tr><td>304.</td><td>Line Graph</td><td>A graph that uses points connected by straight lines to show how data changes in values.

This can be used for time series data, which is a series of data points spaced over uniform time intervals in time order.</td><td></td><td></td></tr>
<tr><td>305.</td><td>Two Way Tables</td><td>A table that organises data around two categories.

Fill out the information step by step using the information given.

Make sure all the totals add up for all columns and rows.</td><td>
Question: Complete the 2 way table below.
<table>
<tr><th></th><th>Left Handed</th><th>Right Handed</th><th>Total</th></tr>
<tr><td>Boys</td><td>10</td><td></td><td>58</td></tr>
<tr><td>Girls</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td></td><td>84</td><td>100</td></tr>
</table>
Answer: Step 1, fill out the easy parts (the totals)
<table>
<tr><th></th><th>Left Handed</th><th>Right Handed</th><th>Total</th></tr>
<tr><td>Boys</td><td>10</td><td>48</td><td>58</td></tr>
<tr><td>Girls</td><td></td><td></td><td>42</td></tr>
<tr><td>Total</td><td>16</td><td>84</td><td>100</td></tr>
</table>
Answer: Step 2, fill out the remaining parts
<table>
<tr><th></th><th>Left Handed</th><th>Right Handed</th><th>Total</th></tr>
<tr><td>Boys</td><td>10</td><td>48</td><td>58</td></tr>
<tr><td>Girls</td><td>6</td><td>36</td><td>42</td></tr>
<tr><td>Total</td><td>16</td><td>84</td><td>100</td></tr>
</table>
</td><td></td></tr>
<tr><td>306.</td><td>Box Plots</td><td>The minimum, lower quartile, median, upper quartile and maximum are shown on a box plot.

A box plot can be drawn independently or from a cumulative frequency diagram.</td><td>
Minimum L.Q Median U.Q Maximum</td><td></td></tr>
<tr><td>307.</td><td>Comparing Box Plots</td><td>Write two sentences.

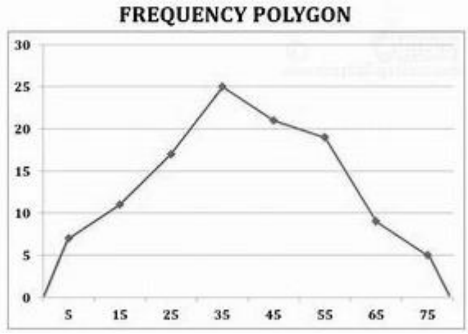
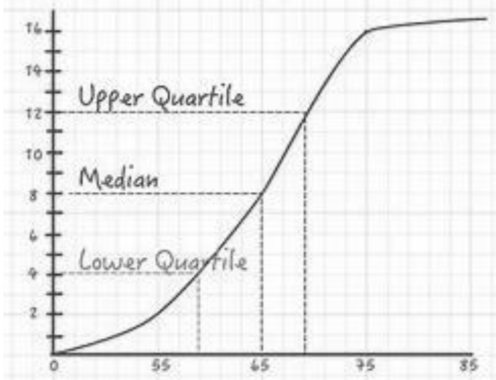
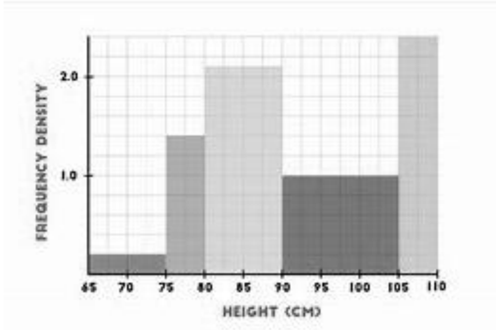
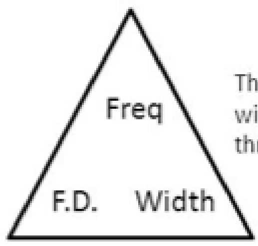
1. Compare the averages using the medians for two sets of data.

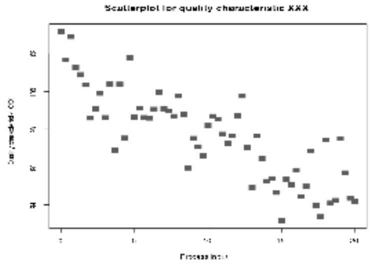
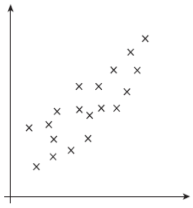
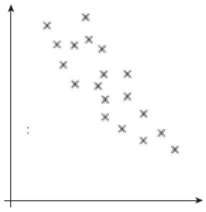
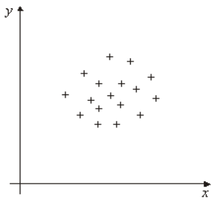
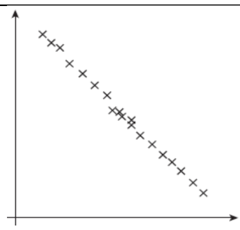
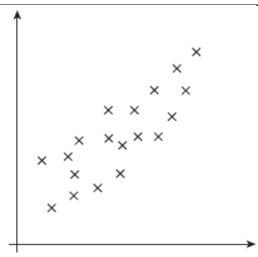
2. Compare the spread of the data using the range or IQR for two sets of data.

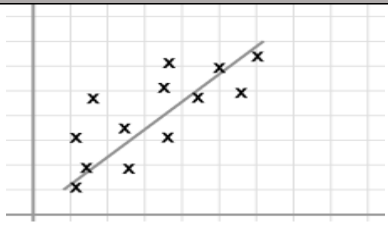
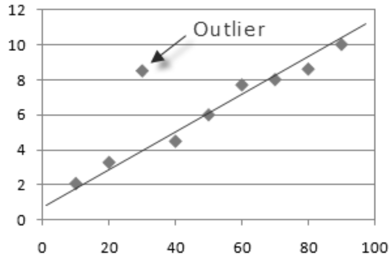
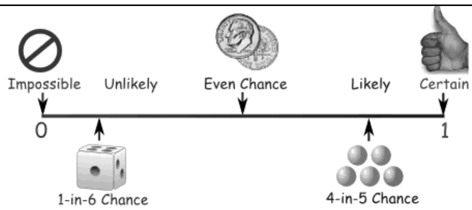
The smaller the range/IQR, the more consistent the data.

You must compare box plots in the context of the problem.</td><td>‘On average, students in class A were more successful on the test than class B because their median score was higher.’

‘Students in class B were more consistent than class A in their test scores as their IQR was smaller.’</td><td></td></tr>
</table>

MATHS – YEAR 11 Higher Tier				RAG
	Whole year:			
308	**Frequency polygon**	A frequency polygon is plotted against the **mid-points** of the data groups and is drawn with a ruler.		
309	**Cumulative frequency**	A cumulative frequency diagram is plotted against the end-points of the data groups and is drawn free-hand with a smooth curve shape. They can be used to find the median (half-way) and quartile (25% and 75%) values		
310	**Histogram**	Histograms are used for representing continuous data with unequal class widths. Bars must not have gaps between them		
311	**Frequency density**	The frequency density can be found using this formula: $\text{frequency density} = \dfrac{\text{frequency}}{\text{class width}}$	 This triangle will help throughout.	
312	**Correlation**	Correlation between two sets of data means they are connected in some way.	There is correlation between temperature and the number of ice creams sold.	
313	**Causality**	When one variable influences another variable.	The more hours you work at a particular job (paid hourly), the higher your income from that job will be.	

MATHS – YEAR 11 Higher Tier				RAG
	Whole year:			
314	**Scatter Graph**	A graph in which values of two variables are plotted along two axes to compare them and see if there is any connection between them.		
315	**Positive Correlation**	As one value increases the other value increases.		
316	**Negative Correlation**	As one value increases the other value decreases.		
317	**No Correlation**	There is no linear relationship between the two.		
318	**Strong Correlation**	When two sets of data are closely linked. The correlation may be positive or negative.	 A stronger negative correlation is shown here.	
319	**Weak Correlation**	When two sets of data have correlation, but are not closely linked. The correlation may be positive or negative.	 A weaker positive correlation is shown here.	

	MATHS – YEAR 11 **Higher Tier**			**RAG**
	Whole year:			
320	**Line of Best Fit (or regression line)**	A straight line that best represents the data on a scatter graph.		
321	**Outlier**	A value that 'lies outside' most of the other values in a set of data. An outlier is much smaller or much larger than the other values in a set of data.	 	
322	**Probability**	The likelihood/chance of something happening. Is expressed as a number between 0 (impossible) and 1 (certain). Can be expressed as a fraction, decimal, percentage or in words (likely, unlikely, even chance etc.)	 	
323	**Probability Notation**	P(A) refers to the probability that event A will occur.	P(Red Queen) refers to the probability of picking a Red Queen from a pack of cards.	
324	**Theoretical Probability**	$\frac{Number\ of\ Favourable\ Outcomes}{Total\ Number\ of\ Possible\ Outcomes}$	Probability of rolling a 4 on a fair 6-sided die = $\frac{1}{6}$.	
325	**Relative Frequency**	$\frac{Number\ of\ Successful\ Trials}{Total\ Number\ of\ Trials}$	A coin is flipped 50 times and lands on Tails 29 times. The relative frequency of getting Tails = $\frac{29}{50}$.	
326	**Expected Outcomes**	To find the number of expected outcomes, multiply the probability by the number of trials.	The probability that a football team wins is 0.2 How many games would you expect them to win out of 40? $0.2 \times 40 = 8\ games$	

<table>
<tr><th colspan="4">MATHS – YEAR 11
Higher Tier</th><th>RAG</th></tr>
<tr><td></td><td colspan="3">Whole year:</td><td></td></tr>
<tr><td>327</td><td>Exhaustive</td><td>Outcomes are exhaustive if they cover the entire range of possible outcomes.

The probabilities of an exhaustive set of outcomes adds up to 1.</td><td>When rolling a six-sided die, the outcomes 1, 2, 3, 4, 5 and 6 are exhaustive, because they cover all the possible outcomes.</td><td></td></tr>
<tr><td>328</td><td>Mutually Exclusive</td><td>Events are mutually exclusive if they cannot happen at the same time.

The probabilities of an exhaustive set of mutually exclusive events adds up to 1.</td><td>Examples of mutually exclusive events:

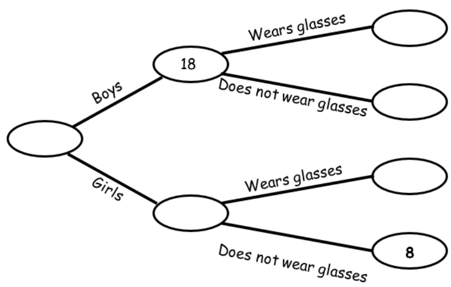
- Turning left and right

- Heads and Tails on a coin

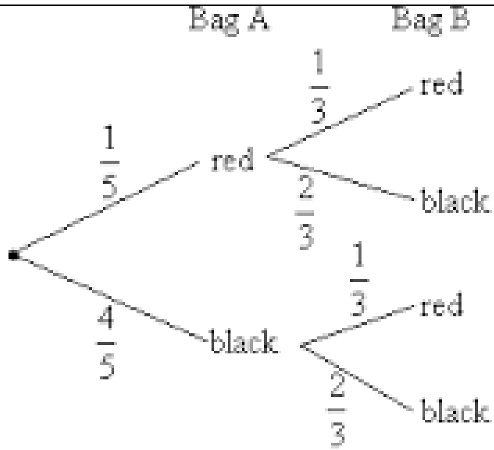
Examples of non mutually exclusive events:

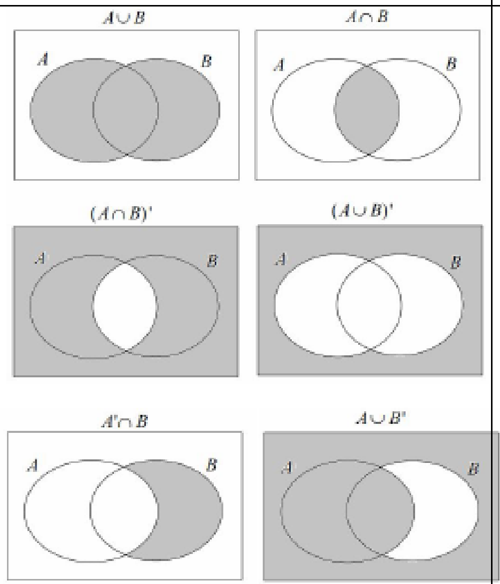
- King and Hearts from a deck of cards, because you can pick the King of Hearts</td><td></td></tr>
<tr><td>329</td><td>Frequency Tree</td><td>A diagram showing how information is categorised into various categories.

The numbers at the ends of branches tells us how often something happened (frequency).

The lines connected the numbers are called branches.</td><td>
</td><td></td></tr>
<tr><td>330</td><td>Sample Space</td><td>The set of all possible outcomes of an experiment.</td><td><table>
<tr><th>+</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr>
<tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr>
</table></td><td></td></tr>
</table>

MATHS – YEAR 11 Higher Tier				RAG
	Whole year:			
331	**Combination**	A collection of things, where the order does not matter.	How many combinations of two ingredients can you make with apple, banana and cherry? Apple, Banana Apple, Cherry Banana, Cherry 3 combinations	
332	**Permutation**	A collection of things, where the order does matter.	You want to visit the homes of three friends, Alex (A), Betty (B) and Chandra (C) but haven't decided the order. What choices do you have? ABC ACB BAC BCA CAB CBA	
333	**Permutations with Repetition**	When something has n different types, there are n choices each time. Choosing r of something that has n different types, the permutations are: $n \times n \times \ldots (r\ times) = n^r$	How many permutations are there for a three-number combination lock? 10 numbers to choose from $\{1, 2, \ldots .10\}$ and we choose 3 of them → $10 \times 10 \times 10 = 10^3 = 1000$ permutations.	
334	**Permutations without Repetition**	We have to reduce the number of available choices each time. One you have chosen something, you cannot choose it again.	How many ways can you order 4 numbered balls? $4 \times 3 \times 2 \times 1 = 24$	

MATHS – YEAR 11 Higher Tier				RAG
	Whole year:			
335	**Product Rule for Counting**	If there are x ways of doing something and y ways of doing something else, then there are xy ways of performing both.	To choose one of $\{A, B, C\}$ and one of $\{X, Y\}$ means to choose one of $\{AX, AY, BX, BY, CX, CY\}$ The rule says that there are $3 \times 2 = 6$ choices.	
336	**Tree Diagrams**	Tree diagrams show all the possible outcomes of an event and calculate their probabilities. All branches must add up to 1 when adding downwards. This is because the probability of something not happening is 1 minus the probability that it does happen. Multiply going across a tree diagram. Add going down a tree diagram.		
337	**Independent Events**	The outcome of a previous event does not influence/affect the outcome of a second event.	An example of independent events could be replacing a counter in a bag after picking it.	
338	**Dependent Events**	The outcome of a previous event does influence/affect the outcome of a second event.	An example of dependent events could be not replacing a counter in a bag after picking it. ‘Without replacement’	

		MATHS – YEAR 11 Higher Tier		RAG
	Whole year:			
339	**Probability Notation**	P(A) refers to the probability that event A will occur. P(A’) refers to the probability that event A will not occur. P(A ∪ B) refers to the probability that event A or B or both will occur. P(A ∩ B) refers to the probability that both events A and B will occur.	P(Red Queen) refers to the probability of picking a Red Queen from a pack of cards. P(Blue’) refers to the probability that you do not pick Blue. P(Blonde ∪ Right Handed) refers to the probability that you pick someone who is Blonde or Right Handed or both. P(Blonde ∩ Right Handed) refers to the probability that you pick someone who is both Blonde and Right Handed.	
340	**Venn Diagrams**	A Venn Diagram shows the relationship between a group of different things and how they overlap. You may be asked to shade Venn Diagrams as shown below and to the right.		

	MATHS – YEAR 11 Higher Tier			RAG
	Whole year:			
341	**Venn Diagram Notation**	∈ means 'element of a set' (a value in the set) { } means the collection of values in the set. ξ means the 'universal set' (all the values to consider in the question) A' means 'not in set A' (called complement) A ∪ B means 'A or B or both' (called Union) A ∩ B means 'A and B (called Intersection)	Set A is the even numbers less than 10. A = {2, 4, 6, 8} Set B is the prime numbers less than 10. B = {2, 3, 5, 7} A ∪ B = {2, 3, 4, 5, 6, 7, 8} A ∩ B = {2}	
342	**AND rule for Probability**	When two events, A and B, are independent: $P(A\ and\ B) = P(A) \times P(B)$	What is the probability of rolling a 4 and flipping a Tails? $P(4\ and\ Tails) = P(4) \times P(Tails)$ $= \frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$	
343	**OR rule for Probability**	When two events, A and B, are mutually exclusive: $P(A\ or\ B) = P(A) + P(B)$	What is the probability of rolling a 2 or rolling a 5? $P(2\ or\ 5) = P(2) + P(5)$ $= \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$	
344	**Conditional Probability**	The probability of an event A happening, given that event B has already happened. With conditional probability, check if the numbers on the second branches of a tree diagram changes. For example, if you have 4 red beads in a bag of 9 beads and pick a red bead on the first pick, then there will be 3 red beads left out of 8 beads on the second pick.