United Learning
The best in everyone™

Knowledge Organiser

Name:	.....
Tutor Group:	.....
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Contents

Non-Fiction Study

Key Terminology		
1	**Bias**	An inclination or prejudice for or against one person or group.
2	**Tone**	Attitudes toward the subject and toward the audience implied in a literary work, for example: formal, informal, sarcastic, etc.
3	**Empathy**	The ability to understand and share the feelings of another.
4	**View**	A particular attitude towards or way of regarding something.
5	**Imperatives**	Verbs used to give orders, commands, warning or instructions.
6	**Expert opinion**	A belief or judgement about something given by an expert on a subject.
7	**Fact**	Something that is known to happen or to exist, especially for which proof exists.
8	**Objective**	Based on real facts and not influenced by personal beliefs or feelings.
9	**Perspective**	A particular attitude towards or way of regarding something.
10	**Subjective**	Influenced by or based on personal beliefs or feelings, rather than based on facts.

Key Knowledge: Non-fiction forms		
11	**Autobiography**	The account of a person's life written by that person.
12	**Biography**	The account of a person's life written by another person.
13	**Diary**	A book in which one keeps a daily record of events and experiences.
14	**Essay**	A short piece of writing on a particular subject.
15	**Letter**	A written or printed message which from one person to another, usually put in an envelope and delivered as mail.
16	**Article**	A piece of writing which reports news and is published in a newspaper or magazine.
17	**Opinion Piece**	An article in which the writer expresses their personal opinion on a particular issue or subject.
18	**Speech**	A formal talk usually given to a large number of people on a special occasion.
19	**Review**	A critical appraisal of a book, play, film, etc, often published in a newspaper or magazine.
20	**Information leaflet**	A leaflet is a little book or a piece of paper containing information about a particular subject.

Poetry Study

Key Terminology		
1	Alliteration	The repetition of the same consonant sound, often at the beginning of words.
2	Emotive language	Word choice which is used to evoke emotion in the reader.
3	Imagery	A literary device used to create a particular image to convey the key ideas/messages of themes in a text.
4	Metaphor	A comparison in which one thing is said to be another.
5	Personification	The attribution of human feelings, emotions, or sensations to an inanimate object.
6	Repetition	A literary device which repeats the same word or phrase a few times to make it memorable.
7	Rhyme scheme	The pattern of a poem's rhyme, often identified using letters e.g. ABABCC.
8	Simile	A comparison that uses 'like' or 'as'.
9	Stanza	A group of lines forming a unit in a poem.

Key Terminology		
10	Structure	The way a poem is organised.
11	Symbolism	The use of symbols to express ideas or qualities.
12	Tone	Feelings or ideas suggested by the language used by the poet.
13	Verse	Another word for poetry; a group of lines forming a unit in a poem, also known as a stanza.
14	Volta	A 'turning point' in a poem.

Form		
15	Form	The way a poem is set out, or a term used to categorise poems which follow particular conventions.
16	Villanelle	A 19-line poem consisting of five units of three lines, rhymed or unrhymed, followed by a quatrain.
17	Petrarchan sonnet	A poem that has 14 lines and a particular pattern of rhyme, for example ABAB CDCD EFGEFG.
18	Ballad	A narrative poem which is typically written in short stanzas.
19	Dramatic monologue	A poem in which an imagined speaker addresses a silent listener.

KPI 9.01 Place Value and Number Sense

1) Place value	The value of a digit relating to its position in a number. In 1482 the digits represent 1 thousand, 4 hundreds, 8 tens and 2 ones.	**2) Integer**	Whole numbers including zero. -2, -1, 0, 1, 2, 3, …	
3) Ascending	Smallest to largest	**4) Descending**	Largest to smallest	
5) Recurring decimals	A decimal that does not terminate.	**6) Using one calculation to perform another**	19 x 18 = 342 19 x 180 = 3420 190 x 18 = 3420 190 x 180 = 34200 1900 x 180 = 342000	108 ÷ 9 = 12 1080 ÷ 9 = 120 108 ÷ 90 = 1.2 108 ÷ 0.9 = 120 108 ÷ 0.09 = 1200
7) Inequality	$a < b$ a is less than b $a > b$ a is greater than b $a = b$ a is equal to b $a \neq b$ a is not equal to b			

KPI 9.02 Decimals

1) Multiplying decimals	1) Remove the decimal points. 2) Multiply. 3) Insert the same number of decimal points in the answer as in the question. 0.5 x 0.3 5 x 3 = 15 0.5 x 0.3 = 0.15	**2) Dividing a decimal by an integer**	0.72÷6 = 0.12 0.972÷8 = 0.1215
		3) Dividing an integer by a decimal	1) Write as a fraction 2) Form an equivalent fraction 3) Divide

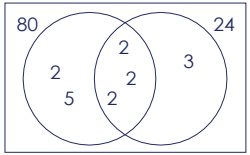
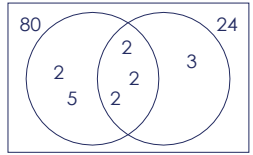
KPI 9.03 Rounding and Estimation

1) ≈	"approximately equal to"	**2) Truncation**	Ignoring all decimal places past a certain point without rounding.
3) Significant figures	The total number of digits in a number, not counting the zeros at the beginning of a number or at the end of a decimal number. 345 000 has 6 significant figures. 0.3047 has 4 significant figures.	**4) Estimate**	Find approximate answer by calculating with numbers rounded to one significant figure.
5) Error Intervals	The range of values (between the upper and lower bounds) in which the precise value could be. **least possible value ≤ x < greatest possible value**		

KPI 9.04 Indices, Powers and Roots

1) Multiplication law	$a^m \times a^n = a^{m+n}$ Same base numbers, ADD the powers.	**2) Division law**	$a^m \div a^n = a^{m-n}$ Same base numbers, SUBTRACT the powers.
3) Power to a power	$(a^m)^n = a^{m \times n}$ MULTIPLY the powers.	**4) Raising a fraction by a power**	$(ab)^n = a^n \times b^n$ Raise each number or variable to the same power.
5) Power of 0	$a^0 = 1.$ Any number or variable to the power of zero equals 1.	**6) Negative powers (integers)**	$a^{-1} = \frac{1}{a}$ $a^{-2} = \frac{1}{a^2}$ $a^{-n} = \frac{1}{a^n}$ A negative power represents the reciprocal.
7) Positive unit fractions	$a^{\frac{1}{2}} = \sqrt{a}$ $a^{\frac{1}{3}} = \sqrt[3]{a}$ $a^{\frac{1}{n}} = \sqrt[n]{a}$	**8) Negative unit fractions**	$a^{-\frac{1}{2}} = \frac{1}{\sqrt{a}}$ $a^{-\frac{1}{3}} = \frac{1}{\sqrt[3]{a}}$ $a^{-\frac{1}{n}} = \frac{1}{\sqrt[n]{a}}$
9) Positive non-unit fractions	$a^{\frac{m}{n}} = (\sqrt[n]{a})^m$	**10) Negative non-unit factions**	$(a)^{-\frac{m}{n}} = \left(\frac{1}{a}\right)^{\frac{m}{n}} = \left(\sqrt[n]{\frac{1}{a}}\right)^m$

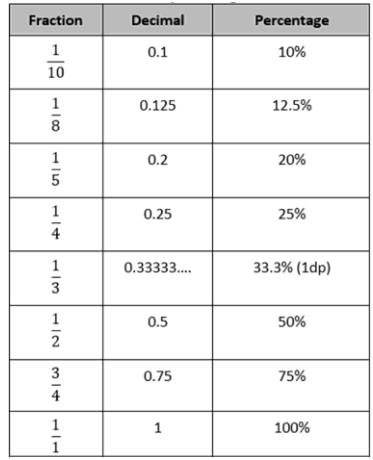
KPI 9.05 Factors, Multiples and Primes

1) Prime numbers	A prime number has two distinct factors; 1 and itself. 2 is the only even prime number. 1 is not a prime number. The first ten prime numbers are: 2, 3, 5, 7, 11, 13, 17, 19, 23 29		
2) Factor	Any whole number that divides exactly into another number leaving no remainder. Factors of 20 are: 1, 2, 4, 5, 10, 20	**3) Multiple**	The result of multiplying a number with a whole number. (times tables!) The multiples of 7: 7, 14, 21, 28, 35, 42, 49, 56, 63, 70 ...
4) HCF - Venn diagram	 HCF of 80 and 24 = 2 x 2 x 2 = 8	**5) LCM - Venn diagram**	 LCM of 80 and 24 = 2 x 2 x 2 x 2 x 3 x 5 = 240

KPI 9.06 Ratio

1) Ratio	A part-to-part comparison. The ratio of a to b is written a:b	**2) Ratio as a fraction**	 Fraction of shapes which are squares: 1:4
3) Equivalent ratios	Multiply or divide all parts of the ratio by the same number.	**4) Simplifying ratios**	Ratios can be simplified by dividing each part of the ratio by the same number. ÷5 (25:15 / 5:3) ÷5
5) Unitary Ratio	Write the ratio 5:3 in the form 1:n ÷5 (5:3 / 1: $\frac{3}{5}$) ÷5	**6) Sharing into a given ratio**	**Add** the parts together. **Divide** the total. **Multiply** this by each part of the ratio.

KPI 9.07 Fractions, Decimals and Percentages

1) Fraction to percentage	If the denominator is a factor of 100, use equivalent fractions. If the denominator is not a factor of 100, use short division and then multiply the answer by 100.	**4) Common conversions**	
2) Percentage to fraction	Write the percentage as a fraction out of 100. Simplify where possible.		
3) Ordering fractions, decimals & percentages	Convert all the values into the same form - all fractions (with the same denominator), all decimals or all percentages. Order the values.		

Fraction	Decimal	Percentage
$\frac{1}{10}$	0.1	10%
$\frac{1}{8}$	0.125	12.5%
$\frac{1}{5}$	0.2	20%
$\frac{1}{4}$	0.25	25%
$\frac{1}{3}$	0.33333....	33.3% (1dp)
$\frac{1}{2}$	0.5	50%
$\frac{3}{4}$	0.75	75%
$\frac{1}{1}$	1	100%

KPI 9.08 Fractions

1) Writing one number as a fraction of another	Write £15 as a fraction of £25. $\frac{15}{25} = \frac{3}{5}$	**2) Reciprocal**	*Reciprocal of* $7 \rightarrow \frac{1}{7}$ *Reciprocal of* $\frac{2}{3} \rightarrow \frac{3}{2}$
3) Fractions of an amount	Divide the amount by the denominator and then multiply the result by the numerator.		
4) Add/Subtract fractions	Make the denominators the same (find the LCM). Use equivalent fractions to change each fraction to the common denominator. Add/subtract the numerators only.		$\frac{2}{7} + \frac{2}{5} = \frac{10}{35} + \frac{14}{35} = \frac{24}{35}$
5) Multiplying fractions	Multiply the numerators. Multiply the denominators. Simplify where possible.		$\frac{4}{5} \times \frac{3}{8} = \frac{12}{40} = \frac{3}{10}$
6) Dividing fractions	Keep the first fraction the same. Change the second to its reciprocal. Multiply the fractions. Simplify/convert to mixed number where possible.		$\frac{4}{5} \div \frac{3}{8} = \frac{4}{5} \times \frac{8}{3} = \frac{32}{15} = 2\frac{2}{15}$

KPI 9.09 Percentages

1) Multiplier	A percentage written as a decimal is the percentage multiplier.	**2) Percentage of an amount with a calculator**	The percentage multiplier multiplied by the amount.
3) Finding 50%	To find 50% divide by two.	**4) Finding 25%**	To find 25% divide by four.
5) Finding 20%	To find 20% divide by five.	**6) Finding 10%**	To find 10% divide by ten.
7) Finding 5%	To find 5% divide by twenty.	**8) Finding 1%**	To find 1% divide by one hundred.
9) Percentage change	$\frac{difference}{original} \times 100$	**10) Reverse percentages**	$original = \frac{new\ amount}{multiplier}$

KPI 9.10 Proportion

1) Direct proportion	A relationship between two variables where, as one increases, the other also increases.	**2) Unitary method**	To find the value of one unit first.
		3) Exchange rate	Tells us how much of one currency you can exchange for another currency e.g. £1 = $1.39

KPI 9.11 Notation			
1) 2a	2 x a	**2) ab**	a x b
3) a^2	a x a	**4) $3a^2$**	3 x a x a
5) a subtracted from b	b - a	**6) a less than b**	b - a
7) a divided by b	$\frac{a}{b}$	**8) b divided by a**	$\frac{b}{a}$
9) 4 times smaller than a	$\frac{a}{4}$ or $a \div 4$	**10) 4 times larger than a**	4 x a → 4a
11) 5^{th} power of a	a^5	**12) Variable**	A letter used to represent any number.
13) Coefficient	The number to the left of the variable. This is the value that we multiply the variable by. $4x$ → The coefficient of x is 4. x → The coefficient of x is 1.	**14) Term**	A single number, variable or numbers and variables multiplied together.

KPI 9.12 Simplifying and Index Laws			
1) Multiplication law	$y^m \times y^n = y^{m+n}$ Same base numbers, ADD the powers. 2ab x 3b = $6ab^2$	**2) Division law**	$y^m \div y^n = y^{m-n}$ Same base numbers, SUBTRACT the powers. $\frac{10x^4 y^5}{2x^2 y} = 5x^2 y^4$
3) Power of 0	$y^0 = 1$. Any number or variable to the power of zero equals 1	**4) Negative powers (integers)**	$y^{-n} = \frac{1}{y^n}$ A negative power represents the reciprocal.

KPI 9.13 Expanding and Factorising

1) Expand	Multiply out the bracket(s) in the expression. E.g. $3(5x + 7) = 15x + 21$	**2) Factorise**	Identify the HCF and rewrite the expression with brackets. E.g. $6x^2 + 9x = 3x(2x+3)$.
3) Expanding double brackets	Writing two brackets next to each other means the brackets need to be multiplied together. $(x + 1)(x +2)=(x + 1)\times(x + 2)= x^2 + 3x + 2$ Note: $(x + a)^2=(x + a)(x + a)$		
4) Factorising quadratics	To factorise a quadratic, put it back into a pair of brackets. To find the terms that go in each bracket, look for a pair of numbers which multiply to give the constant and add together to give the coefficient of x		
5) Difference of two squares (DOTS)	$a^2 - b^2 = (a+b)(a -b)$	E.g. $x^2 - 16 = (x + 4)(x - 4)$	

x	x	+1
x	x^2	$+x$
+2	$+2x$	+2

KPI 9.14 Expressions and Substitution

1) Substitution	Replace a variable with a given value.	**2) Function machine**	Shows the relationship between two variables, the input and the output.
3) Formula	A mathematical relationship or rule expressed in symbols.		

KPI 9.15 Linear Equations

1) Solve	Use inverse operations to find the solution of an equation.	**2) Linear equation**	Contains an equals sign (=) and has one unknown. E.g. $5x - 2 = 2x + 7$

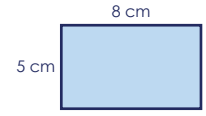
KPI 9.16 Linear Inequalities

1) Representing an inequality on a number line- closed circle	A closed circle is used to show greater than or equal to (or less than or equal to) the number. $x \geq 3$  	**2) Representing an inequality on a number line- open circle**	An open circle is used to show greater than (or less than) the number. $x > 3$ 

KPI 9.17 Perimeter and Area

1) Perimeter

The total distance around the outside of a closed shape.



Perimeter = 5 + 8 + 5 + 8 = 26cm

2) Area

A measure of the space inside a 2D shape. Area is measured in square units.

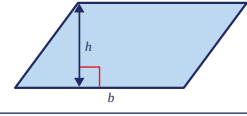
E.g. square centimetres (cm^2), square metres (m^2).

3) Area of a rectangle

Area = length x width

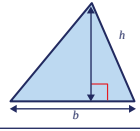
4) Area of parallelogram

Area = base x height



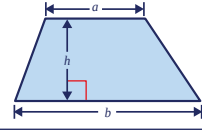
5) Area of triangle

$$\text{Area} = \frac{\text{base} \times \text{height}}{2}$$



6) Area of trapezium

$$\text{Area} = \left(\frac{a + b}{2}\right) \times h$$



7) Converting units of area

cm^2	$\times(10)^2$	mm^2
m^2	$\times(100)^2$	cm^2
km^2	$\times(1000)^2$	m^2

$1cm^2 = 100mm^2$

$1m^2 = 10\,000cm^2$

$1km^2 = 1\,000\,000m^2$

mm^2	$\div(10)^2$	cm^2
cm^2	$\div(100)^2$	m^2
m^2	$\div(1000)^2$	km^2

KPI 9.18 Pythagoras

1) Right-angled triangle

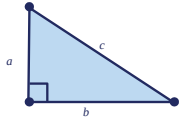
A triangle that contains a right-angle (90 degrees).

2) Hypotenuse

The longest side - opposite the right-angle.

3) Pythagoras' Theorem

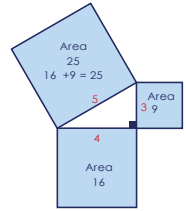
For any right-angled triangle, the area of the square of the longer length (the hypotenuse) is equal to the area of the squares of the shorter lengths added together.



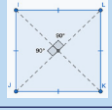
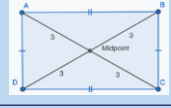
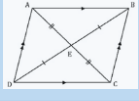
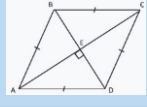
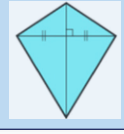
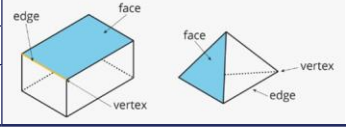
$c^2 = a^2 + b^2$

$a^2 = c^2 - b^2$

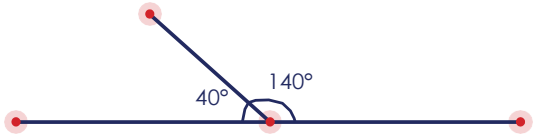
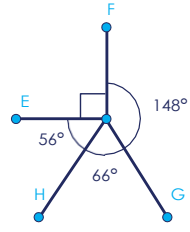
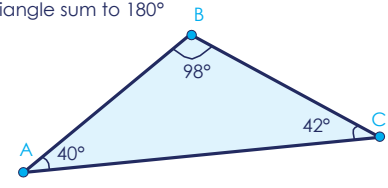
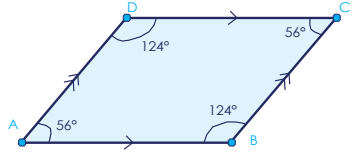
$b^2 = c^2 - a^2$



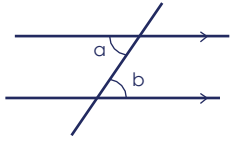
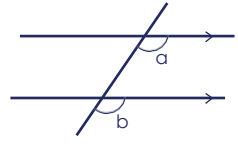
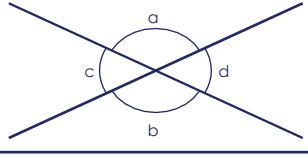
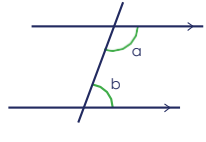
KPI 9.19 Properties of Shapes

1) Polygon	A polygon is a two-dimensional shape with 3 or more straight sides. A polygon is either regular or irregular: Regular – side lengths are equal, and all angles are equal. Irregular – side lengths are unequal, and angles are unequal.		
2) 3 sides	Triangle	**3) 4 sides**	Quadrilateral
4) 5 sides	Pentagon	**5) 6 sides**	Hexagon
6) 7 sides	Heptagon	**7) 8 sides**	Octagon
8) 9 sides	Nonagon	**9) 10 sides**	Decagon
10) 11 sides	Hendecagon	**11) 12 sides**	Dodecagon
12) Equilateral triangle	3 equal angles 3 equal sides 	**13) Isosceles triangle**	2 equal angles 2 equal sides 
14) Scalene triangle	All angles are different All sides are different 	**15) Right angled triangle**	One angle of 90°. Can be isosceles or scalene.
16) Square 	4 right angles 4 equal sides 2 pairs of parallel side Diagonals are of equal length, perpendicular and bisect each other.	**17) Rectangle** 	4 right angles 2 pairs of parallel sides 2 pairs of equal sides Diagonals are of equal length and bisect each other but are not perpendicular.
18) Parallelogram 	2 pairs of equal sized angles 2 pairs of parallel sides 2 pairs of equal sides Diagonals bisect each other but are not of equal length or perpendicular.	**19) Rhombus** 	4 equal sides 2 pairs of equal sized angles 2 pairs of parallel sides Diagonals are perpendicular and bisect each other but are not of equal length.
20) Trapezium	1 pair of parallel sides	**23) Kite** 	1 pair of equal sized angles 2 pairs of equal sides Diagonals are perpendicular and the longer one bisects the shorter one.
21) Right angled trapezium	2 right angles 1 pair of parallel sides		
22) Isosceles trapezium	1 pair of parallel sides 2 pairs of equal sides 2 pairs of equal sized angles		
24) Face	A face is a single flat surface		
25) Edge	An edge is a line segment between faces		
26) Vertex	A vertex is a **corner**		

KPI 9.20 Angle Facts

1) Angles on a straight line	Angles on a straight-line sum to 180° 	**2) Angles around a point**	Angles around a point sum to 360° 
3) Angles in a triangle	Angles in a triangle sum to 180° 	**4) Angles in a quadrilateral**	Angles in a quadrilateral sum to 360° 

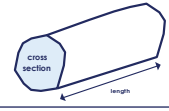
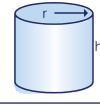
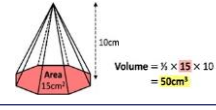
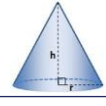
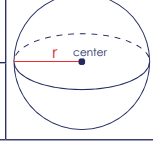
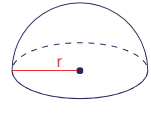
KPI 9.21 Angles in Parallel Lines

1) Alternate angles	Alternate angles are equal, so a = b 	**2) Corresponding angles**	Corresponding angles are equal, so a = b 
3) Vertically opposite angles	Vertically opposite angles are equal, so, a = b and c = d 	**4) Co-interior angles**	Co-interior angles sum to 180°, so a + b = 180° 

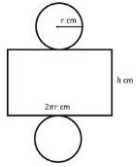
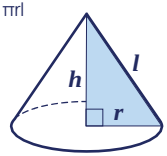
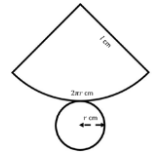
KPI 9.22 Circles

1) Circumference	The perimeter of the circle. $C = \pi d$	**5) Area of a circle**	$A = \pi r^2$
2) Perimeter of a semi-circle	$P = \frac{\pi d}{2} + d$	**6) Area of a semi-circle**	$A = \frac{\pi r^2}{2}$
3) Perimeter of a quarter circle	$P = \frac{\pi d}{4} + 2r$	**7) Area of a quarter-circle**	$A = \frac{\pi r^2}{4}$
4) Perimeter of a three-quarter circle	$P = \frac{3}{4}\pi d + 2r$	**8) Area of a three-quarter circle**	$A = \frac{3\pi r^2}{4}$

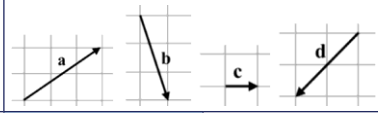
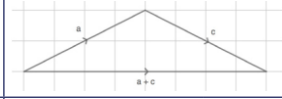
KPI 9.23 Volume

1) Volume	The volume of a solid body is the amount of 'space' it occupies. It is measured in cubic units e.g. cubic centimetres (cm^3).	
2) Prism	Volume of a prism = area of cross section × length.	
3) Cylinder	Volume of cylinder = $\pi r^2 h$	
4) Pyramid	Volume of a pyramid = $\frac{1}{3}$ × area of the base × perpendicular height	
5) Cone	Volume of cone = $\frac{1}{3}\pi r^2 h$	
6) Sphere	Volume of sphere = $\frac{4}{3}\pi r^3$	
7) Hemi-sphere	Volume of hemi-sphere = $\frac{2}{3}\pi r^3$	
8) Converting units of volume	cm^3 ×(10)³ mm^3 m^3 ×(100)³ cm^3 $1cm^3 = 1\,000mm^3$ $1m^3 = 1\,000\,000cm^3$ mm^3 ÷(10)³ cm^3 cm^3 ÷(100)³ m^3	

KPI 9.24 Surface Area

1) Surface Area	The total area of the surface of a three-dimensional object. For example, the surface area of a cube is the area of all 6 faces added together. It is measured in square units. E.g. square centimetres (cm²), square metres (m²).		
2) Cylinder	Surface Area = $2\pi r^2 + 2\pi rh$ 	**3) Cone**	Surface Area = $\pi r^2 + \pi rl$  
4) Sphere	Surface Area = $4\pi r^2$	**5) Hemi-sphere**	Surface Area of a Hemi-sphere = $3\pi r^2$

KPI 9.25 Basic Vectors

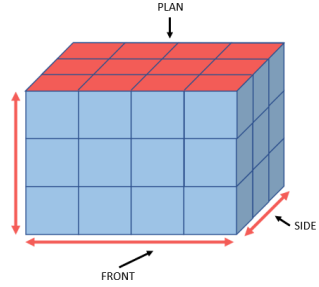
1) Vector	Vectors represent movement of a certain size in a certain direction, they are represented on a diagram with an arrow.		
2) Magnitude	Magnitude is defined as the length of a vector.	**3) Scalar**	A scalar is the number we multiply a vector by.
4) Column vector	$\begin{pmatrix} a \\ b \end{pmatrix}$	a: movement along the x-axis (left/right) b: movement along the y-axis (up/down)	
5) Adding and subtracting column vectors	$\begin{pmatrix} a \\ b \end{pmatrix} + \begin{pmatrix} c \\ d \end{pmatrix} = \begin{pmatrix} a+c \\ b+d \end{pmatrix}$	**6) Multiplying vectors**	To multiply a column vector by a number, we multiply both values in the vector by that number.
7) Resultant vectors	The resultant vector is the vector that results from adding two or more vectors together.		
8) Parallel vectors	Travel in the same or opposite direction. Can be of varying lengths. Must be scalar multiples of one another.	The vectors $\begin{pmatrix} 8 \\ 12 \end{pmatrix}$ and $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ are parallel because $\begin{pmatrix} 8 \\ 12 \end{pmatrix} = 4\begin{pmatrix} 2 \\ 3 \end{pmatrix}$	

KPI 9.26 Sequences

1) Sequence	A pattern of numbers which fit a certain rule.	**2) Term**	A number in a sequence.
3) Term to term rule	The rule for how to get from one number to the next number in the sequence.	**4) Position**	Where a term is in a sequence.
5) Position to term rule	The rule for how to work out a number in a sequence if you know its position.	**6) Nth term**	Used to find a term in a sequence given its position E.g. 5n + 3
7) Linear sequence	The terms increase or decrease by the same amount each time. Also known as an arithmetic sequence. Nth term is written in the form, an + b.	**8) Quadratic sequence**	Nth term is written in the form $an^2 + bn + c$
9) Geometric sequence	A geometric sequence goes from one term to the next by always multiplying or dividing by the same value.	**10) Fibonacci sequence**	The Fibonacci sequence is unique because the next term is found by adding up the two previous terms 1, 1, 2, 3, 5, 8, 13, 21…

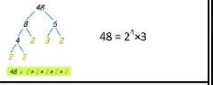
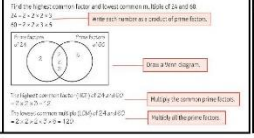
KPI 9.27 Plans and Elevations

1) Plan	View looking vertically downwards.
2) Side elevation	View looking horizontally from the side.
3) Front elevation	View looking horizontally from the front.



Unit 1 - Accelerated

Unit 1 Accelerated

Important Information	
Significant Figures 1 s.f / 2 s.f 368249: 3 00000 / 370000 0.0058763: 0.006 / 0.0059	Sometimes we do not always need to give detailed answers to problems - we just want a rough idea. When we are faced with a long number, we could round it off to the nearest thousand etc. And when we get a long decimal answer on a calculator, we could round it off to a certain number of decimal places. A method of giving an approximated answer is to round off using **significant figures.** **The word significant means:** having meaning.
Estimating	Round each number to 1 s.f including powers and roots.
Prime Factor Tree	
Venn Diagram **To find the HCF and LCM**	

Important vocabulary	
Factor	Numbers we can multiply together to get another number
Multiple	The result of multiplying a number by an integer (not by a fraction).
Prime	A number which is divisible by 1 and itself. A Prime number has 2 factors, itself and 1.
Highest Common Factor (HCF)	The highest number that divides exactly into two or more numbers.
Lowest Common Multiple (LCM)	The smallest positive number that is a multiple of two or more numbers.
Index Form	To write a number to a power or an index. 2^3 is written in index form. 3 is the power or index.
Surd	A number that can't be simplified to remove a square root (or cube root etc). • √2 (square root of 2) can't be simplified further so it is a surd • √4 (square root of 4) CAN be simplified to 2, so it is **NOT** a surd
Rationalise Denominator	Getting rid of any surds from the bottom (denominator) of fractions. Usually when you are asked to simplify an expression it means you should also rationalise it.

Key facts to memorise—Rules of Indices

Index Laws	
$x^m \times x^n$	x^{m+n}
$x^m \div x^n$	x^{m-n}
$(x^m)^n$	$x^{m\times n}$
x^0	1
x^{-n}	$\frac{1}{x^n}$
$x^{\frac{1}{n}}$	$\sqrt[n]{x}$
$x^{\frac{m}{n}}$	$(\sqrt[n]{x})^m$

Surds	
$\sqrt{a}\times\sqrt{b}$	$\sqrt{(a\times b)}$
$\sqrt{a}\times\sqrt{a}$	a
$\frac{\sqrt{a}}{\sqrt{b}}$	$\sqrt{\frac{a}{b}}$
$\frac{b}{\sqrt{a}}$	$\frac{b}{\sqrt{a}}\times\frac{\sqrt{a}}{\sqrt{a}}=\frac{b\sqrt{a}}{a}$
$a\sqrt{c}\pm b\sqrt{c}$	$(a\pm b)\sqrt{c}$
$\frac{c}{a+b\sqrt{n}}$	multiply top and bottom by $a-b\sqrt{n}$

Key facts to memorise— Standard Form

Example—Standard Form	
Standard Form	$A \times 10^n$ (A: number between 1 and 10; ×: times sign; 10^n: power of 10)
87000	8.7×10^4
0.0000087	8.7×10^{-6}
Ordinary Number	You can convert from standard form to **ordinary numbers**, and back again.
8.7×10^4	87000
8.7×10^{-3}	0.0087

Extra Information—Number Problems and Reasoning

When there are m ways of doing one task and n ways of doing a second task, the total number of ways of doing the first task then the second task is:

$$m \times n$$

Exam-style question

Jess has a 4-digit password for her mobile phone.
Each digit can be between 0 and 9 **inclusive.**

a How many choices are possible for each digit of the code?

b What is the total number of 4-digit passwords that Jess can create?
Jess would like to choose an even number.
The code can start with a zero.

c How many different ways are possible now? **(5 marks)**

Communication Hint: Inclusive means that the end numbers are also include.

A factorial is the result of multiplying a sequence of descending integers. For example '4 factorial' = 4! = 4 × 3 × 2 × 1. Make sure you know how to use the factorial button on your calculator. x! !

More Important Information

Important Facts	
Order of Operations **B**rackets **I**ndices **D**ivision **M**ultiplication **A**ddition **S**ubtraction	Exponent (index or power): $6^3 = 6 \times 6 \times 6$ (Base; Shorthand way of representation; Normal representation (Base multiplied exponent number of times))
Numerical Fluency: Addition Subtraction Multiplication and Division using **Negative Numbers.**	$-5 \times -4 = 20$ $-4 - (-9) = 5$ $35 \div (-7) = -5$ + × + = +, − × + = −, + × − = −, − × − = +, + + + = +, − + − = −, + + − = +, − + + = +

Unit 2 – Accelerated Algebra 1

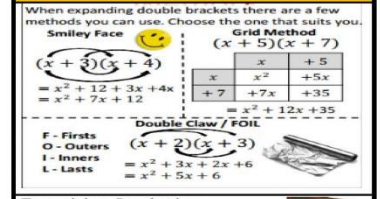
Unit 2 Higher Algebra 1

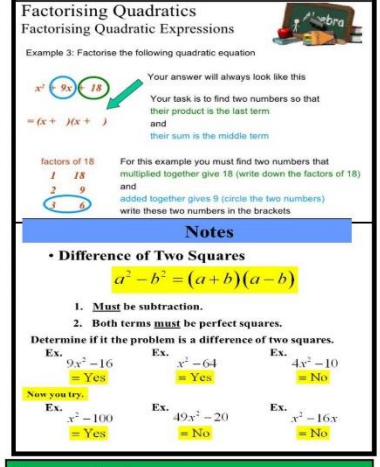
Prior Knowledge	
Order of Operations Brackets Indices Division Multiplication Addition Subtraction	Numerical Fluency: Addition Subtraction Multiplication and Division using Negative Numbers. $-5 \times -4 = 20$ $-4 - (-9) = 5$ $35 \div (-7) = -5$
Evaluating using Powers and roots	$2^2 = 2 \times 2 = 4$ $2^3 = 2 \times 2 \times 2 = 8$ $2^2 \times 2^3 = 2\times2\times2\times2\times2 = 2^5$
Highest Common Factor (HCF)	Break number Into Prime Factors 60 = 2 × 2 × 3 × 5 72 = 2 × 2 × 2 × 3 × 3 HCF = 2 × 2 × 3 = 12

Key facts to memorise

Key Facts	Explanation
Term:	A single number or variable (letter), or numbers and variables multiplied together. Terms are separated by + or – signs
Expression:	A phrase that can contain ordinary numbers, variables (letters) and operators (add, subtract, divide, multiply or indices).
Variable:	A quantity that may change within the context of a mathematical problem or experiment. Represented by a letter
Substitute:	Replacing a variable (example 'x') with a number, where ever the variable occurs.
Expanding	Removing the brackets. () You must follow specific rules when doing this. This is the opposite of Factorising.
Factorising	'take out' any common factors which occur and put these outsides the brackets. This is the opposite of Expanding.
Difference of 2 Squares	A squared term (i.e. a term multiplied by itself) subtracted from another squared term.

Extension Work from Chapter 16





How to Use Key Facts

Terms

A **term** is a number, a letter, or a number and a letter multiplied together.

Like terms contain the same letter to the same power (or do not contain a letter). You can simplify an expression by collecting like terms.

$3x$ $7x$ These are 'like terms' as the **letters** are the same.

$3x$ $7y$ $2x^2$ These are not 'like terms' as the letters are different or the powers are different.

expression $3x + 1$ terms

Simplifying Terms

Terms can be simplified when multiplying or dividing, even when they are not like terms.

$a \times b = ab$ $x \div y = \frac{x}{y}$

When multiplying:
- write letters in alphabetical order
- write numbers before letters

$3x \times 2y = 6xy$
$5a^2 \times 6a^1 = 30a^3$
$a^2 + 4a^2 - 2a^2 = 3a^2$
Remember the power does not change when you are adding and subtracting

Writing Expressions

Nine add a number x → $9 + x$
Fourteen take a number p → $14 - p$
Seven less than a number t → $t - 7$

The cost of a badger is b pence.
A racoon is 5 pence more expensive than a badger and a beaver three times as expensive as a badger.
a) cost of a racoon? $b + 5$
b) cost of a beaver? $3(b + 5)$
c) cost of a racoon and 8 badgers? $b + 5 + 8b = 9b + 5$

How to Use Key Facts

Substitution

When $x = 2$ and $y = 5$ work out the value of
a) $x + y$ b) xy c) $\frac{5x}{y}$ d) $4x + 3y$
a) $2 + 5 = 7$
b) $2 \times 5 = 10$
c) $5 \times 2 \div 5 = 10 \div 5 = 2$
d) $4 \times 2 + 3 \times 5 = 8 + 15 = 23$
Replace x and y with the values given.
Use the priority of operations.

Expand Single Bracket

$3(a + 4) + 4(a + 2)$
$3a + 12 + 4a + 8$
$= 7a + 20$

Expand more than 1 bracket and collect like terms

$4(x + 3) = 4x + 12$ ($4 \times x = 4x$, $4 \times 3 = 12$)
$5(2x + 4) = 10x + 20$ ($5 \times 2x = 10x$, $5 \times 4 = 20$)

Factorising

When factorising you need to Take out as high a factor as Possible.
Example : $12t^2 + 6t$
Although $3(4t^2 + 2t)$ is factorised it is not the Highest factor
$6t(2t + 1)$ is fully factorised.

How to use key Facts

Look through These examples

Factorise	Answer
7x + 14	7(x + 2)
45 - 27k	9(5 - 3k)
12ab + 7b	b(12a + 7)
y^2 - 9y	y(y - 9)
8t - $32t^2$	8t(1 - 4t)
16gh + 28gf	4g(4h + 7f)
$21w^2z$ - 77wx	7w(3wz - 11x)

Unit 2 – Accelerated Algebra 2

Unit 2 Higher Algebra Part 2

Prior Knowledge	
Creating an Equation	**FORMING EQUATIONS** The angles in a triangle are d, d + 30 and d – 5. **Form an equation & find the value of d.** Sum of angles in a △ is 180 d + d + 30 + d – 5 = 180 3d
Calculating Term to Term Rule	The nth term rule of the sequence -4, 0, 4, ... - 4 is being added to all the numbers - the first term in a 4s sequence is 4 - to match the first term in the given sequence (4 to -4), subtract 8 - nth term rule = 4n - 8

HOW TO USE KEY FACTS

Algebraic Index laws

Rule	Example	Rule	Example
$a^m \times a^n = a^{m+n}$	$2^6 \times 2^3 = 2^8$	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$	$\left(\frac{5}{6}\right)^2 = \frac{25}{36}$
$a^m \div a^n = a^{m-n}$	$5^7 \div 5^3 = 5^4$	$a^{-m} = \frac{1}{a^m}$	$9^{-2} = \frac{1}{81}$
$(a^m)^n = a^{m \times n}$	$(10^3)^7 = 10^{21}$	$a^{\frac{x}{y}} = \sqrt[y]{a^x}$	$49^{\frac{1}{2}} = \sqrt[2]{49} = 7$

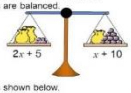
Solving Equations

Solving Equations

Remember:

1. We have previously solved simple equations like the one shown and we looked at the analogy of scales in which both sides are balanced.

$2x + 5 = x + 10$
$x + 5 = 10$
$x = 5$

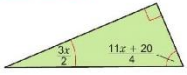


2. We have previously expanded single brackets as shown below.

$5(2x - 3)$ means $5 \times (2x - 3) = 10x - 15$

Problem Solving

Problem-solving Find the size of the smallest angle in the triangle.



Use the facts we know.
Angles in a triangle add to 180° so (11x + 20) / 4 + 3x / 2 + 90 = 180
(11x + 20) / 4 + 6x / 4 = 90 => 11x + 6x + 20 = 360
17x = 340
X = 20

KEY FACTS TO MEMORISE

Key Facts	
Index laws	The laws governing the multiplication/division of terms with indices
Equations	An **equation** is any expression with an equals sign.
Formula	A **formula** is a set of instructions for creating a desired result.
Identity	An equation that is true for all values of the variables.
Solving Equations	Means finding the set of all values of the variable that can be substituted to produce a valid equation.
Changing the Subject	Rearranging an equation so that a different variable is on it's own on one side of the equals sign.
Linear / Arithmetic Sequence	A number pattern which increases (or decreases) by the same amount each time is called a linear sequence. The amount it increases or decreases by is known as the common difference.
Geometric Sequence	A sequence of numbers where each term after the first is found by multiplying the previous one by a fixed, non-zero number called the common ratio.
Quadratic Sequence	A quadratic sequence is a sequence of numbers in which the second differences between each consecutive term differ by the same amount, called a common second difference.

HOW TO USE KEY FACTS

Arithmetic / Linear Sequence

a Work out the nth term of the sequence 3, 7, 11, 15, ... b Is 45 a term of the sequence?

a 4n: 4, 8, 12, 16, ... → −1 → 3, 7, 11, 15, ... (+4 +4)

The nth term is 4n − 1.

The common difference is 4. Write out the first five terms of the sequence for $4n$, the multiples of 4. Work out how to get from each term in $4n$ to the term in the sequence.

Geometric Sequence

Geometric Sequence

A geometric sequence has a common ratio.
The formula for the n^{th} term is

$a_n = ar^{n-1}$

where a_n = n^{th} term of the sequence
a = first term of the sequence
r = common ratio

TRY THESE EXAMPLES

a There are four pairs of integers that multiply to 24 and add up to a negative number.
One pair is −8 and −3. Write down the other three pairs.

b Use your answer to part **a** to write down the factorisation of
i $x^2 - 25x + 24$
ii $x^2 - 14x + 24$
iii $x^2 - 10x + 24$
iv $x^2 - 11x + 24$

Real The deposit, D, needed when booking a skiing holiday is in two parts:
- a non-returnable booking fee, B
- one-tenth of the total cost of the holiday, which is worked out by multiplying the price per person, P, by the number of people, N, in the party.

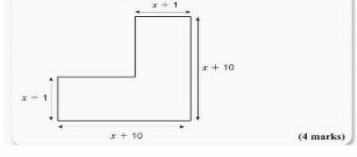
$D = B + \frac{NP}{10}$

a Find the deposit needed to book a holiday for four people when the cost per person is £2000 and the booking fee is £150.
b Make P the subject of the formula.
c What is the price per person when $D = £500$, $B = £150$ and $N = 5$?

iii $(x - 4)(x - 6)$ iv $(x - 3)(x - 8)$

Exam-style question

Work out a simplified expression for the area of this shape.
All the angles are right angles.



(4 marks)

HOW TO USE KEY FACTS

Quadratic Sequence

Find a formula for the nth term of the sequence 8, 23, 48, 83, 128, ...

sequence	8	23	48	83	128
1st differences	+15	+25	+35	+45	
2nd differences	+10	+10	+10		

Work out the second differences.

So $a = 10 \div 2 = 5$
The formula has a $5n^2$ term in it.

Halve the second difference to find the coefficient of n^2.

$5n^2$	5	20	45	80	125
Sequence	8	23	48	83	128

Compare the given sequence with $5n^2$.

The nth term is $5n^2 + 3$

The numbers in the second row are 3 more than those in the first row.

Changing the Subject of an Equation or Formula

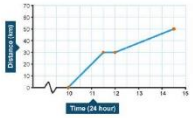
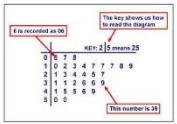
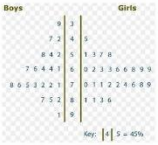
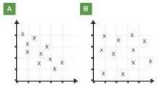
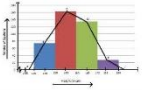
a Make a the subject of the formula $v^2 = u^2 + 2as$
b Make x the subject of the formula $y = \frac{ax + b}{c}$

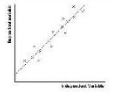
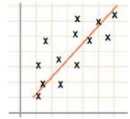
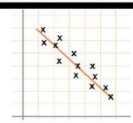
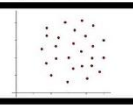
a $v^2 = u^2 + 2as$
$v^2 - u^2 = 2as$ — Subtract u^2 from both sides.
$\frac{v^2 - u^2}{2s} = a$ — Divide both sides by $2s$.
$a = \frac{v^2 - u^2}{2s}$ — Re-write in the form $a = \ldots$

b $y = \frac{ax + b}{c}$
$cy = ax + b$ — Multiply both sides by c.
$cy - b = ax$ — Subtract b from both sides.
$\frac{cy - b}{a} = x$ — Divide both sides by a.
$x = \frac{cy - b}{a}$ — Re-write in the form $x = \ldots$

Unit 3 – Accelerated Interpreting and Representing Data

Unit 3 Interpreting and Representing Data

Important Information	
Time Series graph 	A time series graph is a line graph with time plotted on the horizontal axis.
Stem and Leaf 	A stem and leaf diagram shows numerical data split into a 'stem' and 'leaves'. The leaf is usually the last digit and the stem is the other digits. In a stem and leaf diagram the numbers are placed in order.
Back to Back Stem and Leaf Diagram 	A back to back stem and leaf diagram works th3e same way a s a normal stem and leaf diagram but it compares two sets of data.
Scatter Graph 	A scatter graph shows the relationship between 2 sets of data. Plot the points with crosses do not join them up.
Frequency Polygon 	A frequency polygon is a graph made by joining the midpoints of the tops of the bars in a bar chart with straight lines
Pie Chart 	A pie chart is a circle divided into sectors. Each sector represents a set of data.

Key Facts to Memorise		
Correlation	Correlation may be positive or negative (sometimes there is no correlation) Correlation shows that there may be a link between 2 events . It does not show	
Line of best fit	A line of best fit is a straight line drawn through the middle of the points on a scatter graph. It should pass as near to as many points as possible and represent the trend of the points	
Positive Correlation	**Positive Correlation** is a relationship between two variables in which both variables increase.	
Negative Correlation	**Negative Correlation** is a relationship between two variables such that as the value of one variable increases, the other decreases.	
No Correlation	**No Correlation** means there is no relationship between the variables.	

Important Information	
Mean (Grouped frequency table)	To estimate a mean from a grouped frequency table, add together the products of class midpoints and their frequencies and divide by the total frequency
Mode (Grouped frequency table)	The **Modal class** (or modal group) has the highest frequency
Median (Grouped frequency table)	If the total frequency in a grouped frequency table is n, then the median lies in the group containing the $\frac{n+1}{2}$ th item of data

Important vocabulary	
Line Graph	Shows trends in data
Trend	The trend is the general direction of change between 2 variables
Correlation	The relationships between the sets of data is called correlation. The sets of data are called variables. Correlation may be positive or negative (sometimes there is no correlation) Correlation shows that there may be a link between 2 events . It does not show one event caused the other.
Outlier	An outlier is a value in a data set which is much larger/smaller than all the other values ion the set
Interpolation	Using a line of best fit to predict data values within the range of the data given is called interpolation and is usually
Extrapolation	Using a line of best fit to predict data values outside the range of the data given is called extrapolation and may not be accurate.
Discrete Data	Can only have particular values. For example shoe sizes are usually whole numbers.
Continuous Data	Continuous data is measured and can have any values, for example length and time. Write inequalities for the groups with no gaps between them.

Unit 4 – Accelerated Fractions

Unit 4 Higher Fractions

Ratio and Percentages

Important Information	
Simplifying Fractions	$\frac{6}{48} \xrightarrow{\div 2} \frac{3}{24} \xrightarrow{\div 3} \frac{1}{8}$ (÷2 then ÷3)
Fractions of an Amount	$\frac{7}{10}$ of 40 40 ÷ 10 = 4 4 x 7 = 28
Multiply Fractions	$\frac{3}{4} \times \frac{5}{8} = \frac{(3 \times 5)}{(4 \times 8)} = \frac{15}{32}$
Divide Fraction	**K**eep the first fraction as it is **F**lip the second fraction over **C**hange the sign from divide to multiply
Writing and Simplifying Ratios	Divide both sides By the HCF In this case 4 16 : 12 (÷4) → 4 : 3 (÷4)
Using Multiplier to Calculate amounts	To find 20 % of 60 Write 20% as decimal (divide by 100) = 0.20. Use Calculator to find 0.2 x 60 = 12
Converting Fractions to Decimals and then to Percentage	Convert into a decimal Multiply by 100 CONVERT FRACTIONS TO DECIMALS: $\frac{2}{5} = 0.4$ CONVERT DECIMALS TO PERCENTS: 0.4 = 40 %
Adding and Subtracting Fractions	Both fractions must have the same denominator. Therefore you Find the LCM of both denominators. Work out $\frac{2}{3}+\frac{1}{9}$. $\frac{2}{3}+\frac{1}{9}=\frac{6}{9}+\frac{1}{9}=\frac{7}{9}$ The LCM of 3 and 9 is 9. Write the fractions with denominator 9 and then add. Once we have changed both fractions so that they have the same denominator we simply add or subtract the numerators. (Not the denominators) Finally always simpli-

Key facts to memorise

Example—Basic angle facts	
Adding or Subtracting Mixed Numbers	Step 1. Convert both numbers into improper fractions. Step 2. Find common denominator and re write both fractions. Step 3. Add or subtract the numerators. Step 4. Always simplify the fraction.
Multiplying Mixed Numbers	Step 1. Convert the mixed numbers to improper fractions. Step 2. Multiply the numerators, Multiply the denominators. Step3. Always Simplify the fraction.
Dividing Mixed numbers	Step 1. Convert the mixed numbers to improper fractions. **Step 2. KFC** **K**eep the first fraction as it is **F**lip the second fraction over **C**hange the sign from divide to multiply. Step 3. Multiply the numerators, Multiply the denominators. Step 4. Always Simplify the fraction.
Writing ratios in the form 1 : n	Divide both sides by the lowest number.
Comparing ratios to see which is greater	Convert both ratios to the for 1 : n The value of n will allow you to calculate the greatest ratio.
Recognise Direct proportion	Y is directly proportional to x When as y increases or decreases x increases or decreases in proportion.
Calculate amount after Percentage Increase	Step 1. Calculate the decimal multiplier. If increase by 20% your final amount will be 100% + 20% = 120% Decimal multiplier = 1.2 Step 2. Multiply your original amount by the decimal multiplier.
Calculate Amount after Percentage decrease	Step 1. Calculate the decimal multiplier. If decrease by 15% your final amount will be 100% - 15% = 85% Decimal multiplier = 0.8 Step 2. Multiply your original amount by the decimal multiplier.
Calculate Percentage Change	Percentage Change $\frac{\text{NEW VALUE - OLD VALUE}}{\text{OLD VALUE}} \times 100$
Convert Recurring decimals to Fractions	Identify first repeat pattern, 0.7343434 (first repeated pattern) Let number = x Now multiply by power of 10 so that repeat Starts **immediately after decimal point.** 0.7343434... x 10 = 7.3434,,,,, = 10x Now multiply by power of 10 so **end of repeat is before decimal.** 0.7343434... * 1000 = 734.343434... = 1000x Now subtract 1000x—10x = 734.343434....— 7.343434...

Vocabulary

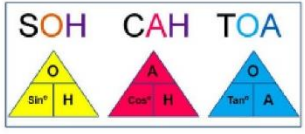
Important vocabulary	
Denominator	The bottom number in a fraction.
Numerator	The topnumber in a fraction.
Mixed Number	A whole number and a fraction combined into one "mixed" number. Example: 1½ (one and a half) is a mixed number.
Improper Fraction	A fraction where the numerator (the top number) is greater than or equal to the denominator (the bottom number).
Reciprocal	The reciprocal of n is 1/n
Percentage	Parts per one hundred. Percent means literally for every 100.
Decimal Multiplier	This is the decimal that represents the percentage you want your answer to represent.
Reciprocal	The reciprocal of a number is: 1 divided by the number
Simple Interest	Interest calculated as a percent of the original loan. Example: a 3-year loan of $1,000 at 10% costs 3 lots of 10% So the interest is 3 × $1,000 × 10% = $300
VAT	Value added tax currently 20%
Inflation	A percentage Increase
Deflation	A Percentage Decrease

Unit 5 Higher – Angles and Trigonometry

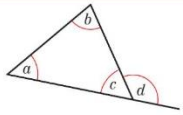
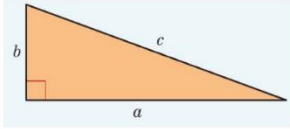
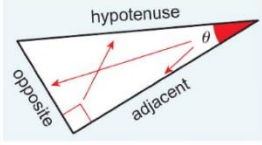
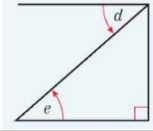
Unit 5 Higher—Angles and Trigonometry

Important vocabulary & Ideas	
Interior Angles	An angle between two adjacent sides inside a polygon.
Exterior Angles	An angle between a side of a polygon and an adjacent side extended outward.
Polygon	A 2D shape made from 3 straight sides or more.
Pythagoras Theorem	It states that the square of the hypotenuse is equal to the sum of the squares of the other two sides.
Hypotenuse (hyp)	Longest side—opposite the right angle.
Opposite (opp)	Opposite the angle given or that you are wanting to find.
Adjacent (adj)	Next to the angle given or that you are wanting to find.
Angle of Elevation	The angle measured upwards frim the horizontal
Angle of Depression	The angle measured downwards from the horizontal
Parallel Lines	**Lines that have the same distant continually between them. They never intersect**

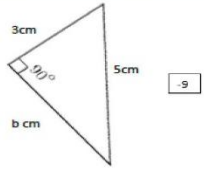
Quick Mnemonic for Trigonometric Ratios



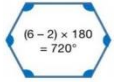
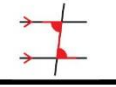
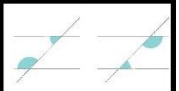
Key facts to memorise

Formulae & Diagrams	
The exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices.	 angle d = angle a + angle b
Exterior Angle of a regular Polygon	$\frac{360}{number\ of\ sides}$
Pythagoras Theorem: $c^2 = a^2 + b^2$	
Identifying hypotenuse, opposite and adjacent sides in a Right Angled Triangle	
Sine Ratio (sin)	$\sin\theta = \frac{opposite}{hypotenuse}$
Cosine Ratio (cos)	$\cos\theta = \frac{adjacent}{hypotenuse}$
Tangent Ratio (tan)	$\tan\theta = \frac{opposite}{adjacent}$
Angle of elevation (e) Angle of depression (d)	

Applying Pythagoras Theorem



Formulae & Diagrams

Sum of Interior Angles in a polygon with n sides	 $(6-2) \times 180 = 720°$
Alternate angles are equal	
Supplementary (co—interior) angles add up to 180°	

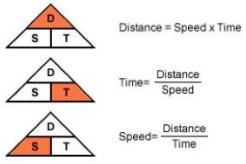
Trigonometric values to memorise

Value of Trigonometric Ratio					
	0	30	45	60	90
Sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
Cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
Tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Asymptote

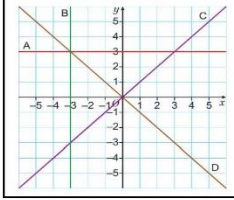
Unit 6 – Accelerated Graphs

Unit 6 Higher Graphs

Important Information



Write down the equation for each line.



ANSWERS

A - $y = 3$

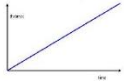
B - $x = -3$

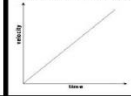
C - $y = x$

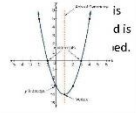
D - $y = -x$

Important vocabulary	
Linear Equation	Generates a straight-line graph
Gradient	The Gradient (also called Slope) of a straight line shows **how steep** a straight line is.
y—intercept	Where the line crosses the y-axis
x—intercept	Where the line crosses the y-axis
Parallel lines	Lines on a plane that never meet. They are always the same distance apart.
Perpendicular Lines	Lines that are at right angles (90°) to
Distance-time graphs	Represents a journey.
Direct Proportion	If two quantities are in **direct proportion**, as one increases, the other increases by the same percentage.
Inverse Proportion	One value increases as the other value decreases.
Reciprocal	The reciprocal of a number is: 1 divided by the number.

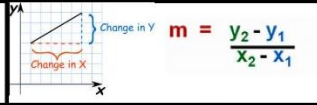
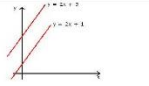
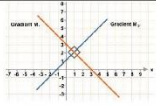
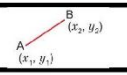
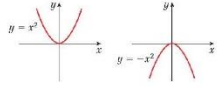
Key facts to memorise

Distance –Time Graph	
Straight Line	Constant speed 
Horizontal Line	No movement
Gradient	Equals the Speed
Average Speed	$\frac{total\ distance}{total\ time}$

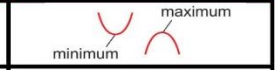
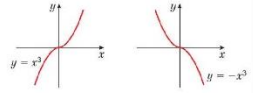
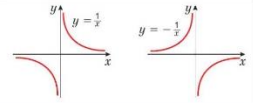
Velocity– Time Graph	
Straight Line	Constant Acceleration 
Horizontal Line	No change in velocity.
Gradient	Equals the acceleration
Acceleration	$\frac{change\ in\ velocity}{time}$

Important Vocabulary	
Quadratic Equation	An equation which contains a term x^2 but no higher power of x. It can also have terms in x and number terms.
Parabola	A plane curve which is mirror-symmetrical and approximately 
Cubic Function	An equation which contains a term x^3 but no higher power of x. It can also have terms in x^2 and x and number terms.

Key facts to memorise

Graphs	
Equation of a Straight Line	$y = mx + c$ m is the gradient and c is the y-intercept.
Gradient	
Parallel Lines	Same gradient $m = 2$ 
Perpendicular Lines	$(m_1)(m_2) = -1$ 
Midpoint	$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$ 
Quadratic Equation	$ax^2 + bx + c = 0$
Quadratic Equation Graph	

Keys facts to memorise

Graphs	
Minimum and Maximum Point	
Quadratic Equation Solutions	Can have 0, 1 or 2 solutions
Cubic Function	$f(x) = ax^3 + bx^2 + cx + d$ where $a \neq 0$
Cubic Function Graph	
Cubic Equation Solutions	Can have 0, 1 or 2 solutions
Reciprocal Functions	

Extra Information

Graph axes do not have to start at zero.

A zigzag line shows that values have been missed out.

When two quantities are in **direct proportion**

- the graph is a straight line through the origin
- when one variable is multiplied by n, so is the other.

9BP - Plants And Photosynthesis

1. Photosynthesis

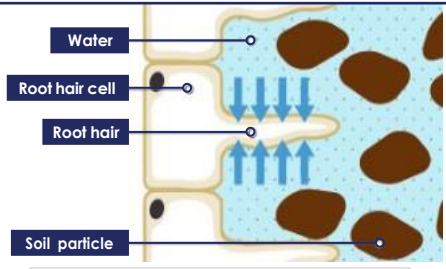
- Plants make their own food (for energy) in a process called **photosynthesis**.
- Photosynthesis helps keep:
  - Levels of oxygen high;
  - Levels of carbon dioxide low.

- Photosynthesis takes place in the **chloroplasts.**
- Chloroplasts contain **chlorophyll** which absorbs the energy transferred by light waves for photosynthesis.

The equation for photosynthesis is:
Carbon dioxide + water → glucose + oxygen

These are the things that plants need for photosynthesis:
- **Carbon dioxide –** absorbed through their leaves;
- **Water -** from the ground through their roots;
- **Light** (a source of energy) - from the Sun.

These are the things that plants make by photosynthesis:
- **Oxygen -** released into the air from the leaves;
- **Glucose:**
  - Turned into **starch** and plant oils, used as an energy store;
  - This energy is released by **respiration;**
  - Used to make **cellulose** for cell walls.



Water is absorbed from the soil by root hair cells

Water is absorbed into the roots by a process called **osmosis**, which does not use energy.
Minerals are absorbed into the roots by a process called **active transport**, which uses energy.

2. Leaves

Feature Of Plant Leaf	Function
Thin	Short distance for carbon dioxide to diffuse into the leaf
Waxy Layer	Prevents water loss by evaporation
Palisade Cells	Contain a lot of chloroplasts to absorb light
Chloroplasts Contain Chlorophyll	Absorbs light
Stomata	Allows carbon dioxide to diffuse into the leaf (and oxygen to diffuse out)
Guard Cells	Open/close stomata depending on conditions
Network Of Tubes (Xylem & Phloem)	Transports water (xylem) and food (phloem)

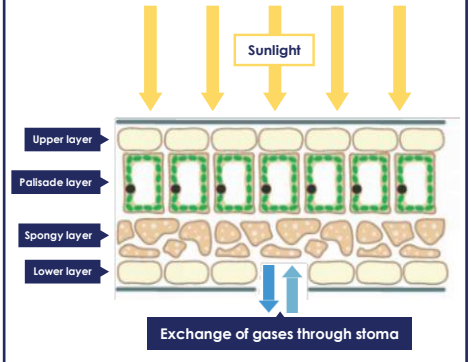
4. Water

- Water is absorbed through the roots, by **osmosis;**
- It is transported through tubes (**xylem**) to the leaf;
- The roots contain cells called **root hair cells:**
  - They increase the **surface area.**
  - They have **thin walls** to let water pass into them easily.
  - They **do not** contain chloroplasts.

6. Respiration v Photosynthesis

Photosynthesis:
Carbon dioxide + water → glucose + oxygen
Aerobic respiration is:
Glucose + oxygen → carbon dioxide + water
The equation for photosynthesis is the **opposite** of the equation for aerobic respiration.
- **Photosynthesis:**
  - **Produces** glucose and oxygen;
  - **Uses** carbon dioxide and water.
- **Respiration:**
  - **Produces** carbon dioxide and water;
  - **Uses** glucose and oxygen.

3. Cross-Section Of A Leaf



5. Carbon Dioxide

- Enters leaf by **diffusion** through the **stomata.**
- **Guard cells** control the size of the stomata.
- Stomata closes in **hot, windy** or **dry** conditions.
- Spongy layer has gaps between cells:
  - Allows carbon dioxide to **diffuse** to other cells in the leaf;
  - Allows oxygen produced in photosynthesis diffuse out of the leaf.

7. Food Security And Pollination

- **Pollination** is the transfer of pollen from one plant to another;
- Pollen can be transferred by **insects** or by **wind;**
- Insects that pollinate plants help us produce our food;
- Our food supply depends on plants:
  - Our food made of, and from plants;
  - The animals we eat feed on plants.

9PM - Matter

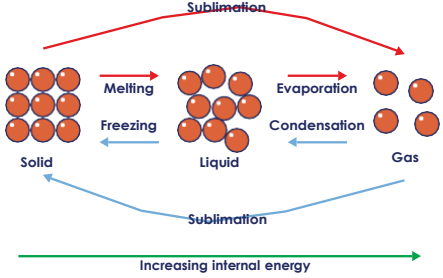
1. Change Of State

- Substances can change state, usually when they are heated or cooled;
- State changes are **reversible** – e.g. ice can be melted and then frozen again;
- No new elements or compounds are formed.

The closeness, arrangement and motion of the particles in a substance change when it changes state:

	Solid	Liquid	Gas
Closeness	All touching	Mostly touching	Far apart
Arrangement	Ordered	Random	Random
Motion	Vibrate, fixed position	Move freely	Move freely (faster than liquids)
Density	Decreasing density ---------->		
Internal Energy	Increasing internal energy ---------->		

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$



2. Pressure In Fluids

- A **fluid** is a liquid or gas;
- All fluids can change shape and flow from place to place;
- Fluids exert pressure at 90° to surfaces – we say that it acts normal to the surface.

4. Brownian Motion

- Gas particles move very quickly;
- Air particles move at 500 m/s on average at room temperature;
- Particles collide with each other very frequently;
- They change direction randomly when they collide;
- Their random motion because of collisions is called **Brownian motion**.

6. Diffusion

- Diffusion is the **movement of particles from an area of high concentration to an area of low concentration;**
- Diffusion does not happen in solids – only fluids (liquids and gases);
- Particles in a solid can only vibrate and cannot move from place to place;
- Diffusion is driven by differences in concentration;
- No diffusion will take place if there is no difference in concentration from one place to another;
- Diffusion in liquids is slower than diffusion in gases because the particles in a liquid move more slowly.

Explaining diffusion in a smelly gas

- When a perfume is released into in a room, the perfume particles mix with the particles of air;
- The particles of perfume are free to move quickly in all directions;
- They eventually spread through the whole room **from an area of high concentration to an area of low concentration;**
- This continues until the concentration of the perfume is the same throughout the room;
- The particles will still move, even when the perfume is evenly spread out.

Diffusion and temperature

Diffusion is faster if the fluid (gas or liquid) is hotter.

3. Atmospheric Pressure

The atmosphere exerts a pressure on you, and everything around you.

Atmospheric pressure changes with altitude. The higher you go:

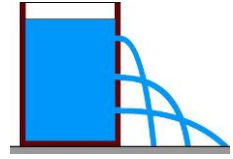
- The lower the weight of the air above you;
- The lower the atmospheric pressure.

5. Pressure In Liquids

Just like the atmosphere, liquids exert pressure on objects.

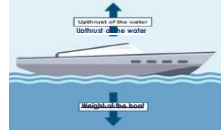
The pressure in liquids changes with depth. The deeper you go:

- The greater the weight of liquid above;
- The greater the liquid pressure;
- Pressure in a liquid increases with depth;
- Jet from the bottom of the bucket travels further.



7. Floating And Sinking

- Liquid pressure is exerted on surfaces of objects in liquids;
- This causes upthrust;
- When an object sinks, the pressure increases and so the upthrust increases;
- It will continue to sink if weight is greater than maximum upthrust;
- When and object floats, the upthrust is equal and opposite to the object's weight.



9PF - Forces In Action

1. Hooke's Law

Hooke's Law says that **the extension of an elastic object is directly proportional to the force applied.** In other words:
- The extension doubles, if the force is doubled;
- There is no extension, if no force is applied.

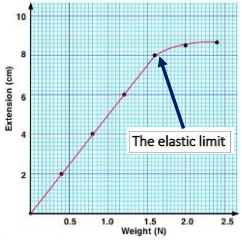
You can investigate Hooke's Law using a spring:
- Hang the spring from a stand and clamp;
- Measure its length with a ruler;
- Hang a mass from the spring and measure the new length of the spring;
- Work out: **extension = new length – original length**;
- Keep adding more masses, measuring the new length each time;
- Work out extension for each mass.

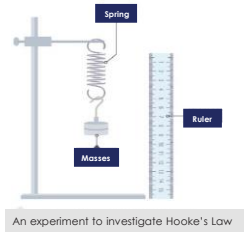
You can then plot a force-extension graph:
- Plot force on the vertical (y) axis;
- Plot extension on the horizontal (x) axis.

Force Applied (N) = Spring Constant (N/m) x Extension (m)

Using Hooke's Law

In a force-extension graph:
- The steeper the line, the stiffer the spring;
- The area under the line is the work done (energy needed) to stretch the spring.



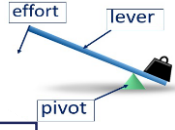


An experiment to investigate Hooke's Law

2. Moments

- A moment is a turning effect of a force.
- Forces can make objects turn if there is a pivot.
- When the turning forces are balanced - the moments are equal and opposite.

Calculating moments
To calculate a moment, you need to know:
- The distance of the force from the pivot;
- The size of the force.



Moment (Nm) (Ncm)	=	Force (N)	x	Perpendicular Distance (m) (cm)

Force multipliers
- Increasing the distance will increase the moment for the same force;
- This is why a longer spanner will loosen a tight nut;
- And a crowbar or long lever can be used to lift heavy objects.

÷100
Centimetres - Metres
x100

÷1000
Metres - Kilometres
x1000

Work Done (J) = Force (N) x Distance (m)

4. Deformation

Elastic materials:
- **Change shape** when a force is exerted on them;
- **Return to their original shape/size** when the force is removed.

Deformation is a change in shape. There are two types of deformation:
- **Stretching** is when the object/material is pulled;
- **Compression** is when the object/material is squashed.

The greater the force exerted, the greater the amount of deformation. If the force is large enough, the object/material may no longer return to its original size. Until you reach this point, a special case called **Hooke's Law** applies.

3. Simple Machines

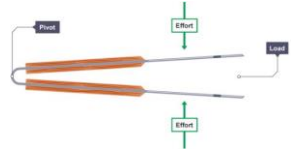
Example of simple machines are **see-saws, wheelbarrows** and forceps. **Simple machines give a bigger force but with a smaller movement.**

See–saw
A force is exerted in one place, causing movement and a force at another place in the see-saw. A see-saw will balance when:

Clockwise Moment = Anticlockwise Moment
Force (N) x Distance (cm) = Force (N) x Distance (cm)

Wheelbarrows
Wheelbarrows are a simple machine with the load near the pivot (the wheel) and the effort on the handles far from the pivot.

Forceps
With forceps, fingers provide the effort force, and this is nearer to the pivot than the load (the object you are picking up):



- Some machines give a smaller force but with a bigger movement.

This is the opposite to the see-saw and wheelbarrow, but again if you multiply the force by the distance travelled, you get the same value for the effort and for the load.

9CR Reactivity

1. Word Equations To Symbol Equations

- Replace names of each substance symbols or formula;
- Use numbers to balance the equation;

Example:

copper + oxygen → copper oxide

2Cu + O_2 → 2CuO

Two copper atoms (2Cu) react with one oxygen molecule (O_2) to produce two units of copper oxide (2CuO).

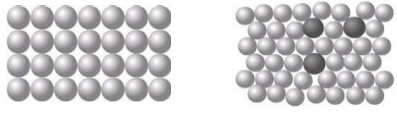
2. Typical Properties Of Metals

Appearance	Shiny
State At Room Temperature	Solid (except mercury, a liquid)
Density	High
Strength	Strong
Malleable Or Brittle	Malleable
Conduct Heat?	Good
Conduct Electricity?	Good
Magnetic Material	Only iron, cobalt & nickel
Sound When Hit	Make a ringing sound (sonorous)

3. Pure Metals V Alloy

The rows of atoms in a pure metal can slide over each other easily.
In an alloy, the different sized atoms disrupt the layers so the atoms can't slide.
This makes alloys more useful than pure metals.

Pure metal **Alloy**



4. Bases V Alkalis

A **base** is a substance that can react with acids and **neutralise** them. Many bases are insoluble in water. If a base does dissolve in water it is called an **alkali.**

Bases are usually:
- **Metal oxides**, such as copper oxide
- **Metal hydroxides**, such as sodium hydroxide, or **metal carbonates**, such as calcium carbonate

General word equations for neutralisation reactions:

Metal oxide + acid → salt + water
Metal hydroxide + acid → salt + water
Metal carbonate + acid → salt + carbon dioxide + water

The lab test for carbon dioxide
Bubble the gas through lime water and watch for it to turn from colourless to a cloudy milky colour.

5. Acids And Metals

Acids react with most metals to produce a salt and hydrogen. This is the general word equation :

metal + acid → salt + hydrogen

The lab test for hydrogen
Place **lighted splint** in the test tube and listen for the gas to burn with a squeaky pop.

6. Naming Salts

Hydrochloric acid → metal **chlorides**
Sulfuric acid → metal **sulfates**
Nitric acid → metal **nitrates**

7. Calculating Relative Formula Mass

Formula mass is calculated by adding together the mass number of each atom in a compound's chemical formula.

E.g. $MgCl_2$ **Ar Mg = 24** **Ar Cl = 35.5**

Formula mass = 24 + (2 x 35.5) = 95

There are 2 chlorines in the chemical formula

9CR Reactivity

8. Reactivity Series

The reactivity series is a list of elements in order of their reactivity:

Potassium
Sodium
Calcium
Magnesium
Aluminium
Carbon
Zinc
Iron
Tin
Lead
Hydrogen
Copper
Silver
Gold
Platinum

Most reactive

Least reactive

If a metal loses its outer electrons more easily, it will be more reactive.

9. Extracting Copper From Copper Oxide

Copper is so unreactive, it does not react with cold or hot water, so it is used for water pipes.

To extract copper:

- Mix **copper oxide** powder with **carbon powder**;
- Heat the mixture strongly in a **crucible**;
- Keep the lid on the crucible, to stop carbon reacting with oxygen in the air;
- The **carbon dioxide** formed in the reaction escapes into the air;
- Let the crucible cool down, you tip the mixture into cold water;
- Brown copper sinks to the bottom, leaving unreacted powder suspended in the water.

These equations represent the reaction:

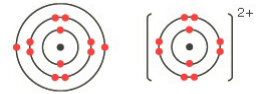
Copper oxide + carbon → copper + carbon dioxide

$2CuO + C \rightarrow 2Cu + CO_2$

10. Why Do Metals React?

Metals react because they want to gain a full outer shell and become stable. They do this by **losing their outer electron(s)** to become **positively charged ions**

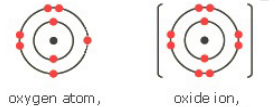
For example:
Magnesium loses its 2 outer electrons to become a +2 ion



Why do non-metals react?

Non-metals react because they want to gain a full outer shell and become stable. They do this by gaining electrons into their outer shell to become negatively charged ion.

For example:
Oxygen gains 2 electrons into its outer shell to become a -2 ion



11. Displacement Reactions

This is when a more reactive metal **displaces** a less reactive metal from its compound.

For example:

Magnesium + copper sulfate → magnesium sulfate + copper

If the more reactive metal is already in the metal compound, nothing happens. For example:

Magnesium sulfate + copper → no reaction

12. Carbon And Metal Extraction

Some metals can be extracted from their metal oxides using carbon if the metal is less reactive than carbon.

The metal is reduced – it has lost its oxygen

Metal oxide + carbon → metal + carbon dioxide

The carbon is oxidised – it has gained oxygen

This works for zinc, iron, tin, lead and copper because they are all less reactive than carbon.

9CE - Energetics And Rates

1. Rate Of Reaction

Reacting particles must **collide** with a minimum amount of energy **(activation energy)** for a chemical reaction to happen.

How quickly a reaction happens is called the **rate of reaction**, and always involves a **time measurement.**

We can **increase reaction rate** by:

1. **Increasing the concentration of liquid reactants** as it **increases the frequency of collisions;**
2. **Increasing the surface area of solid reactants** as it **increases the frequency of collisions;**
3. Using a **catalyst** as it **decreases the energy that particles need to collide with for a successful reaction.**

2. Some Ways To Measure The Rate Of A Reaction

- Time taken for a reactant to disappear;
- Time taken for the reaction mixture to change colour;
- Measure the number of bubbles produced in a certain time;
- Measure the volume of gas produced in a certain time;
- Measure the change in mass in a certain time.

3. Exothermic And Endothermic Reactions

- **Exothermic** reaction - **releases** energy to the surroundings;
- Causes a **rise** in temperature (**positive** temperature change);
- **Endothermic** reaction - **take in** energy from the surroundings;
- Causes a **drop** in temperature (**negative** temperature change).

4. Catalysts

- Speed up reactions;
- Are not used up during reactions;
- Are chemically unchanged after the reaction completes;
- Work by reducing the energy needed to start a reaction (**activation energy**).

In industry, using catalysts often results in **lower** temperature being used in industry, **saving money** and **cutting** the **use of fossil fuels** and their subsequent **emissions.**

Car exhausts have **catalytic converters**.

- They reduce amount of toxic gases released;
- They contain platinum and rhodium as catalysts.

5. Oxidation

In oxidation reactions, a substance **gains oxygen.**
Metals and non-metals can take part in oxidation reactions (be **oxidised**).
Examples:

- Magnesium reacts with oxygen to produce magnesium oxide:

Magnesium + oxygen → magnesium oxide

$2Mg + O_2 \rightarrow 2MgO$

- Carbon reacts with oxygen to form carbon dioxide:

Carbon + oxygen → carbon dioxide

$C + O_2 \rightarrow CO_2$

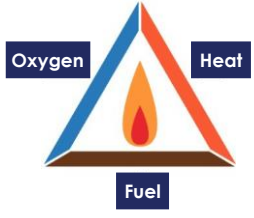
6. Identification Tests

Lime water – colour change from colourless to **cloudy when carbon dioxide.**
Glowing splint – will relight when placed in **oxygen.**
Blue cobalt chloride paper – colour change from blue to pink with **water.**
Hydrogen test - Lit split causes a squeaky pop when placed in **hydrogen.**

9CE - Energetics And Rates

7. Combustion

- **Combustion** is another name for burning fuels.
- It is an **exothermic** reaction.
- It is an example of an **oxidation** reaction.



8. Complete Combustion

- **Fuels** contain **hydrocarbons** which react with oxygen when they **burn;**
- With enough oxygen, **complete combustion** happens:
  - The hydrogen atoms combine with oxygen to make water vapour, H_2O
  - The carbon atoms combine with oxygen to make carbon dioxide, CO_2
  - The **maximum amount of energy** is released.

The equations for the complete combustion of **methane**.

Methane + oxygen → water + carbon dioxide

$$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$$

9. Incomplete Combustion

- Happens when there is **not enough oxygen**;
- Water vapour and carbon dioxide are still produced;
- Two other products are also produced:
  - **Carbon monoxide**, CO; colourless toxic gas.
  - Particles of **carbon** (soot/smoke); causes breathing problems.
- The **maximum amount of energy** is **NOT released.**

10. Thermal Decomposition

This is the **breaking down of a substance using heat**, to form two or more products.

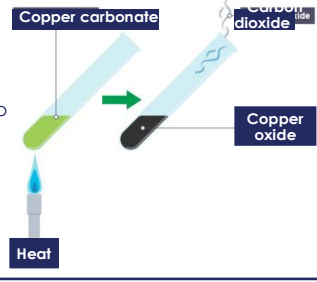
Many **metal carbonates** take part in thermal decomposition reactions.

For example, copper carbonate:
copper carbonate is green; copper oxide is black.
Copper carbonate → copper oxide + carbon dioxide
$CuCO_3 \rightarrow CuO + CO_2$

Other metal carbonates decompose in the same way. When they do, they follow this equation:
metal carbonate → metal oxide + carbon dioxide

For example, calcium carbonate:
calcium carbonate → calcium oxide + carbon dioxide
$CaCO_3 \rightarrow CaO + CO_2$

Thermal decomposition is an example of an **endothermic** reaction. Energy must be supplied **constantly** for the reaction to keep going.



11. Conservation Of Mass

Atoms are not destroyed nor created during chemical reactions, so in any reaction:

Total mass of reactants = total mass of products

9BB - Biological Systems And Processes

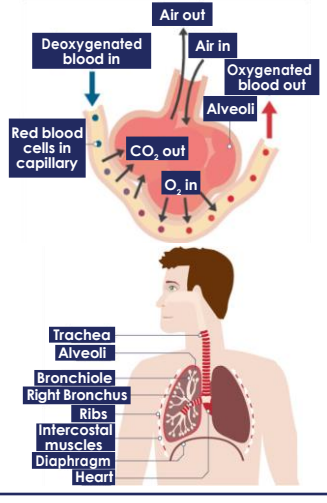
1. The Human Gas Exchange System

- Oxygen is needed for respiration;
- Carbon dioxide produced in respiration needs to be removed;

Gas exchange is moving oxygen from the air into the blood, and removing waste carbon dioxide from the blood into the air.

The respiratory system contains the organs that allow us to get the oxygen we need and to remove the waste carbon dioxide we do not need:

- Air passes from the mouth into the **trachea** (windpipe);
- The trachea divides into two **bronchi** - one for each lung;
- Each bronchus divides into smaller tubes called **bronchioles;**
- At the end of each bronchiole, there are air sacs **(alveoli)**;
- The alveoli increase the **surface** of the lungs.



2. Aerobic Respiration

Energy is needed for:

- Growth and repair;
- Movement;
- Control of body temperature in mammals/birds.

The equation for aerobic respiration is:

glucose + oxygen → carbon dioxide + water

- Glucose and oxygen react to produce carbon dioxide and water and release energy;
- It is **aerobic** respiration because oxygen is used;
- Respiration happens in all living cells, including plant and animal cells;
- Takes place in the **mitochondria** of the cell;
- Energy is released from glucose;
- **Do not** confuse respiration with breathing (which is called **ventilation**).

3. Ventilation

- Ventilation is another word for breathing;
- It involves movements of the **ribs, intercostal muscles** and **diaphragm** to move air in and out of the lungs;
- **Inhale** – breathing in; **exhale** – breathing out.

	Inhaling	Exhaling
Diaphragm	Contracts and moves downwards	Relaxes and moves upwards
Intercostal Muscles	Contract, moving the ribs upwards and outwards	Relax, letting the ribs move downwards and inwards
Volume Of Ribcage	Increases	Decreases
Pressure Inside The Chest	Decreases below atmospheric pressure	Increases above atmospheric pressure
Movement Of Air	Moves into the lungs	Moves out of the lungs

4. Features Of The Alveoli

- Increase surface area of lungs;
- Moist, thin walls (just one cell thick);
- A lot of tiny blood vessels called **capillaries.**

The gases move by **diffusion** (from a **high concentration to a low concentration**):

- Oxygen diffuses from the air into the blood;
- Carbon dioxide diffuses from the blood into the air.

5. Anaerobic Respiration

In humans: The equation for anaerobic respiration in humans is:

glucose → lactic acid

- Lactic acid builds up in the muscles;
- Causing pain and tiredness (fatigue);
- Can lead to cramp;
- Lactic acid is broken down when you start aerobic respiration again.

6. Fermentation

The equation for anaerobic respiration in yeast is:

Glucose → ethanol + carbon dioxide

- Anaerobic respiration happens in microbes (e.g. bacteria);
- They need to release energy from glucose;
- Yeast (unicellular fungi) can carry out an anaerobic process called **fermentation**;
- Ethanol (alcohol) is produced;
- The ethanol is used to make beer and wine;
- The carbon dioxide helps bread rise.

7. Comparing Aerobic & Anaerobic

	Aerobic	Anaerobic
Needs Oxygen?	Yes	No
Needs Glucose?	Yes	Yes
Product(S) Formed	Carbon dioxide and water	Lactic acid
Energy Released	More	Less

8. Impact Of Exercise

Exercise causes an increase in:

- Breathing rate;
- Tidal volume (volume of air breathed in/out in one breath);

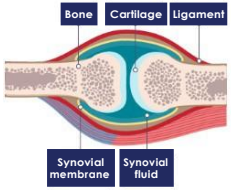
Regular exercise can increase the:

- Strength of the **diaphragm** and **intercostal muscles;**
- Vital capacity (volume of air that can be forcibly exhaled after inhaling fully).

9BB - Biological Systems And Processes

1. Joints

- Most joints allow parts of the skeleton to move;
- The human skeleton has joints called synovial joints.



The synovial joint

- The ends of the bones in a joint are covered with a tough, smooth substance called **cartilage**;
- This is kept slippery by a liquid called **synovial fluid;**
- Tough **ligaments** join the two bones in the joint;
- If two bones moved against each other, without cartilage they would eventually wear away;
- This is called **arthritis.**

Type of joint	Examples	Movement allowed
Hinge joint	Knee, elbow	The same as opening and closing a door, with no rotation (turning)
Ball and socket	Hip, shoulder	Back and forth in all directions, and rotation

2. The Skeleton

- Bone is a living **tissue** with a blood supply;
- It is constantly being dissolved and formed;
- It can repair itself if a bone is broken;
- Calcium and other minerals make bone strong but slightly flexible.

Four functions of the skeleton:

1) Support the body

- The skeleton supports the body. For example, without a backbone we would not be able to stay upright.

2) Protection of vital organs

- The skull protects the brain;
- The ribcage protects the heart and lungs;
- The backbone protects the spinal cord.

3) Movement

- Bones are linked together by joints;
- Some are **fixed joints** – e.g. in the skull;
- Some are **flexible joints** – e.g. the knee;
- Muscles move bones attached by joints.

4) Making blood cells

Two main types of blood cell:

- **Red blood cells**, which carry oxygen;
- **White blood cells**, which destroy **harmful microbes** (pathogens);
- Both are made in the bone marrow - soft tissue inside large bones protected by the hard part of the bone around it.

3. Muscles And Movement

- Muscles work by getting shorter - they contract;
- Muscles are attached to bones by strong tendons;
- During muscle contraction, it pulls on the bone, moving it.

Antagonistic muscles

- Muscles can only pull, they cannot push;
- Muscles work in pairs, called antagonistic muscles.

Your elbow joint has two muscles that move your forearm up or down. These are the **biceps** and the **triceps:**

- To raise the forearm, the biceps contracts and the triceps relaxes;
- To lower the forearm again, the triceps contracts and the biceps relaxes.

- Muscles exert a force on bones when they contract;
- You could work out the force exerted by the biceps muscle using the idea of moments;
- The way in which muscles and bones work together to exert forces is called biomechanics.

4. Drugs

Drugs are a substance that has an effect on the body.
They can be:

- **Medicines** are drugs that treat pain or disease;
- **Recreational drugs** are taken because people like the effects they have on their bodies;
- Some recreational drugs are legal, eg **caffeine**, **tobacco** & **alcohol;**
- Most recreational drugs are illegal, eg **cannabis**, **ecstasy** and **heroin;**
- Recreational drugs can be classified as a **depressant** or a **stimulant;**
- Most recreational drugs can be **addictive.**

5. Asthma

- Asthma affects the bronchioles;
- Airways can become inflamed, swollen and constricted (narrowed);
- Excess mucus is produced.

During an asthma attack:

- The lining of airways becomes **inflamed;**
- Fluid builds up in the airways;
- Muscles around bronchioles contract, which **constricts** airways.

Symptoms are:

- **Wheezing**, **tight chest** and **difficulty breathing.**

6. Smoking And Pregnancy

Smoking can damage the foetus during gestation. For example, it can:

- Increase the risk of complications in pregnancy and birth;
- Make it less likely to have a healthier pregnancy and a healthier baby;
- Increase the risk of stillbirth;
- Make it more likely to be born too early;
- Be more likely to be born underweight.

7. Smoking

Smoking is very harmful to health. Smoke contains harmful substances.

Tar

- Causes cancer of the lungs, mouth and throat;
- Coats the inside of the lungs causing coughing;
- Damages the alveoli, making gas exchange difficult.

Smoke

- Cells in the trachea, bronchi and bronchioles produce mucus;
- Mucus traps dirt and microbes;
- Cells with cilia move the mucus out of the lungs;
- Smoke and tar damages the cilia;
- Smokers cough to move the mucus and are more likely to get bronchitis.

Nicotine

- Nicotine is addictive;
- Nicotine increases heart rate and blood pressure, and makes blood vessels narrower;
- This can lead to heart disease.

Carbon monoxide

- Carbon monoxide takes the place of oxygen in red blood cells;
- This reduces amount of oxygen that the blood can carry;
- It means the circulatory system has to work harder, causing heart disease.

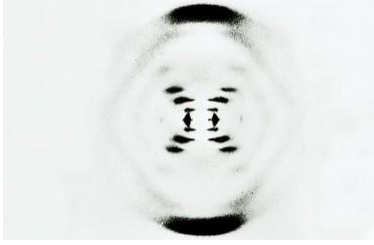
9BB - Biological Systems And Processes

1. Structure Of DNA

Genetic information is passed from one generation to the next.
This is called **heredity** and why we resemble our parents.

The genetic information itself is contained in a complex molecule called **DNA**.

Scientists worked out the structure of DNA in the 1950s. Rosalind Franklin made 'X-ray diffraction' images of DNA.



An X-ray diffraction image of DNA

James Watson and Francis Crick used information from one of her images to work out a model for the structure of DNA.

Work by Maurice Wilkins, a colleague of Franklin, supported their model.

4. Watson And Crick

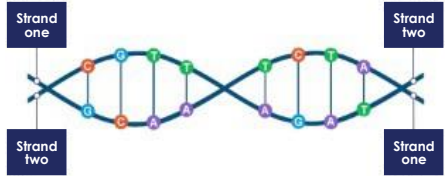
Watson and Crick worked out how DNA was arranged:

- DNA has two strands;
- The strands are twisted to form a **double helix;**
- The strands are held together by **bonds** between **base pairs.**

2. Key terms

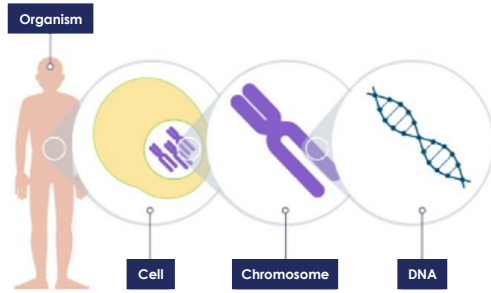
Key Terms	Definition
Base Pair	The pair of nitrogenous bases that connects the (complementary) strands of DNA
Bond	The chemical link that holds molecules together
Chromosome	Strands of DNA
DNA	Deoxyribonucleic acid. The chemical carrying the genetic code
Double Helix	The shape of DNA molecule, two strands twisted in a spiral
Gene	A section of DNA which we inherit from our parents, and which controls part of a cell's chemistry (protein production)
Heredity	Genetic information that determines an organism's characteristics, passed on from one generation to another
Nucleus	Controls what happens inside the cell, and contains chromosomes

5. Diagram of DNA



A DNA molecule showing its base pairs, G-C and A-T

3. Comparing Sizes



Each cell with a nucleus contains chromosomes, which are made from DNA

6. Chromosomes, DNA And Genes

The DNA in all of your cells is approximately two metres long, except for:

- Red blood cells which have none;
- Sperm or eggs only have about one metre.

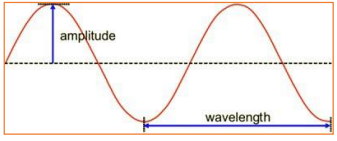
- It is coiled into structures called chromosomes.
- Chromosomes are found in the nucleus of each cell.

- Human body cells each contain **23 pairs of chromosomes;**
- Half of which are from each parent;
- Human gametes (eggs and sperm) each contain 23 chromosomes;
- When an egg is fertilised by a sperm, it becomes a cell with 23 pairs of chromosomes;
- We each have half of our chromosomes and DNA come from each parent;
- DNA makes up genes, which makes up chromosomes;
- One copy of all your chromosomes is called your **genome.**

9PS - Sound

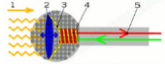
1. Wave Features

- **Amplitude:** the maximum height of the wave from its resting position:
  - The greater the amplitude, the louder the sound;
- **Wavelength:** the distance between two **crests** (tops) next to each other (or any other two identical point on waves next to each other);
- **Frequency:** the number of **waves per second (Hertz - Hz):**
  - The higher the frequency, the closer together the waves are, the higher the pitch.



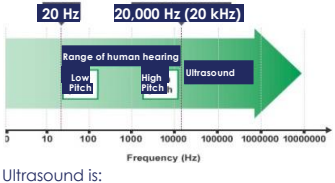
4. Microphones

- Microphones contain a **diaphragm**, which does a similar job to an eardrum;
- The vibrations in air make the diaphragm vibrate. These vibrations are changed to electrical impulses.



6. Ultrasound

Human beings can generally hear sounds as low as 20 Hz and as high as 20,000 Hz (20 kHz).



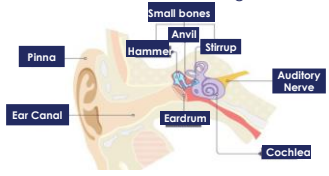
Ultrasound is:

- Any sound with a frequency of more than 20,000 Hz;
- Too high pitched for humans to hear;
- Other animals (e.g. dogs, cats and bats) can hear it;

Ultrasound can be used to check on the health of unborn babies, clean jewellery and in physiotherapy.

2. Ears

- An ear has an **eardrum**, connected to **three small bones;**
- Vibrations in air make the eardrum vibrate which in turn vibrates the three small bones (called **ossicles**) to a spiral structure called the **cochlea;**
- Signals are passed from the cochlea to the brain through the **auditory** nerve.



5. Types Of Waves

All waves transfer energy from place to place.
There are two types of wave: **longitudinal** and **transverse**:

Longitudinal waves
Sound waves are **longitudinal waves.**
The vibrations are **parallel to the direction of travel**.

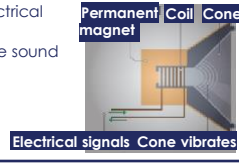
Transverse waves
Light waves (and water waves) are **transverse waves.**
The vibrations are **perpendicular to the direction of travel**

7. Reflection

- Sound waves can reflect off surfaces;
- These reflections are heard as **echoes;**
- **Hard, smooth surfaces** are good at reflecting sound (more echoes);
- **Soft, rough surfaces** are good at absorbing sound (less echoes).

8. Loudspeakers

- Loudspeakers work by converting electrical current into vibrations;
- This moves the cone which creates the sound waves.



3. Water Waves

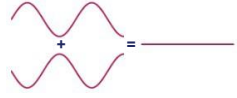
- Water waves move with a transverse motion;
- The **undulations** (up and down movement) are at 90° to the direction of travel;
- Water waves, like all waves, can be **reflected, refracted** and **diffracted.**

Superposition is where two waves meet and they affect each other: **adding** or **cancelling.**

Adding (constructive interference)

If two waves meet each other **in step**, they add together and reinforce each other. They produce a much higher wave, a wave with a greater **amplitude.**

Cancelling (destructive interference)
If two waves meet each other **out of step**, they cancel out.



9. Sound Waves

- When something vibrates, it produces sound;
- These sound waves are carried by vibrating particles;
- Sound can only travel through solids, liquids or gases;
- They cannot travel through empty space (a **vacuum**).

The speed of sound is 340 m/s in air

C1 – Elements, Compounds and Mixtures, Model of the Atom, Electronic Structure

Describe the differences between elements, compounds and mixtures

Element – made of only one type of atom.
Compound – made of more than one type of atom chemically bonded together.
Mixture – made of more than one type of element or compound not chemically bonded together

How can elements be turned into compounds?

Via a chemical reaction. Elements bond with each other to form compounds.

Explain how mixtures can be separated using:

1) Filtration

Using a filter funnel and folded filter paper to separate an insoluble solid (residue) from a liquid (filtrate)

2) Crystallisation

Heat to evaporate a solution until saturated. Allow saturated solution to cool and crystals will form.

3) Simple Distillation

Solution is heated until the solvent evaporates and travels into the condenser where it is cooled to condense and collected.

4) Chromatography

Separates components of a mixture by differing affinity to the mobile and stationary phase.

Complete the timeline by adding details of what each scientist discovered

Democritus and Leucippus
- Describe the first model of the atom proposed by the ancient Greeks

The smallest indivisible particle of a substance.

Thompson
- Describe the plum pudding model of the atom

The atom is a sphere of positive charge with negative electrons dotted throughout like raisins in a Christmas pudding.

Geiger and Marsden
- Describe Geiger and Marsden's alpha particle and gold experiment.

Alpha particles were fired at a thin sheet of gold foil. Most passed straight through and a small proportion were deflected back.

Rutherford
- How did Rutherford use this alpha scattering experiment to change the model of the atom?

The atom is mostly empty space with a tiny and positively charged nucleus at its centre.

Bohr
- Describe Bohr's model for electrons around the nucleus

Electrons orbit around the positively charged nucleus at different energy levels known as shells.

Chadwick
- Which particles do we find inside the nucleus?

Chadwick discovered the neutron which is found inside the nucleus along with the positively charged protons.

Complete this table for sub-atomic particles

Name of particle	Relative charge	Relative mass	Location in the atom
Proton	+1	+1	nucleus
Neutron	0	+1	nucleus
Electron	-1	0	shell

Complete the electronic structure for boron, sodium and fluorine

Draw a diagram of a helium atom;

neutron
proton
electron

Explain the meaning of the term isotope using carbon.

$^{12}_{6}C$ $^{14}_{6}C$

An atom of an element with the same number of protons and electrons but a different number of neutrons.

The radius of an atom is:
$1 \text{ to } 2 \times 10^{-10}$ m
The radius of the nucleus is:
$2 \text{ to } 15 \times 10^{-15}$ m
The radius of a nucleus is less than 1/10000 of that of the atom.

Self assessment
Red/Amber/Green:

I need help with:

9-1 Science AQA C1 – The Periodic Table, Metals and Non-Metals, Group 0, 1, 7 and Transition Metals

What does the group an element is in tell us about the electronic structure?

The number of outer electrons the atom has.

What does the period an element is in tell us about the electronic structure?

The number of shells the atom has.

What do elements with the same number of outer electrons have in common?

Metals and non-metals

A metal is a substances that reacts to form positive ions.

Elements that do not form positive ions are Non-metal

Complete using the words [positive, non-metal, metal]

What problems are encountered when arranging the elements in order of their atomic weights?

Some elements end up in the wrong group for the properties they have.

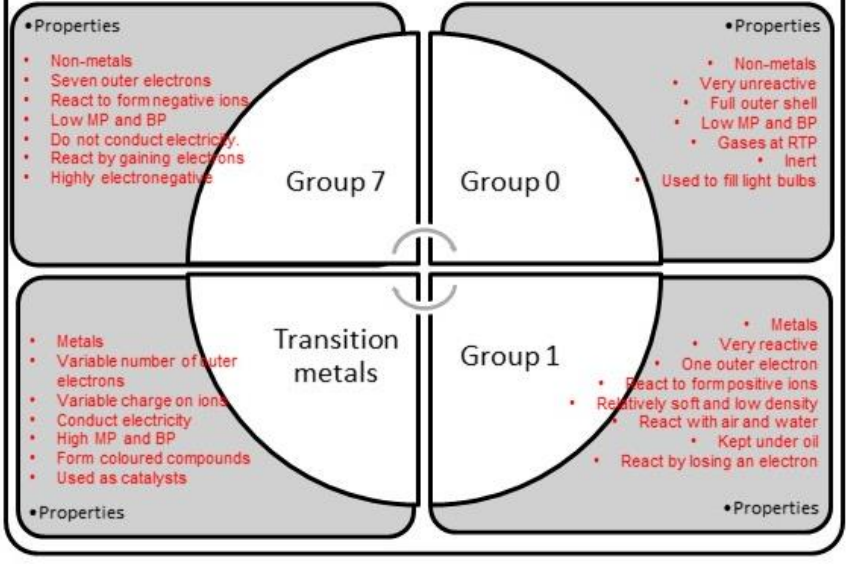
What did Mendeleev do to overcome these problems?

He left gaps for undiscovered elements.

How was Mendeleev's periodic table arranged?

In order of atomic mass with elements with similar properties arranged in columns called groups.

Complete the diagram to show properties of the elements based on their position in the periodic table



Write the balanced symbol equation for each of these word equations:

Group 1

potassium + water → potassium hydroxide + hydrogen

$2K + 2H_2O \rightarrow 2KOH + H_2$

sodium + chlorine → sodium chloride

$2Na + Cl_2 \rightarrow 2NaCl$

Potassium + oxygen → potassium oxide

$2K + \frac{1}{2}O_2 \rightarrow K_2O$

Group 7

chlorine + potassium → potassium chloride

$Cl_2 + 2K \rightarrow 2KCl$

chlorine + potassium bromide → potassium chloride + bromine

$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$

Reactivity trend down the group

Group 1

Increases as you go down the group

Group 7

Decreases as you go down the group

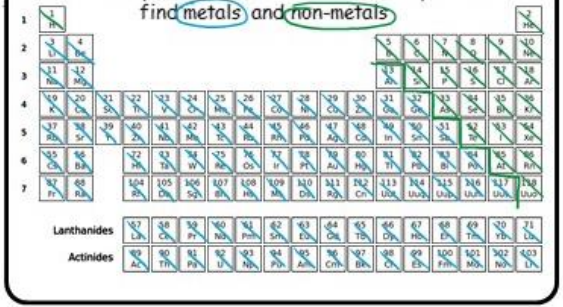
Self assessment

Red/Amber/Green:

I need help with:

Science C3 – Bonding, Structure and Properties of Matter

Colour in the periodic table to show where you would find metals and non-metals



Ionic bonding occurs in compounds formed from metals combined with Non-metals

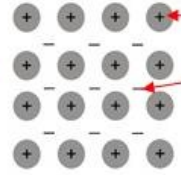
Covalent bonding occurs in most Non-metals elements and in compounds of Non-metals

Metallic bonding occurs in metallic alloys and metals.

[non-metals, alloys metals, non-metals, elements, non-metals, metals]

Label the particles in the diagram of metallic bonding below

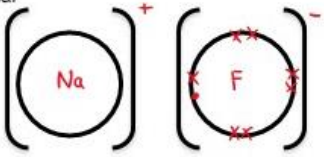
- Strong electrostatic forces of attraction.
- Delocalised electrons can move and rearrange around lattice if shape is changed.



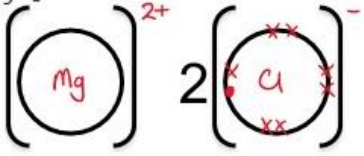
Use the structure of a metal to explain why metals have high melting points, are malleable and conduct electricity.

Draw a dot and cross diagram to show the ionic bonding in:

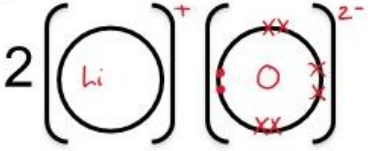
NaF



$MgCl_2$

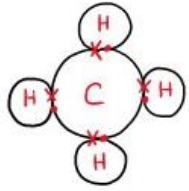


Li_2O

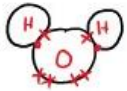


Draw a dot and cross diagram to show the covalent bonding in:

CH_4



H_2O

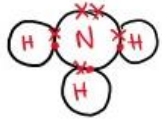


H_2

Cl_2

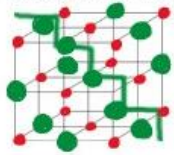
O_2

NH_3



N_2

Draw and label the ions in the ionic lattice for sodium chloride



- = Na^+ ion
- = Cl^- ion

Describe the limitations of using, dot and cross, ball and stick and two and three dimensional diagrams to represent a giant ionic structure.

- There are not really sticks/lines between the ions
- There are not large spaces between ions
- Molecules are not flat
- All models are approximate

What happens to the electrons in a covalent bond?
They are shared between atoms

What happens to the electrons in an ionic bond?
They are transferred from one atom to another atom.

Self assessment
Red/Amber/Green:

I need help with:

Science C3 – How Bonding and Structure are Related to the Properties of Substances

Properties of metals and alloys

This is a picture of the structure of a metal alloy.

1. Why do metals have high melting and boiling points? Strong electrostatic attraction between positive metal ions and delocalised electrons.
2. Why are pure metals soft? The positive metal ions are arranged in layers that can easily slide over each other.
3. Why are alloys harder than pure metals? In alloys there are atoms that disrupt the regular arrangement and prevent sliding.

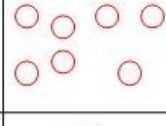
Properties of ionic compounds

Ionic compounds have regular structures (giant ionic lattices) in which there are strong electrostatic forces of attraction in all directions between oppositely charged ions.

These compounds have high melting and boiling points because of the large amount of energy needed to break the many strong bonds.

When molten or dissolved ionic compounds conduct electricity because the ions are free to move and so charge can flow.

The particle model and the three states of matter

	Draw a model of the particles in each state	Give the change in state and describe the forces or bonds being broken		
		Ionic	Molecular	Giant Covalent
Solid		melt / boil: Electrostatic forces	Weak intermolecular forces	Strong covalent bonds
Liquid		freeze / condense: Electrostatic forces	Weak intermolecular forces	Strong covalent bonds
Gas		freeze / condense: Electrostatic forces	Weak intermolecular forces	Strong covalent bonds

What are the limitations of the simple particle model? real particles are not spherical and the forces between the particles are not represented.

Complete the table to summarise the properties of covalent substances

	Properties of covalent molecules	Properties of giant covalent structure	Polymers
Melting point	Low MP – are gases, liquids or low MP solids	Very high MP – hard and strong structures	High MP – but large variation between polymers.
Conductivity	Do not conduct	Do not conduct – except graphite which has delocalised electrons	Do not conduct
Intermolecular forces	Weak intermolecular forces between molecules easily overcome.	No intermolecular forces atoms bonded with strong covalent bonds.	Stronger intermolecular forces due to larger mass of polymer molecules.
Examples	H_2O, N_2, O_2, CH_4, F_2, Cl_2, Br_2, I_2	Carbon – diamond Carbon – graphite SiO_2 – silicon dioxide	Polyethene Polypropylene Polyvinylchloride Polystyrene

To conduct electricity something charged must be free to move. Finish each of the following sentences explaining your answer in terms of the particles involved.

1)Metals conduct electricity because.. delocalised electrons can move

2)Ionic compounds conduct when molten or dissolved because...ions can move

3)Covalent substances (except graphite) do not conduct because...there are no charged particles.

State symbols

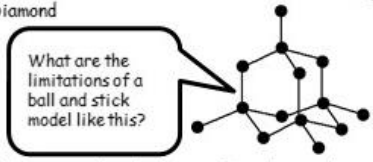
What do the state symbols tell you about this reaction?

$KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$

Two aqueous solutions react to form a precipitate (solid) lead iodide.

Science C3 –Structure and Bonding of Carbon

Diamond



1) How many bonds does each carbon make in diamond? 4

2) Why are diamonds hard? The covalent bonds ae strong and difficult to break

3) What is the melting point of diamond? 3500°C (but strictly speaking diamond sublimes rather than melts)

4) Explain why diamond does not conduct electricity.

There are no charged particles such as ions or delocalised electrons that could carry the charge.

Fullerenes

Fullerenes are allotropes of carbon with spherical shapes.

The structure of fullerenes is based on hexagonal rings of carbon atoms.

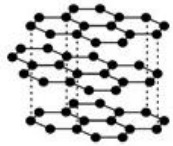
Some fullerenes contain rings with five or seven carbon atoms.

The first fulllerene to be discovered was Buckminsterfullerene (C60) which has a hollow shape.

Carbon nanotubes are cylindrical fullerenes.

[Buckminsterfullerene, atoms, five, allotropes, spherical, hollow, hexagonal,, rings, seven]

Graphite



1) How many bonds does each carbon atom make in graphite? 3

2) Why can graphite be used in a pencil?
The layers rub off easily

3) Why is the melting point of graphite still very high, even though it is soft?
Covalent bonds between carbon atoms are strong.

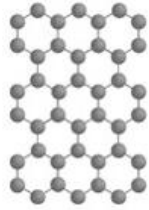
4) What are the forces between the layers called? Intermolecular forces (Van der Waal's forces)

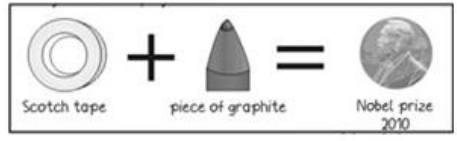
5) Explain why graphite conducts electricity. The delocalised electrons between the layers are free to move and carry the charge.

Write some useful applications of fullerenes here:

- Lubricants
- Drug delivery
- Refined and light materials
- Semi-conductors
- Electrons
- Composite materials

Graphene





Graphene is a single layer of graphite and has properties that make is useful in composites and electronics. In graphene the carbon atoms are making single bonds. Graphene is a semiconductor because one of the electrons is delocalised.

[three, single, delocalised, composites, semiconductor, electronics]

KEY WORDS:

DIAMOND
GRAPHITE
GRAPHENE
FULLERENES
COVALENT BONDING
INTERMOLECULAR FORCES
DELOCALISED ELECTRONS

Self assessment

Red/Amber/Green:

I need help with:

Energy

Potential Energy

Gravitational potential energy is stored when an object is raised above ground level.

The amount of gravitational potential energy (GPE) depends on:
- Mass of the object;
- Height raised.

To calculate GPE gained (E_p) the equation is used:

$$E_p = mgh$$

where
E_p = GPE in J
m = mass in kg
g = gravitational field strength in N/kg
h = height in m
The value of g is 10N/kg on the Earth.

When walking on a flat surface GPE is **constant.** When walking up stair each step increases the GPE as the **overall height** above the ground increases.

A stretched spring has stored **elastic potential energy**. When the force is removed it returns to its original length. **Compressed** springs use the potential energy to keep objects in place.

The amount of elastic potential can be increased by:

Increasing the extension of the spring, e, in metres
Increasing the spring constant, k, in N/m

The elastic potential can be calculated using the equation

$$E_e = \frac{1}{2} ke^2$$

Worked example:
Calculate the energy stored in a spring when it is extended by 7cm. The spring constant is 175 N/m

remember convert cm → m 7 → 0.07

$E_e = 0.5 \times 175 \times (0.07)^2$
$= 0.43$ J

Kinetic energy must be transferred to make objects move.

Kinetic energy store of an object can be increased by:
- Increasing mass of object, m, in kg
- Increasing the speed, v, in m/s

$$E_k = \frac{1}{2} mv^2$$

Worked example:
A car of mass 1900 kg is travelling at a steady speed of 15m/s. Calculate the car's kinetic energy:

$E_k = 0.5 \times 1900 \times (15)^2$
$E_k = 213,750$ J

Calculate how much the energy store increases when the car changes speed to 25m/s.

$E_k = 0.5 \times 1900 \times (25)^2$
$E_k = 593,750$ J

The increase is:
593,750 – 213, 750 = 380,000 J

Converting between units km/h → m/s
- Multiply by 100
- Divide by 3600

example:

$$600 \text{ km/h} = \frac{600 \times 1000}{3600} = 166.6 \text{m/s}$$

Energy

Work done and energy transfer

Work is only done when a **force moves** an object.

More work is done when:
- Force is bigger
- Object moves further.

Calculating work done

Work done = force x distance moved

W = F x s

(in J) = (in N) x (in m)

Energy calculations

When work is done there can also be a change in in **kinetic energy**. This can be used to calculate the force needed to stop an object if the distance it travels is known.

Worked example:
A car of mass 2000 kg stops suddenly travelling at 30 m/s. The distance to stop is 20 m. Calculate the braking force.

$E_k = ½ mv^2$

$E_k = ½ \times 2000\ kg \times (30m/s)^2$
$E_k = 900,000\ J$

The work done by the braking force is 900,000J.

Arranging the equation $F = \frac{W}{s}$

$F = \frac{900\,000}{20}$

F = 45,000 N

The frictional forces caused by the work done will cause a temperature increase on the brakes.

Understanding power

Power is the rate of doing work or transferring energy. A machine which is more powerful will transfer more energy per second compared to a less powerful one.

Power is measured in **watts (w)**. One watt is the transfer of one joule of energy every second.

Calculating power

Power = $\frac{\text{work done in J}}{\text{Time in s}}$ or $\frac{\text{energy transfer in J}}{\text{time in s}}$

These can be written as:

P = W/t or P = E/t

Personal power

Worked example:
I weigh 900N. I climb 6 m vertically in 20 s.

a) How much work do I do?
W = F x s
= 900 x 6
= 5400 J

b) What is my power?
P = W/t
= 5400/20
= 270 W

Specific heat capacity

When a liquid is heated this causes:
- particles to move faster
- the motion opposes the forces of attraction
- they gain more potential energy and kinetic energy.
- This increases the internal energy.

The rise in temperature is dependent on:
- Mass of liquid
- The liquid used
- Energy input to the system.

Specific heat capacity is the amount of energy needed to change the temperature of a 1 kg object by 1 °C.

It is calculated using the equation:

change in thermal energy = mass x specific heat x change in temperature

$\Delta E = m\ c\ \Delta\theta$

where
ΔE = change in thermal energy in J
m = mass in kg
c = specific heat capacity J/kg °C
Δθ = temperature change in °C

Water has a specific heat capacity of 4200 J/kg °C. This shows that it absorbs a lot of energy when it warms up and releases a lot when it cools down.

Worked example:
Calculate the change in thermal energy when 2 kg of water is heated from 20 °C – 90 °C

$\Delta E = m\ c\ \Delta\theta$
= 2 x 4200 x 70
= 588000 J

Energy

Dissipation of energy

Thermal energy can be transferred usefully – when heating/cooking, or as a result of **friction** – which is **wasted.** Friction increases the amount of work needed to be done to make an object move.

Reduction of energy transfer (wasted) can be achieved by:

- **Lubrication** – oiling the moving parts so they easily slide, reducing the friction, reducing energy loss thermally.
- **Insulation** – surrounding a hot object with a material which reduces thermal transfer by conduction, convection or radiation.

Insulation of buildings reduces energy loss and helps to maintain the warmth in the building:

Cavity wall, lost insulation, carpets and curtains, double glazing all help **to reduce the transfer** of energy.

When energy is dissipated the total energy remains the same – energy is never created or destroyed. When frictional forces act up on an object some energy is transferred as heat which raises the temperature of the surroundings and is useless.

Energy efficiency

Efficiency is the indication of how much of the energy supplied to a device is transferred into useful energy output.

$$\text{Efficiency} = \frac{\text{useful output energy transfer}}{\text{Total input energy transfer}} \times 100$$

The wasted energy is dissipated to the surroundings – usually in the form of heat, or sound.

Worked example:
For every 100J or energy supplied to a motor engine, 75J of useful work is done. Calculate the efficiency of the motor.

$$\text{Efficiency} = \frac{\text{useful output energy transfer}}{\text{Total input energy transfer}} \times 100$$

$$= \frac{75}{100} \times 100$$

$$= 75\%$$

Conservation of energy – as energy is never created or destroyed the other 25% must be dissipated as wasted energy to the surroundings.

Using energy resources

Fossil fuels – coal, oil and natural gas are **non-renewable**.

Advantages:

- Energy is concentrated – a small amount releases large quantities.

Disadvantages:

- They take millions of years to form, and are being used up faster than they are replaced.
- Produce high levels of pollution when combusted.

Wind, tidal, solar, hydroelectric, geothermal, biofuel are **renewable.**

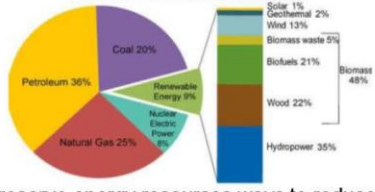
Advantages:

- Less polluting;
- Remade continually;

Disadvantages:

- Produces less energy;
- Solar panels only work during the day;
- Wind turbines only turn when windy;
- Expensive to start up.

Global energy supplies



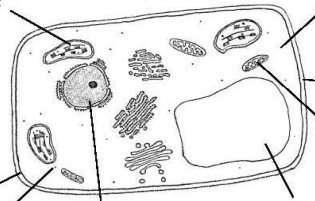
To preserve energy resources ways to reduce the amount of wasted energy in transfers is needed.

Cell Structure and Specialisation

Eukaryotic cells

Eukaryotic cells (including those of plants, animals and algae) contain many subcellular structures that each perform specific functions.

Eukaryotic cell:



Chloroplast (plant cells only)
Contains chlorophyll, a green pigment which absorbs light for photosynthesis

Cytoplasm
Gel-like substance that contains the subcellular structures

Cell wall (plant cells only):
Rigid outer layer made of cellulose that strengthens plant cells

Cell membrane
Partially permeable barrier controlling the transport of substances into and out of the cell (e.g. glucose and O_2 in, CO_2 and urea out)

Mitochondrion
The site of aerobic respiration, releasing energy to drive processes in the body

Ribosome
Where proteins are made

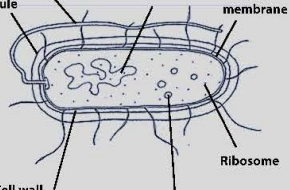
Nucleus
The control centre of the cell – contains DNA for making proteins, and controls reactions in the cell

Vacuole (plant cells only)
A sac of sap that stores salts and sugars and keeps cells rigid

Prokaryotic cells

Prokaryotes include bacteria, like the one illustrated below. Prokaryotes are smaller than eukaryotes, and have different subcellular structures.

Prokaryotic cell:



Single DNA loop
Genetic material is not contained in a nucleus

Flagellum

Capsule

Cell membrane

Ribosome

Cell wall
Does not contain cellulose as in plant cells

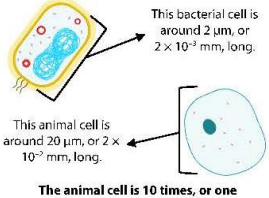
Plasmid
Small ring of DNA, coding for traits such as antibiotic resistance

Scale and size

Animal cells can have a diameter of around 10–30 micrometres (μm), whereas plant cells can be up to 100 μm. Prokaryotes are much smaller at 0.1–5 μm.

Orders of magnitude

Orders of magnitude work in **powers of 10**. If something is 10 times bigger than something else, it is one order of magnitude bigger. If it is 100 times bigger than something, it is two orders of magnitude bigger.



This bacterial cell is around 2 μm, or 2×10^{-3} mm, long.

This animal cell is around 20 μm, or 2×10^{-2} mm, long.

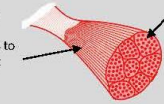
The animal cell is 10 times, or one order of magnitude, bigger than the bacterium.

Animal cell specialisation

Cell **differentiation** is the formation of different cell types from stem cells. It involves the development of special **structures within the cell** that are essential in allowing different cell types to become **specialised** to perform a huge **variety of functions**.

Muscle cells: contracting and relaxing

Sliding protein filaments
Enable muscle fibres to contract and relax



Cells contain lots of mitochondria
To transfer plenty of energy for contraction and relaxation

Neurons: transmitting nervous impulses

Many dendrites
Connect nerve cells to other nerve cells for transfer of nerve impulses

Nerve endings
Contain many mitochondria to supply energy for neurochemical production, used to transmit nerve impulses across synapses

Axon
Can be quite long to carry nerve impulses between locations in the body

Sperm cells: carrying genetic information to the egg

Nucleus
Contains DNA to be passed on

Tail
Moves rapidly to propel the sperm towards the egg cell

Acrosome
Contains digestive enzymes to break down outer layer of egg cell

Midpiece
Full of mitochondria to provide energy for sperm movement

Plant cell specialisation

In most **animals**, differentiation occurs **early** on in development, and cell division later on in life is just for repairing or replacing cells. However, many **plant** cells can differentiate at **any life stage**!

Root hair cells: uptake of water and mineral ions

Long and thin
Increases surface area for water uptake

Large vacuole
Increases rate of water uptake by osmosis into the cell because it is concentrated with salts/sugars

Lots of mitochondria
Provide energy for active transport of mineral ions into the cell

Xylem cells: transport of water and mineral ions

Dead cells
Form a continuous, **hollow** tube with plenty of space for water and mineral ions

No end walls
Water and mineral ions can travel easily up the stem to the leaves

Phloem cells: transport of sugars

Sieve plates
End walls of cells that have pores for sap to move through the vessel

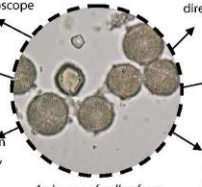
Long, live cells
Live, elongated cells form tubes

Companion cells
Provide energy for phloem cells, which have few organelles to leave room for sap

Microscopy

Development of microscopes

Light microscope



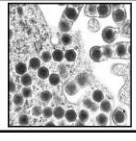
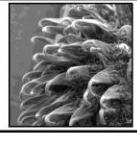
An image of pollen from a light microscope

Electron microscope

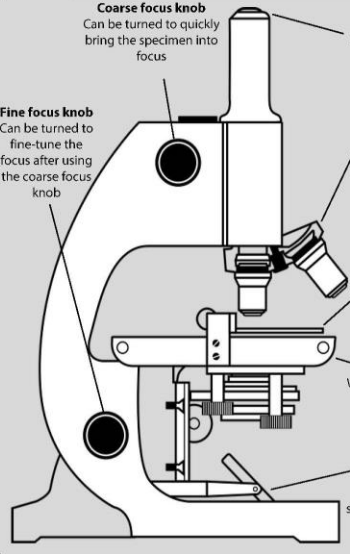
Features of an electron microscope

- Produces an image by firing electrons at an object
- Developed after light microscope
- Can have a magnification of up to 2,000,000×, allowing scientists to improve understanding of many subcellular structures that are not visible using a light microscope
- Expensive
- Larger than light microscope
- Fragile – must be kept at specific temperature, pressure and humidity levels

Types of electron microscope

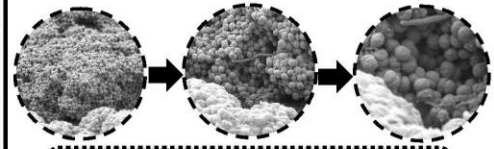
Feature	Transmission electron microscope (TEM)	Scanning electron microscope (SEM)
Magnification	Higher magnification than SEM	Lower magnification than TEM
Resolution	Higher – about 0.2 nm	Lower – about 10 nm
Images produced	2D	3D
Example image		

Light microscope structure



Magnification calculations

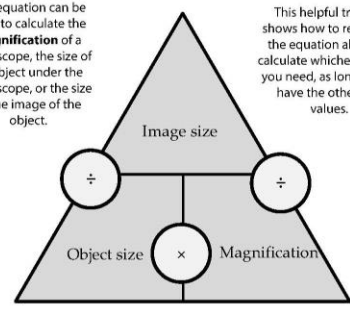
Increasing the **magnification** of a microscope makes the image bigger.



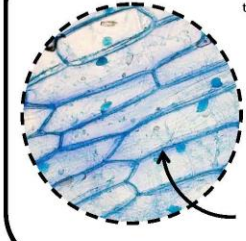
$$magnification = \frac{image\ size}{object\ size}$$

This equation can be used to calculate the **magnification** of a microscope, the size of an object under the microscope, or the size of the image of the object.

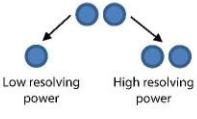
This helpful triangle shows how to rearrange the equation above to calculate whichever value you need, as long as you have the other two values.



Resolving power



The **resolution** of a microscope is its ability to distinguish between two separate points that are close together.



High **resolving power** enables a microscope to produce detailed images of specimens, like this image of onion cells

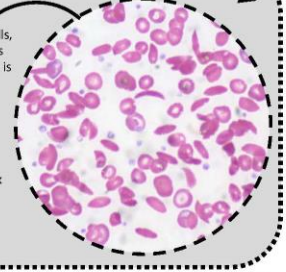
Worked example: magnification

In this image of red blood cells, a cell is around 4 mm across and the actual size of the cell is 10 micrometres (μm):

4 mm = 4000 μm

4000/10 = 400×

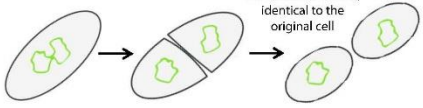
The magnification is 400×



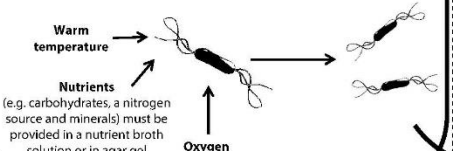
Culturing Microorganisms

Conditions for culture

Microorganisms called bacteria divide by **binary fission** (simple cell division):



To divide at their optimum rate (in some bacterial species, as often as once every 20 minutes), they require the right conditions. Scientists trying to grow bacteria in a lab must meet the following needs of the bacteria:



Number of bacteria

The **mean division time** of the bacterium (the average time taken for a bacterium to divide once) under particular conditions can be used to calculate **how many bacteria** are in a **culture** after a certain amount of time.

Worked example

To find out the number of bacteria present in a population after seven hours if the mean division time is 40 minutes, starting with a single bacterium:

1. Calculate the number of times the bacterial cell divides per hour (60 minutes):

$60 \div 40 = 1.5$ divisions per hour

2. Then, use this to find the number of divisions that will occur over seven hours:

$7 \times 1.5 = 10.5$ divisions over seven hours

3. Finally, to find the number of bacteria in the population after seven hours:

Bacterial number at start $\times 2^{\text{number of divisions}}$

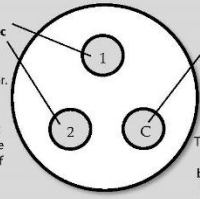
There was one bacterium at the start of this culture, and 10.5 divisions over seven hours:

$1 \times 2^{10.5} = 1448 = 1.4 \times 10^3$ bacteria after seven hours

Inhibiting growth

Bacterial growth can be inhibited by antibiotics and antiseptics. Scientists can investigate the effect of different substances on bacterial growth.

Place filter paper discs soaked in **different antibiotic types or concentrations** (1 and 2) onto the agar.



A **control disc** (C) with no antibiotic is used to compare the effect of the two antibiotics to normal bacterial growth.

The **independent variable** is the type or concentration of antibiotic.

The **dependent** variable in this experiment is bacterial growth, which is found by measuring the zone of inhibition.

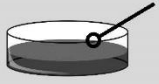
Aseptic technique

Aseptic technique is used to prepare **uncontaminated** cultures of microorganisms. This is important for growing a specific species of bacteria – if your culture is contaminated, you may end up growing other unwanted microorganisms.

How to grow only desired microorganisms:

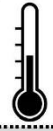
1. **Preparing the Petri dish:** Pour hot, sterilised agar gel onto a Petri dish and leave to cool and set. Petri dishes must be sterilised before use by heating to a high temperature.
2. **Sterile inoculation:** Sterilise an inoculating loop by passing it through a flame until it is red hot, then allowing it to cool. This kills microorganisms that are on the loop to prevent contamination.

Use this loop to add microorganisms to the sterile Petri dish.



3. **Secure dish:** Secure the lid of the dish with sticky tape to prevent contamination from the air, and to prevent your microorganisms from escaping.

4. **Incubation:** Incubate your Petri dish at 25 °C to allow microorganisms to grow for several days. The dish should be incubated upside down to prevent condensation dripping from the lid onto the agar.

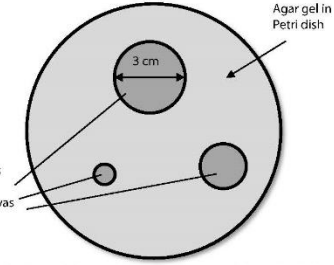


Incubation at higher temperatures such as 37 °C is common practice in laboratories to speed up bacterial growth, but carries the risk of growing pathogens that may be harmful to people.
Lower temperatures such as 25 °C are used in schools to reduce this risk.

Zone of inhibition

The **cross-sectional area** of the zone of inhibition (the **clear zone** around the bacterial colony) can be calculated. In the example below, bacteria have been cultured in the presence of three different antibiotics.

1. **Measure the diameter of the clear zone:**



2. **Divide the diameter by two to give the radius:** $3 \text{ cm} \div 2 = 1.5 \text{ cm}$

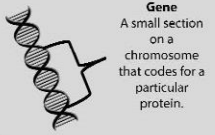
3. **Finally, πr^2 can be used to give the cross-sectional area of the clear zone:** $\pi \times 1.5^2 = \pi \times 2.25 = \mathbf{7.07\ cm^2}$

Cell Division and Stem Cells

Chromosomes

Nucleus
A subcellular structure in eukaryotic cells that contains genetic material in the form of **chromosomes**.

Chromosomes
Thread-like structures usually found in pairs. Made of DNA containing many **genes**.

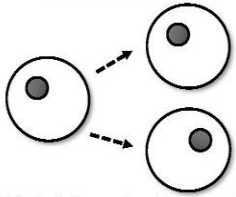


Gene
A small section on a chromosome that codes for a particular protein.

The cell cycle

What is the cell cycle?

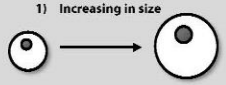
Cell division involves several stages, known as the **cell cycle**.
Division of a cell by **mitosis** results in two new cells with the exact same genetic material as the original cell.



Division is vital for growth and development of an organism.
It also allows the body to repair tissues (for example, if you cut your finger) and replace cells (for example, red blood cells need replacing around every four months).

Stage 1
The cell must prepare for division:

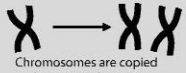
1) **Increasing in size**



2) **Increasing the number of subcellular structures**

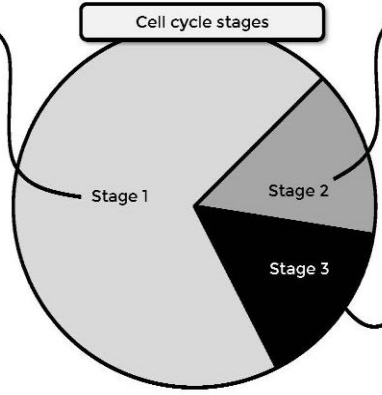
e.g. ribosomes, mitochondria and chloroplasts (in plant cells)

3) **Doubling the genetic material**

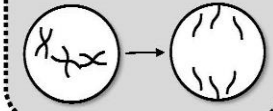


Chromosomes are copied by DNA replication

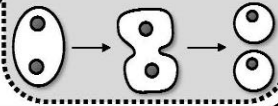
Cell cycle stages



Stage 2
This stage involves **mitosis**.
Pairs of chromosomes separate and are pulled to opposite ends of the cell, and the nucleus divides.



Stage 3
Division of the cytoplasm and cell membranes to form two new cells. Each new cell contains a nucleus with identical genetic material to the original cell.



Stem cells

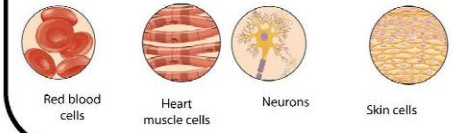
What is a stem cell?

Stems cells are **undifferentiated** cells.

Stems cells are important in embryos to develop new tissues, and in adults for growth and repair.

They can produce more cells of their type.

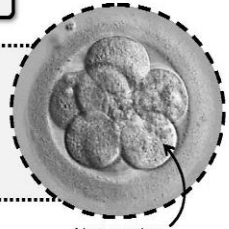
They can also produce differentiated cells.



Importance

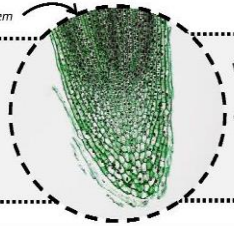
Bone marrow of adult animals contains stem cells that are able to differentiate into several types of cell (e.g. red blood cells).

Scientists can clone stem cells from **human embryos** and produce many types of human cells from them.



A human embryo

A plant meristem



In plants, **meristem tissues** (usually at root and shoot tips) can produce any type of plant cell at any point in a plant's life.

We can use stem cells from plant meristems to clone rare plant species for conservation, and to clone crop plants with desirable features (such as disease resistance).

Therapeutic cloning

Therapeutic cloning involves producing an **embryo** by **cloning a body cell** taken from a **patient**. Stem cells taken from this embryo can then be used in **medical treatments**.

Benefits	Risks / Ethical Issues
Embryonic stem cells have potential for **treating many serious conditions** such as stroke, diabetes and paralysis caused by spinal cord injury.	The embryo is destroyed following the removal of stem cells. Some people see this as **immoral** because the embryo is a potential human life.
	Some people fear that using such cloning techniques could lead to **cloning of human beings.**
Stem cells from the patient **will not be rejected** by the patient's immune system.	The method is **time-consuming** and **expensive.**
	There is a risk of **viral infections** being passed to patients from stem cells.

Cell Transport

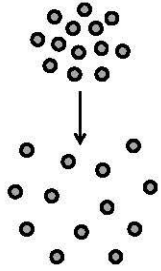
Diffusion

What is diffusion?

The random movement of particles of a gas or a substance in a solution means that they spread out. This causes a net movement of particles down a concentration gradient (from a high concentration to a low concentration).

Why is diffusion important in our bodies?

Diffusion occurs across cell membranes all the time in our bodies, into and out of cells.



For example:

- Urea diffuses out of the cells and into the blood to be excreted by the kidneys.
- Oxygen diffuses into the lungs, and carbon dioxide diffuses out of the lungs, in gas exchange.

Factors that increase diffusion rate:

1. **Steep concentration gradient:** the bigger the difference in concentration between two areas, the faster diffusion will occur
2. **Large surface area of membrane:** the larger the area, the more diffusion will take place within a set period of time
3. **Temperature:** at higher temperatures, particles have more kinetic energy so move more quickly and have a higher rate of diffusion

Single-celled organisms

Single-celled organisms have a large SA:V, so **diffusion of** molecules into and out of the cell provides for all of their needs (exchanging gas, gaining nutrition and removing waste).

Tissue adaptations for diffusion

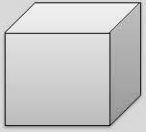
Larger multicellular organisms need transport systems because their SA:V is too small for diffusion alone to meet their needs for survival. These transport systems have adaptations to maximise the rate of diffusion.

Structure	Short diffusion distance	Large surface area	Steep concentration gradient
Cells lining small intestine	Thin membranes	Membrane folded into villi and microvilli	Concentration of soluble food molecules higher in gut than in bloodstream
Alveoli	Thin membranes	Folded	Good blood supply and well ventilated
Fish gills	Thin filaments	Stacks of thin filaments	Good blood supply and continuous pumping of water over gills by flap called operculum
Plant root hairs	Thin membranes	Long and thin	Water is pulled away from roots by transpiration
Plant leaves	Thin structures	Flat and thin	Lots of air spaces and stomata

Surface area:volume ratio

We can calculate and compare the surface area:volume ratio (SA:V) of different organisms. Here, we use cubes to demonstrate how:

This cube has a width of 2 cm, a height of 2 cm and a depth of 2 cm. To find its surface area, we simply multiply the length and width:
2 × 2 = 4 cm
and then multiply the result by the number of sides (6):
4 × 6 = 24 cm²
To find the volume, we multiply the width by the height and multiply this by the depth:
2 × 2 × 2 = 8 cm³
So, for this cube, the **SA:V = 24:8**, or simplified, **3:1**.



For a larger cube with sides of 4 cm, following the same method, we find that the **SA:V = 96:64** or **1.5:1**. This ratio is smaller than that of the smaller cube. This demonstrates that as objects or organisms increase in size, their surface area to volume ratios decrease.

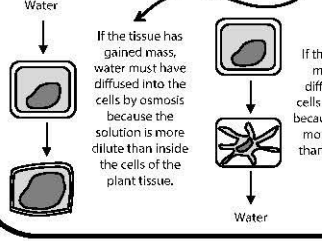
Osmosis

What is osmosis?

Diffusion of water from a more **dilute solution** (lots of water) to a more **concentrated solution** (less water) across a **partially permeable membrane**.

Investigating the effect of different concentrations of salt solution on sweet potato tissue

1. Cut sweet potato into equal-sized cuboids
2. Weigh the pieces
3. Put the pieces into solutions containing different concentrations of salt
4. Remove from solution, dry with paper towel
5. Weigh the pieces again
6. Calculate percentage gain or loss of plant tissue mass



If the tissue has gained mass, water must have diffused into the cells by osmosis because the solution is more dilute than inside the cells of the plant tissue.

If the tissue has lost mass, water has diffused out of the cells into the solution because the solution is more concentrated than inside the plant cells.

Calculating percentage gain/loss

$$\% \text{ change} = \frac{(\text{end mass} - \text{start mass})}{\text{start mass}} \times 100$$

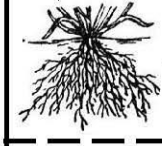
Worked example:
Tissue mass at start: 4.5 g
Tissue mass at end: 6.2 g
(6.2 g − 4.5 g) ÷ 4.5 × 100 = +37.8 g
The plus sign shows a gain in mass. If mass was lost, a minus sign would be in front of the value.

Active transport

What is active transport?

Movement of substances against their concentration gradient (from low to high concentration) using energy in the form of ATP from respiration.

Why is active transport important?



Mineral ions are at low concentration in the soil but are required for plant growth so are taken up by active transport by root hair cells.

Sugar molecules are at a lower concentration in the gut than the blood, but are needed for respiration.

So, sugar molecules are selectively reabsorbed by the kidney, via active transport, and transferred to the blood.

Digestion

Digestive system

Organisation in living organisms

Cells The basic building blocks of organisms → **Tissues** Groups of similar cells

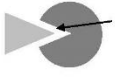
Organs Groups of different tissues performing a function → **Organ systems** Groups of organs working together to form organisms

The **digestive system** is an organ system responsible for digesting and absorbing food, and excreting waste products.

How does digestion occur?

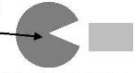
Enzymes catalyse reactions throughout the **digestive system** to **break down food** (carbohydrates, lipids and proteins) into **smaller soluble molecules** that can be absorbed into the **blood** for transport around the body. The resultant molecules can be used to **make new carbohydrates, lipids and proteins**, and some glucose is used in cellular **respiration**.

Enzyme-catalysed reactions



The specific reaction an enzyme catalyses depends on the shape of its **active site**, an area that binds to complementary substrate molecules during reactions.

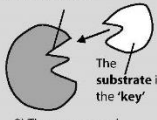
This enzyme will not catalyse a reaction involving this substrate because the substrate is not complementary to its active site.



Lock and key model

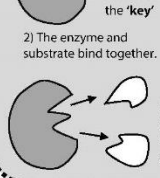
The enzyme's **active site** is the **'lock'**

The **substrate** is the **'key'**



1) The substrate fits perfectly into the active site – they are specific to each other (like a key in a lock).

2) The enzyme and substrate bind together.



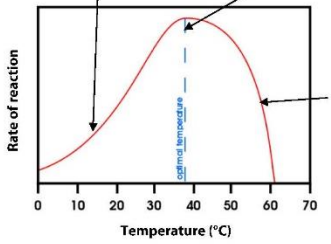
3) The enzyme catalyses the reaction; in this case, the breakdown of a food particle into smaller soluble molecules.

Rate of reaction

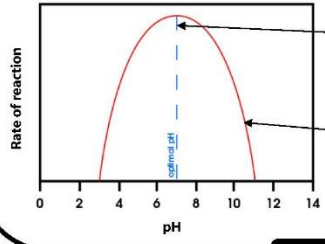
Factors that affect the rate of enzyme-catalysed reactions

As temperature increases, particles have more kinetic energy and move around more. Enzyme and substrate are more likely to collide, so **reaction rate increases**.

Most digestive enzymes in the human body work best at **37 °C**, because this is the temperature of the human body.



If the temperature becomes too high, the enzyme **denatures** (the active site changes shape so that the substrate no longer fits).



Different enzymes work best at different **pH** values.

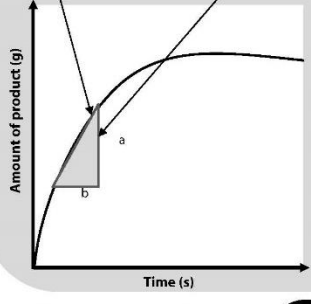
At certain pH values, **bonds in the enzyme break down**, causing the active site to change shape so that the substrate no longer fits inside it.

Practical: investigating effect of pH on rate of reaction of amylase enzyme

Procedure

1) Place test tubes of **starch solutions** in a water bath at 37 °C.
2) Add a **buffer** with a different pH value to each test tube of starch solution.
3) Set up **spotting tiles** with drops of iodine in rows.
4) Add **amylase** into one of the test tubes and start the **stopwatch.**
5) Every 20 seconds, use a pipette to **take a sample** from the test tube and add it to a drop of iodine on the spotting tile.
6) If the reaction has taken place, **iodine** will turn from yellow-red to blue-black.
7) **Repeat** this for each of the test tubes. Record the time it takes for the reaction to take place at each pH in a table.

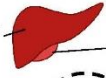
1. Draw a **straight line** on the curve of the graph to represent the gradient at this point – this is the **tangent**.
2. Draw a **horizontal and vertical line** from the tangent to form a right-angled triangle.
3. Measure the **change in product** from the vertical line of the triangle (a) and the **change in time** from the horizontal line of the triangle (b).
4. **Divide (a) by (b)** to find the **gradient**, which is the **rate of reaction**.
5. **Units** for rate of reaction come from the graph. For example, y is in grams (g) and x is in seconds (s), so units for rate are **g/s.**



Digestion of food

Food type	Enzyme(s) that break(s) it down	Reaction (breaking down substances)	Where the enzyme is produced	Food test
Carbohydrate	Amylase, a carbohydrase	Starch → Sugars, e.g. maltose	Small intestine, pancreas, salivary glands	**Iodine solution** turns from yellow-red to blue-black if starch is present.
				Benedict's solution turns from blue to brick-red/orange if reducing sugars are present.
Lipid	Lipases	Lipids → Fatty acids and glycerol	Small intestine, pancreas	Dissolve in **ethanol**, then add to distilled water. A cloudy emulsion is produced if lipids are present.
Protein	Proteases	Proteins → Amino acids	Small intestine, pancreas, stomach	**Biuret reagent** (corrosive) turns from blue to purple if protein is present.

Role of bile



Bile is made in the liver. It is stored in the gall bladder.

Bile is secreted into the small intestine, where it **emulsifies fat into smaller droplets**, increasing the surface area of the lipid.

It also **neutralises hydrochloric acid** from the stomach to make conditions in the small intestine more alkaline.

Overall, the action of bile **speeds up the breakdown of fat** into glycerol and fatty acids by lipases.

Heart, Lungs and Blood

The heart

Inner structure

Aorta – carries blood to the body

Pulmonary artery – carries deoxygenated blood from right ventricle to lungs

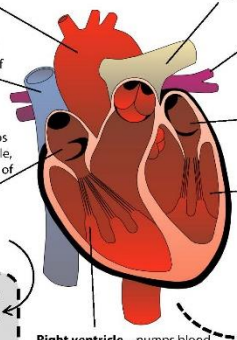
Vena cava – carries deoxygenated blood from the lower part of the body to the heart's right atrium

Pulmonary vein – carries oxygenated blood from lungs to left atrium

Left atrium – pumps blood to left ventricle

Right atrium – pumps blood to right ventricle, and contains a group of cells that act as a pacemaker for the natural resting heart rate

Left ventricle – pumps blood to the body through the aorta

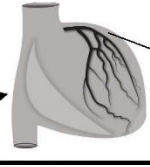


Artificial pacemakers can be used to regulate heart rate if the natural pacemaker fails.

Right ventricle – pumps blood to the lungs through the pulmonary artery

The human body uses a **double circulatory system** – blood passes through the heart twice: once to pump oxygenated blood to the body, and once to pump deoxygenated blood to the lungs.

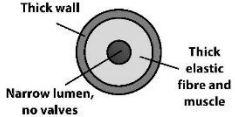
Outer structure



Coronary arteries – carry blood to the left and right sides of the heart to supply the heart muscle with oxygen and nutrients

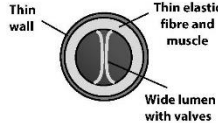
Blood vessels

Arteries



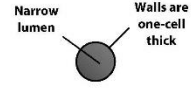
- **Carry blood away from the heart** to the organs of the body
- Blood delivers necessary substances such as oxygen and glucose to cells
- **Artery walls stretch with each heartbeat** then return to normal, pushing blood along at high pressure – this is why artery walls have thick elastic fibres and muscles

Veins



- **Carry blood back to the heart** from the body's organs
- **Blood is at low pressure** so walls are thin and valves are present to stop blood flowing backwards
- **Movement of skeletal muscles** pushes blood in veins back to heart
- **Wide lumen** means there is less resistance to blood flow

Capillaries



- **Network of fine blood vessels that connect arteries and veins**
- **Thin, porous walls** so that small molecules such as oxygen can diffuse from blood to cells, and small waste molecules can diffuse back into the blood from cells
- **Small lumen** just wide enough for one red blood cell enables efficient transfer of oxygen to cells

Lungs

Gas exchange

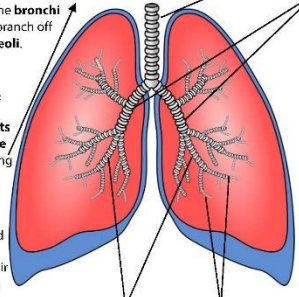
As you breathe in, oxygen-rich air enters the lungs through the **trachea**, into the **bronchi** (and smaller **bronchioles**) that branch off from it, and finally into **alveoli**.

Air in the alveoli has a higher O_2 concentration than blood in capillaries, **so O_2 diffuses down its concentration gradient into the blood** in the capillaries surrounding the alveoli.

Blood that has travelled around the body has a higher concentration of CO_2 than the air in the alveoli, so **CO_2 diffuses from the capillaries into the alveoli** and is breathed out.

Trachea – the main airway, supported and protected by cartilage rings

Bronchi – branch off from the trachea



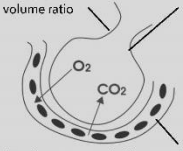
Bronchioles – branch off from bronchi

Alveoli – tiny sacs at the end of the airways of the lung

Alveolar adaptations for gas exchange

Alveoli are small and spherical – high surface area to volume ratio

Thin membrane of alveoli – short diffusion distance

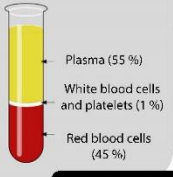


Alveoli are surrounded by a capillary network, and lungs are ventilated. Therefore, concentration gradients of oxygen and carbon dioxide remain high, ensuring a high rate of gas exchange.

Blood components

Plasma

- Blood is both a **tissue** and a body fluid made of **plasma**, which carries red blood cells, white blood cells and platelets in suspension
- Transports blood cells, soluble molecules from digestion, carbon dioxide and urea

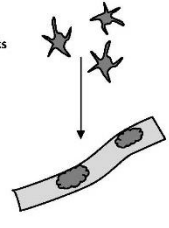


White blood cells

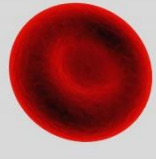
- Part of the **immune system** to defend against pathogens
- Produce **antibodies** against pathogens
- Produce **antitoxins** against toxins produced by pathogens
- Engulf and digest pathogens

Platelets

- Pieces of cells that come together to produce **blood clots**
- Clotting creates **scabs** to stop bleeding and prevent bacteria entering the body through wounds



Red blood cells



- Carry **oxygen** (in haemoglobin) to cells
- Have a **biconcave disc** shape to increase the surface area for diffusion of oxygen
- Have **no nucleus** to make room for haemoglobin to carry the maximum amount of oxygen

Unit 1 - World War 1

A. Long Term Causes:

Keywords:

1. **Militarism** - A belief that it is necessary to have strong armed forces and that this force should be used as a solution to any threat.
2. **Alliance** - An agreement between countries that benefits each of them.
3. **Imperialism** - Extending a nation's power and influence by colonizing other countries.
4. **Nationalism** - An intense form of patriotism where the value and importance of your country is exaggerated.

Remember: the MAIN causes

5. **Great Powers** - Countries that have international influence and military strength.
6. **Balance of powers** - A belief in that the size and power of the alliances of the Great Powers would prevent either side starting a war.
7. **Encirclement** - To be surrounded.
8. **Arms race** - A competition between countries over the development and production of weapons e.g. the production of dreadnoughts (pictured).
9. **Schlieffen Plan** - German plan to quickly attack and defeat France, then turn their forces on Russia if war was to happen.
10. **Kaiser Wilhelm** - Germany's ambitious emperor.

B. Short Term Causes:

Key people:

1. **Archduke Franz Ferdinand** - An Austrian prince, assassinated (killed) in Sarajevo in 1914.
2. **Gavrilo Princip** - Serbian terrorist responsible for shooting the Archduke.

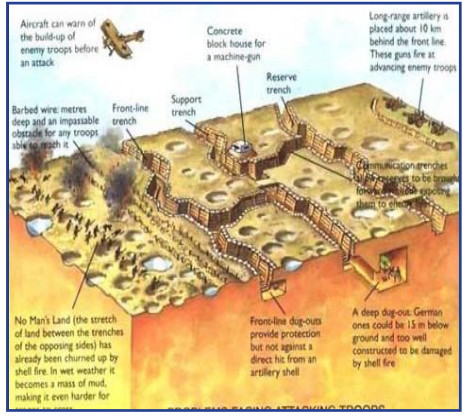
Keywords:

3. **Annex** - To seize (take) an area of land, normally by force, and make it part of your country.
4. **Balkans** – A peninsula in South Eastern Europe made up of countries like Serbia, Croatia, Bulgaria, Bosnia, Albania.
5. **Brinkmanship** - To pursue a dangerous policy to the limits of safety especially in politics.
6. **Ultimatum** - A final demand, the rejection of which will result in a break down of relations.

C. The Western Front:

Keywords:

1. **Conscription** - Forcing ordinary citizens to fight as soldiers in a war.
2. **Stalemate** - A situation where neither side fighting in a war can make progress.
3. **Trenches** - Connection of long narrow ditches for soldiers to take shelter from enemy fire.
4. **Artillery** - Heavy guns and cannons firing shells.
5. **Bombardment** - A continuous attack with shells (shelling), intended to destroy trench defences.
6. **Armistice** - Ceasefire between the Allies and the Germans.
7. **Naval blockade** - Allied efforts to restrict the supply of essential goods back to Germany.
8. **Gas** - A poisonous agent used in warfare.
9. **Tank** - A heavy armoured fighting vehicle carrying guns and moving on a continuous metal track.
10. **General Haig** - Led the British offensive at the Somme.



D. The Treaty Of Versailles:

Keywords:

1. **Big Three** - The leaders of the three main Allied powers – France, Britain, USA.
2. **Treaty** - A formal agreement between states.

Remember the Terms of ToV: LAMB

3. **Land** – Germany gave up 13% of its territory and demilitarised the Rhineland.
4. **Army** – Reduced to 100,000 men.
5. **Money/ Reparations** - Financial compensation for war damage paid by a defeated state. Germany paid £6.6 billion.
6. **Blame** – Germany had to accept the war guilt clause.
7. **Dolchtoss** – Stab in the back theory.

1882 The **Triple Alliance** between Austria-Hungry, Germany and Italy is signed.	**1907** The **Triple Entente** between Britain, France and Russia is signed.	**1908-1909** The **Balkan Crisis** occurred after Austria-Hungry annexed Bosnia and Serbia threatens war.	**28th June 1914** Archduke Franz Ferdinand is **assassinated** in Sarajevo by a Serbian terrorist group.	**23rd-25th July 1914** Austria issues Serbia with an **ultimatum** but it is rejected.	**4th August 1914** Britain issues an ultimatum to Germany and ultimately declares war.	**1916** The Battle of the Somme.	**1917** Russia leaves the war, USA joins.	**11th November 1918** The Armistice.	**1919** Germany signs Treaty of Versailles.

Unit 2 - The Suffrage Movement

A. Keywords

1. **Enfranchisement –** To be given the right to vote.
2. **Manifesto –** A public set of political aims written down.
3. **Propaganda –** Information used to promote a political point that can be misleading or untrue.
4. **Property Rights –** The ability to own land and housing, many women could not gain access to ownership.
5. **Representation –** speaking or acting on behalf of someone.
6. **Suffrage –** The right for women to vote in elections.
7. **Tactics –** An action or strategy carefully planned to achieve a specific end.

B. Suffragist Movement

1. **Constitutional –** A peaceful way of campaigning, often using political methods, such as petitions.
2. **Marches –** A tactic used by both campaigns to get their message heard.
3. **NUWSS – National Union of Women's Suffrage Societies**, also known as suffragists, an organisation that wanted greater equality for women using peaceful methods of protest. Led by Millicent Fawcett.
4. **Suffragist –** A campaigner who believes in constitutional methods and tactics of campaigns.

D. War Time

1. **Home Front –** The people who stay and work in their country, during a foreign war.
2. **Munition factories -** Factories that supplied weapons during WWI, many women worked in them.
3. **Representation of the People Act -** Allowing men over 21 and women over 30 to vote.
4. **The Canary girls -** British women that worked in the munition factories, repeated exposure to TNT turned their skin orange, like canaries.
5. **War Effort -** People who were committed to supporting the troops abroad by mobilising at society at home, helping with supplies from food to munitions.

C. Suffragette Movement

1. **Arson –** Act of deliberately setting fire to property.
2. **'Cat and Mouse' Act –** A law that allowed the police to rearrest women. The police let suffragettes on hunger strike free from prison, until they had eaten, only to arrest them again (pictured).
3. **Force feeding –** Police put a tube down the throats of women on hunger strike in prison to feed them, many drowned using this method.
4. **Militant –** Using confrontational organised tactics, such as destroying property.
5. **Petition –** A document signed by many people demanding political action by the government.
6. **Suffragette –** A campaigner who is prepared to use militant or violent methods and break the law.
7. **Terrorism –** the unlawful use of violence and intimidation, especially against civilians, in the pursuit of political aims.
8. **WSPU –** Women's Social and Political Union, also known as the suffragettes, a political organisation for women only that were led by the Pankhurst family and that were prepared to use militant tactics to achieve their aims.

C. Suffragette Movement

1. **Arson –** Act of deliberately setting fire to property.
2. **Annie Kenney -** A working-class socialist feminist who was active in the WSPU as a militant member and was arrested.
3. **Christabel Pankhurst -** Speaker for the WSPU in 1905. She trained as a lawyer but could not practice as a woman. She fled the country in 1912 for fear for rearrest, and she unsuccessfully ran for parliament in 1918.
4. **Emeline Pankhurst -** Led the WSPU from October 1903. She took militant action such as arson and destroying property and was arrested many times, she went on hunger strike and was force-fed. She died in 1928. Mother of Christabel.
5. **Emily Wilding Davidson -** Joined the WSPU in 1906. By 1911 she was increasingly militant. She was killed whilst campaigning in 1913.
6. **Millicent Fawcett -** She was a leading suffragist and leader of the NUWSS for over 20 years. She was a pivotal in women achieving the vote. She was dedicated to constitutional means and argued militancy was counterproductive.
7. **Nancy Astor MP -** Became the first female MP in 1919, she was American-British, upper-class, and replaced her husband as MP.

1897 NUWSS was formed with Millicent Fawcett as their leader.	**1903** WSPU was formed by Emmeline Pankhurst and her daughters.	**1905** Militant campaign begins, Annie Kenney and Christabel Pankhurst were arrested.	**1908** Mass rally, c.400,000 in London with window smashing with pleas attached to the stones.	**1909** Hunger strikes begin and the police force feed prisoners.	**1913** Emily Wilding Davidson is struck by the King's horse at the Derby and dies.	**1914** World War I begins, all leaders urge women to join the war effort.	**1918** The Representation of the People Act is passed.	**1919** Nancy Astor, The first female MP was elected.	**1928** Equal Franchise Act.

Unit 3 - World War II

A. Keywords

1. **Allied Powers –** Alliance of countries opposing the Axis: Britain, and her Empire, USSR & USA (in 1941).
2. **Axis Powers –** Alliance of Fascist countries, Germany, Italy, Japan.
3. **Radar –** Technology that locates and tracks objects by bouncing radio waves off them.
4. **Total war -** An unrestricted war where the accepted rules of war are disregarded.
5. **Turning Point –** When something important happens that influences the course of the war.

B. Causes Of WWII

1. **Adolf Hitler –** Totalitarian leader of Nazi Germany 1933-45.
2. **Appeasement –** Giving in to a person or groups demands.
3. **Anschluss –** The unification of Germany with Austria.
4. **Blitzkrieg –** 'Lightning war'; German term for fast-moving warfare.
5. **Fascism –** Far right ideology that spread across Japan, Italy and Germany and other countries.
6. **Luftwaffe –** The German air force.

C. The War In The West

1. **Battle of the Atlantic –** Naval war at sea.
2. **Battle of Britain –** German aerial attack on Britain.
3. **Blockade –** U-boats (submarines) prevented American supply ships entering British seas.
4. **Blitz -** Aerial attack on civilian targets to break morale.
5. **D-Day –** Operation Overlord was the Allied amphibious invasion of Normandy in June 1944 (pictured).
6. **Dunkirk –** British soldiers were evacuated from northern France at the start of the war.
7. **Evacuation –** To remove people from somewhere dangerous to somewhere safe.
8. **RAF –** Britain's Royal Air Force.
9. **Rationing –** Limiting the number of supplies (food, fuel, clothes) in times of war.
10. **Winston Churchill –** Prime Minister of Britain, he led a war time coalition.

E. The Role Of USA

1. **General Eisenhower –** Led the D-Day landings for the allies.
2. **Isolationism –** Avoiding political and economic dealings with other countries.
3. **Lend-lease –** The American scheme to supply Britain and USSR in the war before their military joined in 1941.
4. **Manhattan Project –** American nuclear project that developed the first atomic bomb.
5. **Midway -** The naval battle where USA significantly hurt the Japanese fleet in 1942.
6. **FD Roosevelt -** 32nd President of USA from 1933-1945.
7. **Pearl Harbour –** American naval base in Hawaii that was bombed by Japan in 1941.

D. The Eastern Front

1. **Joseph Stalin –** Totalitarian leader of the Soviet Union (Russia).
2. **Operation Barbarossa –** German invasion of the Soviet Union.
3. **USSR -** After the communist revolution Russia became known as the USSR, the Union of Soviet Socialist Republics.
4. **Scorched Earth Policy –** The Soviets torched everything of use so the German offensive struggled to find supplies.
5. **Siege –** When a town is surrounded until the inhabitants surrender or starve.
6. **Stalingrad –** The Soviets defeated the German army by winning a brutal siege.

F. Origins Of The Cold War

1. **Capitalism -** An ideology that includes democratic elections, free trade, individual right, and freedoms.
2. **Cold War -** A war of words and threats, increasing tensions between two superpowers that threatened stability.
3. **Communism –** An ideology that has the Communist Party controlling government and the economy, it focuses on the rights of workers and greater equality.
4. **Conferences –** Yalta and Potsdam war conferences were held between the Grand Alliance to decide what to do with Germany.
5. **Ideology -** A system of ideas and beliefs that forms a political and economic system.
6. **Iron Curtain –** A symbolic barrier between the 'East' (communism) and the 'West' (democracy).
7. **Superpowers –** USSR and USA emerged from WWII as the world's biggest powers, but they had opposing ideologies and were suspicious of each other.
8. **Tension -** When tension increased there was a concern that it would lead to nuclear war.
9. **The Grand Alliance -** The Alliance created after 1941 to defeat Nazi Germany (Britain, USSR, and USA).

1933 Hitler becomes Chancellor and rearms Germany.	**Sept. 1938** The Munich agreement, Britain appeased Hitler.	**March 1939** Hitler invades Czechoslovakia.	**Sept. 1939** Britain and France declare war on Nazi Germany.	**May 1940** Evacuation of Dunkirk.	**July to October 1940** The Battle of Britain.	**June 1941** Germany invades Russia, Operation Barbarossa.	**Dec.1941** Pearl Harbour. America join the war.	**1943** Germany surrender at Stalingrad.	**6th June 1944** D-Day landings.	**8th May 1945** Germany surrender.	**August 1945** USA drop A-bombs on Japan. 	**1946** Churchill's 'Iron Curtain' speech; start of the Cold War.

Unit 4 - The Holocaust

Stage 1: Persecution Of The Jews In The Early 20th Century

Keywords:

1. **Anti-Semitism -** Hostility or prejudice against Jewish people.
2. **Pogrom -** Violent attacks directed against an ethnic minority.
3. **Stereotype -** A widely held but very simplified and often untrue view of a group of people e.g. English people all drink tea.

Key dates:

4. **1905 -** The worst of a wave of pogroms in Odessa; The Protocols of the Elder of Zion are published; The Alien Act passed in Britain.

Stage 2: Life For Jews In Nazi Germany 1933-39

Keywords:

1. **Aryan -** An ancient European race which was the racially pure master race according to Hitler.
2. **Nuremburg Laws -** Passed in 1935 stripping Jews of all their rights as German citizens.
3. **Kristallnacht -** The 'night of broken glass' in which the Nazis and SA smashed and burnt Jewish business and synagogues.

Key dates:

4. **1 April 1933 -** SA boycott of shops and business owned by Jews.
5. **1935 -** Nuremburg Laws passed.
6. **1938 -** Kristallnacht marks the first acts of violence against Jews in Nazi Germany.

Stage 3: The Treatment Of The Jews During WWII:

Key people:

1. **SS -** Elite Nazi troops who were involved in carrying out the Holocaust.

Keywords:

2. **Concentration camp -** Where political prisoners and undesirables were imprisoned and forced into hard labour.
3. **Collaborator -** Local people from invaded countries (e.g. Poland, Lithuania) who carried out atrocities and were also anti-Semitic.
4. **Ghetto –** Walled-off areas in cities in which Jews were forced to live.
5. **Systematic** - In which something is done methodically, according to a plan.

Key dates:

6. **1939 -** Jews are rounded up into ghettoes.
7. **1941 -** Einsatzgruppen start murdering Jews in occupied areas.

Stage 4: The Final Solution From 1942:

Key people:

1. **Himmler -** Head of the SS.
2. **Heydrich -** Head of SS Einsatzgruppen and architect of the Final Solution.
3. **Goering -** Head of the Nazi economy.
4. **Goebbels -** Minister for propaganda.

Keywords:

5. **Fuhrerprinzip -** The leader principle.

Key dates:

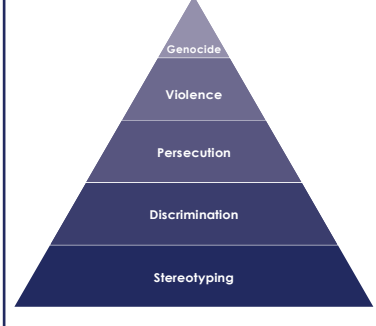
6. **1942-45 -** Zyklon B gas begins to be used to kill Jews in purpose built Extermination camps.

What Was Life Like For Jews In Germany Before The Nazis?

Keywords:

1. **Assimilation:** The process by which a minority integrates socially, culturally and politically into the dominant culture.
2. **Doltschoss:** The 'stab in the back'.

"There is, in fact, no group of people more attached to their native soil than the Jews. In Germany, the Jews have been continuously resident in the country since at least the year 320 and probably much longer."
Joseph Leftwich, 1936



Climate Change

Background

1. Since the 1860s the global climate has been recorded.
2. Since then, the climate globally has increased by 0.8° Celsius.
3. Climate scientists can use methods to find out about the global climate before we started recording it. **(B)**
4. From this evidence we can see that the planet has always gone through periods of warming and cooling. **(A)**
5. However, the rapid increase of CO_2 in the atmosphere from burning fossil fuels, is causing the enhanced greenhouse effect. **(D)**
6. The enhanced greenhouse effect is causing changes to the planet, such as the melting of Arctic sea ice, rising temperatures, and an increase in extreme weather events such as tropical storms. **(E, F)**
7. Countries are trying to resolve the issues related to climate change by limiting the amount of CO_2 released into the atmosphere, this is known as mitigation. **(G, H)**
8. Some countries are trying to adapt to climate change by building flood barriers and growing drought resistant crops. **(G, H)**

A - Changes In Climate (3)

Climate Change	The process of the Earth's climate changing over time.
Glacial Periods	Cold periods.
Inter-Glacial Periods	Warm periods.

B - Measuring Climate Change (3)

Ice Cores	Each layer of ice in a core represents a different year. CO_2 can be measured in each layer, and therefore the temperature.
Tree Rings	Each ring represents a different year. Thicker rings show a warmer climate.
Historical Evidence	Paintings and diaries e.g. paintings of ice fairs on the frozen Thames 500 years ago.

C - Natural Climate Change (3)

Volcanic Eruptions	Ash from volcanic eruptions can block sunlight, making it colder.
Sun Spots	The sun can give out more energy due to an increase in sun spots.
Orbital Change	The orbit of the sun changes from oval (ellipse) to circular approx. 98,000 years

D - Human-Induced Climate Change (5)

Greenhouse Effect	The way that gases in the atmosphere trap heat from the sun. Like glass in a greenhouse they let heat in, but prevent most from escaping.
Greenhouse Gases	Gases like CO_2 and methane that trap heat around the Earth, leading to climate change.
Transport	More cars, so more CO_2 causing the enhanced greenhouse effect.
Farming	Farming livestock produces methane, this is a greenhouse gas.
Energy	More energy required, meaning more fossil fuels burnt, so more CO_2.

E - Effects On People (6)

Tropical Storms	Increase in frequency and intensity so more damage.
Sea-Level Rise	Increased risk of floods, damaging property and businesses.
Melting Arctic Ice	Affects trading routes in the Arctic Circle.
More Droughts/ Floods	Crop failure, could lead to starvation and famine.
Cost Of Defence	Governments have to spend more money on disasters instead of developing.
Environmental Refugees	Pressure on countries to accept refugees.

F - Effects On The Environment (4)

Sea Temperature Rises	Coral bleaching and destruction of marine ecosystems.
More Droughts	Migration/ death of species which can not survive drought conditions.
Melting Glaciers (Ice Rivers)	Will send more fresh water into the sea, causing the sea level to rise.
Melting Arctic Ice	Loss of habitats for animals, such as polar bears.

G - Strategies To Resolve Climate Change (4)

Adaptation	Adapting to climate change to make life easier.
Adaptation Examples (3)	1. Building flood defences. 2. Growing new crops to suit the new climate. 3. Irrigation channels, sending water from areas of surplus to deficit.
Mitigation	Trying to stop climate change from happening by reducing greenhouse gases.
Mitigation Examples (3)	1. International agreements. 2. Alternative energies. 3. Carbon capture.

H - Place Specific Examples (2)

Adaptation	**The Thames Barrier.** Positive: Stops flooding due to rising sea levels. Negative: Expensive
Mitigation	**The Paris Agreement.** Positive: Countries are trying to lower CO_2 emissions. Negative: The USA pulled out and China did not sign up.

Life In An Emerging Country

Background

1. Development means positive change that makes things better.
2. As a country develops it usually means that the people's standard of living and quality of life improve. **(B)**
3. Different factors can affect development such as economic, social, and political factors. **(A)**
4. Emerging countries have begun to experience higher rates of development, with a rapid growth in secondary industries. **(A, C)**
5. Emerging countries have some of the fastest rates of urbanisation in the world. **(D)**
6. This is causing urban areas (cities) to become highly populated; this process can have both opportunities and challenges. One such challenge is the growth of squatter settlements. **(E)**
7. Emerging countries often host the factories of many transnational companies. They provide wages and taxes and can promote development. However, they can also cause negatives impacts. **(F, G)**

A - Characteristics Of Emerging Countries (7)

Bric Countries	Brazil, Russia, India, China.
Mint Countries	Mexico, Indonesia, Nigeria, Turkey.
Industrialisation	The process of a country moving from mostly agriculture (farming) to manufacturing (making) goods.
Employment Structure	How the workforce is divided up between primary, secondary, tertiary and quaternary employment.
Secondary Industry	An industry which manufactures goods.
Exports	Sending goods to another country for sale.
Urbanisation	The growth in the number/ proportion of people living in towns and cities.

B - Development Indicators (3)

GDP Per Capita	The total value of goods and services sold by a country in a year divided by the population.
Human Development Index (HDI)	A development measure which combines GDP per capita, life expectancy and education.
Life Expectancy	The average age you are expected to live to in a country.

C - Encouraging Development (4)

Subsidy	Money given by a government to help an industry keep down the cost of exports.
Tax Breaks	This reduces the amount of tax a company must pay (normally for a fixed period), therefore increasing profit.
Minimum Wage	The lowest wage permitted by law in a country.
Trade Unions	An organisation of workers who work to protect the rights of those employed.

D - Rural To Urban Migration (4)

Rural To Urban Migration	The movement of people from rural areas (countryside) to urban areas (cities).
Push Factor	Things that make people want to leave an area e.g. a lack of jobs.
Pull Factor	Things that attract people to live in an area e.g. good health care.
Mechanisation	When machines begin to do the work which humans once completed.

E - Squatter Settlements (5)

Squatter/ Shanty Settlement	An area (often illegal) of poor quality housing, lacking basic services e.g. water.
Inequality	Differences in wealth, and wellbeing.
Sanitation	Measures to protect public health e.g. clean water and disposing of sewage.
Informal Economy	Jobs which are not taxed, workers do not have contracts or rights.
Quality Of Life	A measure of how 'wealthy' people are, but measured using housing, employment and environment, rather than income.

F - Transnational Corporations (TNCs) (5)

Transnational Corporation	Those that operate across more than one country.
Footloose	Industries which are not tied to a location due to natural resources or transport links.
Globalisation	The increased connectivity of countries around the world e.g. through trade.
Host Country	The country where the TNC places its factories e.g. in an emerging or developing country.
Source Country	The country where the headquarters for the TNC is located e.g. a developed country.

G - Impact Of TNCs

Positive: (5)	1. More jobs. 2. More taxes. 3. Invest in infrastructure projects. 4. GDP increases. 5. Develop workers skills.
Negative: (3)	1. Can exploit workers e.g. long hours. 2. Most of the profits from TNCs leave the country where production takes place. 3. Increased levels of pollution e.g. air and water (from industrial waste).

Unit 9 - Relationships

9.1.1 Describe tu familia - Describe your family	
Mi padre/ mi padrastro	My dad/stepdad
Mi madre/mi madrastra	My mum/stepmum
Mi hermana/o mayor	My older sister/brother
Mi hermana/o menor	My younger sister/brother
Mi media/o hermana/o	My half sister/brother
Mis padres	My parents
Mis abuelos	My grandparents
Tiene(n) el pelo …	S/he has (they have)… hair
Tiene(n) … años	S/he is (they are)… years old
Es…	S/he is…
Son…	They are…

9.1.2 ¿Te llevas bien con tu familia? - Do you get on well with your family?	
Me llevo bien con…	I get on well with…
No me llevo bien con…/Me llevo mal con…	I don't get on well with…
Salimos	We go out
Discutimos	We argue
Compartimos	We share
Nos peleamos	We argue/fight
Tenemos mucho en común	We have lots in common
No tenemos nada en común	We have nothing in common
Me fastidia	S/he annoys me
Me hace reír	S/he makes me laugh
Juntos	Together

9.2.1 ¿Qué haces y cuándo? - What do you do and when?	
Juego	I play
Juego al baloncesto/ Juego en el parque	I play basketball/I play in the park
Hago	Literally: I do/ make(many expressions need hacer)
Hago natación/Hago escalada/Hago ejercicio	I swim – I go swimming/I climb/I exercise
Voy	I go
Voy al centro/Voy a una fiesta/Voy de paseo	I go to town/I go to a party/I go for a walk
Salgo	I go out
Me quedo en mi habitación	I stay in my room
Toco + instrumento	I play an instrument
Toco la guitarra/Toco la batería	I play the guitar/I play the drums

9.2.2 ¿Qué hace tu hermano/a? - What does your brother/sister do at the weekend?	
Juega	S/he plays
Hace	Literally: I do/make(many expressions need hacer)
Hace deporte/Hace sus deberes	S/he does sport/S/he does his/her homework
Va	S/he goes
Sale	S/he goes out
Se queda en su habitación	S/he stays in his/her room
Se entrena	S/he trains
A… le gusta (+ infinitive)…	S/he likes (to…)
Es aficionado/a de …	S/he is a fan of…
Juegan …	They play…
Hacen…	They do…
Somos muy diferentes	We are very different
Tenemos gustos similares	We have similar likes/interests
Su/sus (agrees with the object)	Her/his (su = his or her singular, sus = his or her plural)

Unit 9 - Relationships

9.3.1 ¿Cómo sería tu pareja ideal? - What would your ideal partner be like?	
¿Te gustaría casarte o tener una familia?	Would you like to get married or have a family?
Mi novia/o ideal	My ideal boyfriend/girlfriend
(No) sería…	S/he would (not) be…
Tendría…	S/he would have…
Le gustaría	S/he would like…
Me gustaría	I would like
Casarse	To get married
Separarse	To separate
Divorciarse	To divorce
Enamorarse	To fall in love
Estar comprometido/a	To get engaged
Vivir juntos	To live together
El matrimonio	Marriage
La boda	Wedding
Soltero/a	Single
La libertad	Freedom

9.4.1 ¿Qué hiciste el fin de semana pasado? - What did you do last weekend?	
Tuve que (+ infinitive)	I had to…
Quería (+ infinitive)	I wanted to…
Era/fue…	It was…
Me divertí mucho	I enjoyed myself
Hacía/hizo calor/frío	It was hot/cold
Llovía/llovió	It rained

9.4.2 ¿Qué hacías cuando eras pequeña/o? - What did you used to do when you were little?	
Cuando era pequeña/o	When I was little
Lo que más me gustaba era	The thing I liked the most was…
Me gustaba (+infinitive)	I liked to … /I used to like to…
Me encantaba (+infinitive)	I loved to…/I used to love to…
No soportaba (+ infinitive)	I could not stand…

9.3.2 En tu opinión ¿Qué es un buen amigo? - In your opinion, what is a good friend? (see Exercise Book for adjectives)	
Un buen amigo/una buena amiga es…	A good friend is…
Me hace reír	Makes me laugh
Me hace feliz	Makes me happy
Me ayuda con mis problemas	Helps me with problems
Me acepta	Accepts me
Me entiende	Understands me
Comparte todo	Shares everything
La amistad	Friendship
Comprensiva/o	Understanding

9.3.3 ¿Cuáles son tus planes para el fin de semana? - What are your plans for the weekend?	
Voy a (+ infinitive)	I am going to (+verb/activity)
Voy a salir de fiesta	I am going to go partying
Va a (+ infinitive)	S/he is going
Vamos a (+ infinitive)	We are going
Van a (+ infinitive)	They are going
Espero (+ infinitive)	I hope
Va a ser	It's going to be
Será	It will be
Como siempre	As usual

Unit 10 - Festivals And Celebrations

10.1.1 La comida - Food	
El desayuno	Breakfast
Desayunar	To eat/have breakfast
El almuerzo/la comida	Lunch
La merienda merendar	Afternoon snack
La cena	Dinner/tea
Cenar	To eat /have dinner
Como/Tomo	I eat/I take
Tomo cereales con leche	I take cereals with milk
Una dieta equilibrada	A balanced diet
Comer sano	To eat healthily
La comida grasosa/ grasa	Fatty food
Una comida	A meal
Comida para llevar	Takeaway food
La carne	Meat
Una comida vegetariana/vegana	A vegetarian/vegan meal
Las verduras	Vegetables
El arroz	Rice
La pasta (en salsa de tomate)	Pasta (in a tomato sauce)
El pescado (el atún/el salmón)	Fish (tuna/salmon)
Alrededor del mediodía/ de las seis	At about midday/At about 18:00
Mi plato preferido	My favourite dish
Al volver a casa	When returning home…
Me levanto y luego…	I get up and then…
Juntos en familia	Together as a family

10.1.2 La variedad de la cocina hispánica	
La cocina tradicional	Traditional food/dishes
Una especialidad	A speciality
En América Central	In Central America
En Sudamérica	In South America
El plato nacional	The national dish
Similar a	Similar to
Picante	Spicy
El ajo	Garlic
El maíz	Corn
Los mariscos	Shellfish
Relleno/a de…	Filled with…
En comparación con…	Compared with…

10.2.1 ¿Qué celebraciones se celebran en España/en países de habla hispana? - Which festivals/celebrations are celebrated in Spain/Spanish speaking countries?	
Celebramos…	We/One celebrates…
La Nochevieja	New Year's Eve
El Año Nuevo	New Year's Day
La Navidad	Christmas
La Pascua/la Semana Santa	Easter
El día de la madre	Mothers' Day
El Día de los Muertos	Day of the dead (celebrated in Mexico)
Los Sanfermines	Festival with the running of the bulls
Las Fallas de Valencia	Traditional celebration in Valencia every year
La feria de Abril de Sevilla	April festival of Seville
Un desfile/una procesión	A parade
Los fuegos artificiales	Fireworks
Los regalos	Presents
La tarta de cumpleaños	Birthday cake

Unit 10 - Festivals And Celebrations

10.2.2 Háblame sobre una fiesta que celebraste - Tell me about a past festival/celebration	
El año pasado	Last year
Hace dos meses/un año	Two months/ a year ago
Celebré…/Celebramos…	I celebrated/ we celebrated
Hice/hicimos una tarta de cumpleaños	I made a cake/He/she made a cake
… me compró…	… (s/he) bought me a…
Bailé	I danced
Invité a mis amigos a mi casa	I invited my friends to my house
Organicé una fiesta	I organised a party
Participé	I participated in…
Llevé un disfraz	I wore fancy dress
Fui	I went…
Fue + adjective	It was + adjective
Toda la noche/ todo el día	All night/day
Me divertí mucho	I enjoyed myself
Lo pasé/pasamos genial/ fenomenal/bomba	I/we had a great time

10.2.3 ¿Qué festival/qué fiesta te gustaría visitar y por qué? - What festival would you like to visit?	
(No) me gustaría (+ infinitve)	I would (not) like
Me encantaría (+ infinitve)	I would love
Parece + adjective	It seems + adjective
Parece emocionante	It seems exciting
Me interesa la cultura	I'm interested in culture
Me interesan las tradiciones	I'm interested in traditions
(No) soy religiosa/o	I am (not) religious

10.3 ¿Cómo se compara con las tradiciones de su país? - How does it compare?	
En comparación con…	In comparison to…
Que	Than
Que en España/México	Than in Spain/Mexico
Than in Spain/Mexico	It seems exciting
Es más…	It's more…
Es menos…	It's less…
Mientras que	Whereas
Ponemos/ ponen	We put/they put
Tenemos/ tienen	We have/they have
Comemos/Comen	We eat/they eat
Hacemos/ hacen	We do/they do
Celebramos/celebran	We celebrate/they celebrate

10.4 ¿Qué hay en la foto? - What is there in the photo?	
En la foto hay	In the photo there is/are
Puedo ver	I can see
Una familia/algunas personas/ jóvenes/niños	A family/ some people/young people/ children
Un hombre/ una mujer/un chico/una chica	A man/a woman/a boy/a girl
Al aire libre/dentro	Outside/indoors
Los turistas	Tourists
Parece…(feliz/triste)	S/he seems… (happy/sad)
Parecen (felices/tristes)	They seem… (happy/sad)
Los edificios (modernos/viejos)	Some (modern/old) buildings
Un lago/ una montaña/ un jardín	A lake/ a mountain/ a garden
Hace sol	It's sunny
Hace buen/mal tiempo	It's nice/bad weather
Habla/discute/juega/trabaja/ camina/come	S/he is speaking/ is arguing/is playing/is working/is walking/ is eating
Hablan/discuten/ juegan/ trabajan/caminan/comen	They are speaking/arguing/ playing/working/walking/ eating
Lleva (una camiseta/un jersey/ un vestido/vaqueros/ zapatillas/gafas)	S/he is wearing (a T-shirt/a jumper/a dress/jeans/trainers/ glasses)
A la izquierda/a la derecha	On the left/on the right
En primer plano	In the foreground
Al fondo	In the background

Unit 11: City Or Region In A TL Country

11.1.2 ¿Qué se puede hacer en tu región? - What can you do in your area?	
Hay mucho que hacer	There is lots to do
No hay nada que hacer	There is nothing to do
(No) se puede (+ infinitive)	You/one can (not)
En invierno	In winter
En verano	In summer

11.1.3 Mi región antes - My area before	
Antes	Before
En el pasado	In the past
Había	There was/were or there used to be
Estaba/era	It was/used to be
Más (+ adjective)	More
Menos (+ adjective)	Less/fewer

11.3.2 ¿Dónde te gustaría vivir en el futuro? - Where would you like to live in the future?	
(No) me gustaría/Me encantaría (+ infinitive)	I would (not) like to/ I would love to (+ verb)
En algún lugar (en Francia/en España/en Australia)	Somewhere (in France, in Spain, in Australia)
Un país cálido	A hot country
Un país de habla hispana	A Spanish speaking country
Soy fan de…	I am a fan of
Me entusiasma…	I love/am excited by …
Los deportes de invierno	Winter sports
La comida	The food
El modo de vida	The way of life
La gente es… (people in Spanish is singular!)	People are
Lejos de	Far (away) from
Cerca de	Close to

11.4.1¿Qué quieres comprar? - What do you want to buy?	
Quiero comprar	I want to buy
¿Cuánto cuesta?	How much does it cost?
Cuesta…	It costs…
¿De qué color?	Which colour?
Un recuerdo	A souvenir
Un regalo	A present

11.4.2¿Qué compraste recientemente? - What have you bought recently?	
Compré…	I bought…
Fui a las tiendas/ Fui de compras.	I went to the shops/shopping.
Quise/quería	I wanted
Esperaba	I hoped/was hoping to
Olvidé	I forgot
Tuve que (+ infinitive)	I had to…
Un regalo de cumpleaños	A birthday present
El vendedor/La vendedora	Shop assistant
Cerrado/a	Closed

11.5.1¿Qué país de habla hispana te gustaría visitar? - Which Spanish speaking country would you like to visit?	
Me gustaría visitar…	I would like to visit…
Me encantaría visitar…	I would love to visit…
Visitaría…	I would visit…
Haría …	I would do…
La cultura sudamericana	South American culture
Las ciudades antiguas	Ancient cities
La selva	The jungle
Las montañas	The mountains
Las playas tropicales	Tropical beaches

11.5.2 Los países de habla hispana – ¿Qué quieres hacer allí? - What do you want to do there?	
Quiero (+ infinitive)	I want to (+ verb)
Quisiera/me gustaría (+ infinitive)	I would like to (+ verb)
Descubrir	To discover
Ver	To see
Probar	To try
La comida típica	Local food
Los festivales	Festivals

Unit 12: The World Around Us

12.1.1 ¿Qué problemas medioambientales hay en…? - What environmental problems are there in…?	
(No) hay	There is/are (no)
Tráfico (el)	Traffic
Bolsa de plástico (la)	Plastic bag
Ruido (el)	Noise
Basura (la)	Rubbish
Polución(del aire/del agua) (la)	Pollution
Contaminación (del aire/ de la agua) (la)	Contamination
Espacios verdes (los)	Green areas
No es sostenible	It is not sustainable
Es un desastre	It is a disaster/ a catastrophe

12.1.2 ¿Qué se puede/debería hacer? - What can/should we do/be done?	
Se puede/podemos (+ infinitive)	We can …
Se debería (+ infinitive)	We should …
Usar	Use
Reciclar	Recycle
Reusar	Reuse
Reducir el consumo de	Reduce the consumption of
Ahorrar	Save (as in save up, not to rescue or salvage)
Apagar la luz	Turn the light off
Desenchufar los aparatos eléctricos	Unplug electrical devices
El transporte público	Public transport
Menos	Less
Agua	Water
Una bolsa de plástico	A plastic bag
La energía	Energy
La basura	Rubbish
Las latas	Tins
Las botellas	Bottles
El vidrio	Glass

12.1.3 Cuando eras pequeña/o, ¿hacías más o menos para proteger el medio ambiente? - When you were little did you do more or less to protect the environment?	
Cuando era pequeña/o	When I was little
Antes	Before (in the past)
Era más/menos ecológica/o	I was more/less environmentally friendly
Que ahora	Than now
Hacía mucho - Hago	I used to do a lot – I do
No hacía nada	I didn't used to do anything
Iba a pie – Voy a pie	I used to walk – I walk
Ahorraba - Ahorro	I used to save – I save
(No) reciclaba - Reciclo	I used to/didn't used to recycle – I recycle
Reutilizable	Reusable

Unit 12: The World Around Us

12.2.1 ¿Qué derechos tienen los niños? - What rights do children have?	
El derecho	The right
(No) tengo derecho a…	I (do not) have the right to…
Los niños (no) tienen derecho a…	Children (do not) have the right to…
Tener una identidad	To have an identity
Tener una nacionalidad	To have a nationality
Tener una familia	To have a family
Tener acceso al agua	To have access to water
Comer	To eat
Ir al colegio	To go to school
Ser atendido/a (s)	To be cared for
Salir	To go out
Es justo	It's fair
Es injusto	It's unfair
Es esencial	It's essential

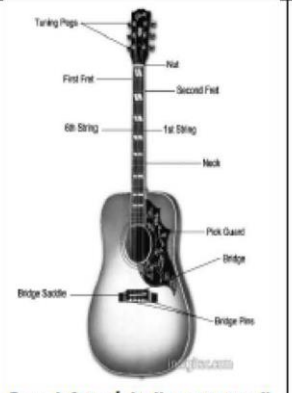
12.2.2 ¿Qué quieres hacer en el futuro? - What do you want to do in the future?	
(No) quiero	I (don't) want
Tengo la intención de …	I have the intention of…
Quiere	S\he wants
Quieren	They want
Estudiar en la universidad	To study at university
Luchar contra la injusticia	To fight injustice
Ayudar a los demás	To help others
Trabajar de voluntaria/o	To do volunteer work
En el futuro	In the future
Me parece	It seems to me

12.3.1 ¿Cómo se puede ayudar a los demás? - How can we help others?	
Podemos/se puede (+ infinitive)	We can
Ser amable con todos	To be nice to everyone
Dar dinero	To give/donate money
Dar ropa	To give/donate clothes
Trabajar de voluntaria/o	To volunteer
Educar a la gente	To raise awareness
Organizar un evento	To organise an event
Una tienda benéfica	A charity shop
Las personas sin hogar = los sintecho	Homeless people

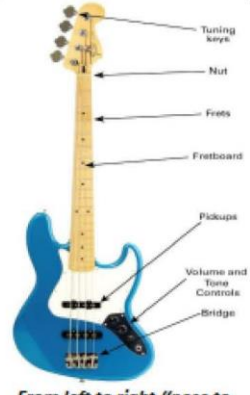
12.3.2 ¿Cómo quieres ayudar en el futuro? - How do you want to help in the future?	
Quiero	I want
Me gustaría	I would like
Cuando sea mayor	When I am older
Recaudar fondos	To fundraise
Un refugio de animales	An animal shelter
Una causa noble	A worthy cause
Una causa importante	An important cause
Una asociación de ayuda (al refugiado, a los animales, a la infancia)	A charity (for refugees, animals, children)

School of Rock – Ensemble (Term 1)

Make sure you can name the strings and main parts of the guitar and bass guitar

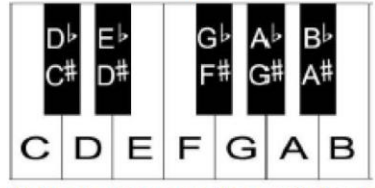


From left to right ('nose to toes'), strings on a guitar = EADGBE



From left to right ('nose to toes'), strings on a bass = EADG

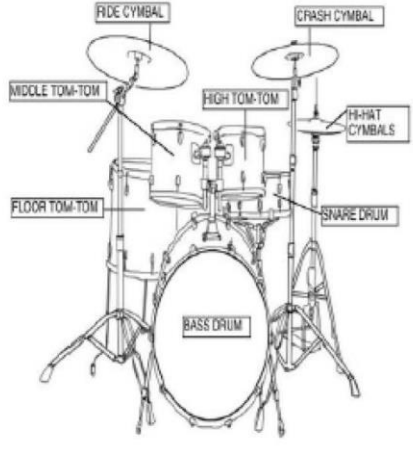
Make sure you know the notes of the piano / keyboard, including the sharps # and flats b



Make sure you can name these musical notes and you know their value

Symbol	American (British) Note Names	Beats
𝅝	Whole note (Semibreve)	4 beats
𝅗𝅥	Half note (minim)	2 beats
♩	Quarter note (crotchet)	1 beat
♪	Eighth note (quaver)	1/2 beat
𝅘𝅥𝅯	Sixteenth note (semiquaver)	1/4 beat

Make sure you can name the different parts of the drum kit



Meet DR SMITH

Revise these words related to DR SMITH and the Elements of Music

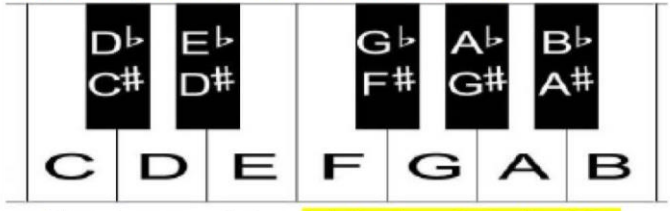
D	Dynamics	Piano = quiet / Forte = loud
R	Rhythm & Tempo	Rhythm = Regular pattern of long & short notes to a pulse Time Signature = How many beats in the bar, Pulse = Regular Beat Syncopation = When the music goes against the beat. Off Beats / Back beats = Music played on the weak beats Moderato = moderate tempo (speed)
S	Structure	Verse+ Chorus = Sections of a song. Riff = A short repeated pattern (popular music)
M	Melody	Melody = the tune in the music
I	Instruments	Do you know the different parts of the ukulele, guitar, bass and drum kit? Intonation = Making sure notes are in tune together. Balance = Making sure all instrumental parts and vocals can be heard.
T	Texture	Texture = How many instruments or voices are playing at one time and how they relate to each other Melody & Accompaniment = where the tune is the focus and other parts accompany
H	Harmony & Tonality	Major Chords = happy sounding chords. Minor Chords = sad sounding chords. Chords = Two or more notes played at the same time. Tonality= Key of the music. Modulation = Change in key, hear a pitch change

Keyboard and Theory Skills (Term 2 and 3)

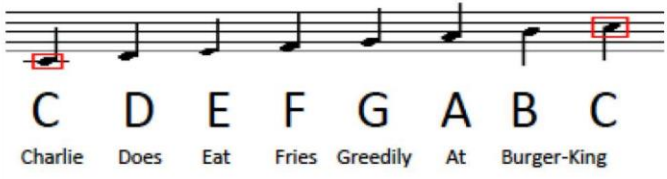
Homework 1

Visit www.musictechteacher.com Quizes, middle column

You will be expected to know the notes of the keyboard...



..and the notes on a music stave, including sharps / naturals and flats



Note Values

Sharps (#) Flats (*b*) Naturals ♮

♩.	Dotted Crotchet = a musical note worth 1 and ½ beats
♫	Quaver= each one worth ½ of a beat

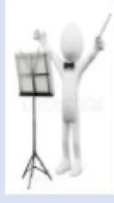
♯	Sharp (move to the right)	♭	Flat (move to the left)
♮	Natural (Go back to the original note)		

Rhythm + Tempo

1. **Time Signature** = How many beats in the bar

Harmony + Tonality

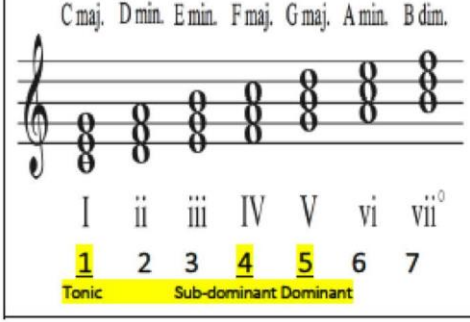
2. **Chromatic** = Notes that don't belong to the key signature
3. **Chord** = Two or more notes played at the same time, producing harmony



Don't Forget DR SMITH!

- Dynamics
- Rhythm + Tempo
- Structure
- Melody + Pitch
- Instruments + Timbre
- Texture
- Harmony + Tonality

CHORDS IN C MAJOR



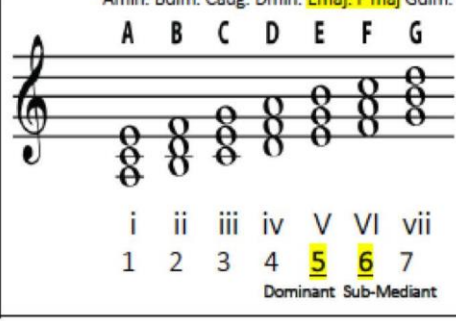
Homework 2

Tonality & Harmony

1. In a minor key (Chord V and VI) are major chords. Section A of Fur Elise is in A minor
2. In a major key (Chord I = Tonic / Chord IV = Sub dominant / Chord V = Dominant) are Primary chords. Section B of Fur Elise is in C major
3. Cadence = A musical full stop using two chords at the end of a phrase. Perfect Cadence = Chord V-I, finished / Imperfect Cadence = Chord I-V, unfinished
4. Modulation = When the music changes Key
5. Inversion = When the notes of a chord are rearranged

CHORDS IN A MINOR

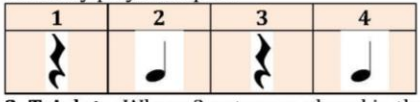
Amin. Bdim. Caug. Dmin. Emaj. F maj Gdim.



Reggae Music – Advanced Rhythm (Term 2 and 3)

Things to do with rhythm…

1.Offbeat = When the accents of the music occur on the **weak beats** of the bar. (Beats 2 + 4) 1 **2** 3 **4.** The rhythm guitar in Reggae music normally plays this part.



2. Triplet = Where 3 notes are played in the time of two.

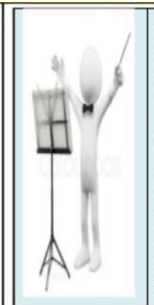
3. Pulse = A regular beat
4. Time Signature = Tell you how many beats are in the bar.
5. Syncopation = When the rhythm goes against the beat of the music.
6. Moderato Tempo = Moderate speed

Note Values

	**Minim**= a musical note worth 2 beats
	Crotchet = a musical note worth 1 beat
	**Dotted Crotchet =** a musical note worth 1 and ½ beats
	**Quaver**= each one worth ½ of a beat
	**Semi Quaver**= each one worth ¼ of a beat
	**Crotchet Rest =** a musical rest worth one beat

Structure

7. Riff = A short repeated catchy part. In Reggae music, normally played by the bass guitar.



Don't Forget DR SMITH!
Dynamics
Rhythm + Tempo
Structure
Melody + Pitch
Instruments + Timbre
Texture
Harmony + Tonality

Things to do with texture…

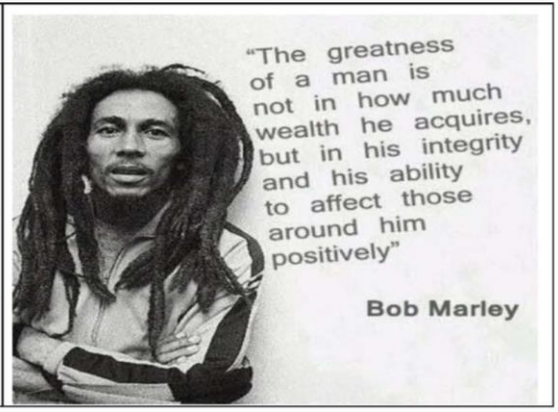
1.Texture = How many instruments or voices are playing at one time and how they relate to each other
2. Melody & Accompaniment = The tune is the focus and other parts accompany.
3. Call & Response/ Antiphony = Copying the leader / Vocal dialogue. (Backing singers in Reggae music)
4. Vocal harmonies = Where voices sing different notes producing chords/ harmony, providing a rich texture.

Instruments + Timbre

Horn section = Consists of the **trumpet, trombone, saxophone** and add melodic interest. Extensive **Percussion** is sometimes used in Reggae music

Things to do with harmony and tonality…

Major & Minor Chords = Bright / Sombre sounding
Primary Chords = Bright sounding (Chords I, IV, V)



Guide to the Orchestra (Term 3)

The best way to remember the **Elements of Music** is to remember this man:
DR SMITH
His name helps spell out the elements of music. See the table to the right.

The **Elements of music** are the **key ingredients** that go into **making a piece of music**. A bit like when you mix ingredients together to make a dish / meal.

D	***Dynamics***	= How **loud or quiet** the music is
R	***Rhythm & Tempo***	**Rhythm** = The subdivision of long & short notes to a pulse **Tempo** = How **fast or slow** the music is
S	***Structure***	= the **layout** of a piece of music
M	***Melody & Pitch***	**Melody** = the **tune** in the music **Pitch** = How **high or low** the notes are
I	***Instruments & Timbre***	**Timbre** = The **sound quality** / tone of a **voice** or **instrument.**
T	***Texture***	= **How many instruments and voices are playing at one given time** and how they relate to each other
H	***Harmony & Tonality***	**Harmony** = The **organisation** of **notes** and **chords** **Tonality** = The key of the music (major ☺ minor ☹)

Dynamic
Piano/ Forte Contrast = Loud & Quiet contrasts

Rhythm
Driving Rhythm = Gives momentum to the music
Rhythmical ostinato = A repeated rhythm throughout
Pulse = A regular pulse
Tempo Contrasts = Fast & Slow contrasts

Structure
Ostinato = A repeated pattern (film / orchestral music)

Melody
High & Low Range = High & Low contrasting pitches
Conjunct= by step melody / **Disjunct**= by leap/ angular melody
Leitmotif / Motif / Theme = Music associated with a character or mood
Fanfare= An important piece of music played by brass instruments

Instruments + Timbre
Timbre = The tone / sound of an instrument or voice
Legato = Smooth / **Staccato** = Short **Accents**= Forced sound
Orchestral Instruments & Electronic Instruments = Synthesised sounds / Special Effects **(SFX)**

Texture
Melody & Accompaniment= Tune and others accompany

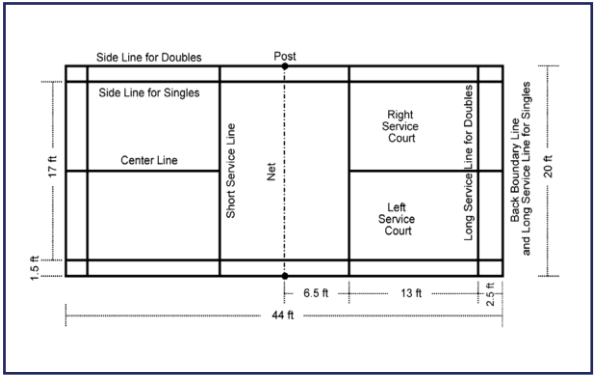
Tonality
Major (energetic/ bright) **/ Minor** (sinister, sombre, dramatic)
Contrasts
Chromatic = Notes that don't belong to the key in the melody
Dissonance= Clashing Chords
Diatonic = Notes that do belong to the key in the melody

Harmony (Harmonic Devices)
Pedal = A long or repeated note held on in a passage of music.
Drone = Two repeated notes held on in a passage of music.

Badminton

Warm Up

Phases of Warm up	What it is?	Specific Examples	Benefits of Warm up
Pulse Raiser	Slowly increasing HR.	Jogging around the Badminton court.	• Warming up muscles. • Preparing the body physically and mentally for competition. • Increase body temperature - Improve flexibility of muscles and joints. • Reduce chance of injury.
Mobility	Taking joints to their full range of movement.	Circling shoulders – opening closing the gate.	
Stretching	Static – stationary - Dynamic – stretches on the move.	Hamstring stretch or lunges.	
Dynamic Movements	Show a change in speed and direction.	Sprint shuttles, fast feet and bounding.	
Skill Rehearsal	Practising movement patterns and skills that will be used in badminton.	Passing forehand with a partner.	



Key Skills

	Key Skills	What is it?	Why is it used?
Defending	Clear Shots	Shots that are hit high and to the back of the court.	To reduce pressure by creating time to regain centre court positioning and to set up more attacking shots in the rally.
Attacking	Smash/Drive	Shots that are hit hard and either flat (straight drive, into body of the opponent) or downwards (smash).	To put pressure on your opponent and reduce the time they must play a return shot. These types of shots are point winning shots.
Positioning Doubles	Sides	This is where you and your partner play alongside each other and take responsibility for shots on your side of the court.	Generally used in men's and women's doubles when teammates are equally strong.
	Front And Back	This is when one player covers the front of the court and the other covers the back-court area.	Mainly used in mixed doubles or when one player has a particular strength in game play.
Outwitting Your Opponent	Drop Shot	A disguised shot which is made to like it is being hit hard to the back of the court but is just touched over the net, dropping short.	This is used to try and catch your opponent unaware. The idea is to win the point or put so much pressure on your opponent they are then out of position and off balance.

Key Skills For Being An Effective Player

Skills	Why it's used
Reading Play	Good players can read the play and react quickly using their – • PERCEPTUAL SKILL - how we see our surroundings/ interpreting a stimulus. For example, reading the opponent's body position to anticipate the type of shot they may play. • COGNITIVE SKILL - thinking skills. Anticipating the opponent's next shot or your next shot depending on court position. • MOTOR SKILL - learned movement outcome.
Positioning	• Maintain a central position on the court to allow to be able to reach all shots. • When playing doubles position, make sure you and your teammate are in opposite areas of the court to ensure full court coverage.
Timing	• Make contact with the shuttle at the highest point. • Racket in the ready position at all times, so you are prepared to play the correct shot. • Use your non racket hand to point at the shuttle to create good body positioning.

Cricket

Warm Up

Phases of Warm up	What it is?	Specific Examples	Benefits of Warm up
Pulse Raiser	Slowly increasing HR.	Jogging around the outfield.	• Warming up muscles. • Preparing physically and mentally for competition. • Increase body temperature. • Improve flexibility of muscles and joints. • Reduce chance of injury.
Mobility	Taking joints to their full range of movement.	Circling shoulders – opening and closing the gate.	
Stretching	Static – stationary - Dynamic - moving stretches.	Hamstrings stretch or lunges.	
Dynamic Movements	Show a change in speed and direction.	Sprint shuttles and fast feet. Running between the wickets.	
Skill Rehearsal	Practising movement patterns and skills that will be used in the activity.	Bowling run up.	

Key Skills

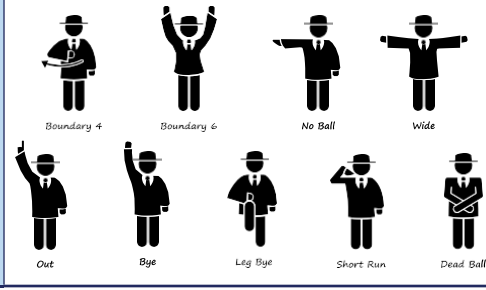
	Key Skills	What is it?	Why is it used?
Batting	**Cut Shot**	Attacking cross batted shot played off the back foot towards the offside.	Attacking shot to score runs, played to a delivery that is pitched short and either straight or on the offside.
Fielding	**Wicket Keeping**	Fielding position directly behind the stumps.	To catch the ball or stop the ball if the batsman misses it. The only fielder that can stump the batsman out.
Bowling	**Spin Bowling**	Bowling but when the ball pitches (lands) it spins in a slightly different direction.	To try and get a batsman out with an unexpected delivery. To outwit the batsman.

Cut shot

Wicket keeping

Spin bowling

Key Skills For Being An Effective Player

Skills	Why it's used
Batting – Judging The Delivery	Good players when batting will be able to judge where the ball will pitch quickly, therefore they can play the relevant shot or try to hit the ball into the gaps in the field to score more runs.
Bowling – Varying Speed When Bowling	Good players when bowling will be able to vary the speed to outwit the batsman and try and get him out.
Fielding – Run Outs	Good players when fielding will be able to stop/catch the ball but also judge which stumps to throw to attempt a run out.
Umpire Signals	

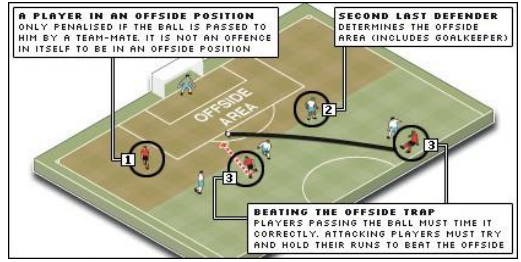
Football

Warm Up

Phases Of Warm Up	What it is?	Specific Examples	Benefits of Warm up
Pulse Raiser	Slowly increasing HR.	Jogging around the football pitch.	• Warming up muscles. • Preparing the body physically and mentally for competition. • Increase body temperature - Improve flexibility of muscles and joints. • Reduce chance of injury.
Mobility	Taking joints to their full range of movement.	Circling shoulders, opening/closing the gate.	
Stretching	Static – stationary - Dynamic - moving stretches.	Hamstring stretch or lunges .	
Dynamic Movements	Show a change in speed and direction.	Sprint shuttles, fast feet and bounding.	
Skill Rehearsal	Practising movement patterns and skills that will be used in the activity.	Pass and moving – rondo.	

Football Rules

- A free kick is given for a foul OUTSIDE the 18-yard box.
- A penalty is given for a foul INSIDE the 18-yard box.
- If it goes out of play off an attacking player on the base line, then it is a goal kick.
- If it comes off a defending player, it is a corner kick.
- Offside -



Key Skills

	What is it?	Why is it used?
Long Passing	Using accuracy and power to move the ball over a long distance to a teammate.	To create attacking opportunities for your team or to prevent losing possession of the ball in a defensive area (clearance). It is also used for goal kicks or corners.
Defending	A role within the team all players must fulfil. Keeping a low body position to put pressure on the opposition.	To prevent the opposition from creating attacking opportunities. To win back the possession of the ball.
Shooting	Using accuracy and power to create opportunities to score in front of the goal.	To create scoring opportunities for your team. Always be prepared for the rebound.

Formations

4-3-3

3-5-2

Handball

Warm Up

Phases Of Warm Up	What it is?	Specific Examples	Benefits of Warm up
Pulse Raiser	Slowly increasing HR.	Jogging up and down the handball court.	• Warming up muscles. • Preparing the body physically and mentally for competition. • Increase body temperature - Improve flexibility of muscles and joints. • Reduce chance of injury.
Mobility	Taking joints to their full range of movement.	Shoulder rotations.	
Stretching	Static/stationary/dynamic/moving stretches.	Triceps/deltoid/hamstring stretches.	
Dynamic Movements	Show a change in speed and direction.	Shuttles and changing direction at speed.	
Skill Rehearsal	Practising movement patterns and skills that will be used in activity.	Passes to a partner.	

Tactics

Passing	• Using the correct passes at the correct time. • Entice players towards you and offload before you are tackled, or your space has gone. • Can you create gaps in the defence and exploit them with a pass?
Receiving	• When receiving the pass in attack, be on the move. • This makes you a more difficult player to mark and defend. • Creates spaces and opportunities to beat defenders and shooting chances.
Shooting	• Look to beat defenders using a feint and dodge. • Use the jump shot to get a better angle of shot and to get closer to the goal. • Use your three steps to beat defenders and get shots away from inside the area (using your jump).
Defending	• Standing together and make yourself tall - create a barrier. • Decision making- when to step off the 6m line to engage in contact. • Always tackle from the front, use your feet to stay in front of attackers.
Attacking	• Use set plays, swap over positions to confuse defenders and utilise the space.
Decision Making	Which pass to use and when. Your positioning on the court, can you swap positions whilst in play? When to tackle and when to let attacker shoot.

Set Plays

Possession Play	Making a lot of passes. Keeping the ball away from the opposition. Be patient with passes.
Fast Break	• Looking to use the quick players who can get up the court quicker than the defenders can get back to defend. • Fast break every time the goalkeeper has the ball. • Look to release the ball as quickly as you can and catch opponents out.
Free Throws	• All players behind the 9 metre line. • You can shoot directly from a free throw. • Move the ball quickly to a wide position. • Take all shooting opportunities.
Penalties	Penalties are awarded for dangerous play when shooting. You must take the shot from the 7 metre mark and your foot must remain behind the line and can not move when taking the shot.
Defending	Staying as tall as possible, meet attackers before they get to the line. Look to force attacking team as wide as possible to make shooting angle as small as possible.
Centre Passes	Once the ball is back to the centre, all attacking players must start in their own half. You do not have to wait for the defending team to be back, this can lead to fast breaks.

Health Related Fitness

Warm Up

Phases Of Warm Up	What it is?	Specific Examples	Benefits of Warm up
Pulse Raiser	Slowly increasing HR.	Jogging around the field.	• Warming up muscles. • Preparing the body physically and mentally for competition. • Increase body temperature - Improve flexibility of muscles and joints. • Reduce chance of injury.
Mobility	Taking joints to their full range of movement.	Circling shoulders – opening/closing the gate.	
Stretching	Static – stationary - Dynamic - moving stretches.	Hamstring stretch or lunges.	
Dynamic Movements	Show a change in speed and direction.	Sprint shuttles, fast feet and bounding.	
Skill Rehearsal	Practising movement patterns and skills that will be used in the activity.	Depending on sport.	

Key Terms

Aerobic	With oxygen.
Anaerobic	Without oxygen.
Maximum HR	Maximum heart rate = 220 - AGE.
RHR	Resting Heart Rate.
Aerobic Threshold	60-80% of Maximum heart rate (HR).
Anaerobic Threshold	80-90% of maximum heart rate (HR).
VO^2 Max	Maximum uptake of Oxygen.
RPE	Rate of perceived exertion.

Principles of Training

Basic Principles of Training	Frequency	How often you train.
	Intensity	How hard you train.
	Time	How long you train for.
	Type	What type of training you do.

Method of Training

Method of Training	Description	Example
Circuit	Exercises performed at stations: - Usually 6-8 stations. - Works all components of fitness.	Station 1: Press ups. Station 2: Burpees Station 3: Sit ups. Station 4: Mountain Climbers. Station 5: Tricep Dips. Station 6: Sprint shuttle.
Interval	High intensity with rests.	Sprint Shuttles.
Continuous	Moderate intensity for a minimum of 20 minutes.	Cross country run around the school field.
Fartlek	This is where the intensity of the training is varied with speeds or different terrains. Known as speed play.	Lines of different cones. Sprint to one colour, jog to another, walk to another then repeat.
Flexibility	This is using a range of stretching movements to increase the range of motion around a joint to improve flexibility.	Stretching after exercise.

Netball

Warm Up

Phases Of Warm Up	What it is?	Specific Examples	Benefits of Warm up
Pulse Raiser	Slowly increasing heart rate and body temperature.	Jogging around the netball court.	• Warming up muscles. • Preparing the body physically and mentally for competition. • Increase body temperature - Improve flexibility of muscles and joints. • Reduce chance of injury.
Mobility	Taking joints to their full range of movement.	Circling shoulders – opening/closing the gate.	
Stretching	Static/stationary/Dynamic/moving stretches.	Hamstring stretch or lunges.	
Dynamic Movements	Show a change in speed and direction.	Sprint shuttles, fast feet and bounding.	
Skill Rehearsal	Practising movement patterns and skills that will be used in the activity.	Pass and moving – bow-tie.	

Key Skills

	Key Skills	What is it?	Why is it used?
Passing	Centre Passes	Centre steps into the circle. On whistle all key players drive forward to receive the pass.	To start the game. WA, WD, GA and GD drive to give options to C player.
Ball Handling	Free Passes	Who should take the pass and movements of the other players?	When a player has been called for contact, obstruction, or footwork.
Shooting	Semi-Circle Tactics	Movement in and around the semi-circle to get the best opportunity to shoot.	Set patterns of play involving GS, GA, WA, C, to maximise shooting opportunities.
Defend	Rebounds	Be able to have quick reactions when a player misses the shot.	Jump higher than others to retrieve the ball.
	Interceptions	Be able to turn over ball and keep control when landing to.	Turnover ball and start the attack to your end.
	Marking	Apply 1M rule and get your distance before hands. You can man mark or mark the space. This is known as zoning.	Perform this everywhere on court to turn over ball (man to man). Working in a zone with your team to block the attack.
Attack	Dodging	Use either sprint or feint to create space anywhere on court.	Used effectively during a centre pass, back or side-line passes.

Key Skills For Being An Effective Player

Skills	Why it's used
Reading Play	Good players can read the play and react quickly using their – • PERCEPTUAL SKILL - how we see our surroundings/ interpreting a stimulus. • COGNITIVE SKILL - thinking skills. • MOTOR SKILL - learned movement outcome.
Positioning	• Players can position themselves between their players and the ball. • Aware of movement of others and not to all crowd an area. • Position during centre passes – one on the inside and outside of their opposition and WA and C positioning around the circle.
Timing	• Knowing when to move and when to hold your space. • Pass the ball in front of the receiving player to move the ball up court. • Timing for rebounds to get the best chance to turn over ball.

Rounders

Warm Up

Phases Of Warm Up	What it is?	Specific Examples	Benefits of Warm up
Pulse Raiser	Slowly increasing HR.	Jogging around the rounders pitch.	• Warming up muscles. • Preparing the body physically and mentally for competition. • Increase body temperature - Improve flexibility of muscles and joints. • Reduce chance of injury.
Mobility	Taking joints to their full range of movement.	Circling shoulders – opening/closing the gate.	
Stretching	Static – stationary - Dynamic - moving stretches.	Hamstring stretch or lunges.	
Dynamic Movements	Show a change in speed and direction.	Sprint shuttles, fast feet and bounding.	
Skill Rehearsal	Practising movement patterns and skills that will be used in the activity.	Catching and throwing in groups.	

Key Skills

	Key Skills	What is it?	Why is it used?
Fielding	Overarm Throw	Fast and powerful throw over a distance.	Deep fielders use to get the ball into bases. Backstop would use to get the ball to 2nd base.
	Underarm Throw	Short but quick throw.	Ball hasn't travelled far, and fielders passes into a base if they are close to 2nd or 4th base.
	Catching	Retrieving the ball from the air.	Throwing to 2nd or 4th base to get batter out.
	Long Barriers On Move	Position yourself for a quick pick up.	Quickly and efficiently collect the ball making an accurate throw to 2nd or 4th base.
Batting	Placement	Changing body position to direct the ball.	Place the ball where no fielders are stood – backhand shot. Adjusting body for the type of shot.
	Contact	To hit the ball consistently into deep field.	The further the ball goes the more likely a batter is to get back to 4th base.
Bowling	Fast	Increase speed of bowl.	Fast bowl reduces the chance of the batter hitting the ball, reducing chance of scoring. Decision making – judging which type of bowl to use depending on batters' strengths and weaknesses.
	Spin	To get the bowl to the batters but adding backspin.	With backspin added to a ball it will not go as far meaning less likely to score.
	Donkey Drop	Ball bowls up and falls at the front of batter's box.	Due to the direction of the ball, batters usually hit the ball vertically into air making it easier to catch.

Key Skills For Being An Effective Player

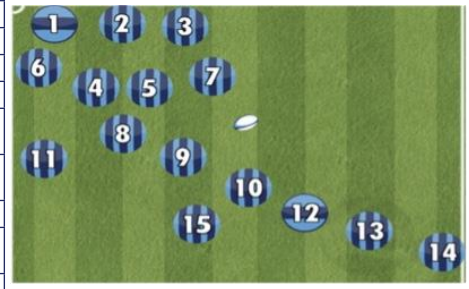
Skills	Why it's used
Reading Play	Good players can read the play and react quickly using their – • PERCEPTUAL SKILL - how we see our surroundings/ interpreting a stimulus. • COGNITIVE SKILL - thinking skills. • MOTOR SKILL - learned movement outcome.
Positioning	Fielders can position themselves effectively depending on the batting team's ability to hit. Remove 3rd base and have an extra deep fielder.
Timing	• Knowing when to move for a ball. • Knowing when to move to hit the ball.

Key Rules

Rules	Definition
Batters	• Batters can take a no ball and score in the usual way, but once you reach 1st post you cannot return. • You cannot be caught out or stumped out at 1st post on a no ball.
Running Around The Pitch	• If a batter stops at a post, they must keep in contact with the post, with hand or bat. If they don't, the fielding side can stump the following post to put the batter out. • Batters can run on to a post even if it has been previously stumped (you don't score if the post immediately ahead has been stumped). • Batters can move on as soon as the ball leaves the Bowler's hand, including no balls.

Rugby

Positions	Numbers
Prop in the front row of the scrum, aim to drive the scrum forward.	1 + 3 Forward
Hooker in the middle of the front row. The hooker's job is to hook the ball back towards his team in the scrum.	2 Forward
Second Row are locked in behind and in between the prop and hooker. Their job is pushing the front row forward.	4 + 5 Forward
Flankers are on the outside of the scrum; their main job is to break off the scrum quickly and tackle the ball carrier.	6 + 7 Forward
Number 8 is at the back of the scrum, between the two second rows. Their role is to control the ball at the back of the scrum.	8 Forward
Scrum Half put the ball into the scrum. As well as this, the scrum half is the key passer of the team. They will pass the ball to the fly half from most rucks.	9 Back
Fly Half is the play maker of the team. The fly half's job is to distribute the ball and bring other players into the game.	10 Back
Centres are in commonly found in the middle of the pitch and must be able to perform all the main skills (passing, tackling & rucking).	12+13 Back
Winger are usually on the outsides of the pitches and their job is to run and score tries.	11+14 Back
Fullback is found at the back of defensive line and acts as a defensive sweeper, like a last line of defence.	15 Back



Key Skills

	Key Skills	What is it?	Why is it used?
Passing/ Decision making	Miss Pass	Passing the ball behind the back of a dummy runner. So, **the ball skips a player** in the attacking line.	To suck in defenders and create space out wide.
	Attack in pods 3 vs 2	Attack in packs of three to isolate parts of the defensive line i.e., 2 forwards (Props) as they are less agile players and cover distance slower.	Expose gaps in defence and create a mismatch in the defensive line.
Rucking	Rucking (Golden Metre)	This means the first player **going past the ball (1 metre),** in the ruck, clearing out any opposing team members.	To retain possession after a tackle.
	Counter Rucking (Jackal)	If the attacking team are slow to the ruck, the initial player from the defending team should look to **'Jackal'** the tackled player.	To steal possession off the attacking team after a tackle.
Attack	Working in Pods	In attacking play, players should **work in groups 3.**	To gain ground.
Kicking	Punt	Kicked from hands, as far as possible.	Used to clear the ball out from defensive line.
	Grubber	Kicked from hands, along the floor.	Advanced attacking kick.
	Place	From a cone/tee, over the posts.	To score conversion/ penalty.

Key Skills For Being An Effective Player

Skills	Why it's used
Fly Hack	Players are allowed the kick the ball when it is in the floor. This is called a fly hack.
Strike And Push	1. When scrummaging players are now allowed to strike (hookers, competing for the ball). 2. The forwards in the scrum are also allowed to push against one another.
Offside	A player is in an offside position if that player is further forward (nearer to the opponents' goal line) than the teammate who is carrying the ball or the teammate who last played the ball.
Ruck	1. Players must enter the ruck through the gate and not from the side. 2. Players must always remain on their feet and not use their hands in the ruck.
Tackle	1. The tackler must release the ball carrier once the tackle has been made. 2. The tackler must then roll away or get back to their feet, before re-joining play. 3. The ball carrier must also release the ball once they have been tackled to the floor.
Uncontested Lineout	Both teams will set up a 3-person lineout comprising of three of the forwards, commonly the second row. The two teams must stand a metre apart in order to create a throwing channel. The team's hooker who has possession will then throw the ball into play but the opposition cannot compete for the ball.

Tennis

Warm Up

Phases Of Warm Up	What it is?	Specific Examples	Benefits of Warm up
Pulse Raiser	Slowly increasing HR.	Jogging around the tennis court.	• Warming up muscles. • Preparing the body physically and mentally for competition. • Increase body temperature - Improve flexibility of muscles and joints. • Reduce chance of injury.
Mobility	Taking joints to their full range of movement.	Circling shoulders, high knees.	
Stretching	Static/stationary/dynamic/moving stretches.	Hamstring walk, rotated lunges, triceps and upper arm stretches.	
Dynamic movements	Show a change in speed and direction.	Sprint shuttles, agility cones, small quick feet.	
Skill rehearsal	Practising movement patterns and skills that will be used in the activity.	Bouncing the ball on racket – stationary, moving, rotating the racket.	

Key Skills

	Key Skills	What is it?	Why is it used?
Ground stroke	**Slice**	A shot that uses backspin to create a low bounce and travels back in the direction from where it came.	To keep the ball low, forcing your opponent to really stretch to get to the ball over the net.
	Topspin	A shot that spins end-over-end and bounces very high in the direction it was hit upon impact.	Increase the player's consistency, allows a player a greater margin of error because topspin brings the ball down toward the ground quicker, a player can hit the ball higher over the net, thus increasing the margin of error.
Advanced shot	**Overhead/ Smash**	A shot that is hit powerfully above the hitter's head with a serve-like motion.	Usually following a poorly hit lob close to the net.
	Lob	A high, loopy shot meant to go over the head of a player at the net.	To put the ball in the open space near the baseline.
	Passing shot	A shot from the backcourt that is designed to go past an opponent at the net, often hit on the run.	When one's opponent is running to the net or at net already.
	Drop shot	A shot that just goes over the net with some disguise and a low bounce.	To make your opponent run forward for the ball, keeping them off balance.

Key Skills For Being An Effective Player

Skills	Why it's used
Reading Play	Good players can read the play and react quickly using their: • **PERCEPTUAL SKILL** - how we see our surroundings/ interpreting a stimulus. • **COGNITIVE SKILL** - thinking skills. • **MOTOR SKILL** - learned physical skill that create movement.
Coordination	The ability to move two or more body parts under control, smoothly and efficiently. E.g. when serving.
Muscular Endurance	The ability to move your body and muscles repeatedly without fatiguing. E.g. hitting 18 shots in a rally.
Power	The ability to exert a maximal force in as short a time as possible. E.g. when hitting a smash.
Speed	The ability to move quickly across the ground or move limbs rapidly through movements. E.g. running to a wide sliced backhand.
Reaction Time	The ability to respond quickly to a stimulus. E.g. Moving to a ball that has unexpectedly hit the net,

Unit 9: Family and Relationships

9.1.1 Décris ta famille - Describe your family	
Mon père/beau-père	My Dad/stepdad
Ma mère/belle-mère	My Mum/stepmum
Mon frère aîné	My older brother
Mon frère cadet/plus jeune	My younger brother
Mon demi-frère	My half brother
Ma soeur aînée	My older sister
Ma soeur cadette/plus jeune	My younger sister
Ma demi-soeur	My half sister
Mes parents	My parents
Mes grands-parents	My grandparents
Elle/il a les cheveux/yeux …	S/he has … hair/eyes
Elle/il a … ans.	S/he is … years old
Elle/il est…/Ils/elles sont…	S/he is…/They are…

9.1.2 Est-ce que tu t'entends bien avec ta famille? - Do you get on well with your family?	
Je m'entends bien avec…	I get on well with…
Je ne m'entends pas bien avec…	I don't get on well with…
On sort	We go out
On discute	We discuss
On partage	We share
On se dispute	We argue
On a beaucoup en commun	We have lots in common
Elle/il m'énerve	S/he annoys me
Elle/il me fait rire	S/he makes me laugh
Ensemble	Together

9.2.1 Que fais-tu et quand? - What do you do and when?	
Je joue	I play
Je joue au basket/Je joue au parc	I play basketball/I play in the park
Je fais	Literally: I do/make (many expressions need faire)
Je fais de la natation/Je fais du sport	I swim – I go swimming/I do sport
Je vais	I go
Je vais au centre/Je vais à une fête	I go to town/I go to a party
Je sors	I go out
Je reste dans ma chambre	I stay in my room
Je joue du/de la/de l' + instrument	I play an instrument
Je joue du piano/Je joue de la guitare	I play the piano/I play the guitar

9.2.2 Que fait ton frère/ta sœur le weekend? - What does your brother/sister do at the weekend?	
Elle/il joue	S/he plays
Elle/il fait	Literally: S/he does/makes (many expressions need faire)
Elle fait du sport/Il fait les devoirs	She does sport/He does homework
Elle/il va	S/he goes
Elle/il sort	S/he goes out
Elle/il reste dans sa chambre	S/he stays in his/her room
Elle/il s'entraîne	S/he trains
Elle/il aime (+infinitive)…	S/he likes (to…)
Elle/il est fan de …	S/he is a fan of…
Elles/ils jouent …	They play…
Elles/ils font…	They do…
Nous sommes très différents	We are very different
Nous avons des goûts similaires	We have similar likes/interests
Son/Sa/Ses (agrees with the object)	Her/his

Unit 9: Family and Relationships

9.3.1 Comment serait ton petit ami idéal/ta petite amie idéale? - What would your ideal boyfriend/girlfriend be like?	
Aimerais-tu te marier ou avoir une famille ?	Would you like to get married or have a family?
Mon petit ami idéal/ma petite amie idéale	My ideal boyfriend/girlfriend
(Ne) serait (pas)…	Would (not) be…
(N') aurait (pas)…	Would (not) have…
Aimerait	Would like…
Je voudrais/J'aimerais	I would like
Me marier	To get married
Séparer	To separate
Divorcer	To divorce
Tomber amoureux	To fall in love
Me fiancer	To get engaged
Vivre ensemble	To live together
Le mariage	Marriage/wedding
Célibataire	Single
La liberté	Freedom

9.3.2 À ton avis, qu'est-ce qu'un bon ami/une bonne amie? - In your opinion, what is a good friend?	
Un bon ami/une bonne amie est…	A good friend is…
Me fait rire	Makes me laugh
Me fait heureux/heureuse	Makes me happy
M'aide avec les problèmes	Helps me with problems
M'accepte	Accepts me
Me comprend	Understands me
Partage tout	Shares everything
L'amitié	Friendship

9.3.3 Quels sont tes projets pour le weekend? - What are your plans for the weekend?	
Je vais (+ infinitive)	I am going
Je vais faire la fête	I am going to go partying
Elle/il va (+ infinitive)	S/he is going
Nous allons (+ infinitive)	We are going
Elles/ils vont (+ infinitive)	They are going
J'espère (+ infinitive)	I hope
Ça va être	It's going to be
Ce sera	It will be
Comme d'habitude	As usual

9.4.1 Qu'est-ce que tu as fait le weekend dernier? - What did you do last weekend?	
J'ai dû (+ infinitive)	I had to…
Je voulais (+ infinitive)	I wanted to…
C'était…	It was…
Je me suis bien amusé(e)	I enjoyed myself
Il faisait chaud/froid	It was hot/cold
Il pleuvait	It rained

9.4.2 Qu'est-ce que tu faisais le week-end quand tu étais petit(e)? - What did you (used to) do at the weekend when you were little?	
Quand j'étais petit(e)	When I was little
J'aimais/J'adorais ça	I liked/loved it/used to like/love it
J'aimais/J'adorais (+infinitive)	I liked/loved to…/I used to like/ love to…

Unit 10: Festivals and Traditions

10.1.1 Qu'est-ce que tu aimes manger? - What do you like to eat?	
Le petit-déjeuner	Breakfast
Le déjeuner	Lunch
Le casse-croûte/Le goûter	A snack
Le dîner	Dinner/tea
Je grignote	I snack
Je mange	I eat
Je prends	I take (or 'I have' + food)
Manger équilibré	To eat a balanced diet
Manger sainement	To eat healthily
Le repas	Meal
Un plat à emporter	A takeaway
La viande	Meat
Le repas végétarien	Vegetarian meal
Les légumes	Vegetables
Le riz	Rice
Les pâtes (à la sauce tomate)	Pasta (in a tomato sauce)
Le poisson (le thon/le saumon)	Fish (tuna/salmon)
Vers midi/vers 18h	At about midday/At about 18:00
Mon plat préféré	My favourite dish
En famille	Together as a family

10.1.2 Que penses-tu de la cuisine francophone? - What do you think of French food?	
La cuisine traditionnelle	Traditional food/dishes
Une spécialité	A speciality
Les pays francophones européens	European French-speaking countries
Les pays francophones africains	African French-speaking countries
Le plat national	The national dish
Semblable à	Similar to
Un piment	A chilli
Un poivron	A pepper
Les noix	Nuts
Les gaufres	Waffles
Les moules-frites	Mussels and chips
La fondue au fromage	Cheese fondue (a melted cheese dish)
En comparaison avec	Compared to

10.2.1 Quelles fêtes sont célébrés en France/dans les pays francophone? - Which festivals/celebrations are celebrated in France/French-speaking countries?	
On fête…	We/One celebrates…
La Saint Sylvestre	New Year's Eve
Le Jour de l'an	New Year's Day
Le Noël	Christmas
Pâques (f)	Easter
La Fête des mères	Mothers' Day
La fête nationale	Bastille Day/ 14th July (in France) or Independence Day in other countries.
Jours fériés (m)	Public holidays/bank holidays
Un défilé (militaire)	A (military) parade
Les chars (m)	Floats (in a parade)
Les feux d'artifice (m)	Fireworks
Un grand repas	A big meal
Les concerts (m)	Concerts
Les cadeaux (m)	Presents
Le gâteau d'anniversaire	Birthday cake
Les bougies (f)	Candles
On va à l'église	We go to church
On offre des cadeaux	We offer/give presents.
On fête dans les rues	We celebrate in the streets
On décore…	We decorate…

10.2.2 Parle-moi d'une fête que tu as célébrée - Tell me about a festival/celebration that you (have) celebrated	
L'année dernière	Last year
Il y a deux mois/un an	Two months/ a year ago
J'ai fêté…/On a fêté…	I celebrated/ we celebrated
J'ai fait un gâteau/Il/elle a fait un gâteau	I made a cake/He/she made a cake
… m'a acheté un/une…	… bought me a…
J'ai invité mes amis chez moi	I invited my friends to my house
J'ai organisé une boum/une fête	I organised a party
J'ai porté un déguisement	I wore fancy dress
Mes parents m'ont permis de/d'… (+ infinitive)	My parents allowed me to…
Avoir une boum	To have a party
Sortir	To go out

Unit 10: Festivals and Traditions

10.2.3 Quel festival/Quelle fête voudrais-tu visiter et pourquoi? - What festival would you like to visit and why?	
Ça a l'air passionnant	It looks exciting
Ça a l'air intéressant	It looks interesting
Je m'intéresse à la culture	I'm interested in culture
Je m'intéresse aux traditions	I'm interested in traditions
Je (ne) suis (pas) religieux/religieuse	I am (not) religious
Le Poisson d'Avril	April Fools' Day
Les blagues	Jokes/pranks
La Chandeleur	Candlemas (religious holiday where pancakes are eaten)

10.3 Comment cela se compare-t-il aux traditions de ton pays? - How does it compare to traditions in your country?	
En comparaison de…	In comparison to…
Que/Qu'en France	Than/Than in France
C'est plus/moins…	It's more…
Tandis que/qu'	Whereas
On met/Ils mettent	We put/they put
On a/Ils ont	We have/they have
On mange/Ils mangent	We eat/they eat
On fait/Ils font	We do/they do
On fête/Ils fêtent	We celebrate/they celebrate
Une couronne	A crown
Jour des Rois	Epiphany (King's day in French) - 6th January
La galette des rois	King cake/epiphany cake
Les pétards de Noël	Christmas crackers
Semblable à	Similar to
(Vraiment) différent(e)	(Really) different
Le Mardi gras	Shrove Tuesday

10.4 Qu'est-ce qu'il y a sur la photo? - What's in the photo?	
Sur la photo	In the photo
Il y a	There is/are
(Aussi) Je peux voir	(Also) I can see
Une famille/ des personnes/gens/des jeunes/ des enfants	A family/ some people/young people/ children
Un homme/Une femme/un garçon/une fille	A man/A woman/a boy/a girl
Dehors/à l'intérieur	Outside/indoors
Elle/il a l'air (content/triste)	S/he seems… (happy/sad)
Elles/ils ont l'air (content/triste)	They seem… (happy/sad)
Des bâtiments (modernes/vieux)	Some (modern/old) buildings
Un lac/une montagne/Un jardin	A lake/ a mountain/ a garden
Elle/il parle /se dispute/joue/travaille/ marche/mange	S/he is speaking/ is arguing/is playing/is working/is walking/is eating
Elles/ils parlent/se disputent/jouent/ travaillent/marchent/mangent	They are speaking/arguing/playing/ working/walking/eating
Elle/il porte	S/he is wearing
À gauche/à droite	On the left/on the right
Au premier plan	In the foreground
En arrière-plan	In the background

Unit 11: A City Or Region In A French Speaking Country

11.1.1 Où habites-tu? - Where do you live? **Qu'est-ce qu'il y a dans ta ville/région? -** What is there in your town/local area?	
Dans ma ville il y a…	In my town there is/are…
Dans ma ville il n'y a pas de…	In my town there isn't…
Une piscine	A swimming pool
Une gare/gare routière	A train station/ bus station
Une boulangerie	A bakery
Une bibliothèque	A library
Un musée	A museum
Un parking	A car park
Un hôtel de ville/ une mairie	A town hall
Un centre commercial	A shopping centre
Un supermarché	A supermarket
Un centre de loisirs	A leisure centre
Un cinéma	A cinema
Un commissariat	A police station
Un parc d'attractions	A theme park

11.1.2 Qu'est-ce qu'on peut faire dans ta région? - What can you/one do in your local area?	
Il y a beaucoup à faire	There is lots to do
Il n'y a rien à faire/il n'y a pas grand-chose à faire	There is nothing to do/there isn't much to do
On peut (+ infinitive)	You/one can
On ne peut pas (+ infinitive)	You/one can't
En été	In summer
En hiver	In winter

11.1.3 Comment était ta région avant? - What was your local area like in the past?	
Dans le passé	In the past
Il y a dix/vingt/cinquante ans	10/20/50 years ago
Il y avait	There was/were or there used to be
Était	Was/used to be
Plus (+ adjective)	More
Plus de (+ noun)	
Plus à (+ verb)	
Moins (+ adjective)	Less/fewer
Moins de (+ noun)	
Moins à (+ verb)	

11.3.1 Comment ça se compare à…? - How does it compare to…?	
En comparaison avec …	In comparison with …
Que/Qu'à Paris	Than/Than in Paris
C'est plus…	It's more…
C'est moins…	It's less…
Ma région est…	My region is…
Le paysage est…	The scenery/landscape is…
La faune et flore est…	The fauna and flora are…
Il y a plus de choses à faire	There are more things to do
Il y a moins de choses à faire	There are fewer things to do
Ma région a plus/moins de…	My region has more/fewer…
Le volcan	Volcano
Les animaux	Animals
Les touristes	Tourists

Unit 11: A City Or Region In A French Speaking Country

11.3.2 Où aimerais-tu habiter à l'avenir? - Where would you like to live in the future?	
J'aimerais/voudrais (+ infinitive)	I would like
Je n'aimerais pas (+ infinitive)	I would not like to
À l'étranger	Abroad
Quelque part (en/au/aux + country)	Somewhere (in + country)
Un pays chaud	A hot country
Un pays francophone	A French-speaking country
Je suis fan de…	I am a fan of
…me plaît	I like …
Les sports d'hiver	Winter sports
La nourriture	The food
La mode de vie	The way of life
Les gens sont…	The people are
Loin	Far (away)
Près (de)	Close (to)

11.4.1 Qu'est-ce que tu veux acheter? - What do you want to buy?	
Je veux acheter	I want to buy
Ça coûte combien ?/Ça fait combien ?	How much does it cost?
Ça coûte…/Ça fait…	That costs…/That comes to …
Quelle couleur ?	Which colour?
Ce souvenir	This souvenir
Ce sweat à capuche	This hoodie
Ces porte-clés	These key rings
Cette écharpe	This scarf
Cette carte postale	This postcard
Cette crème solaire	This sun cream
Collectionner	To collect

11.5.1 Quel pays francophone aimerais-tu visiter? - Which French-speaking country would you like to visit?	
Je voudrais/aimerais visiter…	I would like to visit…
Je visiterais…	I would visit…
Je ferais…	I would do…
La Côte d'Ivoire	The Ivory Coast
La Suisse	Switzerland
La Tunisie	Tunisia
Le Canada	Canada
Le Maroc	Morocco
Le Sénégal	Senegal
Les Seychelles	The Seychelles
La culture nord-africaine	North African culture
La culture nord-américaine	North American culture
Les villes anciennes	Ancient cities
Le désert	Desert
Le Lac Rose	Lake Retba (pink lake in Senegal)
Les plages tropicales	Tropical beaches
Les sports d'hiver	Winter sports

11.5.2 Qu'est-ce que tu veux faire là-bas? - What do you want to do there?	
Je voudrais	I would like
Je veux	I want
Découvrir	To discover
Essayer	To try
La nourriture locale	Local food
Les fêtes traditionnelles	Traditional festivals

11.4.2 Qu'est-ce que tu as acheté récemment? - What have you bought recently?			
J'ai acheté/voulu…	I bought/wanted…	**Un jogging**	A tracksuit
J'ai oublié	I forgot	**Un ballon**	A football
J'ai dû	I had to	**Du maquillage**	Make up
Une gourde	A flask/water bottle	**Le choix**	Choice
Un cadeau d'anniversaire	A birthday present	**Fermé**	Closed

Unit 12 : The World Around Us

12.1.1 Quels sont les problèmes avec l'environnement dans ta région? - What are the environmental problems in your local area?	
Les problèmes	The problems
Grave(s)	Serious
Il y a/Il n'y a pas	There is/are/There isn't/aren't
La pollution de l'air/ de l'eau	Air pollution/ water pollution
Trop de…	Too many/too much…
Assez de…	Enough…
Pollué(e)	Polluted
Les déchets (m)/les ordures (f)	Litter/rubbish
Par terre/dans la mer/dans les rivières	On the ground/ in the sea/ in the rivers
Les espaces verts/ les sites naturels	Green spaces/ natural areas
Mauvais pour les animaux	Bad for the animals
Un sac en plastique	A plastic bag
Le gaz d'échappement	Exhaust fumes
La circulation	Traffic
Les usines	Factories
Le gaz carbonique	Carbon dioxide
C'est une catastrophe!	It's a catastrophe!

12.1.2 Qu'est-ce qu'on peut faire pour protéger l'environnement? - What can we do to protect the environment?	
Nous pouvons/On peut	We can
Nous devrions/on devrait	We should
Il faut	It's necessary to (we must)
Il ne faut pas	We must not
Recycler	(to) recycle
Utiliser	(to) use
Acheter	(to) buy
Protéger	(to) protect
Économiser	(to) save
Les produits écologiques	Eco-friendly products
Du verre	Glass
Du papier	Paper
Une bouteille	A bottle
Une boîte	A can/a box
La poubelle	The bin

12.1.3 Quand tu étais petit(e), faisais-tu plus ou moins pour protéger l'environnement? - When you were little did you do more or less to protect the environment?	
Quand j'étais petit(e)	When I was little
J'étais plus/moins écologique	I was more/less environmentally friendly
Que maintenant	Than now
Je faisais beaucoup	I used to do a lot
Je ne faisais rien	I didn't to do anything
J'allais à pied/ à vélo	I used to walk /go by bike
J'économisais	I used to save
Je (ne) recyclais (pas)	I used to/didn't use to recycle
Une gourde	A flask/water bottle
Réutilisable	Reusable
J'utilise	I use
Je recycle	I recycle

Unit 12 : The World Around Us

12.2.1 Quels droits ont les enfants dans le monde? - What rights do children have in the world?	
Le droit	The right
J'ai le droit de…	I have the right to…
Je n'ai pas le droit de…	I don't have the right to…
Les enfants ont le droit de…	Children have the right to…
Les enfants n'ont pas le droit de…	Children don't have the right to…
Avoir une identité/une nationalité	To have an identity/nationality
Avoir une famille	To have a family
Avoir accès à l'eau	To have access to water
Manger	To eat
Aller à l'école	To go to school
Être protégé(e)(s)	To be protected
Être soigné(e)(s)	To be cared for
Aimer	To love
Sortir	To go out
C'est juste/ injuste/ essentiel	It's fair/unfair/essential

12.2.2 Qu'est-ce que tu veux faire à l'avenir? - What do you want to do in the future?	
Je (ne) veux (pas)	I (don't) want
J'ai l'intention de/d'…	I have the intention of…/I intend to…
Étudier à l'université	To study at university
Combattre l'injustice	To fight injustice
Aider les autres	To help others
Faire du travail bénévole	To do volunteer work

12.3.1 Comment pouvons-nous/peut-on aider les autres - How can we help others?	
Nous pouvons/on peut (+ infinitive)	We can
Être sympa à tous	To be nice to everyone
Collecter des fonds (pour)	To fundraise (for)
Donner	To give/donate
Faire du travail bénévole	To volunteer
Sensibiliser le public	To raise awareness
Organiser un événement	To organise an event
Une association caritative	A charity
L'argent	Money
Les vêtements	Clothes

12.3.2 Comment veux-tu aider à l'avenir? - How do you want to help in the future?	
Je veux /voudrais	I want /would like
C'est enrichissant/important	It's enriching/rewarding/important
Une cause noble/essentielle	A worthy/essential cause
Les SDF	Homeless
Une banque alimentaire	A food bank
Un refuge pour animaux	An animal shelter
Pauvre(s)	Poor

Going out – Wir gehen aus

Kleider/Klamotten	***Clothes***
der Rock	skirt
der Mantel	coat
der Anzug	suit
der Kapuzenpulli	hoodie
die Jeanshose (die Jeans)	jeans
die Hose	trousers
das Kleid	dress
das Hemd	shirt
das T-Shirt	T-shirt
die Schuhe	shoes
die Stiefel	boots

Was trägst du?	***What do you wear/are you wearing?***
Ich trage …	*I wear/am wearing …*
einen kurzen Rock	*a short skirt*
einen langen Mantel	*a long coat*
einen schicken Anzug	*a smart suit*
einen lockeren Kapuzenpulli	*a casual hoodie*
eine weite Hose	*a baggy pair of trousers*

Wie ist es?	***What is it like?***
kurz	*short*
lang	*long*
weit	*wide-leg, baggy*
schmal	*slim-leg, skinny*
schick	*smart*
locker	*casual*
kariert	*checked*
gepunktet	*spotty*
gestreift	*stripy*

Wie ist dein Stil?	***What is your style?***
lässig	*informal*
sportlich	*sporty*
trendig	*trendy*
klassisch	*classic*

Ein erstes Date	***A first date***
Was wirst du machen?	*What will you do?*
Ich werde …	*I will …*
die Karten im Voraus kaufen	*buy the tickets in advance*
einen guten Film auswählen	*choose a good film*
früh ankommen	*arrive early*
… abholen	*pick up …*
etwas Schickes anziehen	*put on something smart*
genug Geld mitnehmen	*take enough money with me*
mit dem Bus in die Stadt fahren	*go by bus to town*
ins Kino gehen	*go to the cinema*
essen gehen	*go out to eat*

Diskussion und Debatte	***Discussion and debate***
Viele/Einige Leute sagen	*Many/Some people say*
Meiner Meinung nach	*In my opinion*
Erstens	*Firstly*
Zweitens	*Secondly*
Schließlich	*Finally*
Du hast gesagt …, aber ich denke	*You said …, but I think*
Auf der einen Seite	*On the one hand*
Auf der anderen Seite	*On the other hand*

Ich mache mich fertig	***I get myself ready***
Ich style mir die Haare.	*I style my hair.*
Ich mache mir die Haare.	*I do my hair.*
Ich putze mir die Zähne.	*I clean my teeth.*
Ich schminke mich.	*I put make-up on.*
Ich ziehe mich an.	*I get dressed.*
Ich sehe mich im Spiegel an.	*I look at myself in the mirror.*
Ich benutze ein Deo.	*I put deodorant on.*
Ich wähle meine Kleider aus.	*I choose my clothes.*

Oft benutzte Wörter	***High-frequency words***
wenn	*when (if)*
immer	*always*
zum Beispiel	*for example*
zuerst	*first of all*
seit	*since (for)*
für	*for*
möglich	*possible*
pro Jahr	*per year*
nächstes Jahr	*next year*
teuer	*expensive*
alle	*all/everyone*
um … zu	*in order to*

School – die Schule

Schulfächer	School subjects
Sprachen:	*languages:*
Deutsch	*German*
Englisch	*English*
Französisch	*French*
Spanisch	*Spanish*
Naturwissenschaft(en):	*science(s):*
Biologie	*biology*
Chemie	*chemistry*
Physik	*physics*
Mathe(matik)	*math(ematic)s*
Informatik	*ICT*
Geschichte	*history*
Erdkunde	*geography*
Politik	*politics*
Gesellschaft	*sociology*
Wirtschaft	*economics*
Kunst	*art*
Musik	*music*
Theater	*drama*
Religion	*RE*
Sport	*PE, sport*
das Wahlfach	*optional subject*
das Pflichtfach	*compulsory subject*

Farben und Kleidung	Colours and clothes
blau	*blue*
braun	*brown*
gelb	*yellow*
grau	*grey*
grün	*green*
rot	*red*
schwarz	*black*
weiß	*white*

Ich trage (nie) …	I (never) wear …
einen Rock	*a skirt*
eine Jeans	*jeans*
eine Hose	*trousers*
eine Jacke	*a jacket*
eine Krawatte	*a tie*
ein Hemd	*a shirt*
ein Kleid	*a dress*
ein T-Shirt	*a t-shirt*
Sportschuhe	*trainers*
Schuhe	*shoes*

Schulsachen	School items
Was hast du	*What have you bought*
(für das neue Schuljahr / die neunte Klasse) gekauft?	*(for the new school year / Year 9)?*
Ich habe … gekauft.	*I bought …*
einen Bleistift	*a pencil*
einen Füller	*a fountain pen*
einen Kuli	*a ballpoint pen*
einen Radiergummi	*a rubber*
einen Taschenrechner	*a calculator*
ein Etui	*a pencil case*
ein Lineal	*a ruler*
Filzstifte	*felt-tip pens*

Das neue Schuljahr	*The new school year*
In der neunten Klasse freue	*In Year 9,*
ich mich (nicht) auf …	*I'm (not) looking forward to …*
den Druck	*the pressure*
die Klassenfahrt	*the class trip*
das Zeugnis	*the report*
die Hausaufgaben	*the homework*
die (Sport-)AG(s)	*the sport clubs*
die Klassenarbeiten	*the tests*
die Prüfungen	*the exams*
neue Fächer	*new subjects*
meine Freunde/Freundinnen	*my friends*
die Noten	*the grades*
am meisten	*mostly*
besonders	*especially*
total	*totally*
(echt) sehr	*(really) very*
weniger	*less*
(gar) nicht	*not (at all)*
nie	*never*
langweilig	*boring*
stressig	*stressful*
schwierig	*difficult*
interessant	*interesting*
einfach	*simple*

Ein Schultag	*A school day*
Was hat (die Klasse 9) in der	*What does (Year 9) have in the*
(ersten) Stunde am (Montag)?	*(first) lesson on (Monday)?*
zweite(n)	*second*
dritte(n)	*third*
vierte(n)	*fourth*
fünfte(n)	*fifth*
Die Schule beginnt / endet um …	*School starts / ends at …*
die (kleine) Pause	*(short) break*
die Mittagspause	*lunch break*
Wir haben … Stunden pro Tag.	*We have … lessons per day.*
Jede Stunde dauert … Minuten.	*Each lesson lasts … minutes.*
Ich habe vier Stunden pro Woche	*I have four lessons of (geography)*
(Erdkunde).	*per week.*
Ich habe viermal pro Woche (Mathe).	*I have (maths) four times a week.*
Mein Lieblingsfach ist (Physik).	*My favourite subject is (physics).*

Fragen stellen	*Asking questions*
Wann?	*When?*
Wie viele?	*How many?*
Um wie viel Uhr?	*At what time?*
Wie oft?	*How often?*
Was?	*What?*
Ist (Mathe) dein Lieblingsfach?	*Is (maths) your favourite subject?*
Warum?	*Why?*
Welches Fach?	*Which subject?*
Wie?	*How?*
Wer?	*Who?*

Die Schulordnung	***School rules***
der Computerraum	*ICT room*
der Schulhof	*playground*
die Aula	*assembly hall*
die Bibliothek	*library*
die Kantine	*canteen*
die Sporthalle	*sports hall*
das Klassenzimmer	*classroom*
das Labor	*lab(oratory)*
das Lehrerzimmer	*staff room*
die Toiletten	*toilets*
Wir dürfen nicht …	*We are not allowed to …*
Wir dürfen weder … noch …	*We are allowed neither … nor …*
schlagen	*to hit*
mobben	*to bully*
(auf dem Schulgelände) rauchen	*to smoke (in the school grounds)*
essen	*to eat*
trinken	*to drink*
Sportschuhe tragen	*to wear trainers*
Handball spielen	*to play handball*
Wir dürfen keine	*We are not allowed to use*
Schimpfwörter sagen.	*swear words.*
Wir dürfen keinen Kaugummi kauen	*We are not allowed to chew gum.*
Wir müssen …	*We have to ...*
den Müll trennen	*separate the rubbish*
immer Hochdeutsch sprechen	*always speak standard German*
ruhig sein	*be quiet*
höflich sein	*be polite*
pünktlich sein	*be punctual*
respektvoll sein	*be respectful*
zu	*too*
sehr	*very*
ziemlich	*rather, quite*
streng	*strict*
ärgerlich	*annoying*
nervig	*irritating*
(un)gerecht	*(un)just*
(un)fair	*(un)fair*
locker	*casual, informal*

Das deutsche Schulsystem	***The German school system***
Ich besuche …	*I go to …*
die Grundschule	*primary school*
die Gesamtschule	*comprehensive school*
die Hauptschule	*a type of secondary school*
die Realschule	*a type of secondary school*
das Gymnasium	*grammar school*
die Oberstufe	*sixth form*
die Ganztagsschule	*all-day school*
das Internat	*boarding school*
der Mittlere Schulabschluss	*German equivalent of GCSEs*
das Abitur	*German equivalent of A levels*
gemischt	*mixed*
privat	*private*
staatlich	*state*
Man hat …	*We have …*
(k)einen Stundenplan	*no / a timetable*
(k)eine Schuluniform	*no / a school uniform*
(keine) Hausaufgaben	*(no) homework*
Man hat tolle / keine Computerräume.	*We have great / no ICT rooms.*
Die Schule ist prima / schlecht ausgestattet.	*The school is very well / badly equipped.*
Ich bin sitzen geblieben.	*I repeated the year.*
Ich muss das Jahr wiederholen.	*I have to repeat the year.*

Eine Klassenfahrt	***A class trip***
Was werden wir am (Mittwoch) machen?	*What will we do on (Wednesday)?*
Ich werde …	*I will …*
Deutsch sprechen	*speak German*
einen Schultag erleben	*experience a school day*
einen Tagesausflug machen	*go on a day trip*
eine Fahrradtour machen	*go on a cycling tour*
ein Kunstprojekt machen	*do an art project*
den Abend bei einer Gastfamilie	*spend the evening with a host*
verbringen	*family*
das (Zirkus-)Museum besuchen	*visit the (circus) museum*
den Freizeitpark besuchen	*visit the theme park*
die Sehenswürdigkeiten besichtigen	*visit the sights*
ins Hallenbad / Freibad gehen	*go to the indoor / outdoor swimming pool*
in der Altstadt bummeln	*stroll around the old town*
Andenken kaufen	*buy souvenirs*
(wieder) nach Hause fahren	*go home (again)*
Es wird … kosten.	*It will cost …*
Das wird Spaß machen.	*That will be fun.*
Heimweh haben	*to be homesick*
reisekrank sein	*to be travel sick*
Die Reise hat … gedauert.	*The journey lasted …*

Notes

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