Year 11 Core Subjects

Knowledge Organiser

September- December 2023

AMBITION, CONFIDENCE, CREATIVITY,
RESPECT, DETERMINATION

Proud to be part of the GREENSHAW LEARNING TRUST

FIVE ACRES HIGH SCHOOL

Why do we have knowledge organisers?
Knowledge organisers are a collation of the basic essential knowledge for success in each subject area that will underpin your learning for the term.

They are designed to provide the information you will need to be committing to your long term memory through recall exercises in Low Stakes Quizzing.

How do we use knowledge organisers?
You should be using these KOs to create your homework quizzes so that you are practising retrieving information.

1. You can do this by testing yourself on the definition of key terms (both recalling the key term and then swapping to recall the definition), practice labelling diagrams, retrieves reasons and justifications for the main learning points.
2. They can also be used for 'memory dumps' where you try to recall as much of the information about a topic as possible and then use the KP to fill in the gaps.
3. They can also be used in class to assist with retrieval of the core knowledge needed for each subject.

You should have these with you at all times in school and out on your desk in all lessons.

If you lose your KO or it becomes too dishevelled, please purchase a new one from the Head of Year or the School Office.

Contents

Question 5: Descriptive or narrative writing.

40 marks

24 marks for content, 16 marks for technical accuracy.

45 minutes writing time approximately.

You are given an image.

From this image, you are asked to create either a piece of descriptive or narrative writing.

The image is there to springboard your ideas and you are not expected to write a photographic representation. Your writing should be using the image for inspiration.

A suggested paragraph structure could include:

Wide focus, narrow focus, switched focus to a person and then either their internalised thoughts or how they make you feel as the narrator.

DO NOT ATTEMPT UNTIL YOU HAVE PLANNED!!!

- Choose a narrative perspective and a mood - this will drive your content and vocabulary choices
- Remember, the image a springboard to help your imagination!
- Maintain a high standard of SPaG throughout- proof read. It's worth 16 marks.
- Include a variety of techniques consistently throughout the piece of writing and make your paragraphs cohesive.

English Language Paper 1 Section B

Punctuation should be accurate a varied and you need to be able to use the following your writing:

- . to mark the end of a sentence that is a complete statement
- , use in lists, in direct speech, to separate clauses, with however.
- ; indicating a pause, typically between two main clauses, takes the place of a co-ordinating conjunction (and, but, or, so).
- : used to precede a list of items, a quotation, or an expansion or explanation.
- A versatile punctuation mark that creates a short pause and emphasise an embedded clause.
- ( ) used to enclose words or figures so as to separate them from the context.
- … inserted into a sentence to indicate a pause or silence.
- ' ' Inverted commas are used for quotations or can sometimes be used to create a sarcastic tone.
- " " Used to show direct speech.
- ? Used at the end of questions
- ! Used to add impact. DO NOT use more than one at a time!

Sentence types:

- Simple sentence: one main clause with a subject and a verb
- Compound sentence: 2 or more main clauses on the same topic joined by a co-ordinating conjunction or semi colon.
- Complex sentence : has one subordinate clause which needs the main clause to make sense.
- Embedded clause : subordinate clause inserted into a main clause to add information
- Fragmented clause: doesn't follow the rules for a main. If used, use very sparingly!
- Vary sentence starters- -ly, double adjective, similes, verbs and prepositions.

Techniques to include:

- Imagery, sensory description, meaningful similes and strong verbs to add tone!
- Make sure you are specific in your noun choices to further show your reader.
- Paragraphs: your work **must** have cohesive paragraphs.

word to use instead of very.

Very noisy
Deafening, clamorous, rowdy, riotous
Very often
Frequently, repeatedly, habitually
Very old
Ancient, elderly, decrepit
Very old-fashioned
Archaic, antiquated, obsolete,
Very painful
Excruciating, agonizing, harrowing
Very pale
Ashen, muted, wan, pallid
Very poor
Destitute, impoverished, deprived
Very powerful
Compelling, dominant, formidable
Very quiet
Hushed, tranquil, serene, undisturbed
Very sad
Sorrowful, inconsolable, forlorn
Very shiny
Gleaming, glossy, lustrous
Very short (in extent)
Brief, condensed, compact
Very shy
Timid, reticent, introverted
Very small
Miniscule, diminutive, squat
Very large
Gargantuan, colossal, tremendous
Very young
Juvenile, babyish, infantile
Very pretty/attractive
Prepossessing, winsome, ravishing
Very scared
Petrified, hysterical, agitated
Very worried
Disturbed, overwrought, fretful

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English Language Paper 1 Section B

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Disturbed, overwrought, fretful

KS4 English Language Paper 2 Section B KO

Question 5: persuasive writing.
40 marks, 45 minutes writing time
24 marks for content, 16 marks for technical accuracy.
Skill: to write a structured argument using a variety of rhetorical techniques.
You are given a statement.
From this statement, you are asked to create either a newspaper article, letter speech, blog or magazine article outlining your opinion on the topic.
DO NOT ATTEMPT UNTIL YOU HAVE PLANNED!!!

- An adjustment to the format to show you are writing a letter, article, report or speech.
- A clear introduction which includes an opinion AND DOES NOT REFER TO THE STATEMENT!
- A structured argument which moves through the problems, solutions and benefits associated with the topic and your opinion.
- You should aim to say 3 things about each point to develop what you say and create a sustained response.
- You need to include a range of rhetorical devices throughout your response which may include literary techniques but in addition AFORESTD/RASH.
- Clear paragraphs
- Accurate and varied spelling and punctuation
- End with a clear conclusion with your final word- we recommend beginning with the adverb Ultimately

Punctuation should be accurate a varied and you need to be able to use the following your writing:

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- Vary sentence starters- -ly, double adjective, similes, verbs and prepositions.

Key Techniques to include:

- Anaphora, epistrophe, repetition, tripling, emotive language, expert opinion, juxtaposition (They say; we say) and clever use of pronouns will all help to add weight to your argument.
- Paragraphs: your work **must** have cohesive paragraphs. Problems, solution and benefits help you to create a structured argument, rather

Key definitions:
Formats:
A letter will usually start with Dear Sir, Dear Editor, Dear Prime minister or the name of the person you are writing to.
A speech will normally begin with a salutation such as Good evening, ladies and gentlemen (Or whoever you are addressing.)
A Newspaper article will start with a headline whilst **a magazine article** will need a title. Similarly **a blog** will start with a headline/title.
Report: uses a heading and subheadings
Techniques to use
Anaphora: Repetitive of a word at the beginning of successive clauses
Antithesis: Contrast of ideas by creating parallel structures
Epistrophe: Repetition of a word at the end of sentences
Epizeuxis: repetition of a word in the middle of clause
Euphemism: A politer/more pleasant way of saying something that is less pleasant or socially acceptable
Hyperbole: Deliberate exaggeration
Hypophora: When a writer poses a question and then immediately answers.
Metaphor: A figure of speech that includes a direct comparison between two things
Onomatopoeia: Words that directly represent sounds
Oxymoron: Two words together with opposing meanings
Pronouns: I, you, we, they, us, them are used to create unification or division
Simile: A comparison using 'like' or 'as'
Tripling: repeating a word or phrase or idea

KS4 English Language Paper 2 Section A KO

Question 1: identify 4 true statements from a possible 8. 4 marks, 5 minutes

Skill: identify specific information.

- Read the statements carefully
- Skim and scan through the text, looking for one thing at a time.
- Only shade in the box once you have established all the correct answers.
- Take care for misleading statements!

Question 2; Write a summary of the differences or similarities in a text. 8 marks, 12 minutes

Skills: to synthesise two texts but also to make details inferences, which is not clear form the question.

- Make sure that you refer to both texts
- Need to use inference
- Read the question closely – similarities or differences?
- Use comparative connectives
- Use quotations to support
- Keep quotations short
- Use key words for the question
- Aim for 2-3 similarities/differences
- 1-2 sides of the answer booklet

Language of inference:

- Suggests
- Implies
- Demonstrates
- Insinuates
- Conveys
- Indicates
- Hints
- Signifies

Language of comparison, used for both question 2 and 4:

- On the other hand
- In contrast
- Contrastingly
- In opposition
- Differs
- Alternatively
- Elsewhere
- On the contrary
- Whereas
- However
- Likewise
- Also
- In addition
- Additionally
- Moreover
- Furthermore
- Accordingly
- Indeed
- Equally
- Similarly

Question 3: comment on the writer's use of language. 12 marks 15-18 minutes

SKILLS: identify and comment on specific language choices and methods used by the writer. Very similar to language paper 1, except it is worth more marks and may find some persuasive techniques as well as literary ones.

• Uses the whole text

•Consider the connotations of the language.

•What do you find out? How is this achieved by the writer? Why does the writer show you this?

•Look for patterns or a semantic field in the language and explore the effect.

•Aim to include 3-4 developed responses to quotations. (2-3 sides)

Other useful techniques in addition those on Paper 1 to look for might include:

- Hyperbole
- Facts and statistics
- Opinions
- Expert opinion
- Rule of three
- Anecdotal evidence
- Emotive language
- Pronouns

Helpful sentence starters:

- The writer implies, indicates ...
- The reader interprets...
- The use of... suggests...
- What is emphasised is...
- One interpretation may be...
- The effect on the reader is...
- The reader is invited to feel...
- The author is trying to...
- The use of... is indicative of...

Question 4: compare the writers thoughts and feelings and the methods they use. 16 marks, approximately 20 minutes

Skill: to be able to compare the key components of a text and identify what the writer's opinion is by making inferences and referencing subject terminology.

- Use both texts and includes quotations from both texts.
- Starts with a thesis statement which is then proved through the body of the essay.
- Needs to include inferences about what the writer thinks or feels about the topic.
- Uses comparative connectives and discourse markers
- Keep quotations short to show confident handling of the text.
- A high proportion of the response will be inference about what the writer thinks or feels.
- Should be 3-4 sides of an answer booklet
- Clear focus on the effects of the language and techniques and what they reveal about the writer's opinion.

Useful phrases, as well as language of comparison and inference might included:

- The writer seems to suggest...
- The writer her is indicating that they think...
- The writer is implying...
- The writer seeks to convey the impression that...
- The writer is clearly demonstrating that...
- The writer is of the opinion that...

Macbeth KO Lit Paper 1

Key Characters

Macbeth Eponymous protagonist, ambitious and ruthless

Lady Macbeth Defies expectations, strong and ambitious, evil and conniving, but is driven mad through guilt.

Witches Supernatural beings, give prophecies, could represent conscience or fate

Banquo M's friend, sons prophesied to rule, killed and returns as ghost

Duncan A Good king, praises M at start and rewards him but is politically weak. Heis murdered in Act 2

Macduff The Thane of wife who is loyal to Scotland, sacrificing his wife and children who are both killed by Macbeth; he kills M; born by caesarean

Malcolm Heir to throne, a good holy man, finally crowned as the rightful heir and restores Scotland from Macbeth's tyranny.

Fleance Banquo's son, represents innocence and justice and escapes Macbeth's murderers.

Ross, Lennox (and **Old Man**) minor Lords who are used to demonstrate the negative impact Macbeth's tyrannous reign has on The great chain of being

The Porter Comic interlude after Duncan's murder which breaks the tension but also alludes to hell.

Hecate The Goddess of witchcraft who intervenes with the witches and demands that they work against Macbeth. Not necessarily a part written by Shakespeare but added later to demonstrate the complete chaos and how evil has to work for good to restore equilibrium.

Lady Macduff The antithesis to Lady Macbeth, and serves as a shining example of a medieval woman, brutally slaughtered by Macbeth. She emphasises his wickedness.

Key Vocabulary

Ambition A strong desire to achieve something (Latin ambire – to canvas for votes)

Regicide Killing a king (Latin rex – king, French –cide kill)

Antithesis Direct opposite (Greek – opposition, resistance, placing against)

Hallucination To see something that does not exist (Greek allusein – be uneasy or distraught)

Atrocity Cruelty (Latin atrox – cruel, terrible)

Treason Betraying one's country (Latin traditio – handing over, surrender, a giving up)

Divine Of, or like God (Latin divinus – of a god)

Manipulation The act of manipulating someone in a skilfull manner (Latin manipulus – handful, handling of objects)

Remorseless Without guilt or regret (Re – again Latin mordere – to bite)

Virtuous Having high moral standards (Latin virtus – virtue)

Prophecy A prediction of the future (Latin prophetia – gift of interpreting the will of gods)

Masculinity Qualities considered to be of a man (Latin – masculus – male)

Equivocator Someone who uses language to hide the truth (Latin aequivocator – agent)

Tanistry The strongest warrior succeeds the leader

Primogeniture The first born son succeeds as leader.

Context

Queen Elizabeth Loved Shakespeare's plays as a great supported – inspired many powerful female characters such as Lady Macbeth. She famously said 'I have the body of a woman but the heart of a man.'

King James I Elizabeth I had no children so James I was deemed the 'rightful king' in the 'Great Chain of Being' but this caused much disruption to religious subjects, and so, many were hung for treason. He was particularly interested in the supernatural and ghosts – even writing a book on the subject - Deamonologie

Gun Powder Plot Guy Fawkes amongst others plotted to blow up the houses of Parliament in a perilous act of treason against James I and this clearly inspired much of this play.

Supernatural Due to a lack of modern science, witches and the supernatural were often blamed for bad luck and natural disasters.

Scottish Society Scottish society believed that, to be a man, one must take advantage of opportunities given to climb the social ladder.

The Divine Right of Kings The idea that kings got their power from God and not from their subjects. James I was a believer in this, and the idea meant that any treasonous activity was a crime against God. Only a century earlier, England had suffered under the massive disorder of the Wars of the Roses, so many supported the idea to avoid civil unrest

The Great Chain of Being A hierarchy with God at the top, then angels, kings and queens, nobles, humans, animals, plants, minerals. Any disruption to this chain was thought to lead to dire consequences for the world.

Patriarchy Patriarchal societies are those in which men dominate, and inheritance passes through male heirs, see primogeniture and tanistry for clarification.

Plot Summary:
Act I scene i – The three witches gather to meet Macbeth and Banquo.
Act I scene ii – Duncan hears that the Thane of Cawdor has betrayed him, and that Macbeth has proven himself to be a hero.
Act I scene iii – Macbeth and Banquo hear the predictions from the witches that Macbeth will be Thane of Cawdor and the next king, and Banquo's children will be kings. Ross arrives and tells Macbeth that he is the new Thane of Cawdor. Act I scene iv – Duncan decides to make his son Malcolm the heir to his throne and tells Macbeth that he will visit his castle.
Act I scene v – Lady Macbeth reads a letter from her husband about the events so far, and invokes the spirits to give her the strength to do what needs to be done to murder the King. Act I scene vi – Duncan arrives at Macbeth's castle and is
Act II scene i – Banquo feels uneasy about the night. Macbeth makes his way to Duncan's room to kill him and sees a dagger floating in the air before him. He leaves the stage to murder Duncan.
Act II scene ii – Macbeth forgets to leave the bloody daggers in Duncan's room after the murder and Lady Macbeth berates him before putting them back.
Act II scene iii – Duncan's body is discovered by Macduff the next day. Macbeth pretends to be angry and kills the servants to keep them out of the way. Duncan's sons, Malcolm & Donalbain, flee the castle.
Act II scene iv – Macduff reports that suspicion for the murder has fallen on the kin's sons; Macbeth has travelled to Scone to be crowned. welcomed by Lady Macbeth.
Act III scene i – Macbeth is king and Banquo is suspicious about how the witches' predications have come true. Macbeth convinces murderers to assassinate Banquo.
Act III scene ii – Lady Macbeth tries to get her husband to talk to her about his plans but he refuses.
Act III scene iii – Banquo is murdered but his son, Fleance, escapes.
Act III scene iv – At a feast that night, Macbeth sees the ghost of Banquo and acts strangely in front of his guests. Lady Macbeth tries to convince everyone this is normal behaviour.
Act III scene v – The witches discuss events so far; Hecate, the ruler of the witches, predicts the downfall of Macbeth.
Act III scene vi – Macduff has left for England to rouse support against Macbeth as suspicion and grows against the new king.
Act IV scene i – Macbeth meets the witches who show him a series of apparitions. They tell him to beware Macduff, that he cannot be harmed by anyone 'born of a woman' and that he will be safe until Birnam Wood moves to the castle at Dunsinane. They also show him a line of Banquo's heirs. Macbeth decides to murder Macduff's family as a result of the first apparition.
Act IV scene ii – Macbeth's murderers kill Lady Macduff and her children.
Act IV scene iii – Macduff and Malcolm discuss what it means to be kind. Macduff discovers his family's murder and, with Malcolm, leads an army to attack Macbeth.
Act V scene i – A doctor and Lady Macbeth's servant watch Lady Macbeth sleep walking and trying to wash an imaginary blood spot from her hands.
Act V scene ii – Malcolm's army is at Birnam Wood and hear reports that Macbeth's supporters are deserting him.
Act V scene iii – Macbeth is under siege and places all his hope in the predictions from the witches.
Act V scene iv – Malcolm orders his army to cut down branches from Birnam Wood to disguise the number of soldiers.
Act V scene v – Macbeth is told of his wife's death and about the news that Birnam Wood seems to be approaching. He resolves to die fighting.
Act V scene vi - ix – Macbeth is killed by Macduff (who reveals he was delivered by caesarean and so not properly 'born'). Malcolm becomes the new king of Scotland and order is restored.

Symbols

Blood – a symbol of guilt and violence

Sleep- a symbol of innocence. When Macbeth mentions that cannot sleep, Shakespeare is referencing his lack of innocence.

The supernatural – belief in witchcraft was widespread and Shakespeare uses prophecy, hallucinations, ghosts and magic to give the play a menacing, unnatural feel. The symbolise the perpetual threat to The great chain of being.

Darkness- symbolic of how the couple seek to conceal their evil crime from God and how they evoke evil.

Key themes:

Order and disorder: The natural world becomes chaotic when Duncan dies. As Macbeth's reign continues, social chaos is demonstrated.

Ambition: The Macbeth's ambition to be powerful drives the play and their downfall is directly linked to this.

Appearance versus reality: people and events are not always as they seem- 'fair is foul and foul is fair.'

Power and conflict: Many battles are fought- the play begins and ends with a battle as well as Macbeth's internal conflict between good and evil.

Kingship: What makes a good king compared to a bad one.

Key vocabulary and terminology

Assonance – repetition of a vowel sound of emphasis
Atmosphere- mood or feeling
Couplet – 2 lines of rhyming poetry
Caesura- punctuation in the middle of a line for emphasis
Dramatic monologue- narrative told only from the narrator's viewpoint
Enjambement- overlapping sentence into the following the line.
Extended metaphor – metaphor running through the poem rather than singular reference
Form- the shape of a poem
Free verse- poem that does not have a regular rhyme structure
Half rhyme- partial rhyme scheme
Iambic pentameter – 10 syllables with 5 stressed syllables
Narrative- account of events
Oxymoron – contradictory placement of words – eg bitter sweet
Prose- any writing not in verse form
Rhyme scheme – pattern of rhyming eg ABAB
Simile – comparison to enhance understanding using like or as
Sonnet form- 14 lines in iambic pentameter. Either **Italian/Petrarchan** or **English/Shakespearean**
Octet – 8 lined stanza (posing the problem or question in a Patrarchan sonnet.
Sestet –(6 lines stanza, often presenting the answer or question to the octet)
Cinquain/quintet – 5 line stanza
Quatrain/quartet – 4 line stanza
Tercet- 3 line stanza
Volta- turning point of a sonnet between the octet and the sestet (Line 9)
Natural imagery – imagery inspired by nature

Love and Relationships Anthology

Poetry Knowledge organiser KS4

Love and Relationships Anthology key themes

- Love
- Loss
- Separation
- Parent/child
- Nature
- Distance
- Closeness
- Changing relationships
- Reconciliation/renewal
- Death of a relationship
- Parting
- Differences between generations

Structuring your response:

Your thesis statement introduction introduces your main argument and how each poem relates to the theme of the question.

3 points of comparison, where each point adds something new to your argument about the theme in the question and the poems are similar or different in this respect. Use what, how, why to develop your response

Conclusion which sums up your ideas about both poems and what the author is telling you about the them.

Language of comparison:

- Similarly, likewise, in the same vein.
- However, although, conversely.

The poems and suggested links between poems:

'When We Two Parted': compares well with Neutral Tones, Love's Philosophy, Sonnet 29
'Love's Philosophy': compares well with Neutral Tones, When We Two Parted, Singh Song, Sonnet 29
Porphyria's Lover: compares well with The Farmer's Bride, Love's Philosophy, Sonnet 29
Sonnet 29: compares well with Love's Philosophy, Porphyria's Lover, Neutral Tones
Neutral Tones: compares well with Winter Swans, When We Two Parted, Sonnet 29
The Farmer's Bride: compares well with Porphyria's Lover, Neutral Tones, Sonnet 29
Walking Away: compares well with Mother, any Distance, Follower
Letters From Yorkshire:
Eden Rock: Compares well with When We Two Parted, Walking Away, Follower
Follower: Compares well with Walking Away, Mother, any distance, Before You Were Mine
Mother, any Distance: compares well with Before You Were Mine, Follower, Walking Away
Before You Were Mine: compares well with Follower, Walking Away
Winter Swans: compares well with Neutral Tones, Sonnet 29, When We Two Parted
Singh Song!: compares well with When We Two Parted, Love's Philosophy, Sonnet 29
Climbing My Grandfather: compares well with Before You Were Mine, Mother Any Distance, Follower, Walking Away

Unseen poetry KO

AO1 = 12 marks	**You are being judged on how well you: Read, understand and respond to texts.** • maintain a critical style and develop an informed personal response • use textual references, including quotations, to support and illustrate interpretations.
AO2 = 12 marks	**You are being judged on how well you: Analyse the language, form and structure used by a writer to create meanings and effects.** • use relevant subject terminology where appropriate.

Evaluative Verbs

Satirises – using satire (a way of criticising people or ideas in a funny way) to show that people or ideas have bad qualities and are wrong - usually political.

Presents – introduces an idea.

Demonstrates – provides a clear explanation or example.

Amplifies – emphasises using extra impact and returning to the same idea/point. It makes this idea/point seem very important.

Conveys- carries or presents

Contrasts – presents ideas in opposition

Insinuates – hints at, implies.

Alludes to- references or suggests

Language of comparison:

Similarly, likewise, additionally, also.

However, although, conversely, contrastingly.

Phrases to show writer's purpose:

The writer is inviting the reader...

The writer is perhaps suggesting...

The writer indicates that...

The writer has used this to...

Phrase to show comparison of effect on the reader: (8 mark question)

Similarly, this also makes the reader...

Conversely, the reader then feels...

Strategic exam response tips:

Read the question- this will tell you what the poem is about

Read the title- This will help you to know what the poem is about

Read the poem through, annotating key ideas, techniques and language as you go.

What form does the poem take? This will further help to unlock meaning.

Where is the punctuation? - Can you identify where the enjambment and caesura are? Why are they there?

Look for patterns in language- are key words repeated? Is there a semantic field? Why has the writer chosen this?

Identify a key image- what does the writer use this to suggest about the theme of the poem?

How are the ideas structured- what stays the same or changes in the poem? (The first 2 and last 2 lines are good places to look.)

How to answer the 24 mark question:

You should spent 30 minutes in total on this question in the exam.

You should spend 5 minutes reading and annotating the poem using the checklist on the left hand side – language, form and structure.

Always ask yourself WHAT, HOW, WHY.

Identify and explore 3 ideas linking to your thesis statement. (preferably a combination of form, language, structure and techniques

Introduce these in your thesis statement introduction and then explore each of these ideas throughout the essay.

Remember to include a quotation with your summative idea about the poem and the theme.

How to answer the 8 mark question:

You should spend 15 minutes on this question in the exam. (3 minutes reading the second poem and planning, 12 minutes writing)

Unpick the second poem (3 mins).

Pick 3 METHODS(HOW) to compare – use words from the table on the left to compare them.

Start with the method and then analyse the WHAT and WHY (effect on the reader)

Compare the effect on the reader.

A Christmas Carol KO Lit Paper 1

Key characters

- **Ebeneezer Scrooge** Transforms from misanthropist to philanthropist
- **Bob Cratchit** Represents the noble poor, challenges perceptions of the poor
- **Ghost of Christmas Past** Shows us Scrooge was not always hard and cold, importance of memory
- **Ghost of Christmas Present** Shows Scrooge what Christmas spirit really is. Introduces Ignorance and Want to teach Scrooge the error of his ways
- **Ghost of Christmas Yet to Come** Shows Scrooge his dire fate unless he changes
- **Tiny Tim** Represents Christian values and is a symbol for the most vulnerable in society. He is a key character in Scrooge's transformation
- **Jacob Marley** Scrooge's dead business partner, the catalyst for Scrooge's transformation.
- **The Portly Gentlemen** An example of those members of society who were socially responsible.
- **Fezziwig** A shining example of how a boss could practice philanthropy

Key Themes

- **Redemption** Dickens shows Victorians it is possible to change their ways through the transformation of Scrooge
- **Family** Offers warmth and love – complete contrast to Scrooge's chosen life
- **Christmas** A time of love, hope, charity and kindness to show Dickens' moral message
- **Social Injustice** Dickens highlights the social injustice of Victorian England to bring about reform
- **Threat of Time** Scrooge needs to act quickly or he will walk in purgatory for all time.
- **Social responsibility** Dickens uses the novella to demonstrate the importance of generosity.
- **Generosity** The need to share and fulfil Christian obligations
- **Philanthropy** those characters who share this trait are much happier as a result of their behavioural choice.
- **Supernatural** A fashionable 1843 theme which is used to teach Scrooge how to change.

Key Vocabulary

- **Misanthropy** Dislike of humankind (Greek miso – hating Greek - Anthropos – man)
- **Philanthropy** Desire to help others, usually through charity (Greek – philanthopos – man-loving)
- **Stave** The parallel lines music is written on (English – staff, support)
- **Novella** A short novel (Italian – novel)
- **Avarice** Greed (Latin – avarus – greedy)
- **Penitence** Sorrow for committing sin (Latin – paenitent – repenting)
- **Industrial** Related to industry and factories (French – industriel – resulting from labour)
- **Revolution** A great change (Latin – revolve – turn, roll back)
- **Apparition** Supernatural appearance (Latin – appartionem – an appearance)
- **Benevolent** Wishing to do well, kindly (Latin – benevolentum – wishing someone well)
- **Covetous** Desiring to obtain and own (French – coveitos – desire, eagerness, ambition)
- **Ominous** An indication of coming evil (Latin – ominosis – full of foreboding)
- **Tremulous** Shaking (Latin – tremulus – shaking, quivering)

Top Tips for an extract question:

- ✓ Work through the novella chronologically – beginning, middle and end. Fit the extract into your plan and make sure you reference the whole novella
- ✓ Remember to explore the language in each quotation using appropriate subject terminology
- ✓ Identify the writer's purpose- Dickens wanted to change middle class attitudes towards poverty and make them more generous.
- ✓ Include a thesis statement to introduce your argument

Devices used

Omniscient Narrator Dickens makes use of a narrator that is not a direct part of the story. They provide us with an overview of the story but focuses specifically on Scrooge and his responses to what is happening. They do not offer a sympathetic portrait, often the style is one of mockery. It is clear we are meant to detest Scrooge at the beginning but the gradual unfolding of his story allows us to like him by the end.

Pathetic Fallacy A technique that links human emotion to the weather. Throughout the novella warmth is linked to community and love and coldness is linked to hard-heartedness and a lack of love. This is further emphasized with Scrooge when we find out that 'no warmth could warm, no wintry weather chill him.' Scrooge is the most extreme version of the effects of self-interested capitalism.

Antithesis The opposite of someone or something, antithesis is used throughout the novella to show that there is a better way. Fezziwig's form of business is an antithesis to Scrooge's, the first stave is the antithesis of the final stave, Bob is the antithesis of Scrooge...

Allegory A story that teaches a moral lesson, using the characters as symbols. In ACC Scrooge represents the Victorian businessmen that take advantage of the poor. Fred represents the ideal of the middle class. The Cratchits represent the noble poor. Tiny Tim represents children and their vulnerability. Fezziwig represents an alternative way of doing business.

Parallel **Stave** (1 and 5) Basically, the end is the reverse of the beginning- everything that Scrooge fails to do in Stave 1 is reversed in Stave 2 to symbolise his transformation.

Symbolism As an allegorical story, much of what is presented by Dickens is a device used to explore his message of generosity and benevolence.

Useful terminology
Satire- use of humour or ridicule to criticise
Asyndeton- list without conjunctions
Polysyndeton- list with conjunctions (and)
Simile- comparing using 'like' or 'as'
Metaphor- saying one thing is another
Personification- make object human
Pathetic fallacy- weather to create mood
Pathos- language to evoke pity
Allusion- reference to another literary work
Hyperbole- exaggerated statement
Connotation- associated meaning of word
Characterisation- built up description of character in text
Semantic field- words related in meaning
Imagery- visually descriptive language

Writer's purpose: social reform
Dickens is writing to influence the reader at a time when the middle classes took little social responsibility for the effects of the industrial revolution on the working classes. Workers were kept in servitude due to appalling pay and conditions. They were powerless to alter their situation until the middle classes, like Scrooge, chose to improve their situation.

Structure and form
Conflict- problem faced by characters
Resolution- point where conflict is resolved
Foreshadowing- clue about something later
Foreboding- sense that something will occur
Juxtaposition- two contrasted ideas
Backstory- insight into character's past
Exposition- revelation of something
Poetic justice- good rewarded bad punished
Melodrama- exaggerated characters/events
Motif- repeated image or symbol
Antithesis- contrast of ideas in same grammatical structure
Authorial intrusion- where author pauses to speak directly to reader
Allegory- characters/events represent ideas about religion, morals or politics
Polemic- a moral lecture versus novella- short novel
Parallel stave- many elements in the first stave is inverted in the final stave.
Malthusian economics – Reformation of the Poor Laws in 1834 left the poor destitute and reliant on workhouses. Malthusian economists supported the idea that the unproductive poor should work their way out of poverty and charity should not be given to those who were 'undeserving'. Scrooge is a supporter of Malthus- "If they would rather die they had better do it and decrease the surplus population." Dickens challenges these ideas continually through the novella.

Plot summary:
STAVE 1: • Christmas Eve and Scrooge is at work in his counting house. Despite the cold, he refuses to spend money on coals for the fire for himself or Bob Cratchit. Scrooge is miserable and alone. • Scrooge is visited by the Ghost of Marley, his dead business partner. Marley tells Scrooge because of his sinful, greedy life, he has to wander the Earth wearing heavy chains. Marley tries to stop Scrooge from doing the same. He tells Scrooge that three spirits will visit him during the next three nights. Scrooge falls asleep.
STAVE 2: • The Ghost of Christmas Past takes Scrooge into the past. Scrooge revisits: his childhood school days, his apprenticeship with Fezziwig, and his engagement to Belle, who leaves Scrooge as he loves money too much to love another human being. Scrooge sheds tears of regret before being returned to his bed.
STAVE 3 • The Ghost of Christmas Present. Scrooge watches the Cratchit family eat, enjoy and be thankful for a tiny meal in their little home. He sees Bob Cratchit's crippled son, Tiny Tim, whose kindness and humility warm Scrooge's heart. The spectre shows Scrooge his nephew's Christmas party. Scrooge asks the spirit to stay until the very end. At the end of the stave, the ghost reveals two starved children, Ignorance and Want.
STAVE 4 • The Ghost of Christmas Yet to Come takes Scrooge through a sequence of scenes linked to an unnamed man's death. Scrooge, is keen to learn the lesson. Scrooge learns the dead man is himself and is desperate to change his fate and promises to change his ways. He suddenly finds himself safely tucked in his bed.
STAVE 5 • Scrooge is a changed man. He rushes out onto the street hoping to share his newfound Christmas spirit. He sends a turkey to the Cratchit house and goes to Fred's party, As the years go by, he continues to celebrate Christmas with all his heart. He treats Tiny Tim as if he were his own child, gives gifts for the poor and is kind, generous and warm

Number

Topic	Topic code	R	A	G
Calculating with roots and fractional indices	U851, U985, U772, U299			
Converting recurring decimals to fractions	U689			
Surds	U338, U663, U872, U499			
Rationalising the denominator	U707, U281			
Error intervals	U657, U301, U587			

Algebra

Topic	Topic code	R	A	G
Expanding triple brackets	U606			
Operations with algebraic fractions	U685, U457, U824			
Factorising quadratic expressions: ax^2+bx+c	U858			
Simplifying algebraic fractions	U294			
Factorising to solve quadratics equations	U228, U960			
Using the quadratic formula	U665			
Completing the square to solve quadratics	U397, U589			
Quadratic equations in context	U150			
Quadratic simultaneous equations	U547			
Index laws	U235, U694, U662			
Equation of a straight line: Perpendicular lines	U898			
Quadratic graphs: Turning points	U769			
Quadratic simultaneous equations on graphs	U875			
Exponential graphs	U229			
Exponential growth and decay problems	U988			
Trigonometric graphs	U450			
Graph transformations	U598, U487, U455			
Velocity-time graphs	U937, U562, U611			
Rate of change graphs	U638, U652, U862			
Estimating gradient from a curve	U800			
Estimating area under a curve	U882			
Equation of a circles and tangents	U567			
Linear inequalities as graph regions	U747			
Quadratic inequalities	U133			
Functions	U637, U895, U448, U996			
Recurrence relations	U171			
Quadratic sequences	U206			
Iteration and numerical methods	U434, U168			
Algebraic proof	U582			

Sparx Maths Higher Skills List

Ratio and proportion

Topic	Topic code	R	A	G
Algebraic direct and inverse proportion	U407, U138			
Compound units: Density problem solving	U910			

Geometry

Topic	Topic code	R	A	G
Congruence proofs	U866, U887			
Enlargements	U134			
Describe combined transformations	U766			
Circle theorems: Angles inside a circle	U459, U251			
Circle theorems: Tangents and chords	U489, U130			
Circle theorems problems	U808			
Prove circle theorems	U807			
Volume of frustums	U350			
Volume: Problem solving	U543, U426			
Similar Shapes: Area and volume	U630, U110			
Pythagoras' Theorem in 2D and 3D	U385, U541			
Right-angled trigonometry: Problem solving	U319, U283, U545, U967			
3D trigonometry	U170			
The area rule	U592			
Sine rule	U952			
Cosine rule	U591			
Trigonometry and bearings	U164			
Vectors problems	U781, U560			

Probability

Topic	Topic code	R	A	G
Product rule for counting	U369			
Conditional probability	U246, U821, U806			
Probability from Venn diagrams	U476, U748, U699			

Statistics

Topic	Topic code	R	A	G
Averages	U877, U717			
Cumulative frequency diagrams	U182, U642			
Box plots	U879, U837, U507			
Frequency polygons	U840			
Histograms	U814, U983, U267			
Capture-recapture	U328			

Number

Topic	Topic code	R	A	G
Ordering positive integers	U600			
Ordering decimals	U435			
Ordering negative numbers	U947			
Adding and subtracting positive integers	U417			
Multiplying and dividing positive integers	U127, U453			
Adding and subtracting negative numbers	U742			
Multiplying and dividing negative numbers	U548			
Adding and subtracting decimals	U478			
Multiplying and dividing with place value	U735			
Multiplying and dividing with decimals	U293, U868			
Order of operations	U976			
Prime numbers, prime factorisation	U236, U739			
Factors, multiples, HCF and LCM	U211, U751, U529			
Powers and roots	U851			
Using standard form	U330, U534			
Calculating with standard form	U264, U290, U161			
Equivalent fractions and simplifying fractions	U704, U646			
Mixed numbers and improper fractions	U692			
Ordering fractions	U746			
Addition and subtraction of fractions	U736, U793			
Multiplication and division of fractions	U475, U544			
Converting and ordering fractions, decimals and percentages	U888, U594			
Fractions of amounts	U881, U916			
Percentages of amounts	U554, U349			
Percentage change	U773, U671			
Reverse percentages	U286, U278			
Simple interest	U533			
Rounding	U480, U298			
Rounding to significant figures	U731, U965			
Estimating answers	U225			
Value for money	M681			

Sparx Maths Foundation Skills List

Algebra

Topic	Topic code	R	A	G
Algebraic expressions	U613			
Collecting like terms	U105			
Substitution	U201, U585, U144			
Expanding brackets	U179, U768			
Factorising expressions	U365			
Index laws	U235, U694, U662, U103			
Changing the subject	U556			
Coordinates	U789, U889			
Midpoints	U933			
Plotting straight line graphs	U741			
Equations of straight line graphs	U315, U669			
Parallel lines	U377			
Distance-time graphs	U403, U914, U462, U966			
Quadratic graphs	U989, U667			
Linear equations	U755, U325, U870, U505, U599			
Quadratic expressions and equations	U178, U228			
Linear sequences	U213, U530, U498, U978			
Other sequences	U958, U680			

Ratio and proportion

Topic	Topic code	R	A	G
Simplifying ratios	U687			
Sharing amounts in a ratio	U753, U577			
Converting between ratios, fractions and percentages	U176			
Direct proportion	U721, U640			
Inverse proportion	U357, U364			
Proportion graphs	U238			
Units of measure: Length, Mass and Capacity	U102, U388			
Units of measure: Time	U902			
Units of measure: Area	U248			
Currency conversion	U610			
Conversion graphs	U652, U638, U862			
Compound units: Speed	U151			

Geometry

Topic	Topic code	R	A	G
Properties of 2D shapes	U121, U849			
Properties of 3D shapes	U719			
Nets of 3D shapes	U761			
Angles: Measuring, Drawing and Estimating	U447			
Angle on a line and about a point	U390			
Vertically opposite angles	U730			
Angles on parallel lines	U826			
Angles in a triangle	U628			
Combining angle facts	U655			
Angles in a quadrilateral	U732, U329			
Angles in polygons	U427			
Bearings	U525, U107			
Translations	U196			
Reflections	U799			
Enlargements	U519			
Rotations	U696			
Congruence	U790, U866			
Area and perimeter of simple shapes	U993, U970, U351, U226			
Area of triangles, parallelograms and trapeziums	U945, U575, U424, U265, U343			
Circles	U767			
Circumference	U604, U221			
Circle area	U950, U373			
Surface area	U929, U259, U871			
Volume of cuboids	U786			
Volume of prisms and cylinders	U174, U915			
Similar shapes	U551, U578			
Scale diagrams	U257			

Sparx Maths Foundation Skills List

Probability

Topic	Topic code	R	A	G
Probability scale	U803			
Probability of single events	U408, U510, U683			
Experimental probability	U580			
Expected outcomes	U166			
Listing elements in a set	U748, U296			
Probability from Venn diagrams	U476			
Frequency trees	U280			
Sample space diagrams	U104			
Tree diagrams	U558, U729			

Statistics

Topic	Topic code	R	A	G
Collecting data, frequency tables	U322, U120			
Two-way tables	U981			
Bar charts	U363, U557			
Pictograms	U506			
Pie charts	U508, U172			
Stem and leaf diagrams	U200, U909			
Mode	U260			
Mean	U291			
Median	U456			
Range	U526			
Choosing averages	U717			
Scatter graphs	U199, U277, U128			

GCSE Mathematics Foundation Tier

Number · Algebra · Ratio, proportion and rates of change · Geometry & measures · Probability · Statistics

BIDMAS N3

...or BODMAS. Use the correct order of operations; take care when using a calculator.

- **B**rackets
- **I**ndices (or p**O**wers)
- **D**ivision and **M**ultiplication
- **A**ddition and **S**ubtraction

Types of number N4

Integer: a "whole" number

Factors; the divisors of an integer

➔ **Factors of 12 are 1, 2, 3 ,4, 6, 12**

Multiples; a "times table" for an integer (will continue indefinitely)

➔ **Multiples of 12 are 12, 24, 36 ...**

Prime number: an integer which has exactly two factors (1 and the number itself). Note: 1 is not a prime number.

HCF, LCM N4

Highest Common Factor (HCF)

➔ **Factors of 6 are 1, 2, 3, 6**
Factors of 9 are 1, 3, 9
HCF of 6 and 9 is 3

Lowest Common Multiple (LCM)

➔ **Multiples of 6 are 6, 12, 18, 24, ...**
Multiples of 9 are 9, 18, 27, 36, ...
LCM of 6 and 9 is 18

Prime factors N4

Write a number as a product of its prime factors; use indices for repeated factors:

➔ $720 = 5 \times 3^2 \times 2^4$

Powers and roots N6, N7

Special indices: for any value a:

$$a^0 = 1$$

$$a^{-n} = \frac{1}{a^n}$$

➔ $$3^{-4} = \frac{1}{3^4} = \frac{1}{81}$$

Calculating with fractions N8

Adding or subtracting fractions; use a common denominator...

➔ $$\frac{4}{5} - \frac{1}{3} = \frac{12}{15} - \frac{5}{15} = \frac{7}{15}$$

Multiplying fractions; multiply numerators and denominators...

➔ $$\frac{4}{7} \times \frac{2}{3} = \frac{8}{21}$$

Dividing fractions; "flip" the second fraction, then multiply...

➔ $$\frac{2}{7} \div \frac{5}{6} = \frac{2}{7} \times \frac{6}{5} = \frac{12}{35}$$

Fractions, decimals N10

Fraction is numerator ÷ denominator

➔ $$\frac{5}{8} = 5 \div 8 = 0.625$$

Use place values to change decimals to fractions. Simplify where possible.

➔ $$0.45 = \frac{45}{100} = \frac{9}{20}$$

Learn the most frequently used ones:

$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{3}{4}$
0.5	0.25	0.1	0.2	0.75

Surds N8

Look for the biggest square number factor of the number:

➔ $\sqrt{80} = \sqrt{16 \times 5} = 4\sqrt{5}$

Standard form N9

Standard form numbers are of the form $a \times 10^n$, where $1 \leq a < 10$ and n is an integer.

Standard units N13

1 tonne = 1 000 kilograms
1 kilogram = 1 000 grams

---

1 kilometre = 1 000 metres
1 metre = 100 centimetres
= 1 000 millimetres
1 centimetre = 10 millimetres

---

1 day = 24 hours
1 hour = 60 minutes = 3 600 seconds
1 minute = 60 seconds

Rounding N15

Truncate the number, then use a "decider digit" to round up or down.
Decimal places: use the decimal point

➔ **162.3681 to 2dp;**
162.36 | 81 = **162.37 to 2dp**

Significant figures: use the first non-zero digit.

➔ **162.3681 to 2sf;**
16 | 2.3681 = **160 to 2sf**

➔ **0.007 039 to 3sf;**
0.007 03 | 9 = **0.007 04 to 3sf**

Error intervals N15

Find the range of numbers that will round to a given value:

➔ $x = 5.83$ **(2 decimal places)**
$5.825 \leq x < 5.835$

➔ $y = 46$ **(2 significant figures)**
$45.5 \leq y < 46.5$

Note use of ≤ and <, and that the last significant figure of each is 5.

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Algebraic notation A1

$$ab = a \times b$$
$$3y = y + y + y$$
$$a^2 = a \times a$$
$$a^3 = a \times a \times a$$
$$a^2b = a \times a \times b$$
$$\frac{a}{b} = a \div b$$

Equations and identities A3

An equation is true for some particular value of x...

➔ $2x + 1 = 7$ **is true if** $x = 3$

...but an identity is true for every value of x

➔ $(x + a)^2 \equiv x^2 + 2ax + a^2$

(note the use of the symbol ≡)

Laws of indices A4

For any value a:

$$a^x \times a^y = a^{x+y}$$
$$\frac{a^x}{a^y} = a^{x-y}$$
$$(a^x)^y = a^{xy}$$

➔ $\left(\frac{2pq^4}{p^3q}\right)^3 = \frac{8p^3q^{12}}{p^9q^3} = \frac{8q^9}{p^6}$ or $8q^9p^{-6}$

Expanding brackets A4

$$p(q + r) = pq + pr$$

➔ $5(x - 2y) = 5x - 10y$

$$(x + a)(x + b) = x^2 + ax + bx + ab$$

➔ $(2x - 3)(x + 5)$
$= 2x^2 - 3x + 10x - 15$
$= 2x^2 + 7x - 15$

Reverse of expanding is factorising - putting an expression into brackets.

Quadratics A18

Solve a quadratic by factorising.

➔ **Solve** $x^2 - 8x + 15 = 0$

Put into brackets (taking care with any negative numbers)...

$$(x - 3)(x - 5) = 0$$

...then either $x - 3 = 0$ or $x - 5 = 0$, so that $x = 3$ **or** $x = 5$.

Difference of two squares A4

$$a^2 - b^2 = (a + b)(a - b)$$

➔ $x^2 - 25 = (x + 5)(x - 5)$

Simultaneous equations A19

➔ **Solve** $\begin{cases} 2x + 3y = 11 \\ 3x - 5y = 7 \end{cases}$

Multiply to match a term in x or y

$$\begin{cases} 10x + 15y = 55 \\ 9x - 15y = 21 \end{cases}$$

Add or subtract to cancel...

$$19x = 76, \text{ so } x = 4$$

Finally, substitute and solve...

$$2 \times 4 + 3y = 11, \text{ so } y = 1$$

Rearrange a formula A5

The subject of a formula is the term on its own. Use rules that "balance" the formula to change its subject

➔ **Make** x **the subject of**

$$2x + 3y = z$$

Here, subtract $3y$ from both sides...

$$2x = z - 3y$$

...then divide both sides by 2...

$$x = \frac{z - 3y}{2}$$

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Sequences A24, A25

Triangular numbers:

1st	2nd	3rd	4th	5th
1	3	6	10	15

Square numbers ($n^2 = n \times n$):

1^2	2^2	3^2	4^2	5^2
1	4	9	16	25

Cube numbers ($n^3 = n \times n \times n$):

1^3	2^3	3^3	4^3	5^3
1	8	27	64	125

nth term of an arithmetic (linear) sequence is $an + d$

➔ **nth term of 5,8,11,14,... is $3n+2$ (always increases by 3; first term is $3 \times 1 + 2 = 5$.)**

Geometric sequence; multiply each term by a constant ratio

➔ **3, 6, 12, 24, ... (ratio is 2)**

Fibonacci sequence; make the next term by adding the previous two ...

➔ **2, 4, 6, 10, 16, 26, 42, ...**

$y = mx + c$ A9

Equation of straight line $y = mx + c$

m is the gradient; c is the y intercept:

➔ **Find the equation of the line that joins (0 , 3) to (2 , 11)**

Find its gradient...

$$\frac{11-3}{2-0} = \frac{8}{2} = 4$$

...and its y intercept...

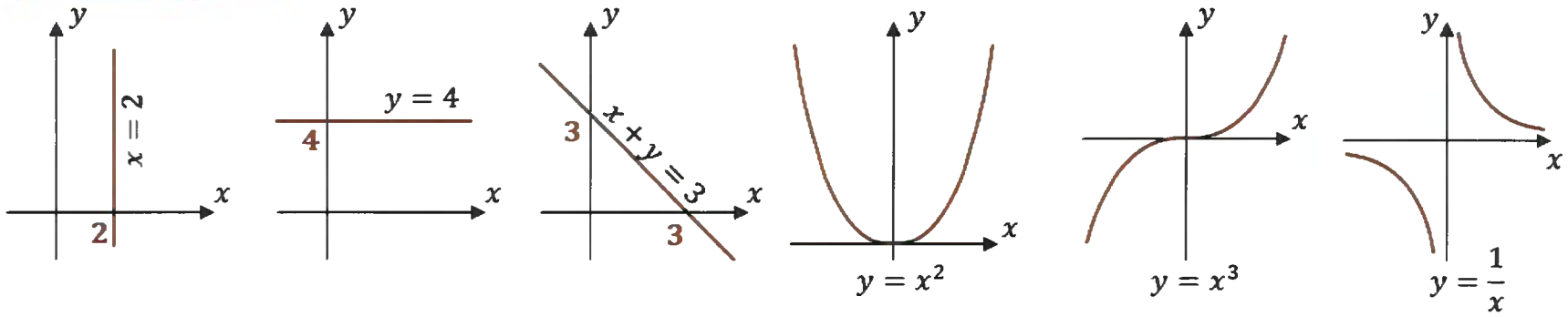
Passes through (0 , 3), so c = 3.

Equation is $y = 4x + 3$.

Parallel lines: gradients are equal;

➔ **$y = 2x + 3$ and $y = 2x - 5$ both have gradient 2, so are parallel.**

Standard graphs A12



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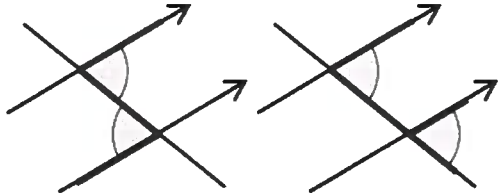
Angle facts

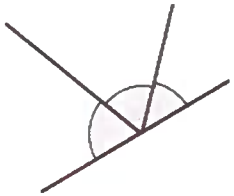
G3

Equal angles in parallel lines: always use correct terminology...

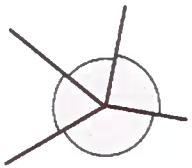


Alternate angles · Corresponding angles

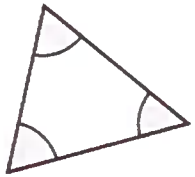
Angles on a straight line total 180°



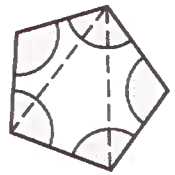
Angles in a full turn total 360°



Interior angles in a triangle total 180°

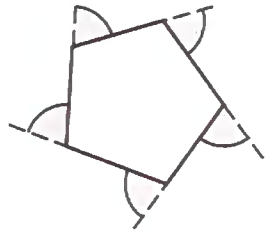


Use this for the interior angles of any polygon...



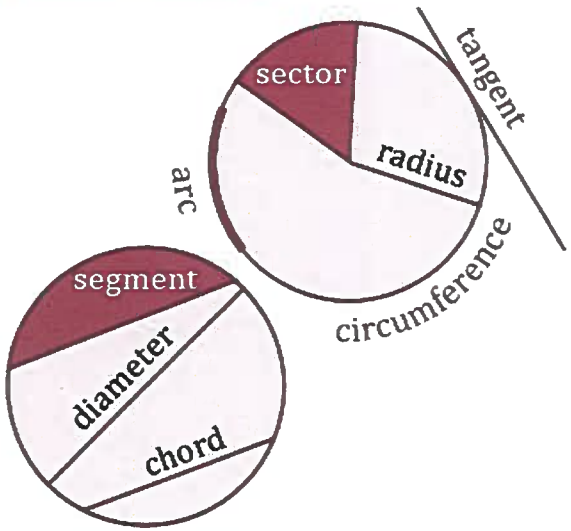
...or $180° \times (n - 2)$

Exterior angles always total 360°



Parts of a circle

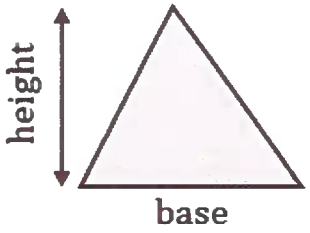
G9



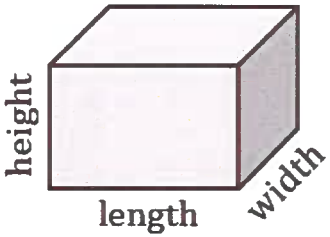
Areas and volumes

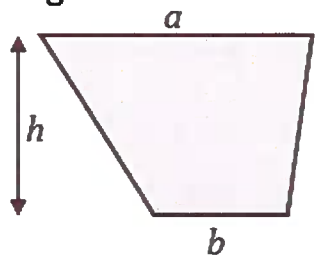
G16, G17, G18, G23

Area of triangle $= \frac{1}{2} \times$ base $\times$ height



Volume of cuboid = length × width × height

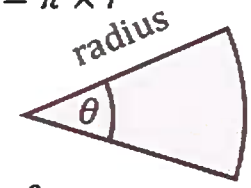




Area of trapezium $= \frac{1}{2}(a + b) \times h$

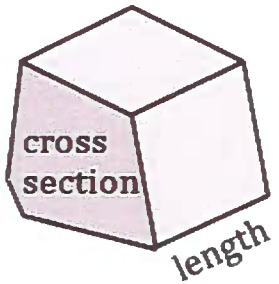
Circumference of circle $= \pi \times D$

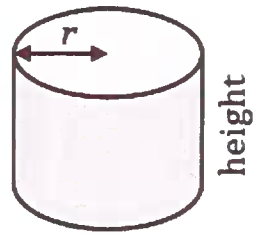
Area of circle $= \pi \times r^2$



Arc length $= \frac{\theta}{360°} \times \pi \times D$

Area of sector $= \frac{\theta}{360°} \times \pi \times r^2$





Volume of cylinder = $\pi r^2 \times$ height

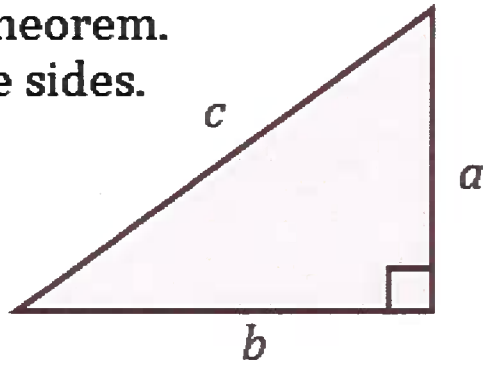
Volume of prism = area of cross section × length

Right angled triangles

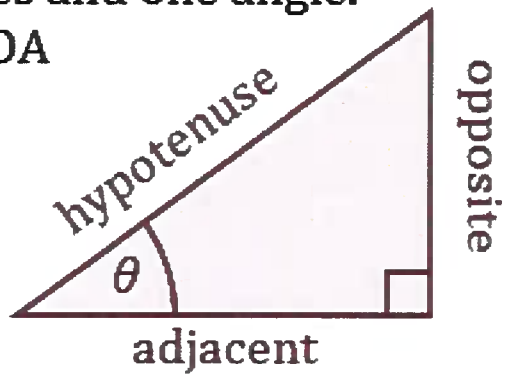
G20, G22

Pythagoras Theorem.
Links all three sides.
No angles.

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



Trigonometry.
Links two sides and one angle.
SOH | CAH | TOA



$\sin\theta = \frac{\text{opp}}{\text{hyp}}$ $\cos\theta = \frac{\text{adj}}{\text{hyp}}$ $\tan\theta = \frac{\text{opp}}{\text{adj}}$

Use "2ndF" or "SHIFT" key to find a missing angle

The longest side of any right angled triangle is the hypotenuse; check that your answer is consistent with this.

Special values of sin, cos, tan
Learn (or be able to find without a calculator)...

$\theta°$	$\sin\theta°$	$\cos\theta°$	$\tan\theta°$
0	0	1	1
30	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{3}}$
45	$\frac{1}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	1
60	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$
90	1	0	

Transformations

G7, G8

Reflection
- Line of reflection

Translation
- Vector

Rotation
- Centre of rotation
- Angle of rotation
- Clockwise or anticlockwise

Enlargement
- Centre of enlargement
- Scale factor (if SF < 1 the shape will get smaller).

Probability

P8, P9

$$p = \frac{n(\text{equally likely favourable outcomes})}{n(\text{equally likely possible outcomes})}$$

$p = 0$	impossible
$0 < p < 0.5$	unlikely
$p = 0.5$	evens
$0.5 < p < 1$	likely
$p = 1$	certain

Probability rules

P8, P9

Multiply for independent events

➔ **P(6 on dice and H on coin)**

$$\frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$$

Add for mutually exclusive events

➔ **P(5 or 6 on dice)**

$$\frac{1}{6} + \frac{1}{6} = \frac{2}{6}$$

Apply these rules to tree diagrams.

Division using ratio

R5

Use a ratio for unequal sharing

➔ **Divide £480 in the ratio 7 : 5**

7 + 5 = 12, then £480 ÷ 12 = £40

7 × £40 = £280, 5 × £40 = £200

(check: £280 + £200 = £480 ✓)

Ratio and fractions

R8

Link between ratios and fractions

➔ **Boys to girls in ratio 2 : 3**

$\frac{2}{5}$ are boys, $\frac{3}{5}$ are girls.

Percentages

R9

$$y \text{ percent of } x = \frac{y}{100} \times x$$

➔ **Increase £58 by 26%.**

$$\frac{26}{100} \times £58 = £15.08$$

£58 + £15.08 = £73.08

$$y \text{ as a percentage of } x = \frac{y}{x} \times 100\%$$

➔ **The population of a town increases from 3 500 to 4 620. Find the percentage increase.**

$$\frac{1\,120}{3\,500} \times 100\% = 32\%$$

$$\text{Note: fraction} = \frac{\text{increase}}{\text{original}}$$

Speed, distance, time

R11

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

➔ **A car travels 90 miles in 1 hour, 30 minutes. Find its average speed.**

90 miles ÷ 1.5 hours = 60 mph

Averages

S4

Mode: most frequently occurring

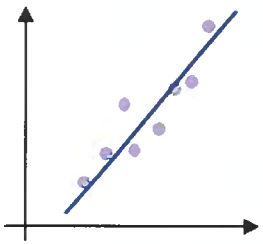
Median: put the data in numerical order, then choose the middle one

$$\text{Mean} = \frac{\text{total of items of data}}{\text{number of items of data}}$$

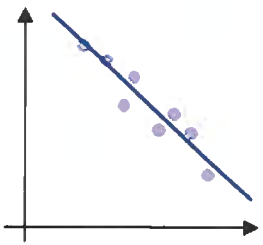
Correlation

S6

Positive correlation



Negative correlation



GCSE Mathematics Higher Tier

Number · Algebra · Ratio, proportion and rates of change · Geometry & measures · Probability · Statistics

Listing strategies N5

Product rule for counting:

➔ $4 \times 3 \times 2 \times 1 = 24$ ways to arrange the letters P, I, X and L.

Powers and roots N6, N7

Special indices: for any value a:

$$a^0 = 1$$

$$a^{-n} = \frac{1}{a^n}$$

$$a^{\left(\frac{p}{q}\right)} = \sqrt[q]{a^p}$$

➔ $$3^{-4} = \frac{1}{3^4} = \frac{1}{81}$$

➔ $$8^{\left(\frac{2}{3}\right)} = \sqrt[3]{8^2} = 4$$

Surds N8

Look for the biggest square number factor of the number:

➔ $\sqrt{80} = \sqrt{16 \times 5} = 4\sqrt{5}$

Rationalise the denominator N8

Multiply the numerator and denominator by an expression that makes the denominator an integer:

➔ $$\frac{4}{\sqrt{7}} = \frac{4 \times \sqrt{7}}{\sqrt{7} \times \sqrt{7}} = \frac{4\sqrt{7}}{7}$$

➔ $$\frac{2}{4+\sqrt{5}}$$

$$= \frac{2}{4+\sqrt{5}} \times \frac{4-\sqrt{5}}{4-\sqrt{5}} = \frac{2(4-\sqrt{5})}{11}$$

Standard form N9

Standard form numbers are of the form $a \times 10^n$, where $1 \leq a < 10$ and n is an integer.

Error intervals N15

Find the range of numbers that will round to a given value:

➔ $x = 5.83$ (2 decimal places)

$$5.825 \leq x < 5.835$$

➔ $y = 46$ (2 significant figures)

$$45.5 \leq y < 46.5$$

Note use of ≤ and <, and that the last significant figure of each is 5.

Equations and identities A3

An equation is true for some particular value of x...

➔ $2x + 1 = 7$ is true if $x = 3$

...but an identity is true for every value of x

➔ $(x + a)^2 \equiv x^2 + 2ax + a^2$

(note the use of the symbol ≡)

Laws of indices A4

For any value a:

$$a^x \times a^y = a^{x+y}$$

$$\frac{a^x}{a^y} = a^{x-y}$$

$$(a^x)^y = a^{xy}$$

➔ $\left(\frac{2pq^4}{p^3q}\right)^3 = \frac{8p^3q^{12}}{p^9q^3} = \frac{8q^9}{p^6}$ or $8q^9p^{-6}$

Difference of two squares A4

$$a^2 - b^2 = (a+b)(a-b)$$

➔ $x^2 - 25 = (x+5)(x-5)$

Rearrange a formula A5

The subject of a formula is the term on its own. Rearrange to

➔ Make x the subject of

$$2x + ay = y - bx$$

$$2x + bx = y - ay$$

$$x(2+b) = y - ay$$

$$x = \frac{y - ay}{2 + b}$$

GCSE Mathematics Higher Tier

Number · Algebra · Ratio, proportion and rates of change · Geometry & measures · Probability · Statistics

Functions A7

Combining functions:

$$fg(x) = f(g(x))$$

➔ If $f(x) = x + 3$ and $g(x) = x^2$

$$fg(x) = x^2 + 3$$
$$gf(x) = (x + 3)^2$$

The inverse of f is f^{-1}

➔ If $f(x) = 2x + 5$ then

$$f^{-1}(x) = \frac{x - 5}{2}$$

$y = mx + c$ A9

Equation of straight line $y = mx + c$
m is the gradient; c is the y intercept:

➔ **Find the equation of the line that joins (0 , 3) to (2 , 11)**

Find its gradient...

$$\frac{11 - 3}{2 - 0} = \frac{8}{2} = 4$$

...and its y intercept...

Passes through (0 , 3), so c = 3.

Equation is $y = 4x + 3$.

Transformations of curves A13

Starting with the curve $y = f(x)$:

Translate $\begin{pmatrix} 0 \\ a \end{pmatrix}$ for $y = f(x) + a$

Translate $\begin{pmatrix} -a \\ 0 \end{pmatrix}$ for $y = f(x + a)$

Reflect in x axis for $y = -f(x)$
Reflect y axis for $y = f(-x)$

Velocity - time graph A15

Gradient = acceleration (you may need to draw a tangent to the curve at a point to find the gradient);
Area under curve = distance travelled.

Quadratics A11, A18

If a quadratic equation cannot be factorised, use the formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

➔ **Solve $2x^2 + 3x - 7 = 0$**

$$x = \frac{-3 - \sqrt{9 - (-56)}}{2 \times 2} = -2.73$$

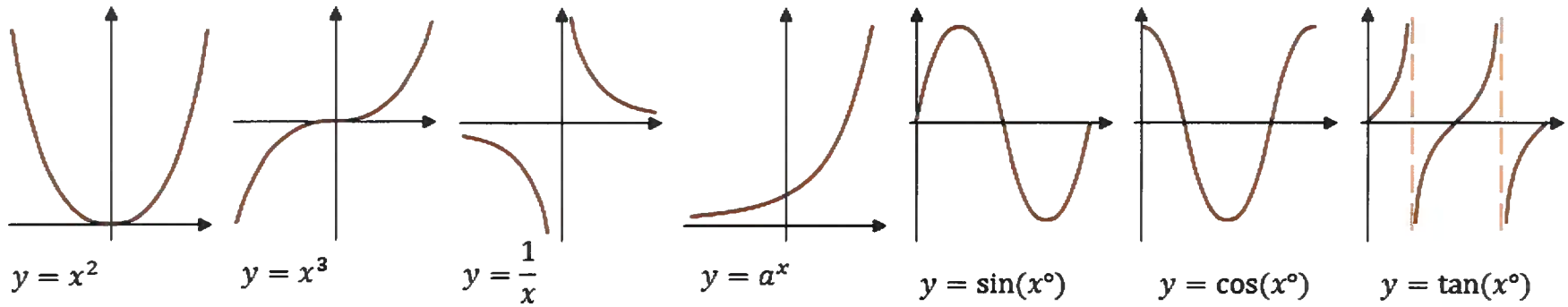
$$\text{or } x = \frac{-3 + \sqrt{9 - (-56)}}{2 \times 2} = 1.23$$

Complete the square to find the turning point of a quadratic graph.

➔
$$y = x^2 - 6x + 2$$
$$y = (x - 3)^2 - 9 + 2$$
$$y = (x - 3)^2 - 7$$

Turning point is at (3 , −7)

Standard graphs A12



GCSE Mathematics Higher Tier

Number · Algebra · Ratio, proportion and rates of change · Geometry & measures · Probability · Statistics

Equation of a circle — A16

$x^2 + y^2 = r^2$ is a circle with centre (0 ,0) and radius r.

➔ **$x^2 + y^2 = 25$ has centre (0 , 0) and radius 5.**

Simultaneous equations — A19

One linear, one quadratic;

➔ **Solve** $\begin{cases} x + 3y = 10 \\ x^2 + y^2 = 20 \end{cases}$

Rearrange the linear, and substitute into the quadratic

$$x = 10 - 3y$$
$$\text{so } (10 - 3y)^2 + y^2 = 20$$

Expand and solve the quadratic

$$100 - 60y + 9y^2 + y^2 = 20$$
$$10y^2 - 60y + 80 = 0$$
$$y = 2 \text{ or } y = 4$$

Finally, substitute into the linear and solve, pairing values...

$x + 3 \times 2 = 10$ so $(x , y) = (4 , 2)$

$x + 3 \times 4 = 10$ so $(x , y) = (-2 , 4)$

Iteration — A20

You will be given the formula to use:

➔ **Solve $x^3 + 6x + 4 = 0$ by using the iteration $x_{n+1} = \sqrt[3]{6x_n - 4}$.**

Start with $x_1 = -2.8$.

$$x_2 = \sqrt[3]{6 \times (-2.8) - 4} = -2.750\ldots$$

$$x_3 = \sqrt[3]{6 \times (-2.750\ldots) - 4} = \cdots$$

Repeat until you know the solution, or you do as many as the question says.

Sequences — A24, A25

nth term of an arithmetic (linear) sequence is $bn + c$

➔ **nth term of 5,8,11,14,... is $3n+2$ (always increases by 3; first term is $3 \times 1 + 2 = 5$.)**

nth term of a quadratic sequence is $an^2 + bn + c$

➔ **First three terms of $n^2 + 3n - 1$ are 3, 9, 17, ...**

Geometric sequence; multiply each term by a constant ratio

➔ **3, 6, 12, 24, ... (ratio is 2)**

Fibonacci sequence; make the next term by adding the previous two ...

➔ **2, 4, 6, 10, 16, 26, 42, ...**

Percentages: multipliers — R9, R16

Percentage increase or decrease; use a multiplier (powers for repetition)

➔ **Initially there were 20 000 fish in a lake. The number decreases by 15% each year. Estimate the number of fish after 6 years.**

$$20\,000 \times 0.85^6 = 7\,500 \text{ (2sf)}$$

Formula for compound interest

$$\text{Total accrued} = P\left(1 + \frac{r}{100}\right)^n$$

➔ **I invest £600 at 3% compound interest. What is my account worth after 5 years?**

$$£600 \times \left(1 + \frac{3}{100}\right)^5 = £695.56$$

Direct & inverse proportion — R10

y is directly proportional to x:

$y = kx$ for a constant k

➔ **b is directly proportional to a^2; $a = 6$ when $b = 90$. Find b if $a = 8$.**

$b = ka^2$; $a = 6$ and $b = 90$ for k;

$90 = k \times 6^2$ so $k = 2.5$, $b = 2.5a^2$

$b = 2.5 \times 8^2 = 160$

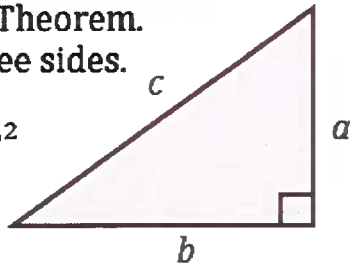
y is inversely proportional to x:

$yx = k$ or $y = \frac{k}{x}$ for a constant k

Right angled triangles

G20

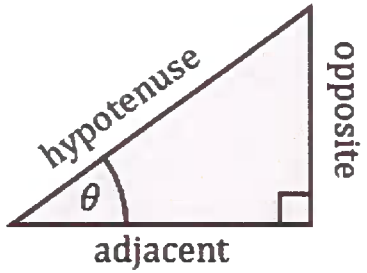
Pythagoras Theorem.
Links all three sides.
No angles.
$a^2 + b^2 = c^2$



Trigonometry.
Links two sides and one angle.
SOH | CAH | TOA

$\sin\theta = \frac{\text{opp}}{\text{hyp}}$ $\cos\theta = \frac{\text{adj}}{\text{hyp}}$ $\tan\theta = \frac{\text{opp}}{\text{adj}}$

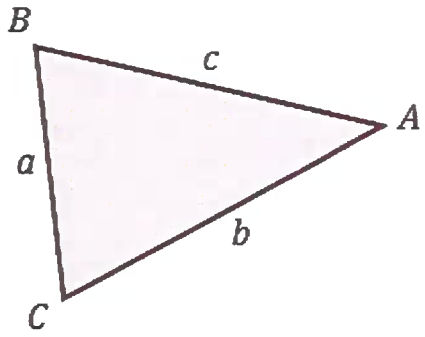
Use "2ndF" or "SHIFT" key to find a missing angle



The longest side of any right angled triangle is the hypotenuse; check that your answer is consistent with this.

Advanced trigonometry

G21, G22



A is opposite *a*
B is opposite *b*
C is opposite *c*

Sine Rule
Use if you are given an angle-side pair

Missing side: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Missing angle: $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

Cosine Rule
Use if you can't use the sine rule

Missing side: $a^2 = b^2 + c^2 - 2bc\cos A$

Missing angle: $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Special values of sin, cos, tan
Learn (or be able to find without a calculator)...

$\sin 0° = 0$, $\cos 0° = 1$, $\tan 0° = 0$

$\sin 30° = \frac{1}{2}$, $\cos 30° = \frac{\sqrt{3}}{2}$, $\tan 30° = \frac{1}{\sqrt{3}}$

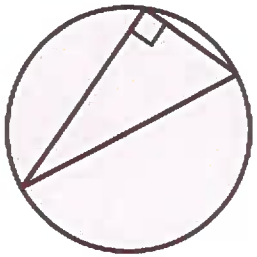
$\sin 45° = \frac{1}{\sqrt{2}}$, $\cos 45° = \frac{1}{\sqrt{2}}$, $\tan 45° = 1$

$\sin 60° = \frac{\sqrt{3}}{2}$, $\cos 60° = \frac{1}{2}$, $\tan 60° = \sqrt{3}$

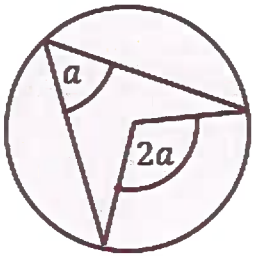
$\sin 90° = 1$, $\cos 90° = 0$

Circle theorems

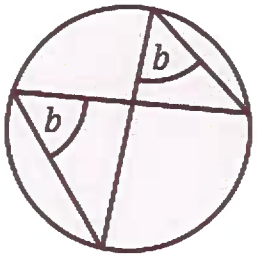
G10



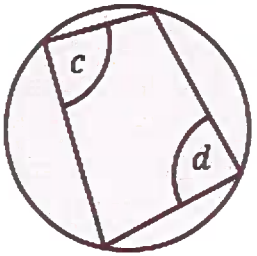
Angle in a semicircle is 90°



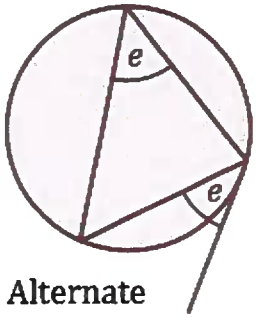
Angle at the centre is double the angle at the circumference



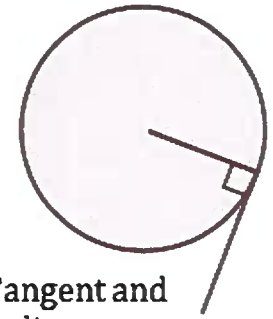
Angles in the same segment are equal



Opposite angles in a cyclic quadrilateral total 180°



Alternate segment theorem



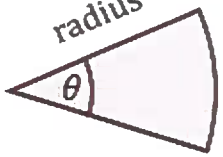
Tangent and radius are perpendicular

Areas and volumes

G16, G17, G18, G23

Circumference of circle = $\pi \times D$

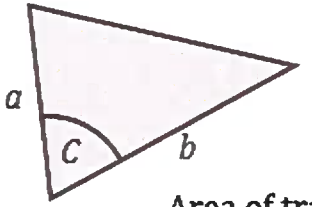
Area of circle = $\pi \times r^2$

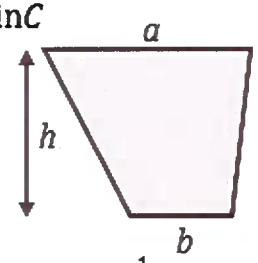


Arc length = $\frac{\theta}{360°} \times \pi \times D$

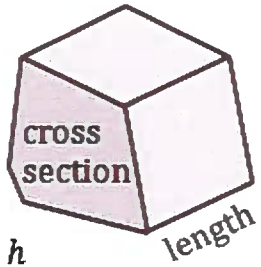
Area of sector = $\frac{\theta}{360°} \times \pi \times r^2$

Area of triangle = $\frac{1}{2}ab\sin C$

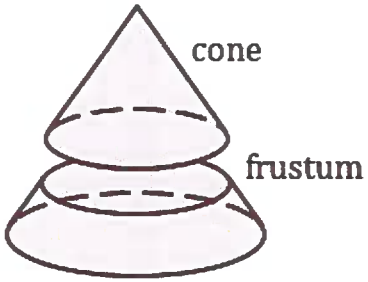




Area of trapezium = $\frac{1}{2}(a+b) \times h$



Volume of prism = area of cross section × length



Volume of cone = $\frac{1}{3}\pi r^2 h$

Volume of frustum is difference between the volumes of two cones

Transformations

G7, G8

Reflection
- Line of reflection

Translation
- Vector

Rotation
- Centre of rotation
- Angle of rotation
- Clockwise or anticlockwise

Enlargement
- Centre of enlargement
- Scale factor (if $-1 < SF < 1$ the shape will get smaller).

Similar shapes

G19

Ratios in similar shapes and solids:

• Length/perimeter	$1:n$	$a:b$
• Area	$1:n^2$	$a^2:b^2$
• Volume	$1:n^3$	$a^3:b^3$

Probability rules

P8, P9

Multiply for independent events

➔ **P(6 on dice and H on coin)**

$$\frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$$

Add for mutually exclusive events

➔ **P(5 or 6 on dice)**

$$\frac{1}{6} + \frac{1}{6} = \frac{2}{6}$$

Apply these rules to tree diagrams.

In general,...

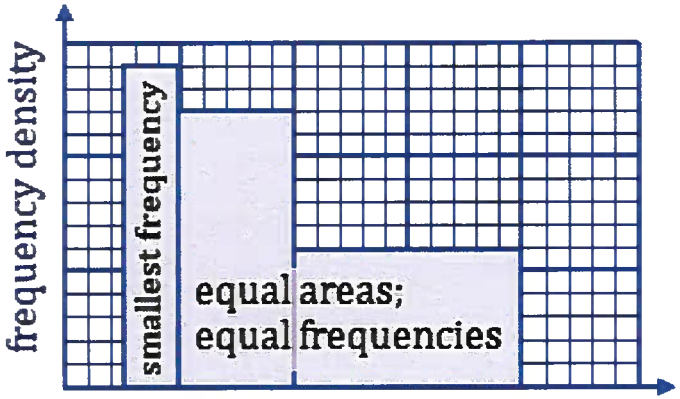
P(A or B) = P(A) + P(B) − P(A and B)

P(A and B) = P(A given B) × P(B)

Histograms

S3

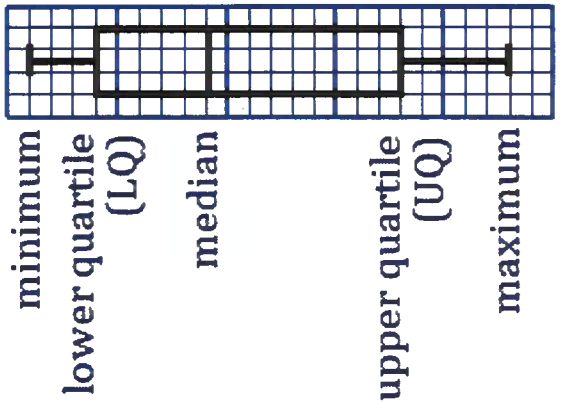
Frequency = frequency density multiplied by class width. This means that bars with the same frequency have the same area.



Box plots

S4

Interquartile range (IQR) = UQ − LQ



Year 11 Biology Knowledge Organiser
Homeostasis and Response page 1

Box 1 - Homeostasis

Homeostasis is the regulation (control) of the internal conditions of the body. It is vital for proper enzyme functioning, and indeed all cell functions. Unless chemical and physical conditions in the body are kept within strict limits, cells die. Our bodies constantly and automatically regulate the internal conditions in the body to maintain optimum functions. Some factors that need controlling by homeostasis in the human body:

- Blood glucose concentration
- Body temperature
- Water levels
- Nitrogen levels

The regulation that takes place can be carried out by the **nervous system**, the **endocrine system** (which produces hormones), or a combination of the two. These automatic control systems we use for homeostasis all include:

- **Receptor cells** – these detect changes in the environment. These changes are called **stimuli**.
- **Coordination centres** – these receive information from receptor cells (electrical or chemical information) and process the information. Examples include the brain, spinal cord and pancreas.
- **Effectors** – these are muscles or glands, which carry out the responses as directed by the control centre. Muscles **contract** and glands release chemicals, such as hormones.

Box 2 - The human nervous system

The nervous system is a network of neurones (nerve cells), bundled into nerves. It includes the nerves all over the body and the **central nervous system**, which consists of the **brain** and **spinal cord**. The nervous system allows us to react to the surroundings and control our behaviour. It can act involuntarily (in **reflexes**) or voluntarily.

Information from receptor cells, in the form of electrical impulses, passes along neurones to the central nervous system (CNS for short); the CNS coordinates the response by transmitting electrical impulses to the effectors (muscles or glands).

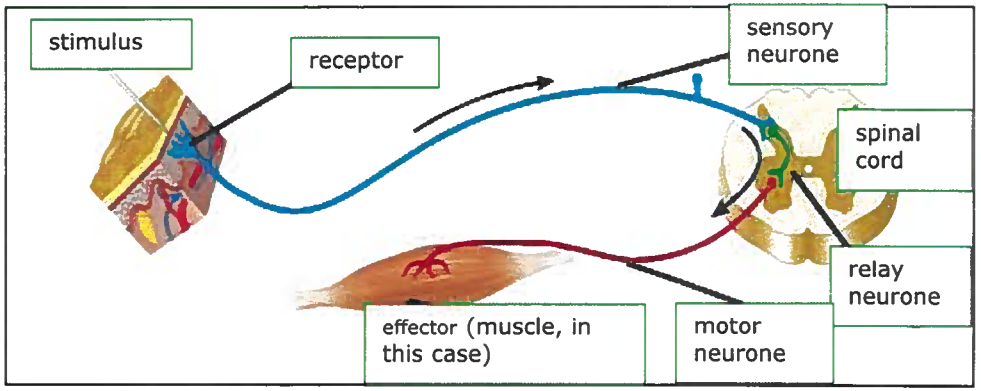
A reflex arc causes reflex actions, which are rapid and automatic (automatic because they don't involve the conscious part of the brain) and are designed to prevent harm from coming to the body.

Key Terms	Definitions
Homeostasis	The regulation of conditions inside the body (and cells) to maintain a stable internal environment in response to changes in both internal and external conditions.
Endocrine system	The network of hormone-producing glands in the body. Hormones are chemical messengers that travel in the bloodstream to their target tissues.
Stimulus	A change in the environment, detected by a receptor cell. E.g. light, sound, chemicals (smells and tastes), pressure, pain, temperature etc.
Nerve	A nerve is a collection of many nerve cells; nerve cells are called **neurones**. Neurones transmit (carry) information as **electrical impulses**.

Box 3 -The reflex arc and reflex actions

Reflex actions, for instance pulling your hand away from a pain stimulus, follow a simple pathway.

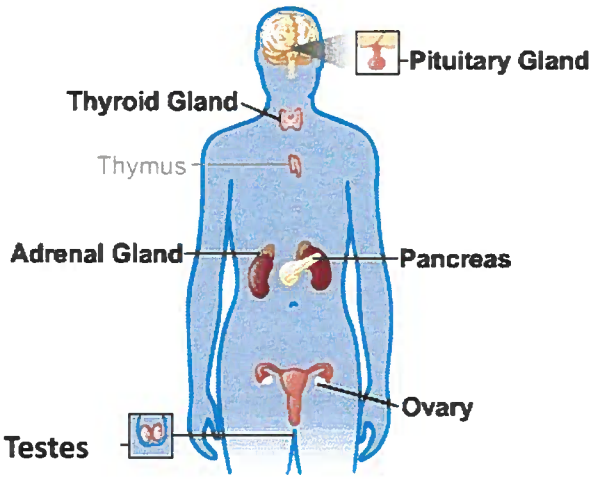
1. The **receptor** detects the **stimulus** and passes electrical impulses along the **sensory neurone** to the CNS (the spinal cord, in this case).
2. There is a junction (tiny gap) between the sensory neurone and the **relay neurone** called a **synapse**. Here, a chemical (neurotransmitter) is released that diffuses across the gap and causes an electrical impulse to pass along the relay neurone.
3. There is another synapse between the relay neurone and the **motor neurone**, again a chemical is released that causes the electrical impulse to pass along the motor neurone.
4. The impulse arrives at the **effector** – in this example, a muscle that contracts to pull your hand away from the source of pain.



Year 11 Biology Knowledge Organiser
Homeostasis and Response page 2

Box 4 - The human endocrine system

Hormones are released by endocrine glands directly into the bloodstream so they can be transported to a target organ or tissue and cause an effect. In comparison with the nervous system, the effects caused by the endocrine system are slower but act for longer. The hormones themselves are large protein molecules.



Key Terms	Definitions
Hormone	A molecule released by an endocrine gland; hormones travel in the bloodstream to a target tissues/organs and produce an effect when they reach them.
Secrete	The proper term for 'release' of a chemical in the body, such as a hormone from an endocrine gland.
Glycogen	Large chemical, made from glucose, that acts as a store of glucose in liver and muscle cells.
Pituitary gland	The 'master gland' of the endocrine system, since, through its hormone release, it controls other endocrine glands, making them release hormones.

Box 5- Controlling blood glucose concentration

Blood glucose concentration is monitored and controlled by the **pancreas**. When blood glucose concentration rises (for instance, soon after eating), the pancreas detects this and releases the hormone **insulin**. Insulin causes glucose to move from the blood into cells (such as muscle and liver cells where it is converted it to **glycogen** for storage). This *lowers* blood glucose concentration back down to normal levels.

Higher Tier: when blood glucose concentration drops too low, the pancreas detects this and releases the hormone **glucagon**. Glucagon causes muscle and liver cells to convert glycogen back into glucose and release it into the blood. This *raises* blood glucose concentration back to a normal level. This is an example of a **negative feedback loop**.

Diabetes (FT & HT)

Diabetes is when blood glucose levels are not properly maintained.

Type 1: affects young people and is not linked to lifestyle. The pancreas does not produce enough insulin, leading to high blood glucose levels.

Treated with insulin injections.

Type 2 affects older people and is linked to obesity and lack of exercise. The body does not respond to insulin.

Treated with a carbohydrate controlled diet and exercise.

Box 6 - Negative Feedback - Higher tier

Negative feedback is an important concept in homeostasis. Secretion of correcting hormones is stimulated by a change from the normal level of a condition in the body. The hormone brings the condition back under control, so its release is no longer stimulated. The level of many hormones can be controlled in this way.

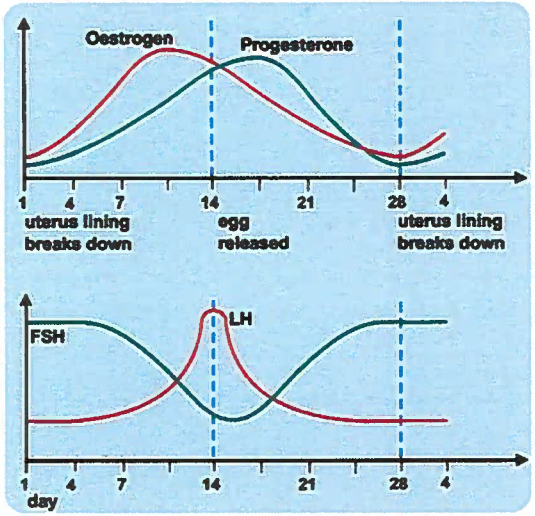
Thyroxine, secreted by the thyroid gland, is controlled by negative feedback. Thyroxine stimulates the **basal metabolic rate** – the baseline for the speed of chemical reactions in the body. This is important in growth and development.

Adrenaline is released by the adrenal glands when a person is scared or stressed. It increases the **heart rate**, increasing the delivery of oxygen and glucose to the brain and muscles. This prepares the body for 'fight or flight' – combat or running away.

Year 11 Biology Knowledge Organiser
Homeostasis and Response page 3

Box 7 - Reproductive Hormones

During puberty reproductive hormones cause secondary sex characteristics to develop.
Oestrogen is the main female reproductive hormone, it is produced in the ovary. **LH and FSH** are produced after puberty and play an important part in the **Menstrual Cycle.**
Testosterone is the main male reproductive hormone it is produced by the testes and it stimulates sperm production.



Box 8 - Reducing Fertility

Hormones can be used to reduce fertility; Contraception aims to prevent pregnancy. Natural methods are when sex is avoided during periods of fertility (abstinence). Sterilisation, where the sperm duct in the male or the oviduct in the female is cut, is a permanent method of preventing pregnancy.

Combined Pill	A pill taken daily that contains oestrogen and progesterone, preventing the production of FSH (oestrogen) and causing a thick mucus that prevents sperm from entering the uterus (progesterone). 99% effective, but can cause side effects like nausea and headache, no protection from STIs.
Progesterone only pill	This has fewer side effects than the combined pill but it is less effective.
Patches, implants and injections	These contain oestrogen or progesterone and release hormones continuously to maintain levels. They are effective as they don't rely on the person taking a tablet.
IUD	An intrauterine device, this T-shaped device is inserted into the uterus to kill sperm and prevent the implantation of the egg.
Barrier Methods	Condoms worn over the penis during intercourse prevent sperm from entering the vagina. A diaphragm is a shallow plastic cup that fits over the cervix, the entrance of the uterus forming a barrier, it is used with a spermicide gel to disable or kill the sperm.

Key Terms	Definitions
Menstrual Cycle	The 28 day female reproductive cycle where an egg is released every 28 days.
Oestrogen	It causes the lining of the uterus to grown, it stimulates (starts) the release of LH and inhibits (stops) the release of FSH.
FSH	Follicle-Stimulating Hormone - produced in the **pituitary gland** - causes an egg to mature in one of the ovaries & stimulates the ovaries to produce **oestrogen**.
LH	**Lutenising Hormone -** produced by the **pituitary gland -** stimulates the release of the egg at day 14 of the cycle.
Progesterone	Produced in the ovaries by the remains of the follicle after ovulation - maintains the lining of the uterus during the second half of the cycle. When the level of progesterone falls, the lining breaks down. (Menstruation – Period) Progesterone inhibits (stops) the release of LH and FSH.
Contraception	A method used to avoid pregnancy

Box 9 - The use of hormones to increase fertility/ treat infertility - HT

In some females the level of FSH and LH is too low to allow eggs to mature. They can be given FSH and LH to stimulate (start) ovulation. This allows females to conceive (get pregnant). It doesn't always work and may need to be repeated (making it expensive). The female may then have too many eggs produced causing multiple pregnancies.
In Vitro Fertilisation (IVF) can also be used if fertility hormones don't work, involving the fertilisation of an egg away from the body. This is an expensive process with a low success rate, this can also lead to multiple births.

1. A woman is given FSH and LH to stimulate egg maturation.
2. The eggs are collected from the mother and fertilised by sperm from the father in the laboratory.
3. The fertilised eggs develop into embryos, one or two embryos are inserted into the mother's uterus. Hopefully, they implant and the female will become pregnant.

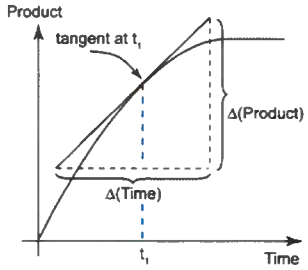
Year 11 Chemistry Knowledge Organiser
The rate and extent of chemical change page 1

Box 1 - Rate of Reaction

The rate of reaction is the speed at which a chemical reaction is happening. This can vary hugely from reaction to reaction.

The rate of reaction can be calculated either by measuring the quantity of **reactant used or the quantity of product made in a certain length of time.** The quantity can either be a volume measured in cm^3 , a mass measure in grams (g) or an amount measured in Moles (mol).

Box 2 - Measuring Rate of Reaction-Higher Tier

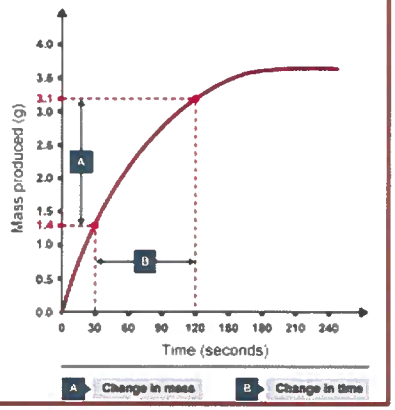


The gradient of a volume or mass/time graph will give you the rate of reaction at a specific time. However when the line is a curve you need to draw **a tangent** to measure the gradient. To draw a tangent follow the following steps

1. Line you ruler up across your graph, so that it touches the line on the point that you want to find out the gradient
2. Adjust the ruler until the space between the ruler and the curve is equal on both sides
3. Draw the line and pick two easy points that will allow you to calculate the gradient of the line.

Box 4 - Calculating the Mean Rate of Reaction - Higher Tier

To calculate the mean rate of reaction in a given time period using a graph you need to pick two y values on the graph and two x values, calculate the difference (subtract the small values from the large value) and the divide the value on the y axis by the valued on the x axis.



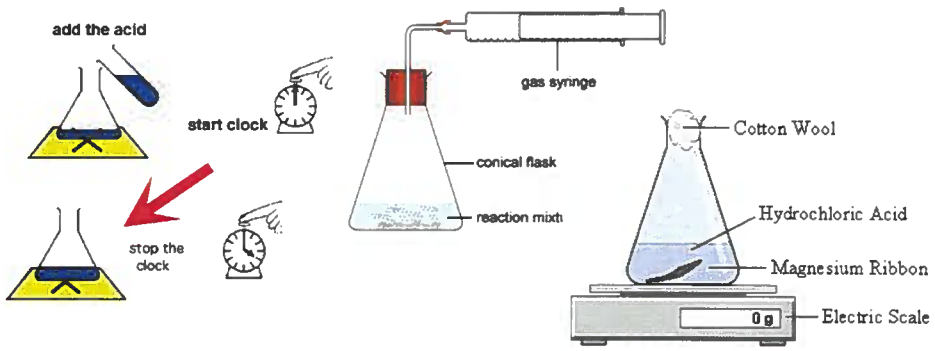
Key Terms	Definitions
Rate of Reaction	The rate at which reactants are being turned into products
Reactant	What is used in a chemical reaction
Product	What is made in a chemical reaction
Catalyst	A substance which speeds up a chemical reaction without being used up
Tangent	A straight line that touches a curve at a point

Equation	Meanings of terms in equation
Rate of Reaction= $\frac{Reactant\ used}{time}$	*Reactant used can either be measured in Moles, grams or cm^3 depending on whether it is a solid or gaseous reactant*
Rate of Reaction= $\frac{Product\ Made}{time}$	*Reactant used can either be measured in Moles, grams or cm^3 depending on whether it is a solid or gaseous product*

Box 3 - Measuring the Rate of Reaction

There are several experiments that can be used to measure the rate of a chemical reaction.

1. Measuring the mass lost in a chemical reaction (marble chips and hydrochloric acid is a good example)
2. Measuring the volume of gas produced (decomposition of hydrogen peroxide is a good example)
3. Time taken to make an X disappear, due to formation of a precipitate (sodium thiosulphate and hydrochloric acid is a good example)

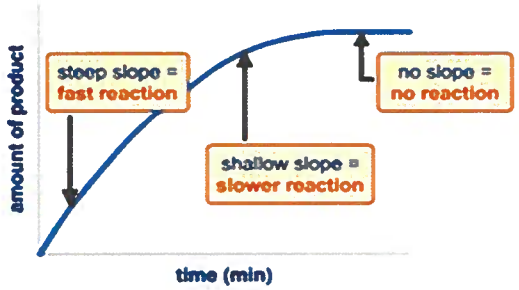


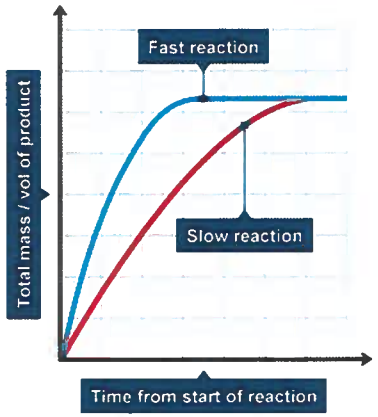
Year 11 Chemistry Knowledge Organiser
The rate and extent of chemical change page 2

Box 5 - Interpreting Rate of Reaction Graphs

The results from rate of reaction experiments can be plotted on a line graph. For example how the mass changes against time or how much gas is made against time. Different lines can be plotted for different conditions, the **steeper the gradient, the faster the reaction.**

It is important to remember that the graphs flatten off (plateau) at the same point as the same amount of reactant is being used.





Box 6 - Collision Theory

Collision Theory: reactions occur when particles **collide** with a certain amount of **energy**.

The minimum amount of energy needed for the particles to react is called the **activation energy**, which is different for each reaction.

The rate of a reaction depends on two things:

· the **frequency** of collisions between particles. The more often particles collide, the more likely they are to react.

· the **energy** with which particles collide. If particles collide with less energy than the activation energy, they will not react.

Key Terms	Definitions
Activation Energy	The minimum energy required for a chemical reaction to take place
Collision Theory	The theory that states for a chemical reaction to happen, particles must collide with sufficient energy
Gradient	The measurement of how steep a line is on a graph
Frequency	The amount of times something happens in one second
Concentration	The number of particles in a given volume

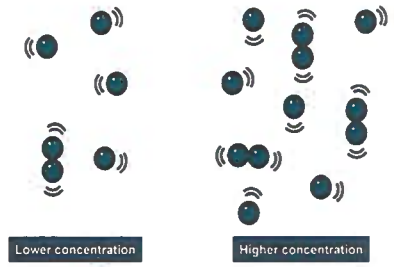
Box 7 - Factors which affect Rate of Reaction

Being able to slow down and speed up chemical reactions is important in everyday life and in industry. We can change the rate of a reaction by:

· Changing temperature
· Changing pressure (gaseous reactions)
· Changing the concentration of a solution
· Changing the surface area
· Adding a catalyst

Box 8 - Collision Theory - Concentration

If the concentration of a solution is increased then there are more particles in a given volume, therefore collisions are **more frequent** and the chemical reaction is faster. Concentration **is directly proportional** to rate of reaction (if you double the concentration you double the rate).



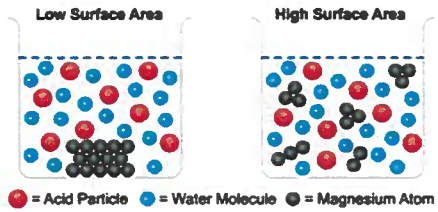
Year 11 Chemistry Knowledge Organiser
The rate and extent of chemical change page 3

Box 9 - Collision Theory - Temperature

When you increase the temperature of something the particles will move around faster, this increases the **frequency of the collisions.** As well as that, as the particles are moving faster the particles collide with more energy making it more likely that collisions exceed the **activation energy.**

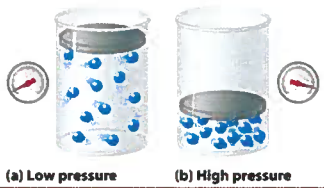
Box 10 - Collision Theory - Surface Area

When you increase the surface area of a solid (you cannot increase the surface area of a liquid or gas). You increase the number of particles that are available for collision, therefore increasing the frequency of collisions therefore increase the rate of reaction.



Box 11 - Collision Theory - Gas pressure

If the reaction is carried out in the gaseous state, then increasing the pressure will increase the rate of reaction. If there are more particles in a given volume of gas, then collisions will be more frequent and therefore the reaction will be faster.

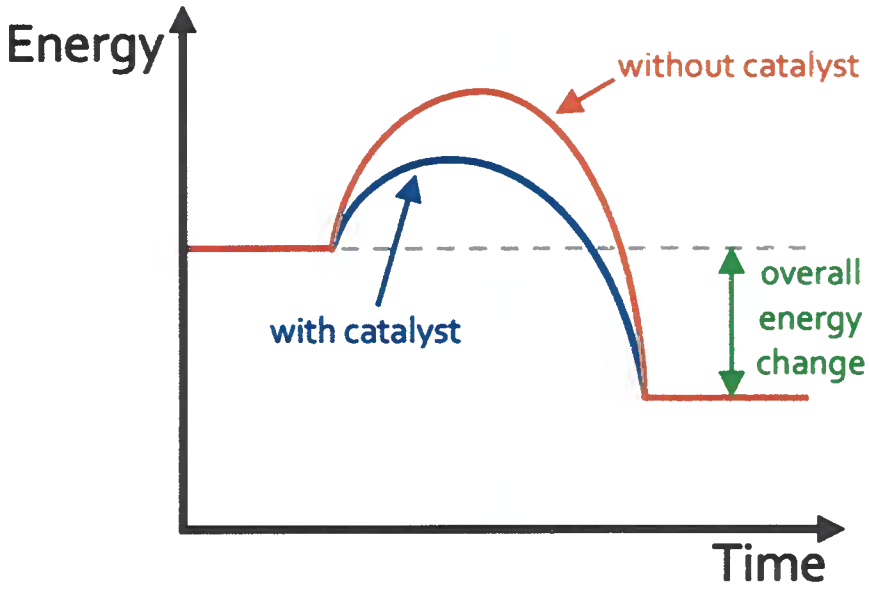


Key Terms	Definitions
Enzymes	A biological catalyst
Reaction Profile	A graph which show the energies of the reactants and products at different stages of the chemical reaction

Box 12 - Collision Theory - Catalysts

A catalyst is a substance which speeds up a chemical reaction without being used up. It speeds up a reaction because it **lowers the activation energy** needed for the reaction, by providing an alternative reaction pathway and this means that there are more **successful collisions and a faster reaction.**

The effect of a catalyst is shown on the reaction profile below:



Catalysts are not included in a chemical equation as they are not used up in a chemical reaction.

Box 13 - Enzymes

Enzymes **are biological catalysts**, they speed up chemical reactions in biological systems for example in digestion in animals. Unlike catalysts enzymes have an optimum temperature where they work best, this is usually around 37.

Year 11 Chemistry Knowledge Organiser
The rate and extent of chemical change page 4

Box 14 - Reversible reactions

In some chemical reactions, the products of the reaction can react together to produce the original reactants. These reactions are called reversible reactions. They can be represented in the following way:

$$A + B \rightleftharpoons C + D$$

The symbol ⇌ has two half arrowheads, one pointing in each direction. It is used in equations that show reversible reactions:

- the forward reaction is the one that goes to the right
- the backward reaction is the one that goes to the left

The reaction mixture may contain reactants and products, and their proportions may be changed by altering the reaction conditions.

Box 15 - Ammonium chloride

Ammonium chloride is a white solid. It breaks down when heated, forming ammonia and hydrogen chloride. When these two gases are cool enough, they react together to form ammonium chloride again.

This reversible reaction can be modelled as:

ammonium chloride ⇌ ammonia + hydrogen chloride

$$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$$

Box 16 - Energy changes in reversible reactions

If a reaction is exothermic in one direction, it will be endothermic in the other direction. The same amount of energy is transferred in both the forwards and reverse reaction.

Copper sulfate

Blue copper sulfate is described as hydrated. The copper ions in its crystal lattice structure are surrounded by water molecules. This water is driven off when blue hydrated copper sulfate is heated, leaving white anhydrous copper sulfate. This reaction is reversible:

hydrated copper sulfate ⇌ anhydrous copper sulfate + water

$$CuSO_4.5H_2O(s) \rightleftharpoons CuSO_4(s) + H_2O(l)$$

The forward reaction is endothermic and the reverse reaction is exothermic.

Key Terms	Definitions
Reversible	A chemical reaction which can go both ways.
Anhydrous	A substance containing no water.
Hydrated	Containing water of crystallisation, which can be removed by heating strongly.

Box 17 - Dynamic equilibrium

When a reversible reaction happens in a closed container, it reaches a dynamic equilibrium. At equilibrium:

- the forward and backward reactions are still happening
- the forward and backward reactions have the same rate of reaction
- the concentrations of all the reacting substances remain constant

1. Hydrated copper sulfate is heated.

2. Water is driven off

3. Water is added to anhydrous Copper sulfate

4.Hydrated copper sulfate reforms

Year 11 Chemistry Knowledge Organiser
The rate and extent of chemical change page 5

Box 18 - Chemical reactions are reversible and may reach a dynamic equilibrium in a closed system. The position of equilibrium of a reversible reaction can be altered by changing the reaction conditions. The equilibrium position of a reversible reaction is a measure of the concentrations of the reacting substances at equilibrium.

Box 19 - Background to the Haber process

Nitrogen gas is reacted with hydrogen gas to make ammonia gas. The forward reaction is exothermic.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The equilibrium position is:

- to the left if the concentrations of N_2 and H_2 are greater than the concentration of NH_3
- to the right if the concentration of NH_3 is greater than the concentrations of N_2 and H_2

Key Terms	Definitions
Equilibrium	In chemical reactions, a situation where the forward and backward reactions happen at the same rate, and the concentrations of the substances stay the same.
Equilibrium position	A measure of the relative concentrations of substances in an equilibrium, showing if there are more reactants or products at equilibrium.

Box 20 - Le Chatelier's principle

The equilibrium position changes due to the following reaction conditions:

- changing the pressure
- changing the concentration
- changing the temperature

When a change is made to a system at equilibrium, **the position of equilibrium moves to counteract the change that was made**.

For example, if the **temperature is increased**, the position of equilibrium moves in the direction of the endothermic reaction, **reducing the temperature**.

Box 21 - Changing the concentration

If the concentration of a reactant (on the left) is increased, the equilibrium position moves in the direction away from this reactant, and so more of the products are produced (on the right). If one of the products is removed from a reaction (on the right), then the position of equilibrium moves to the right to make more of that product.

Box 22 - Changing the pressure

If the pressure is increased in a reaction involving gases, the equilibrium position moves in the direction of the fewest molecules of gas, to reduce the pressure. There are fewer molecules on the right-hand side of the equation for the Haber process:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

$$1 + 3 = 4\ molecules \qquad 2\ molecules$$

If the pressure is increased, the equilibrium position moves to the right.

Box 23 - Changing the temperature

In a reversible reaction, if the reaction is exothermic in one direction, it is endothermic in the other direction. If the temperature is changed, the dynamic equilibrium position moves in the direction of the reaction that will reverse the change.

For example, in the Haber process:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(forward reaction is exothermic, reverse reaction is endothermic)

If the temperature is increased, the endothermic reaction is favoured – here, the reverse reaction, so the equilibrium position moves to the left and the temperature is reduced (endothermic reactions absorb energy). This means that less ammonia (NH_3) is produced.

Year 11 Physics Knowledge Organiser
Forces I page 1

Box 1-Scalar and vector quantities

Scalar quantities have **magnitude** (size) only.

Vector quantities have **magnitude and direction**. Vector quantities are represented using arrows.

Scalar quantities (units)	Vector quantities (units)
Distance (m)	Displacement (m)
Speed (m/s)	Velocity (m/s)
Temperature (°C)	Momentum (kg m/s)
Mass (kg)	Acceleration (m/s^2)
	Forces (N)

Box 2 - Contact and Non-contact Forces

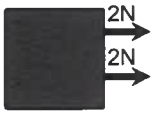
Forces are always the result of objects **interacting** with each other. All forces can be classified as contact or non-contact forces.

Contact forces – forces act when interacting objects are touching.
Non-contact forces – forces act when interacting objects are not touching

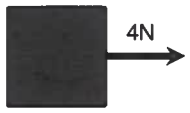
Contact forces	Non contact forces
Friction	Gravity
Air resistance	Electrostatic force
tension	Magnetic force
Normal contact force	

Box 3 -The Resultant Force

In real life, there are usually several forces acting on any given object. The resultant force is the term used for the overall force, when all the forces are taken into account. It's used to determine how an object will move (see Newton's 1st and 2nd Laws). All the forces are shown with vectors (arrows – see above), the resultant force replaces multiple force arrows with just one arrow, which has the same effect on the object as all the other forces acting at once:



Two forces are acting in the same direction:
resultant force is determined by adding the two forces
eg 2N right + 2N right = 4N right



Two forces are acting in opposite directions:
resultant force is determined by subtracting one force from the other
eg 6N left – 2N right = 4N left

Key Terms	Definitions
Scalar quantity	Describes quantities that only have a magnitude (size). E.g. speed (how fast something is moving).
Vector	A quantity with both a size (magnitude) and a direction; vectors can be represented with arrows. E.g. velocity (how fast in a given direction)
Force	Forces are pushes or pulls that act on an object. Forces have size and direction so are vector quantities. Forces are the result of objects interacting with each other.
Contact forces	For these forces to act, the interacting objects have to be physically touching.
Non-contact forces	For these forces to act, the interacting objects don't have to be touching (they are physically separate).
Resultant force	The single overall force acting on an object. It has the same effect as all the forces acting on the object all together.

Box 4 - Resultant Force continued

If the forces acting on an object are equal in magnitude and opposite in direction, then the resultant force is ZERO. You can say the forces are balanced.

Resultant force = '0' (the forces cancel out), the object will keep doing what it was doing – either stationary (not moving at all), or moving along at a constant (steady) speed. Zero resultant force means the direction can't change.
If there is a resultant force, the object's speed will change; or the shape of the object will change; or the direction of the object will change.

HT – You also need to be able to resolve forces – see higher tier – next page

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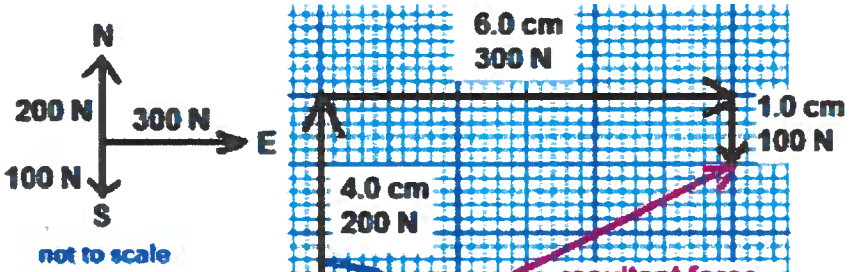
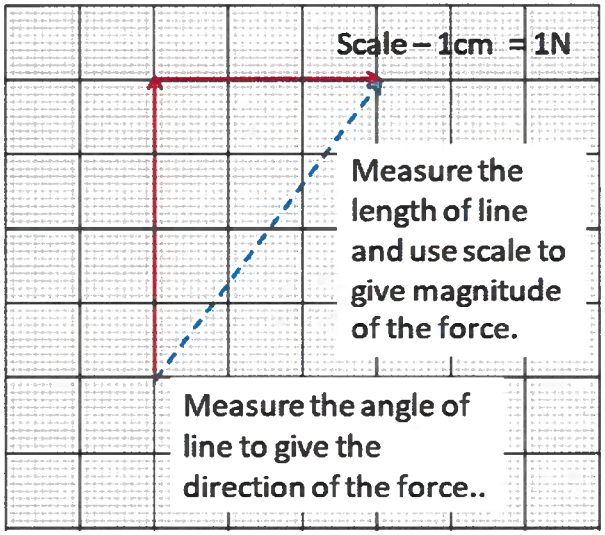
Box 5 – Resolving forces

- The resultant force is easy to calculate where the individual forces are in the same plane (i.e. individual forces are all horizontal or all vertical): add the forces up, considering the signs of the forces – See page 1, Box 3
- Example 1 and example 2 – The force arrows are drawn tail to tip. The shape is completed by the resultant force (dotted arrow in example on the left and and pink arrow in example 2 on the right)

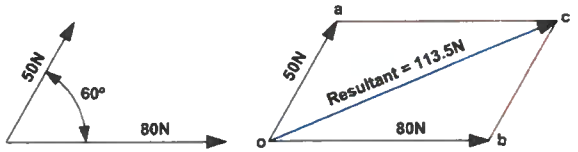




Key terms	Definitions
Vector	A quantity with both a size (magnitude) and a direction; vectors can be represented with arrows.
Force	An interaction between two objects that leads to the objects pushing or pulling on one another
Resultant force	The single overall force acting on an object, which has the same effect as all the individual forces combined. Resultant force is the sum of the individual forces.
Parallelogram	A quadrilateral with two sets of parallel sides (including rectangles)
Resolve	To carry out the process of splitting a force vector that acts at an angle into vertical and horizontal components

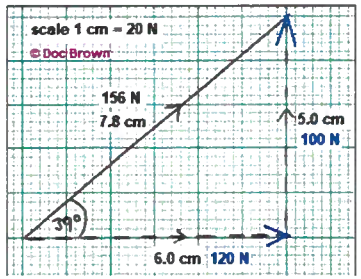
Box 6 – Resolving forces

- If the individual forces are at any angle to each other besides 180°, the **parallelogram rule** is useful: draw a parallelogram using the force arrows; the resultant force is the **diagonal** of that parallelogram.



Parallelogram of Forces

- You can also go the other way: if a resultant force is shown at some angle from the horizontal/vertical, it can be **resolved** into a vertical component and a horizontal component. See example below.



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Box 7 - Work Done and Energy Transfer
Whenever work is done, it means that energy has been transferred (in other words, energy has transferred from one store to another store). Work is always done when a force acting on an object causes an object to move a distance.
The amount of work done can be calculated using the equation:
Work done = Force x Distance - See equation

For example, a force of 1000 N makes this car move 200 m to the left

The work done is calculated by: *W* = 1000 x 200 = 200 000 J
This means 200 000 J of energy was transferred.

Box 8 - Work Done Against Frictional Forces
When objects move, they are almost always moving *against* frictional forces – so the friction arrow is opposite to the direction of motion.
Doing work against frictional forces causes an energy transfer to the thermal store of the object, which raises the temperature of the object (and the surrounding air!). For example, brakes get hotter when used to slow down a car.

Remember, there are frictional forces even when an object moves through the air – often this is called air resistance (but it's just a type of friction).

Box 9 - The Joule
The joule (J) is the unit for energy, and also the unit for work done. It has a particular definition, based on the equation for work done. 1 Joule = 1 Newton metre.
This means that 1 J is the amount of work done when a force of 1 N causes an object to move 1 m.
This is because ***Work done = Force x distance,*** so 1 J = 1 N x 1 m

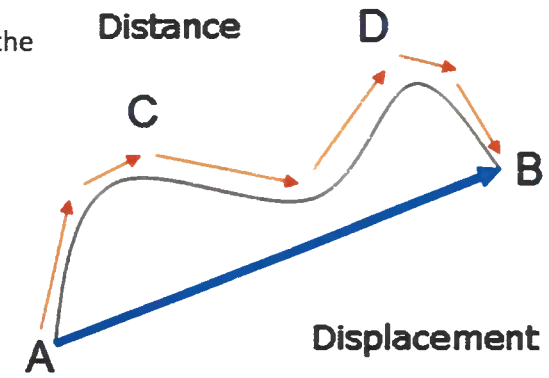
Box 10 - Distance vs. Displacement
Distance is a measure of how far an object moves. It is a **scalar** quantity.
Displacement is a **vector** quantity and is always measured in a straight line from start to end of a journey and includes the direction the object travelled, often given as a compass bearing in degrees. See the diagram in Box 11.

Key Terms	Definitions
Work done	The measure of how much energy is transferred when a force makes an object. You can say: 'a force does work on an object when it makes it move'. Doing work always involves the transfer of energy. This is a scalar quantity.
Distance	How far an object moves. It does not include direction , so distance is a scalar quantity.
Displacement	The distance and direction an object moves in a straight line from where it started to where it stops. This is measured in metres. It is a vector quantity, because it includes the direction an object moved.
Friction	A contact force that results when two objects move past each other. They have to be touching.

Equation	Meanings of terms in equation and units
Work done = force x distance W = F s	*W = work done (joules, J)* *F = force (newtons, N)* *s = distance (metres, m) – aka displacement*

Box 11 - Distance vs. Displacement Diagram
Displacement = straight line from A to B.
e.g. 50m Direction NE. (North East)

Distance is the total length of the journey, with visits to C and D during the journey.
e.g. 85m



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Box 12 - Weight

Mass measures how much material there is (in kg) in an object.

Weight measures the **force** acting on an object due to gravity. The force of gravity close to Earth is due to Earth's **gravitational field.**

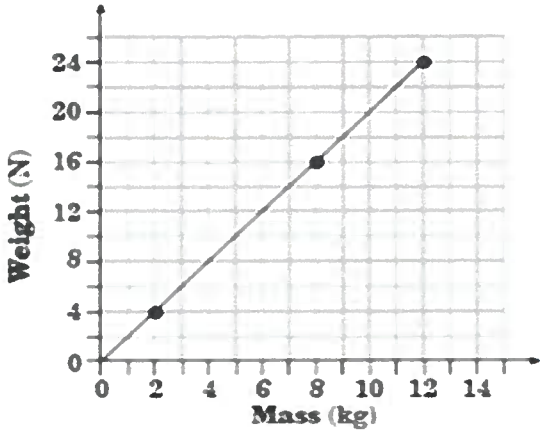
The weight of an object depends on the gravitational field strength at the point where the object is.

Weight can be calculated.

Weight = mass x gravitational field strength

W = m g

Weight and mass are directly proportional.

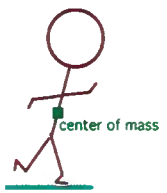


We can show this as:

W ∝ m, using the symbol for a directly proportional relationship.

Box 13 - Centre of Mass

When drawing force diagrams we show the weight (or other forces) acting on just a single point on the object. This is the exact centre of a symmetrical object (it will be more complicated for an asymmetrical object), and is called the **centre of mass**. Centre of mass is the point where we consider weight to act: as a result, force arrows should start on the centre of mass.



Key Terms	Definitions
Weight	Weight is a **force** (hence, it is a vector quantity), caused by gravity acting on a mass. Since it is a force, it is measured in newtons.
Mass	Mass measures the amount of material in an object, and is measured in kilograms (kg).
Gravitational field strength	The measure of how strong the gravitational field of a large object is. For instance, the gravitational field strength on Earth is about 10 N/kg. This means that a weight of 10 N acts on each kg of mass on Earth.
Centre of mass	The point at which the weight of an object is considered to act – the 'middle' of the object's mass.
Newtonmeter	A device to measure weight. It simply consists of a spring and a calibrated scale.

Equation	Meanings of terms in equation
Weight = Mass x Gravitational field strength W = m g	*W = weight (newtons, N)* *m = mass (kilograms, kg)* *g = gravitational field strength (newtons per kilogram, N/kg) – on Earth, this is 9.8 N/kg*

Box 14 - Measuring Weight

Weight can be measured using a **calibrated** spring balance – a **newtonmeter.** This can be a mechanical or digital newtonmeter.

A calibrated spring is a spring with a scale to show far much it has stretched

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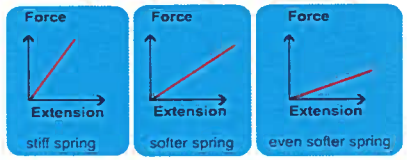
Box 15 Forces and Elasticity

Elastic objects are objects that return to their original shape when a deforming force is removed.
Elastic potential store is the energy stored by an object that is under **elastic deformation**. Think of a stretched rubber band – it isn't doing anything, but if you release it the stored energy is transferred to kinetic store, so you can fire it at someone.

Box 16 - Force and Extension/Compression

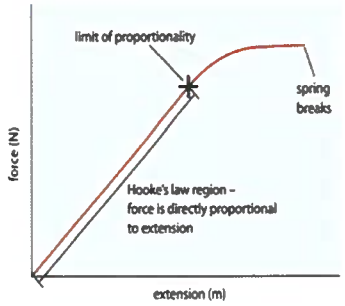
The extension of an elastic object, like a spring, is directly proportional to the force applied to it, provided the limit of proportionality of the spring is not exceeded. This also works with the compression of an object –'*e*' just means the amount of compression.
The **spring constant** measures how much extension you get for your force. A large spring constant means it won't stretch far compared to a spring with a small spring constant, if the same force is applied (see examples above). The spring constant can be calculated from the gradient of a graph of force against extension.



When force is applied to a spring, it moves a distance, so **work is done.** In other words, energy is transferred. The energy gets stored in the spring (or elastic object) in the **elastic potential store *(E_e)***. The amount of elastic potential energy is calculated by the equation shown on the right. If an object has been elastically deformed, the work done on the object and the energy store by the object are the same.

Box 17 – Limit of Proportionality

On graph showing force against extension, you can see when the limit of proportionality is reached by looking at where the graph starts to curve. (Labelled x on this example).



Key Terms	Definitions
Elastic deformation	Deformation (bending, stretching or compressing an object) is elastic if the object returns to its original shape once the force is removed
Deformation	Bending, stretching or compressing an object
Extension	The change in length of an object such as a spring. Subtract length when NO force is applied from the length when a force is applied.
Directly proportional	This term describes a type of relationship between two variables. It is shown by a straight line on a graph that goes through the origin.
Limit of proportionality	The limit of a directly proportional relationship. It can be shown on a graph if the line is straight to being with (indicating a directly proportional relationship) then curves.
Linear relationship	Simply, a relationship between two variables that is graphed as a straight line.
Non-linear relationship	A relationship between two variables that is shown with a curved line on a graph.
Gradient	The gradient of a graph is how steep it is. Calculate gradient by dividing the change in the variable on the y-axis by the change in the variable on the x-axis.

Equation	Meanings of terms in equation
Force = spring constant x extension $F = k e$	*F = force (newtons, N)* *k = spring constant (newtons per metre, N/m)* *e = extension (metres, m)*
Elastic potential energy = 0.5 x spring constant x extension² $E_e = 0.5 k e^2$	*E_e = elastic potential energy (joules, J)* *k = spring constant (newtons per metre, N/m)* *e = extension (metres, m)*

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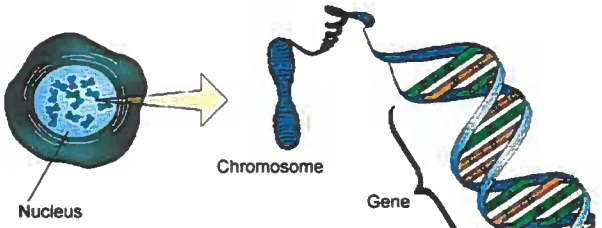
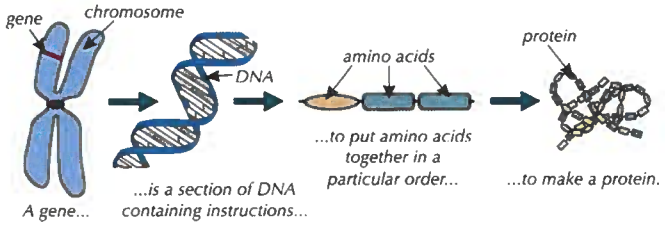
Box 1 - DNA

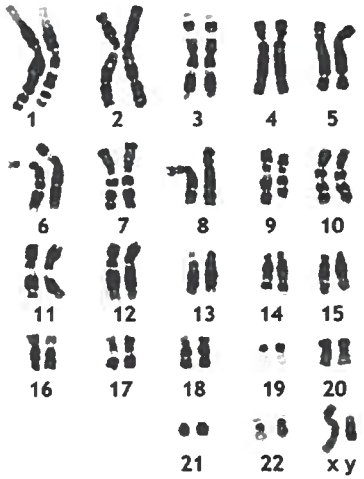
The genetic material in the nucleus of a cell is made of a chemical called DNA. It is a polymer (a very long molecule made up of monomer units that repeat over and over) with two strands that form a spiral called a **double helix.** The DNA contains coded information which are the instructions for the organism. This includes its structure, and all chemicals it needs to function.

DNA is contained in **chromosomes** which are located in the nucleus of cells. Most cells contain a pair of each chromosome. For example, human body cells contain 23 pairs of chromosomes – so 2 of chromosome number 1, 2 of chromosome number 2 etc.

A **gene** is a small section of DNA found on a chromosome. Each **gene** codes for (tells the cell to make) a particular sequence of amino acids which are put together to make a specific protein. There are 20 amino acids that can be used, but they can make up thousands of proteins depending on the order that they are assembled. For example, the **gene** or code for making the hormone insulin (a protein) is different to the **gene** or code for making the enzyme lipase (a protein). The two proteins contain different amino acids in different orders because the genes are different. The DNA in the gene determines the order that the amino acids are assembled when the cell makes new protein.







Key Terms	Definitions
DNA	The chemical that makes up the genetic material in all cells. DNA is a polymer and arranged as a double helix.
Double helix	A double-stranded spiral
Chromosome	Structure in cells containing DNA. Body cells contain two copies of each chromosome – one that originated from the mother and the other that originated from the father.
Gene	A section of DNA found in a chromosome that codes for a specific protein
Genome	The entire (whole) genetic material of an organism

Box 2 - The genome

A genome is the entire set of genetic material in an organism. The human genome has been fully sequenced, so we know exactly the order of genes on each chromosome.
The micrograph shows the 23 pairs of chromosomes found in human body cells, where pair 23 is the sex chromosomes (XY in this person).

Understanding the human genome is very useful for science and medicine for many reasons, including:

- Identifying genes in the genome linked to different types of disease
- Understanding which genes are linked to inherited diseases could help us to understand them better and help develop effective treatments for them
- Tracing human migration patterns from the past. All modern humans descended from a common ancestor who lived in Africa and now have tiny differences in their genomes which can be traced to understand when and how populations split off in a different direction.

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Box 3 - Types of reproduction

There are two types of reproduction: sexual and asexual.

- **Sexual reproduction** involves <u>two</u> parents. Mixing of genetic information occurs as the male and female gametes (produced during meiosis) fuse which leads to genetic variety in offspring. The offspring inherit 50% of the genetic information from each parent and will exhibit characteristics of both parents. The offspring is *genetically unique*.
- **Asexual reproduction** involves only one parent and there is **no** fusion of gametes. There is **no** mixing of genetic information. This leads to *genetically identical* offspring (they are **clones**). No meiosis takes place (since there are no gametes); only mitosis is involved.

Box 4 - Meiosis

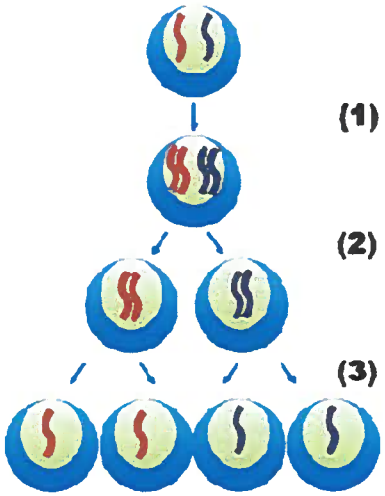
Meiosis and **mitosis** are both types of cell division. **Mitosis** is carried out by cells for growth and repair. Cells produced are genetically identical to the original (parent)

Meiosis takes place in **reproductive organs** and results in the formation of **gametes**. Gametes are sex cells. The female gamete is the **egg cell** (in animals and plants). The male gamete is the **sperm cell** in animals and **pollen** in plants. Cells produced are genetically different to the parent cell.

In all body cells, the chromosomes appear in pairs (in humans, there are 23 pairs, so 46 chromosomes altogether). Red blood cells are the exception as they have no nucleus and therefore no DNA.
Gametes contain **half** the number of chromosomes of body cells, since they contain one from each chromosome pair. In humans, this means that each gamete contains 23 single chromosomes.

When a cell divides to form gametes:

- Copies of the genetic information are made – each chromosome doubles (1)
- The cell divides twice (2) and (3) to form four gametes, each with a single set of chromosomes
- All gametes are genetically different from each other (3) and from the parent cell. They are non-identical.
- Each gamete contains half the number of chromosomes of the parent cell.

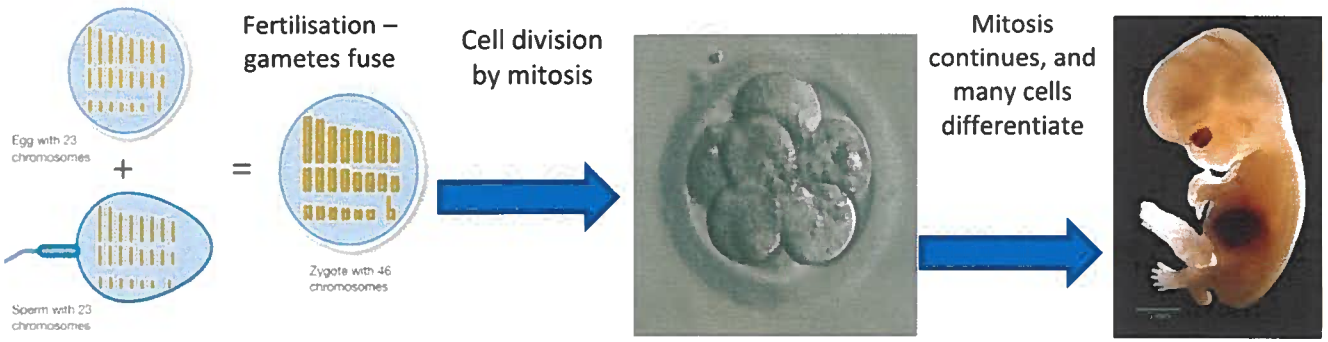


Gametes made during meiosis

Key Terms	Definitions
Reproduction	Making offspring. All organisms reproduce.
Reproductive organs	Meiosis to form gametes takes place in testes and ovaries in animals, and anthers and ovaries in flowering plants.
Offspring	Offspring is a generic term for children – it applies to any type of organism.
Gametes	Sex cells, such as pollen, egg cells, sperm cells. Gametes are produced by meiosis.
Meiosis	Type of cell division that produces gametes.
Fusion	The joining/fusing of gametes in sexual reproduction.
Differentiation	The process of becoming a specialised cell. Specialised cells are the result of differentiation of **stem cells**.
Clone	An organism that is genetically identical to another organism

Box 5 - Fertilisation

- The **fusion** (joining) of male and female gametes. When the gametes fuse, their nuclei (each containing half the number of chromosomes) join together into one and the genetic information is combined, so that the cell formed has a full set of chromosomes (in pairs again) – This is 46 chromosomes (23 pairs) in humans.
- The new cell divides by mitosis to make a copy of itself. Mitosis repeats many times to produce many new cells in an embryo. As the embryo develops, these cells start to differentiate into specialised cells that make up a whole organism.



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Box 6 - Genetic inheritance

The genes you inherit from your parents control what characteristics you develop. Different genes (on different parts of the chromosome) control different characteristics. Different versions of each gene are called **alleles**. During fertilisation, two gametes (each containing single chromosomes and therefore single alleles) fuse. The fertilised egg will have 2 alleles for each characteristic – one inherited from the mother and one from the father.
Most characteristics are determined by genes interacting, but some characteristics are determined by a single gene, or rather, the two alleles of a single gene. For example fur colour in mice and re-green colour blindness in humans. In genetic diagrams, letters are used to represent alleles.

The alleles present in an individual organism, or genotype, operate at a molecular level to develop characteristics that can be expressed as phenotype.

E.g. Cat fur length. Allele for short fur is dominant (F). The allele for long fur is recessive (f)
In picture 1, both parents are homozygous dominant (genotype: FF). This means all the gametes they produce will all contain the allele F for short fur. , At fertilisation the only possibility is for the offspring to have **genotype** FF. So all their offspring have the short fur **phenotype**.

In picture 2, both parents have long hair, so have the genotype ff (homozygous recessive). Gametes produced all have the f allele, so all their offspring must have long hair too. (ff)

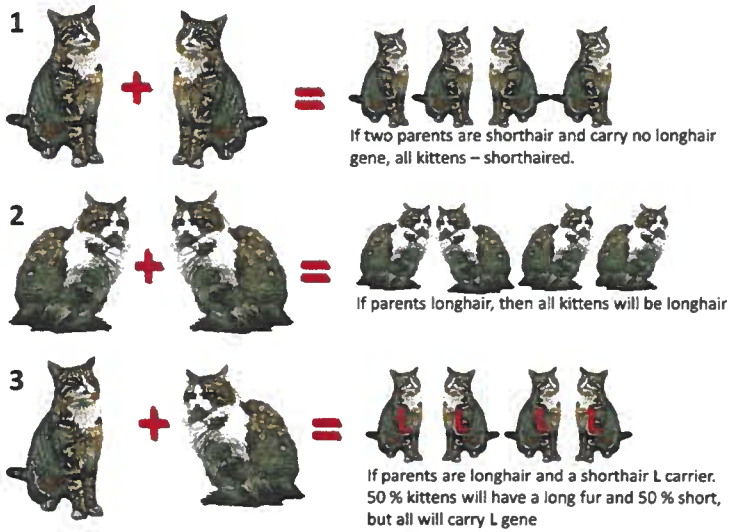
In picture 3, the first parent has short hair but is heterozygous (genotype: Ff) – so they produce gametes with either F or f allele. When they mate with a long hair cat (ff), the offspring will have genotypes either Ff or ff. Half of them will have short hair (with genotype Ff) and half will have long hair (with genotype ff).

Box 7 - Probability and ratios

Knowing the genotypes of the parents allows you to work out the **probability** of each genotype (and therefore phenotype) in the offspring. It does not guarantee, like in the bottom cat example, that they'll have four kittens, or that half will have long hair. What it tells us is: for each kitten, there is a 50% chance of it having long hair.

The other way of saying this is that the **expected ratio** of offspring genotypes is 1:1 for long:short hair. So if the bottom two cat parents had 50 kittens, we'd expect 25 of each hair length.

Key Terms	Definitions
Allele	A form or version of a gene. E.g. the gene for eye colour has 2 alleles, brown and blue
Express	In genetics, to 'express' a gene means for it to be used by the body to make a protein, causing a characteristic.
Dominant	A dominant allele is always expressed, even if only one copy is present. A capital letter is used to represent the allele e.g. D.
Recessive	A recessive allele is only expressed if two copies are present. A lower case letter is used to represent the allele e.g. d.
Genotype	The alleles present for a characteristic. Often represented with two letters: e.g. DD, Dd or dd.
Phenotype	The physical characteristic that results from a particular genotype.
Trait	Another word for characteristic.
Homozygous	Describes a genotype where both alleles are the same – e.g. DD is homozygous dominant; dd is homozygous recessive.
Heterozygous	Describes a genotype where the two alleles are different (one dominant, one recessive) – e.g. Dd.



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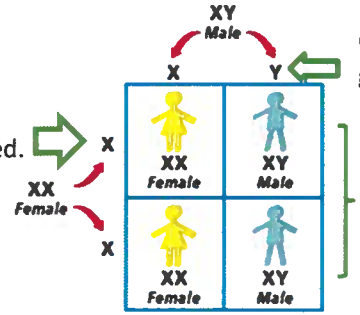
Box 8 - X and Y Chromosomes

There are 23 pairs of chromosomes in every human body cell. 22 pairs control body characteristics and the 23rd pair determines sex – whether the offspring is male or female. The 23rd pair can be XY or XX
Males have an X and a Y chromosome, XY – the Y chromosome causes male characteristics.
Females have 2 X chromosomes, XX.

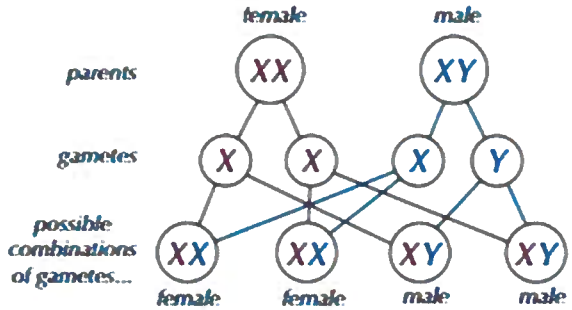
During meiosis to form gametes in males, the 23rd pair (XY) get separated. Half of the sperm cells formed by meiosis will carry single X chromosomes and the other half will carry single Y chromosomes. All eggs formed by meiosis in females will carry a single X chromosome.
On fertilisation when the gametes fuse and the chromosomes pair up, there is a 50% chance that the offspring will be male (XY) and a 50% chance the offspring will be female. The Punnett square diagram below shows this. The genetic diagram also shows possible offspring genotype.

On the side, the possible female gametes are placed.



On the top, the possible male gametes are placed.

The possible combinations are shown inside the squares. The ratio of female:male is 2:2, simplifying to 1:1.



Box 9 - Genetic crosses, Punnett Squares and Ratios

It is possible to calculate ratios of **possible** genotypes and phenotypes in specific genetic crosses by using Punnett squares. Possible offspring genotypes are shown in the highlighted coloured squares.
Using the fur length in cats from the previous page as examples, remember the allele for short fur is dominant, shown by F, and the allele for long fur is recessive shown by f

1. Genetic cross – one homozygous dominant parent and one homozygous recessive parent (FF x ff)

		Gametes	
		f	f
Gametes	F	Ff	Ff
	F	Ff	Ff

Genotype of offspring: 100% heterozygous
Phenotype of offspring: All short fur

2. Genetic cross – two heterozygous parents

		Gametes	
		F	f
Gametes	F	FF	Ff
	f	Ff	ff

Genotype of offspring: 25% homozygous dominant: 50% heterozygous: 25% homozygous recessive (1:2:1)
Phenotype of offspring: ratio of short fur to long fur:
75% : 25% or 3:1

3. Genetic cross – one homozygous dominant parent and one heterozygous parent

		Gametes	
		F	f
Gametes	F	FF	Ff
	F	FF	Ff

Genotype of offspring: 50% homozygous dominant: 50% heterozygous (1:1)
Phenotype of offspring: All short fur

<u>Don't forget:</u> Punnet squares allow us to make predictions – sometimes nature doesn't always follow maths! Practice yourself: genetic cross Ff x ff. What are the ratios?

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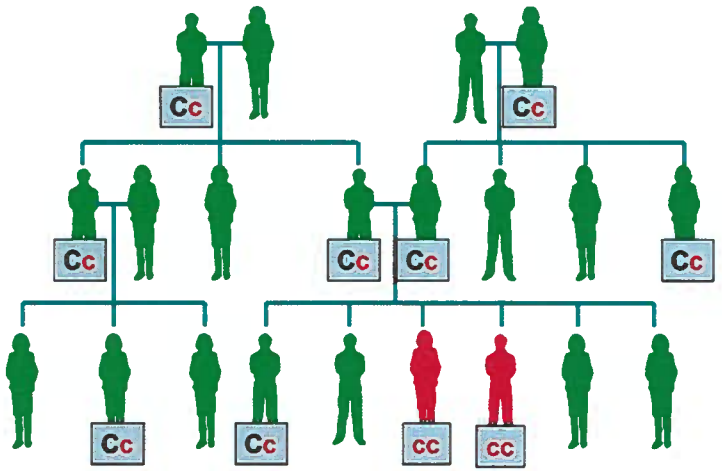
Box 10 - Inherited disorders

A genetic disorders is a disorder caused by the inheritance of certain alleles., which can be passed on to an individual's offspring.
Two examples to know:

- **Polydactyly**: a condition where people have extra fingers or toes. This is caused by a dominant allele, so only one copy of the allele is needed to have the condition.
- **Cystic fibrosis**: a disorder of cell membranes, leading to thick and sticky mucus being produced in the lungs and intestines. It is caused by a recessive allele (c), so individuals with cystic fibrosis are all homozygous recessive (cc). As the allele for cystic fibrosis is recessive, heterozygous individuals are healthy **carriers** of the allele. If both parents are carriers of the recessive allele (Cc), there is a 1 in 4 chance of the child having cystic fibrosis.

Studying family trees can help genetic scientists decide whether a disorder is caused by a recessive or dominant allele. In the family tree shown, C is the allele for healthy cell membranes, and c is the allele for disordered cell membranes (cystic fibrosis). Both parents must have at least one c to have children with cystic fibrosis, as the family tree shows



Cc – heterozygous carrier

cc – homozygous recessive – person with cystic fibrosis

CC – where no genotype is shown

Key Terms	Definitions
Screening	The practice of checking for a disease or an inherited disorder.
Carrier	An individual with one copy of the recessive allele that causes an inherited disorder (e.g. Cc for the cystic fibrosis genotype). As a result, they don't have the disorder, but they can pass one allele for it onto their offspring.
Genetic cross	A term given to mating between two individuals, producing offspring.
Punnett square	A tool used to predict the outcome of a genetic cross.

Box 11 - Embryonic Screening

Embryonic screening is a way of detecting inherited disorders, such as cystic fibrosis, by checking for the presence of these known alleles, either in embryos produced during IVF, before they are implanted, or from the placenta of an embryo already in the mother's uterus.
Screening can be used to inform whether an embryo should be implanted in the uterus (IVF), or, if used during pregnancy, to decide whether a termination should take place.
There are arguments for and against embryonic screening and can be divided into 3 groups, economic (£), social (S) and ethical (E).

For	Against
Helps to stop people suffering from certain disorders as if termination or non-implantation is chosen, less people will be born with inherited disorder (E)	Screening embryos is expensive (£), so no available to everyone because of cost (S)
Could reduce healthcare costs associated with treating disorders (£)	Risk of miscarriage when screening embryos already in the mother's uterus (E)
If an inherited disorder is diagnosed in a pregnancy, then the parents have the choice to have a termination (E)	Implies that people with genetic disorders are less desirable within society (S)

Year 11 Chemistry Knowledge Organiser
Organic Chemistry page 1

Box 1 - Crude Oil

Crude oils is a mixture of chemicals called hydrocarbons.

- These are compounds that contain **hydrogen and carbon atoms only. It is made from ancient sea creatures, mainly plankton.**
- Crude oil straight out of the ground is not much use.
- Crude oil is a mixture of different hydrocarbons, called **fractions**.
- Crude oil is separated into the different fractions that each has its own use.
- The process of separating crude oil into fractions is called fractional distillation, which is possible because the different hydrocarbons (fractions) in crude oil each have **different boiling points**.

How does fractional distillation work?

- Crude oil is heated so it vaporises/boils/turns to a gas.
- The vapours rise up the column, which is cooler towards the top.
- The vapours gradually cool as they rise and condense at their boiling points.
- Hydrocarbons with different size molecules condense at different levels/temperatures.
- The crude oil is separated into a series of fractions with similar numbers of carbon atoms and boiling points. These are called fractions.

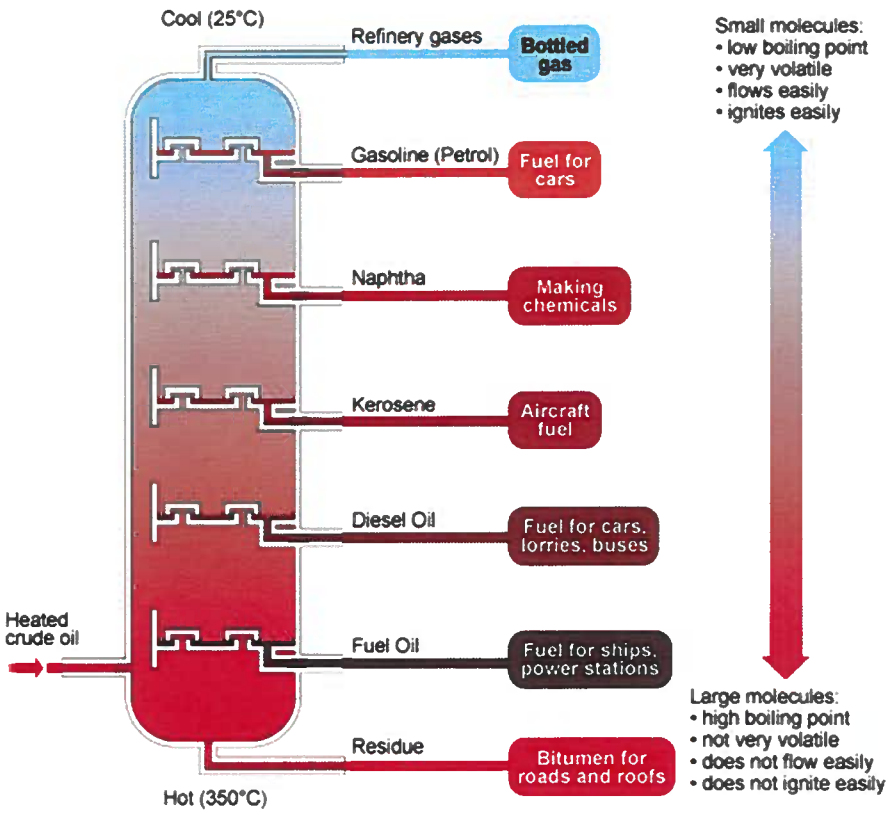
As the number of carbon atoms increases:

- The chains become longer
- Boiling point increases
- Flammability decreases (catches fire less easily)
- Viscosity increases (liquid becomes thicker)

Key Terms	Definitions
Hydrocarbon	A compound which contains only hydrogen and carbon (covalently bonded)
Fractional Distillation	The process where crude oil is separated into different compounds through evaporation
Viscosity	The ability of a liquid to flow

Box 2 - Fractional Distillation Column

Below is a diagram of a fractionating column; you need to know the uses but not the names of each fraction:



Year 11 Chemistry Knowledge Organiser
Organic Chemistry page 2

Box 3 - Alkanes

Crude oil is largely made up of a family of hydrocarbons called alkanes

- Alkanes are saturated hydrocarbons - these contain only a single covalent carbon to carbon bonds.
- General formula for an alkane - C_nH_{2n+2}
- you can either represent alkanes with a **molecular formula**:

CH_4 C_2H_6 C_3H_8 C_4H_{10}

or a **displayed formula**:

Methane Ethane Propane Butane

C – carbon, H – hydrogen, the lines indicate covalent bonds

Box 4 - Cracking

- Shorter hydrocarbons are useful as fuels, however crude oil contains fewer of these molecules than is needed. Longer chain hydrocarbons have uses, but crude oil contains more of these longer chain hydrocarbons than is needed.
- The solution to this **supply and demand** issue is to break longer chain hydrocarbons down into short ones using a process called **cracking.**
- **Cracking** is a thermal decomposition reaction that uses heat to break down the longer chain hydrocarbons.

How Cracking Occurs

EITHER: Long chain hydrocarbons are **heated**, turned into a vapour and passed over a hot catalyst in catalytic cracking

OR: Long chain hydrocarbons are mixed with **steam** and heated to very high temperatures

Cracking produces two products:

1. Shorter alkane(useful as a fuel) 2. An alkene (used to make polymers).

Summary

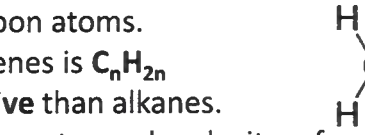
Long Chain Alkane → Short Chain Alkane + Alkene

$C_{10}H_{22}$ → C_8H_{18} + C_2H_4

Key Terms	Definitions
Alkane	A hydrocarbon that contains only carbon to carbon single bonds
Cracking	A process where longer chain hydrocarbons are broken down into smaller more useful ones. There are 2 ways - by catalytic cracking or steam cracking.
Alkene	A hydrocarbon that contains at least one carbon to carbon double bond.

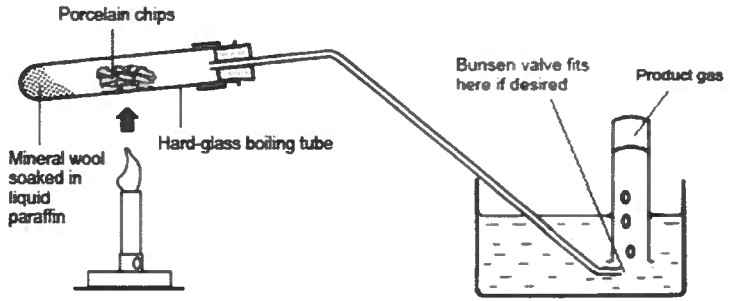
Box 5 - Alkenes

- Alkenes are unsaturated hydrocarbons have at least one double bonds between the carbon atoms.
- General formula for alkenes is C_nH_{2n}
- Alkenes are **more reactive** than alkanes.
- They react with bromine water and make it go from orange to colourless.
- Alkanes do not have a double bond so the bromine water stays orange.



Box 4 - Cracking Reaction Diagram

Experimental set up for catalytic cracking:



Year 11 Physics Knowledge Organiser
Waves page 1

Box 1 - Types Of Wave

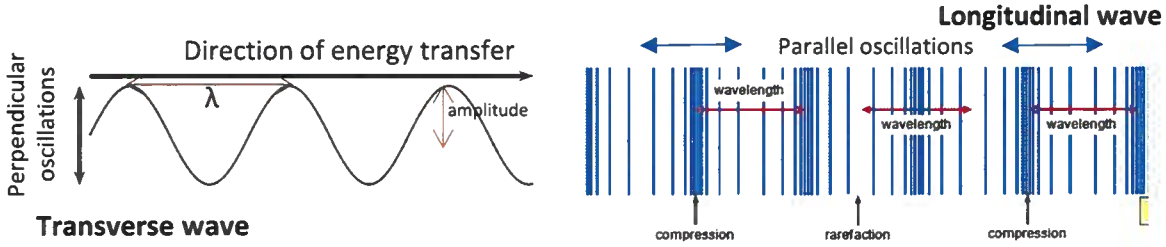
Waves can be **mechanical**, which means they involve particles moving, or **oscillating**, such as waves in the sea or sound waves in the air. Or, they can be **electromagnetic**, which don't involve any particles oscillating – instead, EM waves involve vibrations or oscillations of the electromagnetic field. **All waves involve the transfer of energy**.

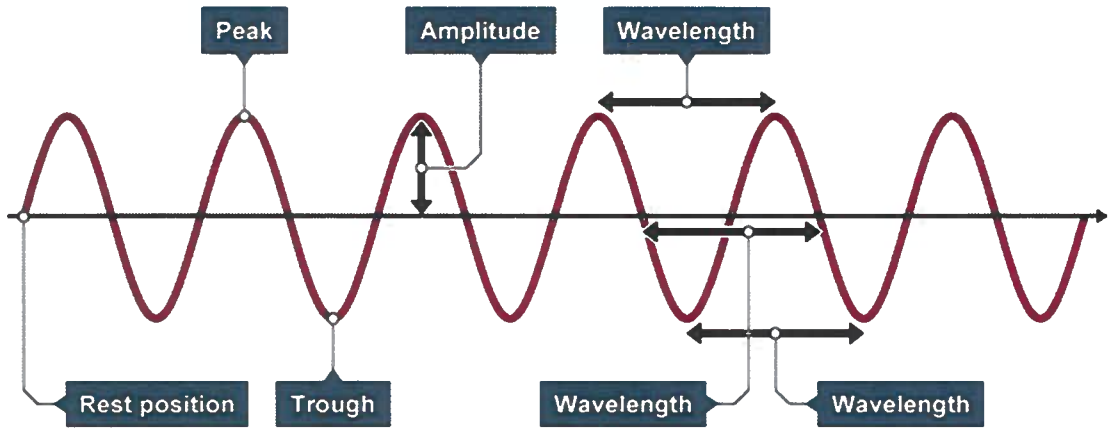
The other way of defining types of wave is whether they are **longitudinal** or **transverse**. Which one they are depends on the direction of the oscillations compared to the direction of energy transfer by the wave.

- In **transverse waves**, the oscillations are **perpendicular** to the direction of energy transfer.
- In **longitudinal waves**, the oscillations are **parallel** to the direction of energy transfer. They show areas of compression and rarefaction – see diagram.

Only the energy transferred moves forward, the particles or the field oscillate, meaning they move backwards and forwards or up and down.

Examples: ALL electromagnetic waves for example radio waves and light are transverse. Mechanical waves which involve the oscillation of particles can be either longitudinal or transverse. For instance: sound waves are mechanical and are longitudinal. Ripples in water are mechanical waves and are transverse.





Key Terms	Definitions
Wave	A wave is an oscillation (vibration) that transfers energy without transferring any matter, by making the particles of the substance (or fields) that it is travelling through oscillate.
Oscillations	Vibrations or movements. These movements are of particles in **mechanical** waves, or of the electromagnetic field when it comes to **electromagnetic** waves.
Perpendicular	At right angles to.
Displacement	The distance travelled from the rest point by a particle or field during an oscillation.
Amplitude	The amplitude of a wave is the maximum displacement of a point on the wave from the rest point.
Wavelength	The distance from a point on one wave to the equivalent point on the next wave along. This is easiest to measure at the distance from the centre of one area of compression to the next (longitudinal waves) or the distance from peak to peak (transverse waves). Symbol: λ
Frequency	The frequency of a wave is the number of complete waves that pass a point per second. Symbol: f
Period	The period, or time period, of a wave is the time it takes to complete a full wave. Symbol: T
Rest point	This is a point shown in the middle of the wave diagram for a transverse wave, it may be called the mid-line or undisturbed position.

Box 2 - The Wave Equation – the equations below are used to calculate the number of waves that pass a point a second and the speed of a wave.

Equation	Meanings of terms in equation
Period = 1 / frequency $T = \frac{1}{f}$	*T = time period (seconds, s)* *f = frequency (hertz, Hz)*
Wave speed = frequency x wavelength $v = f\lambda$	*v = wave speed (m/s)* *f = frequency (Hz)* *λ = wavelength (metres, m)*

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Waves page 2

Box 3 - Electromagnetic Waves (EM Waves)

EM waves are always **transverse waves**. They transfer energy from the source of the waves to an **absorber** – an object that absorbs the energy of the wave. These waves are an oscillation in a magnetic and electrical field and can transfer energy through a vacuum (an area without particles). EM waves occur all over the universe naturally, and we can produce them ourselves for all sorts of uses.

EM waves all travel at the **same velocity** through empty space (a vacuum) – at what we call the speed of light. However, the wavelength of EM waves varies from a few kilometres to wavelengths even smaller than an atom. The EM waves form a **continuous spectrum**, but for convenience we've grouped the infinite types of waves into seven groups of wavelengths, based on their properties. Learn the order of EM waves in the EM spectrum. Notice that a *longer* wavelength equates to a *lower* frequency and vice versa – this is clear from the wave equation.

Long wavelength → Short wavelength

Radio waves	Microwaves	Infrared	Visible light	Ultraviolet	X-rays	Gamma rays

Low frequency → High frequency

Visible light is the only kind of EM wave we can detect with our eyes (hence the name). Thus, we can only detect a limited range of EM waves without special equipment. However, it is easy to understand examples of how EM waves transfer energy. If you are standing in front of a fire, you feel the warmth thanks to infrared. Getting sunburn is due to the transfer of energy by ultraviolet waves from the Sun. Using Wi-Fi means a transfer of energy by radio waves and microwaves.

Box 4 - Properties Of EM Waves

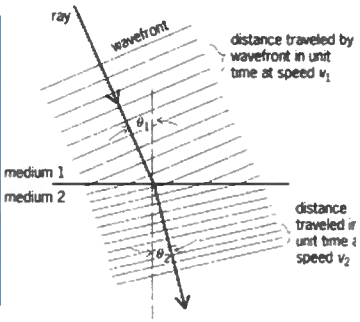
All EM waves can be **reflected**, **refracted**, **absorbed** or **transmitted** *depending* on the wavelength of the EM wave and the **medium** they are travelling through, or surface they are reaching.

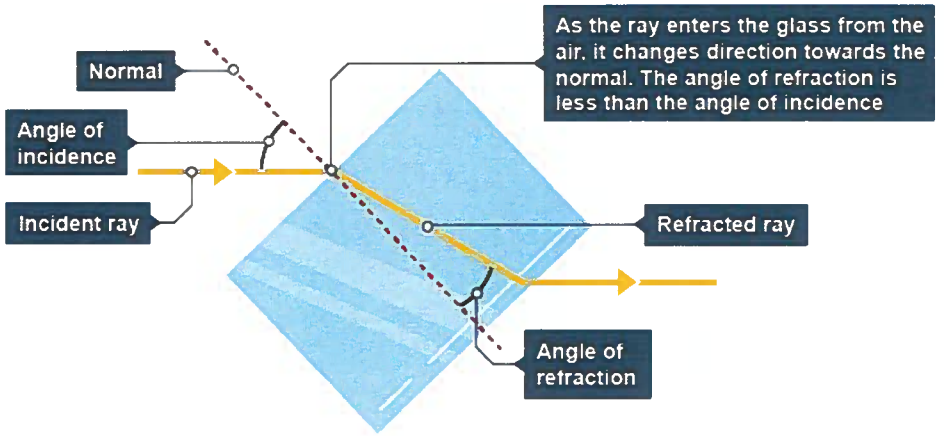
Refraction occurs when a wave changes the medium it is travelling through. Refraction is a change in direction of the wave, and it happens at the boundary, or junction, between the media – for instance, the surface of a sheet of glass would be the boundary between the glass and the air. You need to be able to draw diagrams to show refraction, like the example opposite. Notice that the light ray refracts *towards* the normal as it enters the glass (this is because it slows down), and refracts *away* from the normal as it leaves the glass (it speeds back up), ending up parallel to the original ray in air. If the light ray enters the block along the normal line, no refraction occurs but the wave speed still reduces.

Key Terms	Definitions
Reflection	Rebounding of a wave from a surface. The angle between the **incident** (in-going) wave and the **normal** is the same as the angle between the reflected wave and the normal.
Refraction	Changing direction of a wave due to a change in the **medium** it is travelling through.
Absorption	'Taking in' energy from a wave and transferring it to another form, usually heat. For instance, you warming up if you lie in the sunshine (revising science, of course).
Transmission	A wave travelling through a material. Right now, visible light waves are being transmitted through the air to your eyes.
Media	*Singular 'medium'*. The medium is the material through which a wave travels.
Normal	A 'construction line' (made up line to help with diagram drawing) at right angles to a surface at the point where the wave hits the surface.

Box 5 - HT: More On Refraction

Refraction is due differences in the velocity of the waves in difference media. The diagram shown here represents the **wave fronts**. The wave slows down as it enters medium 2, but the near edge slows first. The other end is faster, as it is still in medium 1. This is what causes the 'bending' of the wave towards the normal.





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Waves page 3

Box 6 - Electromagnetic Waves (EM Waves): Producing Them

EM waves can be generated by changes in atoms or the nuclei of atoms. For instance, gamma rays are produced during nuclear decay.

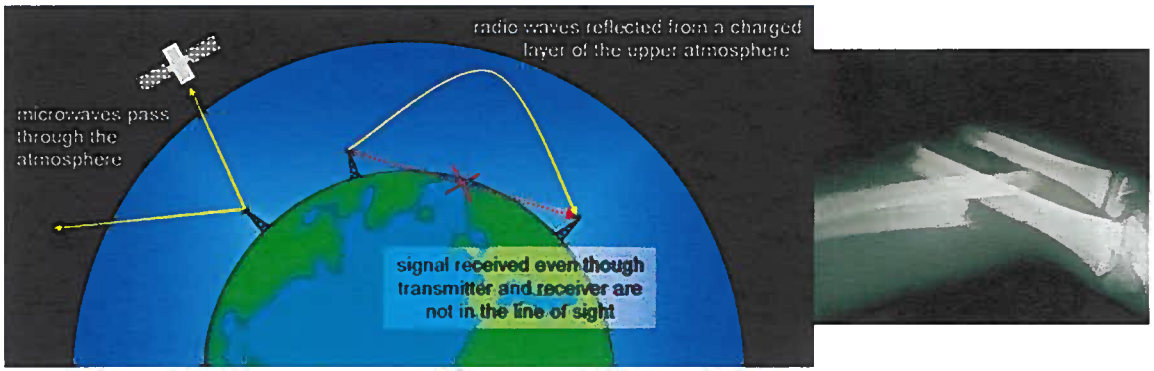
HT – Humans produce radio waves by using an alternating current , this is a flow of charge that changes direction a set number of times a second (set to the frequency of the wave that needs to be transmitted). The change in direction of the current causes an oscillation in an electron and magnetic field, this creates a radio wave. The wave then passes into the air and can be received by a receiver which absorbs the energy of the radio wave. This energy is then transferred to the electrons in the material of the receiver, these oscillate generating an alternating current at the same frequency as the transmitted wave. These are used to communicate information.

Box 7 - Dangers Of EM Waves

Ultraviolet waves, X-rays and gamma rays are potentially dangerous types of EM waves, since they can have hazardous effects on human tissues. How severe the effects are depends on the type of radiation and the size of the **dose** received.

Doses of radiation are measured according to how great the risk of harm to the body is. The radiation dose, or danger due to **exposure** to radiation, is measured in **sieverts** (Sv).

A specific risk due to exposure to ultraviolet waves: they cause skin to prematurely age and increase the risk of skin cancer as the DNA within the nucleus of a cell can mutate when exposed to UV.
X-rays and gamma rays are **ionising** types of radiation. This means they can damage DNA, causing mutations and therefore increasing the risk of cancer.



Key Terms	Definitions
Radiation dose	The risk of harm due to exposure to radiation.
Exposure	Receiving and absorbing radiation (by the body).
Sievert	The measure of radiation dose. As with the usual prefix: 1000 millisieverts (mSv) = 1 sievert (Sv)
Ionising	Describes radiation that forms ions by 'knocking' electrons off atoms to make ions. An ion is a charged particle.
Cancer	Type of disease caused by specific mutations to DNA, resulting in cells dividing out of control (making a tumour).

Box 8 - Applications Using EM Waves

It is not exaggerating to say that EM waves dominate our technology and our lives. Here are some examples of the practical applications of EM waves:

- **Radio waves**: used for *television*, *radio* and Bluetooth. A signal carried by radio waves can get from a transmitting mast to a receiver by being reflected off a layer in the atmosphere. (see the diagram below)
- **Microwaves**: The type of wave is used in satellite communication, the waves can pass through the atmosphere, allowing satellites to pass signals around the curve of the Earth. Microwave ovens use a specific frequency of wave, this frequency is absorbed by water molecules, causing them to vibrate and increase their internal energy store and in turn increase the temperature of food.
- **Infrared**: electrical heaters, cooking food, infrared cameras. All objects emit infrared, but hotter objects emit more. An infrared camera detects infrared instead of visible light, so it can see hotter objects in the dark – night vision.
- **Visible light**: *fibre optic communication* (like the best broadband). Optical fibres reflect pulses of light all the way along their length. The pulses of light transmit the information.
- **Ultraviolet**: This type of radiation is used in tanning salons to provide an artificial tan. Some chemicals absorb UV light and emit, give out light energy, we call these chemicals fluorescent. Regularly used for invisible security markings and labelling to help police identify the owners of stolen property.
- **X-rays**: both medical imaging for *diagnosis* (like broken bones) and medical *treatments*. X-rays can pass through soft tissue (like muscle), but not bone. That's why an X-ray image works to show up bones, and any breaks.
- **Gamma rays**: used in medical treatments such as radiotherapy. These have the highest level of energy transfer due to their high frequency.

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Inheritance, variation and evolution 2 page 1

Box 1 - Variation

Variation is the differences in the characteristics of individuals in a population. There are 2 types of variation:

- **Genetic variation** – In sexual reproduction, fusion of gametes results in the offspring inheriting genes from both the mother and the father. No two members of a species are genetically identical (except for identical twins!) Some characteristics are determined only by genes e.g. eye colour in humans, blood group, some inherited disorders. There is usually extensive (a lot of) genetic variation within a population of a species.
- **Environmental** variation - Some differences are only due to the conditions in which an organism developed and lives e.g. light intensity in plants. High light intensity results in good growth and a larger plant than one growing in low light intensity

Most characteristics are determined by a mixture **of genetic and environmental factors** e.g. health in humans. Some people are more likely to get heart disease because of their genes, but lifestyle choices (environmental) will affect the risk of getting heart disease.

Box 2 - Mutations and Variants

A mutation is a change in an organism's DNA that results in the gene being altered. A genetic variant is formed. Sometimes gene mutations lead to changes in the protein that the gene codes for. Overall:

- Mutations happen continuously;
- most mutations will not affect the phenotype at all;
- some will influence the phenotype (maybe change it a bit);
- very few mutations cause a total change leading to a new phenotype. This is rare.

If the new phenotype formed makes the organism better suited to the environment, it will lead to a relatively rapid change in the species, by **natural selection**.

Box 3 - Formation of new species

A species is a group of organisms that can breed together to produce **fertile** offspring.
Over long periods of time, the phenotype of different populations of an organism can change due to natural selection. This is usually because the two populations live in a different environment. If two populations of one species become so different in phenotype that they can no longer interbreed (breed together) to produce fertile offspring, they have formed two new species.

Key Terms	Definitions
Variation	The differences in the characteristics of individuals in a population.
Genetic variation	Differences in the genome between individuals.
Genetic variant	Different versions of a gene that arise from a mutation
Mutation	A change in an organism's DNA. – so the gene is altered resulting in a genetic variant being produced.
Evolution	Change in the inherited characteristics of a population over time through **natural selection**, which may result in the formation of a new species.
Natural selection	The process that changes the inherited characteristics of organisms over time.
Species	A group of organisms that can breed together to produce fertile offspring
Fertile	An organism can reproduce to produce healthy offspring

Box 4 - Evolution

Evolution is the change in inherited (genetic) characteristics of organisms over time. Charles Darwin proposed **The Theory of Evolution by Natural Selection.**
It states that:

- All species of living things have evolved from simple life forms that first developed more than 3 billion years ago
- A population of organisms shows variation – there are **variants** in the population for each characteristic
- The organisms are in **competition** to survive
- Only the variants with the phenotypes best suited to the environment survive
- Surviving variants then reproduce
- The genes for the successful phenotype get passed to the offspring and become more common in the next generation. This continues from generation to generation.
- The changing of the inherited characteristics of a population over time is evolution

Darwin's theory was not widely accepted at first due to lack of evidence, lack of understanding of the mechanism of inheritance and widely held religious views that God was responsible for creation of life. Now, it is the most widely accepted theory of how life evolved.

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Inheritance, variation and evolution 2 page 2

Box 5 - Evidence for evolution

Darwin's Theory of Evolution by Natural Selections is now widely accepted as more evidence has emerged to support it. Evidence for evolution includes:

1. The fossil record – used by Darwin when proposing his theory but more evidence has been discovered that supports his theory
2. Scientists now understand the mechanism of inheritance of characteristics by offspring through genes.
3. Scientists understand how resistance to antibiotics evolved in bacteria.

Box 6 - Fossils

Fossils are the 'remains' of organisms from millions of years ago, which are found in rocks.
Fossils may be formed:

1. From parts or organisms that have not **decayed** because one or more of the conditions needed for decay by microorganisms are absent. Microorganisms require oxygen, water, and the correct temperature & pH in order to decay dead organisms. E.g. of fossils include mammoths frozen in glaciers (too cold), insects in amber (no oxygen)
2. Bones, teeth and shells (hard parts of the animals) are replaced by **minerals** from the surrounding rocks as they decay leaving a rock-like substance shaped like the original part
3. Preserved **traces** of organisms – so not their actual bodies, but impression traces like footprints, droppings, burrows and the traces of roots.

Fossils can show how much or how little different organisms have changed as life has developed on Earth.

The Origins of Life on Earth

Scientists cannot be certain about how life began on Earth. There is a lack of valid evidence. Many early forms of life were soft-bodied (without hard parts), and so have left very few traces behind.
What traces there were have been mainly destroyed by geological activity (movements of tectonic plates and volcanic activity. This means the fossil record is **incomplete.**

Box 7 - Extinction

Extinction is when no living individuals of a species remain. The fossil record contains many species that are now extinct. Species become extinct because:

- The environment changes too quickly e.g. destruction of habitat so the species does not evolve quickly enough to survive.
- A new predator kills them all
- A new disease kills them all
- They can't compete with another (new) species for food
- A catastrophic event kills them all (e.g. volcanic eruption or meteor

Key Terms	Definitions
Fossil	The remains of organisms from millions of years ago, found in rocks. They are formed in different ways – see main text.
Mutation	A change in the DNA of an organism. Occurs continuously.
Strain	A variant of microorganism within a species – so they are not a different species to other variants, but have a key difference in their phenotype (e.g. being resistant to an antibiotic). New strains are produced by **mutations**.
Resistant strain	Describes a variant form of bacteria with resistance to a specific antibiotic.
MRSA	An example of a resistant strain of bacteria. that can cause increased surgical recovery times in hospitals
Extinction	When there are no remaining individuals of a species still alive.

Box 8 - Antibiotic resistant bacteria

Bacteria can evolve rapidly because they reproduce at a rapid rate – every 20 minutes if conditions are favourable.
Mutations in the DNA of bacterial pathogens produce new **strains** (see keywords)
Some strains of bacteria might be **resistant** to an antibiotic. When a person is infected by bacteria of a certain species, and is treated for the infection using antibiotics, resistant strains are NOT killed. They survive and reproduce, passing the gene for resistance to their offspring. The population of resistant strain increases. The resistant strain will then spread because people are not immune to it and there is no effective treatment. An example of one such antibiotic resistant strain of bacteria is MRSA.

To reduce the rate of development of antibiotic resistant strains

- doctors should not prescribe antibiotics for non-serious or viral infections (antibiotics don't kill viruses)
- Patients need to **finish the course** of antibiotics they get prescribed, so all bacteria are killed and none survive to mutate and form resistant strains.
- Agricultural use of antibiotics in **agriculture** should be restricted

Development of new antibiotics is slow and is unlikely to keep up with the emergence of new resistant strains of bacteria.

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Box 9 - Selective breeding

During selective breeding, domesticated animals or plants are bred for particular **genetic** characteristics that are desirable or beneficial to humans. Humans have been carrying this out for thousands of years since they first bred food crops from wild plants and **domesticated** animals.

1. Parents with the desired characteristic are chosen from a mixed population
2. They are bred together (allowed to reproduce)
3. Offspring with the desired characteristic are bred together.
4. This continues over many generations until all the offspring show the desired characteristic.

Some examples of characteristics that selective breeding is used to obtain: Disease resistance in food crops, Animals which produce more meat or milk, Domestic (pet) dogs with gentle natures, Large or unusual flowers.

Selective breeding can result in **'inbreeding'** where some breeds are particularly prone (susceptible) to disease or inherited defects. This is because by selecting for particular characteristics (therefore alleles), there is a reduction in the number of different alleles in the population and a higher chance of inheriting alleles that cause defects.

Box 10 - Genetic engineering

Genetic engineering is the process of transferring a gene responsible for a desired characteristic from one organism's genome into another organism's so that it also has the desired characteristic. This is done by 'cutting out' the desired gene and transferring it into the cells of another organism.

Genetic engineering has been used to:

- Produce genetically modified bacteria that make human insulin to treat diabetes
- Produce sheep which make drugs in their milk to treat human diseases
- Produce plant crops which are resistant to diseases or which can produce bigger better fruits.

Box 12 - HT: Genetic engineering – the steps

The summary is given left. The steps in more detail:

1. **Enzymes** are used to cut out, or *isolate*, the required gene.
2. This gene is placed in a **vector**, usually a bacterial plasmid or a virus.
3. The vector is used to insert the gene into cells of the second organism (e.g. the food crop).
4. Genes are transferred to the cells of animals, plants or microorganisms at an early stage in their development so the organism develops with the desired characteristic.

Key Terms	Definitions
Selective breeding	The process by which humans breed plants and animals for particular genetic characteristics (also known as artificial selection)
Domesticated	Animals/plants used in agriculture (or for pets) are called domesticated species.
Inbreeding	The result of selective breeding can be inbreeding, where limited genetic variation can make organisms more prone to disease or inherited defects.
Genetic engineering	Modifying the genome of an organism by introducing a gene from another organism, giving a desired characteristic.
Genetically modified	GM for short. Describes organisms (especially crops) that have had their genome modified by genetic engineering.
Yield	The amount of useful product you get from a plant or animal used in agriculture (e.g. mass of fruit).
Vector (HT)	In genetic engineering, a vector is a piece of genetic material used to transfer a gene. It is usually a bacterial plasmid or virus.

Box 11 - Genetic engineering – the benefits and risks

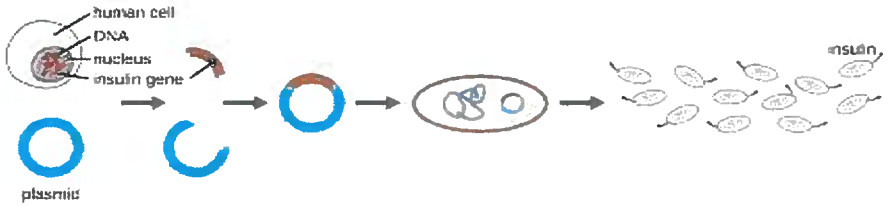
Benefits:

Has the potential to treat disease and modify the human genome to overcome some inherited disorders. **Genetically modified (GM)** crops can produce higher yields of food or can be modified to produce certain nutrients, be resistant to insect attack or herbicides.

Risks/Concerns

Genes from the chromosomes of humans and other organisms can be 'cut out' and transferred to cells of other organisms. This may cause unforeseen problems in the long term.

GM crops may affect the populations of wild flowers and insects. Some people believe that the effects of eating GM crops on human health have not been fully explored.



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Box 13 - Classification

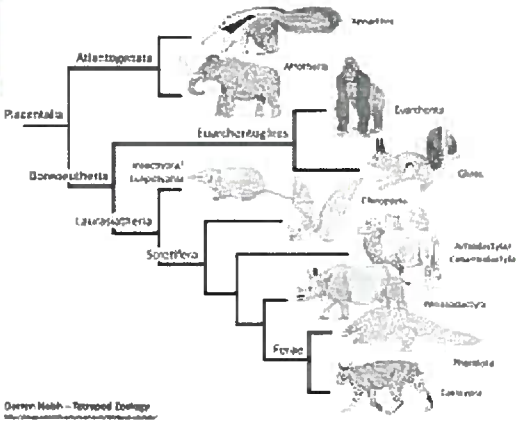
Classification is the sorting of living things into groups to aid identification.
Two methods: The Linnaean system and the three-domain system:

The Linnaean System: Described by Carl Linnaeus in the 1700s. The traditional system sorts according to their **structure** and **characteristics**. Living things are first divided into kingdoms containing all organisms, then sub-divided into smaller and smaller groups.
These groups, in order of size (based on how many organisms fit in each one) are called: **kingdom, phylum, class, order, family, genus** and **species**. You need to remember this (see mnemonic below)

The Three-Domain System: Described by Carl Woese (1990). As evidence of internal structures became more developed due to improvements in microscopes, and the understanding of biochemical processes progressed, new models of classification were proposed. Chemical analysis led Woese to propose the Three-Domain System where all organisms are classified into only 3 groups: **Archaea** (primitive bacteria), **Bacteria** ('true bacteria') and **Eukaryota** (includes eukaryotes – living things with a nucleus, including animals, plants, fungi and protists)

Naming organisms: Uses the Binomial system. Every organism has its own two part name. The first part refers to the **Genus** that the organism belongs to, and the second part is the **species**. See below for the domestic cat, *Felis catus*, and the lion, *Panthera leo*.

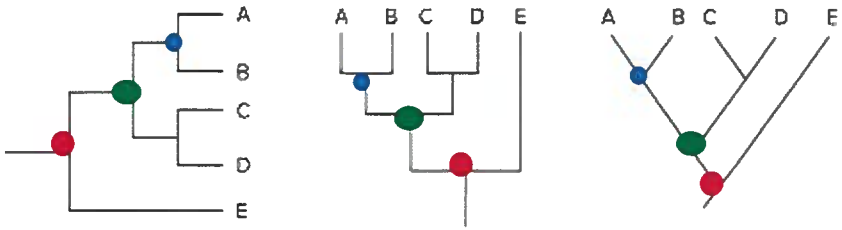
Linnaean system	Domestic cat	Lion	Mnemonic
Kingdom	Animalia	Animalia	King
Phylum	Chordata	Chordata	Prawn
Class	Mammalia	Mammalia	Curry
Order	Carnivora	Carnivora	Or
Family	Felidae	Felidae	Fat
Genus	Felis	Panthera	Greasy
Species	catus	leo	Sausages



Key Terms	Definitions
Classification	The sorting of living things into groups to aid identification. groups. Two methods: The Linnaean system and the three-domain system.
Kingdom	The largest group in the Linnaean system. All organisms are grouped into 5 kingdoms: animals, plants, fungi, bacteria and protists
Biochemistry	The study of chemicals in living organisms, such as DNA, proteins, carbohydrates and lipids.
Three-domain system	A modern model of classification, based on the genetic differences between organisms, builds on Linnaeus' system.
Archaea	**Primitive bacteria** usually living in extreme environments e.g very hot water around volcanic geysers, salt lakes.
Bacteria	'**True bacteria**' e.g. *E.coli, Staphylococcus*. Look similar to Archaea but have many biochemical differences
Eukaryota	All organisms with a **nucleus**: plants, fungi, protists and animals. Includes multicellular organisms and unicellular organisms (that are not bacteria)
Evolutionary tree	A method used by scientists to show how they believe organisms are related. They use current classification data for living organisms and fossil data for extinct organisms.

Box 14 - Evolutionary Trees

These show how scientists think different species are related to each other. They show common ancestors and relationships between species. The more recent the common ancestor, the more closely related the two species – and the more characteristics they're likely to share.
An evolutionary tree starts with one 'trunk' – the **common (distant) ancestor** for all species shown (A, B, C, D, E). A and B are closely related as they share a common ancestor . They are not as closely related to C and D as their common ancestor is older . E is the most distantly related species



Paper One –Buddhist belief and teaching

Key terms:

Dhamma	**The Buddha's teachings – how to reach the state of enlightenment**
Dependent arising	**The idea that everything is dependent on everything else**
Anicca	**One of the three marks of existence- impermanence**
Anatta	**One of the three marks of existence- no fixed self**
Dukkha	**Suffering or dissatisfaction – something Buddhists seek to overcome**
Siddhartha Gautama	**The religious teacher and founder of Buddhism**
Buddha	**An enlightened being**
Jakaka 075	**A book of popular tales about the life of the Buddha**
Nibbana	**A state of complete enlightenment which lies outside the cycle of samsara**
Tanha	**Craving – second noble truth**
Enlightenment	**A state of spiritual wisdom which arises from understanding the nature of reality**
Ascetic	**A lifestyle of strict self-denial – rejected by Siddhartha for the Middle Way**
Three watches	**Three realisations Siddhartha made in order to become enlightened**
Samsara	**The cycle of life, death and re-birth**

KPI1: Buddha's early life and four sights

Buddha means 'enlightened'. Siddhattha Gautama, later to become the Buddha, lived in the 5th century BC and was a prince born into a rich family. He had an easy life in **luxury**, living in what is now Nepal. He was inspired to leave this life by the **Four Sights.**

The Four Sights Siddhartha saw on his trip outside the palace were:

1. An old man – everyone ages
2. An ill man – everyone becomes ill
3. A dead man – all things die
4. A holy man – the only answer to these problems

KPI2: Buddha's enlightenment and the three watches

After seeing the four sights, Siddhartha rejected his life of luxury and left the palace. Siddhartha lived for six years as an **ascetic** (someone who denies themselves worldly pleasures).

After this time, he realised that this was not the answer and came up with the idea of the **'Middle Way'** between luxury and asceticism. Siddhartha meditated under a tree and was tempted by the demon **Mara.** Over three watches of the night he became **enlightened** and from then on known as the **Buddha.**

The three watches of the night

- **All previous lives**
- **The cycle of samsara (life, death and rebirth)**
- **All beings suffer (Dukkha)**

KPI3: To examine the importance of the Dhamma.

A Buddhist is best described as someone who takes refuge in the **Three Jewels (also known as Three Refuges).** The Dharma holds the key beliefs for Buddhists. The **Dhamma** is the teaching of the Buddha and the universal law, following it will reduce their own suffering and the suffering of others.

I go to refuge in the **Buddha**, I go for refuge in the **Dharma**, I go for refuge in the **Sangha.**

KPI4: To examine what is meant by the three marks of existence.

Buddhism teaches that there are three characteristics that are fundamental to all things. **The Three Marks of Existence** are the fundamental Buddhist beliefs about the nature of human existence.

1. **Suffering (Dukkha):** Suffering is part of the human condition, a natural result of anatta and anicca. It can only be overcome by becoming enlightened.
2. **Impermanent (Anicca)** that everything is impermanent and continually changing. Failure to recognise this
3. leads to clinging and suffering.
4. **Having no permanent self (Anatta).** The Buddha taught that there is no fixed part of a person that does not change. There is no permanent self.

KPI5: To understand why the four noble truths are important to Buddhists.

3. The **third** noble truth teaches that there is an end to suffering. It can be achieved by overcoming ignorance and craving.

- **Nibbana** literally means the extinction- the extinction of the three poisons.

4. The fourth noble truth **'magga'** is seen as the cure to end suffering.
   The fourth noble truth is the **eightfold path**, which consists of 8 aspects that Buddhist can practice and follow in order to achieve **enlightenment.**
   The eightfold path is split into ethics, mediation, wisdom.

KPI5: To understand why the four noble truths are important to Buddhist

I teach suffering, its origin, cessation and path. That's all I teach", declared the Buddha 2500 years ago.

1. The truth of suffering **(Dukkha)** Suffering comes in many forms.: old age, sickness and death.
2. The truth of the origin of suffering **(Samudāya)** The three roots of evil**/three poisons** Greed and desire, represented in art by a rooster, Ignorance or delusion, represented by a pig ,Hatred and destructive urges, represented by a snake.

One of the main causes of suffering is tanha or craving

Paper One –Buddhist belief and teaching

Key terms:

Theravada	**Oldest form of Buddhism, found in southern Asia**
Mahayana	**Found in Tibet, China, Taiwan, Japan, Korea, and Mongolia. Mahayana Buddhism is not a single group but a collection of Buddhist traditions: Zen Buddhism, Pure Land Buddhism, and Tibetan Buddhism**
Pure Land	**Mostly found in Japan – a form of Mahayana Buddhism. Based on faith in Amitabha**
Bodhisattva	**An enlightened person who chooses to remain in samsara to teach others**
Arhat	**A 'perfected person' who has overcome the main sources of suffering**
Five Aggregates (Skandha)	**Theravada Buddhists are taught that the human personality is made up of five parts**
Sunyata	**Mahayana Buddhism0 This means 'emptiness'.**
Six perfections	**The practices/characteristics of a Bodhisattva**

KPI 8- To analyse the different features and beliefs amongst schools in Buddhism

https://www.bbc.co.uk/bitesize/guides/zr7ck2p/revision/5

Theravada	**Mahayana**
Theravada Buddhists are taught that the human personality is made up of five parts- **Five Aggregates/ Skandha's Form, Sensation, Perception, Mental formation and Consciousness**	**Sunyata -** This means **'emptiness'**. This idea can be understood as meaning that everything depends upon something else. All things lack an intrinsic nature. Basically, everything is empty. Sunyata can be understood as being very similar to **anatta** (one of the Three Marks of Existence).
In Theravada Buddhism, a person who has achieved **nibbana** is known as an **arhat**. A Buddhist who has taken this path will follow the Noble Eightfold Path. They may also join a Buddhist community in order to focus their attention on achieving enlightenment with others who are on the same path.	**Everyone can achieve enlightenment.** Mahayana Buddhists believe that all humans have the nature of the Buddha within them already. **Buddha Nature**
Theravada Buddhism teaches that the ideal Buddhist is an **Arhat** (a 'perfected person'). An Arhat has become free from the three poisons (ignorance, greed and hatred) and will not be reborn when they die. A person becomes and Arhat by following the **Eightfold Path**	Mahayana Buddhism teaches that the ideal Buddhist is a **Bodhisattva**. Bodhisattvas choose to **remain in samsara** to help others become enlightened. A person becomes a bodhisattva by developing the **Six Perfections.**
	Pure Land Buddhists believe it is impossible to become enlightened in this realm and so aim to be reborn into the Pure Land to be taught by Amitabha Buddha. Their main practice is chanting **Amitabha** Buddha's name

KPI6- Explain Buddhist teachings on how to end suffering

The path end suffering is the Middle Way and consists of eight practices (**the Eightfold Path**) that are sometimes grouped into three sections (the Threefold Way).

Ethics- right speech, action, livelihood

Meditation- right effort, mindfulness, concentration

Wisdom- right understanding, intention

KPI7- To describe the different schools in Buddhism

Theravada Known as the 'lesser vehicle' as only male monks achieve enlightenment. Oldest form of Buddhism, found in southern Asia
Mahayana Known as the 'greater vehicle' as anyone can become enlightened. Teaches sunyata or emptiness – nothing as a separate soul or self
Pure Land Mostly found in Japan – a form of Mahayana Buddhism. Based on faith in Amitabha Buddha and his paradise

KPI9- To Explain the importance of the Six perfections

"However innumerable sentient beings are; I vow to save them." Bodhisattva vow

The six perfections give guidelines as a structure for how to live a good life and behave in a morally good way.

Generosity

Morality

Patience

Energy

Meditation

Wisdom

PCSHE Year 11 Topic 1 – Communication in Relationships

KPI1: Key Terms

- **Consent**: Consent is a person's permission or agreement by choice to anything that informs them. Consent must be freely given, it is reversible, it must be informed, enthusiastic and very specific.
- **Underage**: Under the age of 16.
- **Age of consent**: The age where someone can legally agree to taking part in sexual activity. In the UK the age of consent is 16.
- **Legislation**: the law
- **Prosecuted**: to bring legal action against a crime or punishment of a crime for the breaking of a law.
- **Sexual consent**: The giving of permission by a person to engage in any form of sexual activity including penetrative and oral sex.
- **Affirmative consent**: Consent is only given when a person agrees verbally to engage in sexual activities including penetrative and oral sex.
- **Coercion**: The action or practice of persuading someone to do something they wouldn't normally do or something they don't want to do by using force or threats.
- **A person who is minor**: A person who is under the age of 18 and legally considered a child.

KPI2 – What is consent?

Consent is a person's permission or agreement by choice to anything that informs them. For example, their body, personal space, time, money and belongings.

We all have the right to be asked for consent in situations that involve us, and the responsibility to ask others for consent in situations that involve them. Consent is important because it gives people **choice** and **control** over decisions that affect them.

Consent is:

- Freely given. It's not okay to pressure, trick, or threaten someone into saying yes.
- Reversible. It's okay to say yes and then change your mind — at any time!
- Informed. You can only consent to something if you have all the facts.
- Enthusiastic. You should do stuff you WANT to do, not things people expect you to do. If someone doesn't seem enthusiastic stop and check in.
- Specific. Saying yes to one thing (like going to the bedroom to make out) doesn't mean you're saying yes to other things (like having sex).

Consent cannot be given when:

- When a person is drunk or high, to the point that they are unable to speak or look after themselves.
- Asleep or Passed Out – if they are not conscious they are unable to agree to any sexual activity. If someone passes out whilst engaging in sexual activity – STOP!
- They are Underage – Legally a person under the age of 16 cannot give consent to any sexual activity.
- Mental disability or learning difficulties which mean they are unable to fully understand what they are consenting to.

KPI3 – Consent and the Law

In the UK, the age of consent is 16. This means that a person under the age of 16 cannot legally consent to sexual activity because they are seen as not having the capacity to do so. The law applies to everyone, regardless of gender or sexual orientation in England, Wales, Scotland and Northern Ireland.

The law is designed to protect young people from abuse, harm of being taken advantage of. If someone is under the age of 16 and decides to have sex anyway, it is still vital that they and their partner(s) are able to consent to sex in every other capacity.

According to the law, there are no circumstances in which someone under the age of 13 can consent to any sexual activity or act.

KPI4 - Sexual Relationships:

Why do people have sex?

- Reproduction; Physical health; Enjoyment; Promotes good mental health; Love and commitment; Expression.

How do you know if you're ready to have sex? Ask the following questions...

- ❑ Does it feel right?
- ❑ Do you trust the person you want to have sex with?
- ❑ Are you equally willing to have sex?
- ❑ Do you feel comfortable with this person?
- ❑ Would you feel able to change their mind?
- ❑ Can you talk to this person openly about your fears, worries, or concerns?
- ❑ Can you talk about contraception and protection, and is this a shared decision?
- ❑ Are you both open, honest and mature enough to discuss STIs?
- ❑ Do you feel under any pressure to have sex?
- ❑ Are you having sex because you think everyone else is and you don't want to be left behind?
- ❑ Are you having sex because you are worried about what will happen if you don't (e.g. their partner might leave them)?

PCSHE Year 11 Topic 1 – Communication in Relationships

KPI5 – Unhealthy Relationships

What are the signs of an unhealthy relationship?

- Pressuring you
- Isolating you from friends
- Controlling
- Digital monitoring
- Dishonesty
- Disrespect
- Hostility
- Harassment
- Intimidation

KPI7 – Child Sexual Exploitation

What is child sexual exploitation?
Someone taking advantage of someone under the age of 18 sexually, for their own benefit. Through threats, bribes, violence, humiliation, or by telling you that they love you, they will have the power to get the child to do sexual things for their own, or others people's benefit or enjoyment.

It is important to remember that:

- Anyone can be a victim of sexual exploitation – it can happen to any gender, of any age, of any sexual orientation.
- Sexual exploitation is a form of child abuse
- It comes in many forms (peer-on-peer, by an older adult, someone being a boyfriend/girlfriend of the victim, at parties, as well as criminal exploitation)
- People who carry out sexual violence, use it as a weapon to control, initiate and exert power over others.
- Sexual exploitation is **never the victim's fault.**

KPI6: Relational Violence and Abuse

Relational violence/abuse is a pattern of abusive and coercive behaviours used to have power and control over an ex or current partner. This behaviour tends to get worse over time. There are different types of violence and abuse:

- **Physical**: the intentional use of physical force or power to hurt, intimidate, control or punish others. Hitting, slapping, shoving, grabbing, pinching, biting, hair pulling, etc. are types of physical abuse. This type of abuse also includes denying a partner medical care or forcing alcohol and/or drug use upon him or her.
- **Emotional**: includes coercive control – the intentional use of threats, humiliation and intimidation to harm, punish or frighten others, cause others to be dependent, isolate others from support, exploit, degrade or dehumanize others.
- **Verbal:** The intentional use of verbal abuse aiming to belittle, upset, threaten, frighten, intimidate or control others.
- **Sexual:** The intentional use of force, threats, or intimidation to make someone do something sexual or sharing intimate photos to shame, humiliate or control someone etc.
- **Economic Abuse:** Is defined as making or attempting to make an individual financially dependent by maintaining total control over financial resources, withholding one's access to money, or forbidding one's attendance at school or employment.
- **Psychological Abuse:** Elements of psychological abuse include - but are not limited to - causing fear by intimidation; threatening physical harm to self, partner, children, or partner's family or friends; destruction of pets and property; and forcing isolation from family, friends, or school and/or work.

*Relationship violence and abuse are all about **power** and **control.** It's normal for relationships to have ups and downs and conflict, and it's okay to have mixed feelings about people. When someone's behaviour in a relationship becomes about having power and control over someone else, it's a big warning sign that the relationship is not healthy.*

KPI8 – Sexual Harassment

Sexual harassment can be physical, verbal or emotional, and can take place online, in person and/or on physical surfaces such as graffiti on a toilet cubicle. Anyone can be subjected to sexual harassment. Sexual harassment often targets one or more of these characteristics: a person's appearance, body parts, sex, sexual orientation, gender identity, sexual experience and activities, disability/ability.

Sexual harassment is **unwanted** behaviour of a sexual nature which:

- Violates someone's dignity
- Intimidates, degrades of humiliates someone
- Creates a hostile or offensive environment or makes someone feel exposed or unsafe

It is always the victim's perception of the behaviour that identifies it as harassment, not the **intentions** of the person doing the behaviour. Therefore, excuses like "it was only fun", "it was just banter" or "they're really sensitive" aren't effective defences when someone is accused of harassment.

Who Can you turn to for help and Support	
Parents or trusted family members and Friends	The Police / Community support officers
School Safe Guarding Team or any member of staff.	
Women's Aid	Helpline: 0808 2000 247 **24hr** https://www.womensaid.org.uk
Men's Advice Line	Helpline: 0808 801 0327 Monday-Friday 9am-5pm http://www.mensadviceline.org.uk/
NSPCC	Helpline: 0808 800 5000 (24 hours, every day) nspcc.org.uk
Childline	Helpline: 0800 1111(24 hours, every day) https://www.childline.org.uk
Rape Crisis	Helpline: 0808 802 9999 (12-2:30 and 7-9:30) rapecrisis.org.uk
Survivors UK – Male Rape and Sexual Abuse Support	survivorsuk.org
RASAC (Rape and Sexual Abuse Support Centre)	National Helpline: 0808 802 9999 (12-2.30 & 7-9.30) rasasc.org.uk

PCSHE Year 11 Topic 2: Health Choices and Independence

Key Terms:

- **Stress**: A state of mental or emotional strain or tension resulting from adverse or demanding circumstances.
- **Wellbeing**: The state of being comfortable, healthy, and happy.
- **Adverse**: Unfavourable or negative.
- **Strain**: Pressure or tension on something or someone.
- **Productive**: Achieving or producing results or outcomes effectively.
- **Revision**: The process of reviewing and studying material in preparation for exams or tests.
- **Aerobic activity**: Physical activity that raises the heart rate and improves cardiovascular fitness.
- **Flight or fight response**: The body's automatic response to a perceived threat, preparing it to either confront or escape the threat.
- **Cardiovascular**: Relating to the heart and blood vessels.
- **Immune system**: The body's defence system against infections and diseases.
- **Meditation**: A practice of focusing the mind and inducing a state of calm and relaxation.
- **Optimism**: A positive or hopeful attitude towards the future.
- **Depression**: A mental health disorder characterized by persistent sadness, loss of interest, and other symptoms that affect daily life.
- **Anxiety**: A mental health condition characterized by excessive worry, fear, and nervousness.
- **Blood transfusion**: The process of taking blood from one person (donor), processing it, and then giving it to another person (patient).
- **Red blood cells**: Blood cells that contain hemoglobin and carry oxygen throughout the body.
- **Shortage**: A condition of lacking an adequate amount or quantity.
- **Donor**: A person who voluntarily gives blood or organs for the purpose of helping others.
- **Sickle cell disease**: A genetic blood disorder characterized by abnormal, sickle-shaped red blood cells that can cause
- **Chemotherapy**: The use of drugs to treat cancer by killing or inhibiting the growth of cancer cells.
- **Stem cell transplants**: Medical procedures involving the transplantation of stem cells to replace damaged or diseased cells in the body.
- **Donation**: The act of voluntarily giving blood, organs, or other body tissues for medical use to help others.
- **Opt-in system**: A system in which individuals must actively choose or volunteer to participate.
- **Opt-out system**: A system in which individuals are considered willing donors unless they have explicitly stated their decision not to participate.
- **Excluded group**: A category of individuals who are not automatically included in the organ donation system due to specific circumstances or conditions.
- **Breast Cancer**: A type of cancer that forms in the breast tissue, typically characterized by the presence of abnormal cells that multiply and form a tumor.
- **Self-screening**: The process of examining oneself to detect any changes or abnormalities in the body.
- **GP**: General Practitioner, a primary care physician or doctor.
- **Testicular Cancer**: A type of cancer that develops in the testicles, the male reproductive organs that produce sperm and testosterone.
- **Puberty**: The stage of development during which a person reaches sexual maturity.
- **Benign**: Not cancerous or harmful.
- **Cysts**: Fluid-filled sacs or growths that can develop within the body.

KPI 1 – Wellbeing

Stress: A state of mental or emotional strain or tension resulting from adverse or demanding circumstances.

Some stress is good as it can motivate people however too much can be detrimental, especially if over a long period of time.

Top tips for dealing with exam stress:

1. Always take a moment just to breathe, whether in the exam, before or after.
2. Remember that school does offer support, just reach out and ask!
3. Keep your work balanced. Spend time revising but socialise and relax too.
4. Keep a self-care routine so that your revision is the most productive it can be whilst you feel as good as possible.
5. Break up revision with food and exercise to make sure you stay energised.
6. Remember that results do not define you.
7. Find a revision space and style that works for you
8. Work to your own pace – everyone is different in how they work.
9. If you feel nervous about the time pressure of an exam, practice timing yourself when you revise, or try some test papers.
10. Plan in some treats to reward yourself and celebrate when it's all over!

Importance of exercise:

Exercise increases your overall health and your sense of well-being, which puts more pep in your step every day. But exercise also has some direct stress-busting benefits.

- **It pumps up your endorphins.** Physical activity may help bump up the production of your brain's feel-good neurotransmitters, called endorphins. Although this function is often referred to as a runner's high, any aerobic activity, such as a rousing game of tennis or a nature hike, can contribute to this same feeling.
- **It reduces negative effects of stress.** Exercise can provide stress relief for your body while imitating effects of stress, such as the flight or fight response, and helping your body and its systems practice working together through those effects. This can also lead to positive effects in your body—including your cardiovascular, digestive and immune systems—by helping protect your body from harmful effects of stress.
- **It's meditation in motion.** After a fast-paced game of racquetball, a long walk or run, or several laps in the pool, you may often find that you've forgotten the day's irritations and concentrated only on your body's movements.
- As you begin to regularly shed your daily tensions through movement and physical activity, you may find that this focus on a single task, and the resulting energy and optimism, can help you stay calm, clear and focused in everything you do.
- **It improves your mood.** Regular exercise can increase self-confidence, improve your mood, help you relax, and lower symptoms of mild depression and anxiety. Exercise can also improve your sleep, which is often disrupted by stress, depression and anxiety. All of these exercise benefits can ease your stress levels and give you a sense of command over your body and your life.

PCSHE Year 11 Topic 2: Health Choices and Independence

KPI 2 - Blood Transfusions:

A blood transfusion involves taking blood from one person (a donor), processing it, then giving it to someone else (a patient).

Why might a blood transfusion be needed?

A blood transfusion may be needed if you have a shortage of red blood cells.
This may be because your body's not making enough red blood cells or because you have lost blood.
For example, you may need a blood transfusion if you have:

- a condition that affects the way your red blood cells work – such as sickle cell disease or thalassemia
- a type of cancer or cancer treatment that can affect blood cells – including leukemia, chemotherapy or stem cell transplants
- severe bleeding – usually from surgery, childbirth or a serious accident
- A blood transfusion can replace blood you have lost, or just replace the liquid or cells found in blood (such as red blood cells, plasma or cells called platelets).

Donation:

- For **blood** and **stem cell donation**, an **opt-in system** is in place. Individuals must volunteer to give blood or sign up to the stem cell register.
- For **organ donation**, an **opt-out system** is in place. All adults will be considered to have **agreed to donate their organs** when they die unless they have **recorded a decision not to donate** or are in an excluded group. Families will still be consulted about organ donation and the **donor's faith, beliefs** and **culture** will be **respected**.

KPI 3 – Self-screening information

Breast Cancer – Self-screening

- know what's normal for you
- look at your breasts and feel them
- know what changes to look for
- report any changes to a GP without delay

Look at your breasts and feel each breast and armpit, and up to your collarbone. You may find it easiest to do this in the shower or bath, by running a soapy hand over each breast and up under each armpit. You can also look at your breasts in the mirror. Look with your arms by your side and also with them raised.

See a GP if you notice any of the following changes:

- a change in the size, outline or shape of your breast
- a change in the look or feel of the skin on your breast, such as puckering or dimpling, a rash or redness
- a new lump, swelling, thickening or bumpy area in one breast or armpit that was not there before
- a discharge of fluid from either of your nipples
- any change in nipple position, such as your nipple being pulled in or pointing differently
- a rash (like eczema), crusting, scaly or itchy skin or redness on or around your nipple
- any discomfort or pain in one breast, particularly if it's a new pain and does not go away (although pain is only a symptom of breast cancer in rare cases)

Testicular Cancer – Self-screening

From puberty onwards, it is important to check your testicles regularly. Testicular cancer is usually always cured but it is easier to treat when it is diagnosed early. Checking for testicular cancer is sometimes called testicular self-examination. Doing this regularly means you soon get to know what feels normal for you. A normal testicle should feel smooth and firm, but not hard.
Hold your scrotum in the palm of your hand. Use your fingers and thumb to examine each testicle. You should feel for:

- lumps or swellings
- anything unusual
- differences between your testicles.

It is normal for the testicles to be slightly different in size. It is also normal for one to hang lower than the other. The epididymis (tube that carries sperm) is behind the top of each testicle. It feels like a soft, coiled tube. It is common to get harmless cysts or benign lumps in the epididymis. Treatment for these may vary. Other conditions can cause lumps or swellings, and most lumps are not cancer. But it is important you get your doctor to check anything unusual as soon as possible.

If you need further support...

Home and school support:

- A friend
- A teacher
- Your tutor
- Parents/carers
- Mr Ogden
- Mrs Loveridge
- Mrs Jones
- Mrs Hayward
- Mr Hayward

Reputable Organisations:

- www.childline.org.uk/info-advice/you-your-body/my-body
- www.nhs.uk/change4life
- www.nhs.uk/live-well
- www.tomkerridge.com/full-time-meals (for family friendly meal ideas, including cooking healthy food within a limited kitchen).
- Young Minds: www.youngminds.org.uk
- Contact your GP
- Contact Orchid: https://orchid-cancer.org.uk/testicular-cancer/ (0808 802 0010)
- Visit trekstock: https://www.trekstock.com/ (a resource for young people affected by cancer which provides counselling and support
- Breast Cancer Now – https://breastcancernow.org
- Teenage Cancer Trust - www.teenagecancertrust.org