



Year 9 Knowledge Book 2026-2027 CORE SUBJECTS



Saint Benedict
A Catholic Voluntary Academy



Love, Belief, Integrity, Knowledge



OUR VALUES

**BE WHO GOD MEANT YOU TO BE AND YOU
WILL SET THE WORLD ON FIRE.**

LOVE

As we know we are loved by God, we will learn to love ourselves and care for our own body mind and soul.

We will show love to one another by being patient and kind, not by being rude, boastful or proud.

As one body in Christ, we will ensure that no member of our community is left out or left behind

BELIEF

We will encourage one another and build each other up.

We will let our light shine, making the world a better place for all.

KNOWLEDGE

We will value knowledge: intelligent hearts acquire knowledge, the ears of the wise seek knowledge.

INTEGRITY

We will always strive to make the right choice even when this is the harder path to take.

We will live and work sustainably.

**AT SAINT BENEDICT
WE DEVELOP THE
CHARACTER OF OUR
COMMUNITY THROUGH
OUR CURRICULUM AND
CULTURE.**



MY EQUIPMENT PLEDGE

To succeed you must be prepared. Every night before school, you need to check your school bag to ensure that you have all the correct equipment.

Here is the list of equipment you need for every lesson:

- ☐ Black or blue pens
- ☐ Red pens (one or two)
- ☐ A ruler
- ☐ A pencil
- ☐ A scientific calculator (CASIO)
- ☐ A rubber
- ☐ A protractor
- ☐ Colouring pencils
- ☐ A sharpener
- ☐ Glue stick
- ☐ Your KNOWLEDGE BOOK

I pledge that I will always bring the correct equipment to class so that I can effectively learn.

Your signature:

Parent/carer's signature:

Form tutor's signature:

.....

.....

.....

BE WHO GOD MEANT YOU TO BE
AND YOU WILL SET THE WORLD ON FIRE

ST CATHERINE OF SIENA

Respect

What is Respect?

Showing respect is an important part of life, and how you maintain relationships.

Three types of respect:

1. Respect Yourself
2. Respect Others
3. Respect the Planet

Why is respect important?

Receiving respect from others is important because it helps us to feel safe and to express ourselves. Respecting others helps maintain a peaceful world and encourages others to be better people. Showing respect to our planet allows us to maintain it for future generations.

Key words	Definitions
Respect	Due regard for the feelings, wishes and rights of others
Honour	The quality of knowing and doing what is morally right
Dignity	Sense of pride and self respect
Relationships	The way two or more people or groups connect and behave towards each other
Worthiness	The quality of being good enough

Rules and Sanctions

Build up a loving community

Key word	
Conduct	The way in which a person behaves.
Unacceptable	Something that is not suitable or appropriate.
Boundaries	The limits of something.
Sanction	A penalty or action taken when a rule or law has been broken.
Consistent	Acting in the same way overtime to be fair.

Behaviour

Rules and sanctions are things which guide our behaviour. We follow rules and regulations to be fair and consistent. Sanctions occur if we do not follow rules or deliberately break them.

Preparation for life

All aspects of life require us to follow rules. There are rules in school; rules in your family and home; rules to follow when crossing the road and using the bus and so on. Structure and rules allow us all to know what is acceptable and how to conduct ourselves. Rules reassure us

The law

We are all bound by the rules of the law. If we break the law, we face a raft of different sanctions. Ultimately, having rules in schools is about a lifelong understanding about what is right and what is wrong.

Kindness

Key word

Empathy	Understand and share feelings of others
Compassion	Concern for misfortune of others
Compliment	Praise or congratulate others
Considerate	Thoughtfulness and sensitivity to others
Generous	Being liberal with things

Treat others how you would want to be treated yourself.

What is Kindness?

The quality of being friendly, generous and considerate

What does it mean to be kind?

To have empathy/sympathy, be compassionate, looking for good in people.

Why is it important to be kind?

Makes you feel happy, feel good about yourself

Builds strong relationships

Inspires others

How can we show kindness?

Smile

Hold the door open for somebody

Say something nice (compliment)

Invite somebody sat on their own to join you

Manners

Listen to somebody

3

Emotions

Key Words

Feelings	An emotional state or reaction.
Relationships	The state of being connected with someone else.
Instinct	A fixed pattern of behaviour.
Intuitive	Using what you feel to be true even without conscious reasoning.
Reaction	Something done, felt or thought in response to a situation or event.
Identification	The act or process of identifying someone or something.

Work and play in harmony

What are emotions?

Emotions are biological states associated with the nervous system.

Thoughts, feelings, behavioural responses, and relationships all generate emotions.

An instinct or, intuitive reaction or feeling can create emotions

Identifying feelings

Making sense of what and how you feel is not always easy. To do this, we need to regularly check in with ourselves, making time to think about the feelings we are having and naming them. To do this, we need to think about our daily lives which may help us to see patterns of behaviour.

Not all feelings or emotions are bad or negative!

It is important to recognise when you feel happy; relaxed and good about yourself. Knowing what has led to these feelings can help us identify things we do not like which may cause us negative feelings.

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Verbal Communication

Treat each other with dignity and justice

Key Words	
Clarity	Vocal clarity means you do not speak too fast or too slowly. You consider carefully the words you mean and whether your listener can understand you.
Honesty	Honesty is speaking the truth.
Respect	Respect means that you accept somebody for who they are, even when they are different from you or you do not agree with them.
Appropriate	fitting the practical or social requirements of the situation.
Tone	a quality in the voice that expresses your feelings or thoughts, often towards the person being spoken to or the subject being spoken about
Courtesy	politeness, good manners, or consideration for other people.

What is verbal communication?

Verbal communication is the use of words to share information with other people.

What does it mean to communicate effectively?

Every time you verbally interact with someone you are aiming to develop your understanding of the world; you may be wishing to obtain information, respond to a request or offer support or guidance to another. In every one of these exchanges you are representing your tutor, your family and most importantly yourself.

Why is it important to communicate effectively?

All young people need to develop good speech, language and communication skills to reach their full potential.

Speech, language and communication underpin the basic skills of literacy and numeracy and are essential for you to understand and achieve in all subjects.

How can we communicate effectively?

Make eye contact

Speak honestly

Consider your role within the school

Consider the role of the person you are speaking to

Think carefully why you need to speak to the person you are addressing

Where necessary adapt as your conversation develops

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Manners

Key Words	
Manners	A person's words or way of behaving towards others.
Respect	A regard for the feelings, wishes, or rights of others.
Listen	To take in what you hear.
Harmony	A time of behaving in one way to produce a pleasing effect.
Vocabulary	The range of words that we know and use.
Gratitude	The quality of being thankful; readiness to show appreciation for and to return kindness.

Loving...harmony...dignity

Treat your neighbour as yourself

The way in which we behave and speak towards others, reflects in their actions and words towards us.

Show the best side of yourself

When you speak to others, always show respect; be polite and thankful. Use the words 'please, thank you, sorry and pardon' when communicating with others.

Manners are for every situation

Every interaction has space for the use of manners: speech, emails, messages. Often when we get upset or angry we don't use manners.

However it does calm a situation if you do.

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Change

Key Words	Definition
Change	Make or become different
Organised	Make arrangements or preparations for an event or activity
Opportunity	A time set of circumstances that make it possible to do something
Coping	To deal effectively with something difficult
Embrace	Accept (a belief, theory or change) willingly and enthusiastically
Strategies	A plan of action designed to achieve a long term or overall aim

Develop potential to the full

Find the positive

Don't allow yourself to become negative about the changes in your life. Change is good, keep repeating it.

Feeling vulnerable

Facing change can be very overwhelming, leaving you feeling very emotional. Make it your mission to be proactive and respond to it positively.

Talk about it

It's good to talk about change in your life. Focus on problems, solutions and the positives that change will bring. Try to avoid focussing on the negatives and letting emotions take over.

Study Skills – Ways to learn and remember

Self quizzing (look, cover, write)



Read through the information in the knowledge book that you want to learn



Cover the information up



Write down as much as you can remember



Use the knowledge book to;

- a) Correct any mistakes
- b) Add any information that you forgot

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Study Skills – Ways to learn and remember

Spacing



Complete a self quiz of the information you want to learn



Wait for a day or 2 (depending on the deadline)



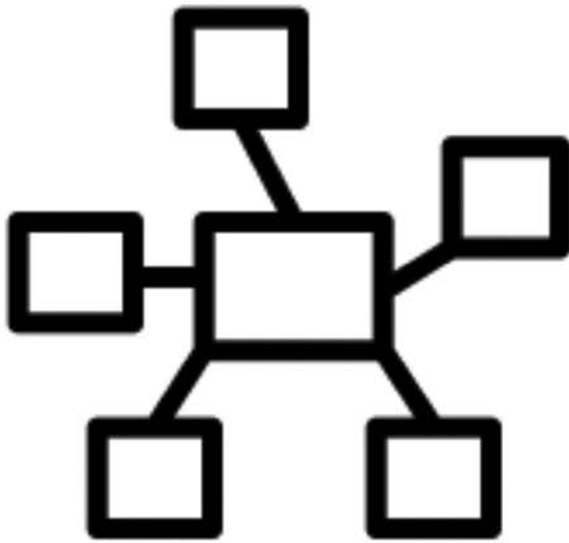
Repeat the self quiz.

The more times you can repeat this process, the more you will be able to remember without the book

2

Study Skills – Ways to learn and remember

Elaboration



Think about the topic that you are studying

Ask questions such as who, what, why, where, when how. Try to find the answers

See how these ideas connect - a mind map will be useful for this

3

Study Skills – Ways to learn and remember

Concrete Examples

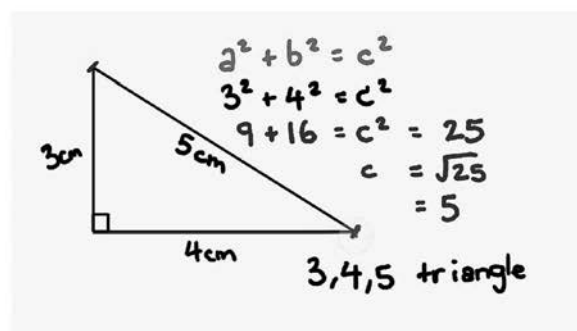


Pythagoras theorem example

If you tried to explain Pythagoras's theorem to someone verbally, it would be quite hard to understand.

By using a concrete example that shows exactly how to use Pythagoras theorem, it is much easier to remember, understand and use

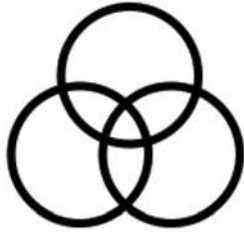
A concrete example is an clear example of an abstract idea



4

Study Skills – Ways to learn and remember

Interleaving



Research says we will actually learn more effectively if we mix our study skills up rather than using the same techniques all the time

1. Try to use different study skills rather than just one technique.

2. When revising for exams, prepare a revision timetable and try to revise more than one subject during a session

5

Study Skills – Ways to learn and remember

Dual Coding



As well as **writing** information down, **create an icon/ drawing** too for individual facts. This helps your brain to remember the information

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Year 9 English Knowledge Organiser

Full academic year

Grammar

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Complex Sentences

Page 5 Comma
Semi-Colon
Colon

Page 6-8 ISPAED
Apostrophes
Paragraphs



Full academic year

Capitalisation in English means using capital (uppercase) letters in the right places.

Start of a sentence: Always capitalise the first word.

Names and titles: Capitalise names of people, places, days, months, and specific things.

The word "I": Always capitalise "I" when you talk about yourself.

Titles of books, films, etc.: Capitalise the main words in titles.

Holidays and events: Capitalise special days.

The cat is sleeping.

Sarah, London, Monday, August, the Eiffel Tower.

I went to the park.

Harry Potter and the **Goblet of Fire**.

Christmas, Halloween, World Book Day.

3

TERM 1



A simple sentence is a complete piece of information. It contains a subject, a verb and sometimes an object.

The pen fell on the floor.



A compound sentence contains two main clauses (like two simple sentences). These are joined with a conjunction: *and, but, so, because*.

Miss Kelly was tired, so she bought a large coffee.



A complex sentence contains a main clause and a subordinate clause.

Whilst it was raining, Mr Thornhill enjoyed a cup of tea in his office.

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A comma indicates a pause between parts of a sentence or separates items in a list.

I went to Morrisons and bought linguine, king prawns, garlic and chilli flakes.



A semi-colon can be used between two closely related independent clauses, provided they are not already joined by a coordinating conjunction.

Miss Kureczko was busy; she wouldn't even answer the phone.



A colon is used to precede a list of items, a quotation, or an expansion or explanation.

Monday: the worst day of the week.



ISPACE indicates the various ways you can start a sentence. It stands for –ING verbs, Simile, Preposition, Adverb, Connective, -ED verbs.

–ING verb

-ING verb example: Flying proudly in the wind, the flag reigned over the castle

Simile

Simile example: Like a predator, the child caught the escaping balloon.

Preposition

Preposition example: Turning to my right, I saw the corridor I was meant to walk down.

Adverb

Adverb example: Nervously, the cat padded its way across the room.

Connective

Connective example: Finally, she arrived at her front door.

-ED verb

-ED verb example: Withered, the trees stood like ancient guards.



An apostrophe is used to indicate either possession or the omission of letters.

Apostrophes for possession

Using an apostrophe + s ('s) shows that one person/thing owns or is a member of something.

Recce's ballet class
Iqra's bike
Jake's pen
Jess' room

Apostrophes for contractions

When you combine two words to make a contraction, you will always take out some letters. In their place, use an apostrophe.

they + have = they've
are + not = aren't
they + will = they'll



A paragraph is a distinct section of a piece of writing, usually dealing with a single theme and indicated by a new line.

New paragraphs should start with a topic sentence, and information within the paragraph should stay focused on that topic.



Ti - stands for **Time**, so start a new paragraph for a different time period.



P - stands for **Place**, so start a new paragraph for each new place.



To - stands for **Topic**, so start a new paragraph for each new topic, idea or subject.



P - stands for **Person**, so start a new paragraph for each new person or change of speaker in a dialogue.

A helpful way to remember when to start a new paragraph is to learn TiPToP.

English skills



Full academic year

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TIER THREE VOCABULARY

WORD	DEFINITION
Adjective	A word describing or naming an attribute of a noun e.g <i>Tasty cheese</i>
Adverb	A word that describes how a verb is being done e.g <i>Walked quickly</i>
Alliteration	The repetition of the same sound in a sequence of words beginning with the same letter e.g <i>Cautious cat</i>
Allusion	A reference to another literary text, event or person e.g I am the Juliet to your Romeo !
Foreshadowing	A warning or indication of (a future event).
First person narrative	When a narrator recounts events from their own point of view using the first person such as "I", "us", "our" and "ourselves"
Genre	A style or category of art, music, or literature e.g <i>Gothic, Comedy</i>

WORD	DEFINITION
Metaphor	A figure of speech in which a word or phrase is applied to an object or action to which it is not literally applicable e.g <i>Love is a battlefield</i>
Noun	A word used to identify a person, place or thing e.g <i>Table, love</i>
Pathetic fallacy	When the weather reflects the mood or tone of a character.
Personification	The attribution of human feelings and responses to inanimate things or animals e.g <i>The clouds cried</i>
Simile	A figuring of speech involving the comparison of one thing with another thing of a different kind e.g <i>Love is like a battlefield</i>
Symbolism	The use of symbols to represent ideas or qualities
Third person narrative	When the poet writes about a character who isn't the speaker
Verb	A word describing an action or how something is done e.g <i>Walking</i>

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TIER THREE VOCABULARY

WORD	DEFINITION
Ellipsis	Intentionally leaving out a word, sentence, or whole section from a text without altering its original meaning
Emotive language	Words which elicit a powerful emotional response
Exaggeration	Representing something as being larger, better, or worse than it really is
Direct address	Referring to the reader directly using the pronouns ' we ' or ' you '
Facts	Something which can be proven to be true
Knowledge	Knowing the topic/subject you are writing or speaking about
Repetition	The repetition of a word or phrase across the text

WORD	DEFINITION
Onomatopoeia	The process of creating a word that phonetically imitates, resembles, or suggests the sound that it describes e.g ' Zap ' ' sizzle ' ' Pow '
Opinion	A belief which cannot be proven to be true
Oxymoron	A figure of speech in which apparently contradictory terms appear in conjunction e.g Happy accident
Pun	A joke using the different possible meanings of a word or the fact that there are words which sound alike but have different meanings e.g Denial is a river in Egypt.
Archaic pronoun	Archaic pronouns are personal pronouns that were commonly used in Shakespeare's writing e.g Thou, thee, thine, thy

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ORACY - RESPONDING VERBALLY

Practicing oracy means getting better at speaking and listening. It helps you talk clearly, share your ideas, and listen to others. This can make you more confident, help you learn better in all subjects, and prepare you for things like teamwork, debates, and job interviews in the future.

Supporting or agreeing

- I strongly believe that...
- It is my opinion that...

Expanding or building on...

- Adding on what X said...
- Building on what X said...
- I have been listening carefully, and I would like to add a new point...

Passing on the dialogue...

- X, what do you think?
- X, what do you think about what I said?
- X, do you agree or disagree?

Challenging/ disagreeing

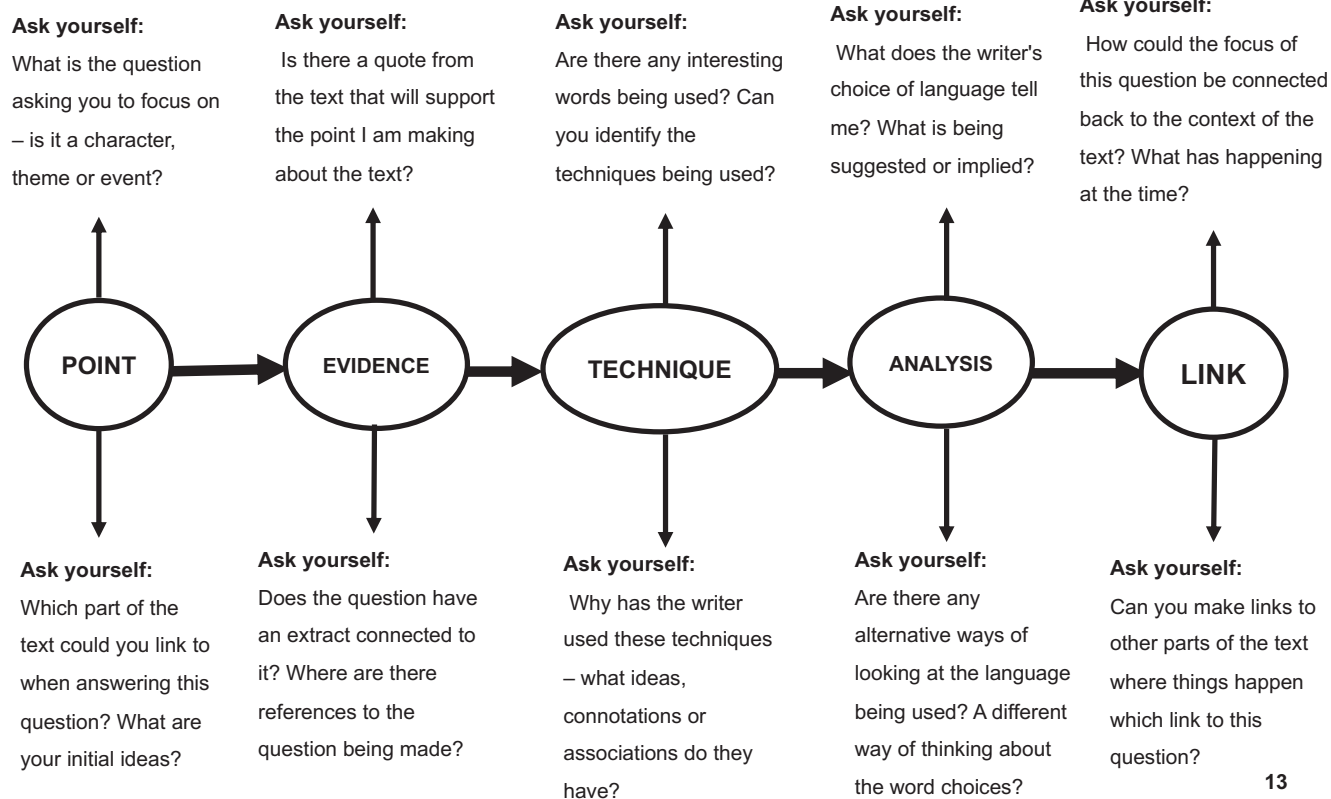
- I have a different idea...
- I disagree...
- I would like to challenge something that X said...
- I would like to respectfully challenge...

Concluding or end words...

- My final thoughts are...
- There are lots of powerful arguments, but my own opinion is...
- For me, the strongest argument is...

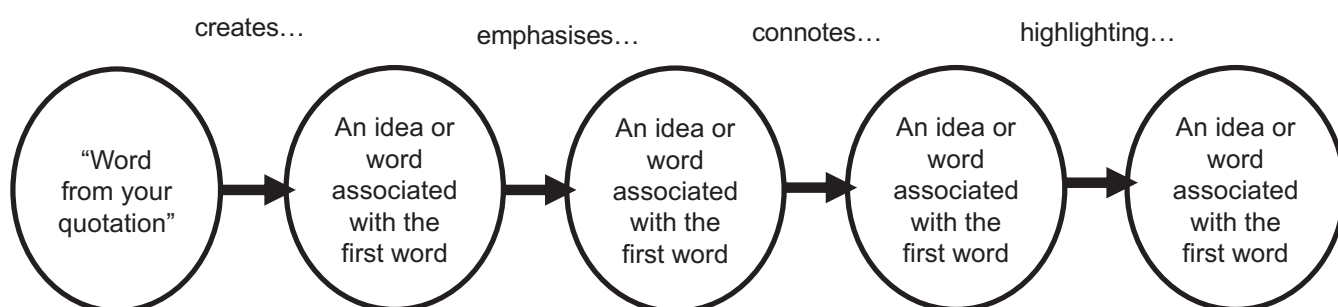
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RESPONDING TO A TEXT



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FINDING CONNOTATIONS

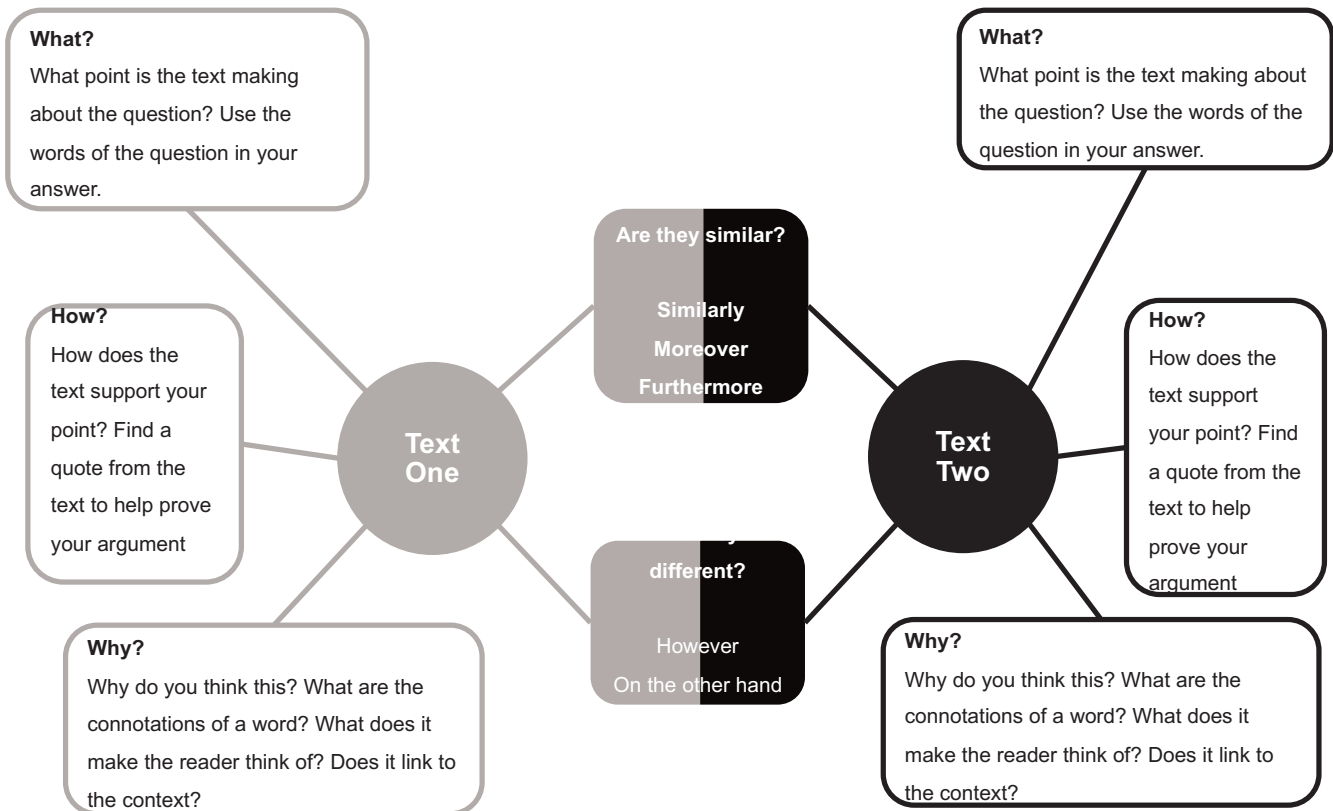


The word "_____" creates an image of _____.

It emphasises _____ because it connotes _____.

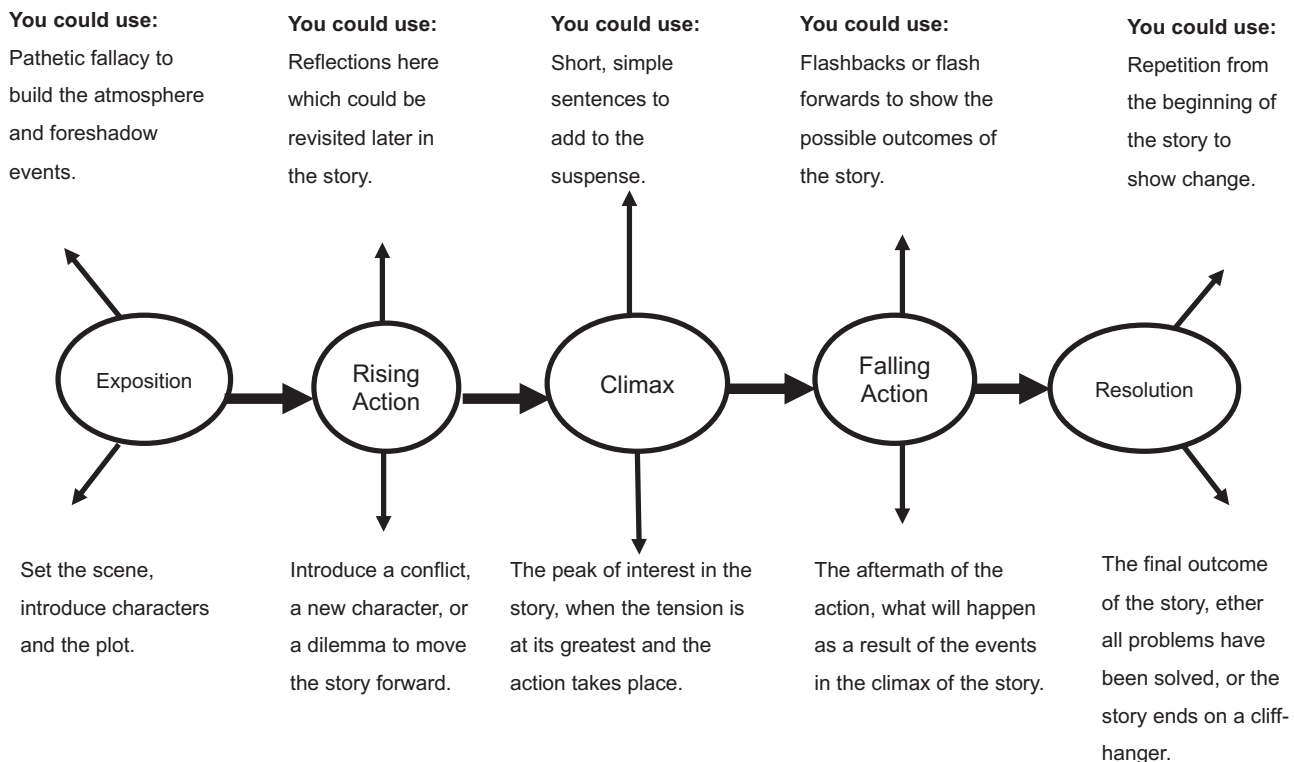
This highlights _____ and therefore makes the reader feel _____ about _____.

COMPARING TWO TEXTS



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NARRATIVE STRUCTURE



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Year 9 Texts



Full academic year

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Ghost Boys



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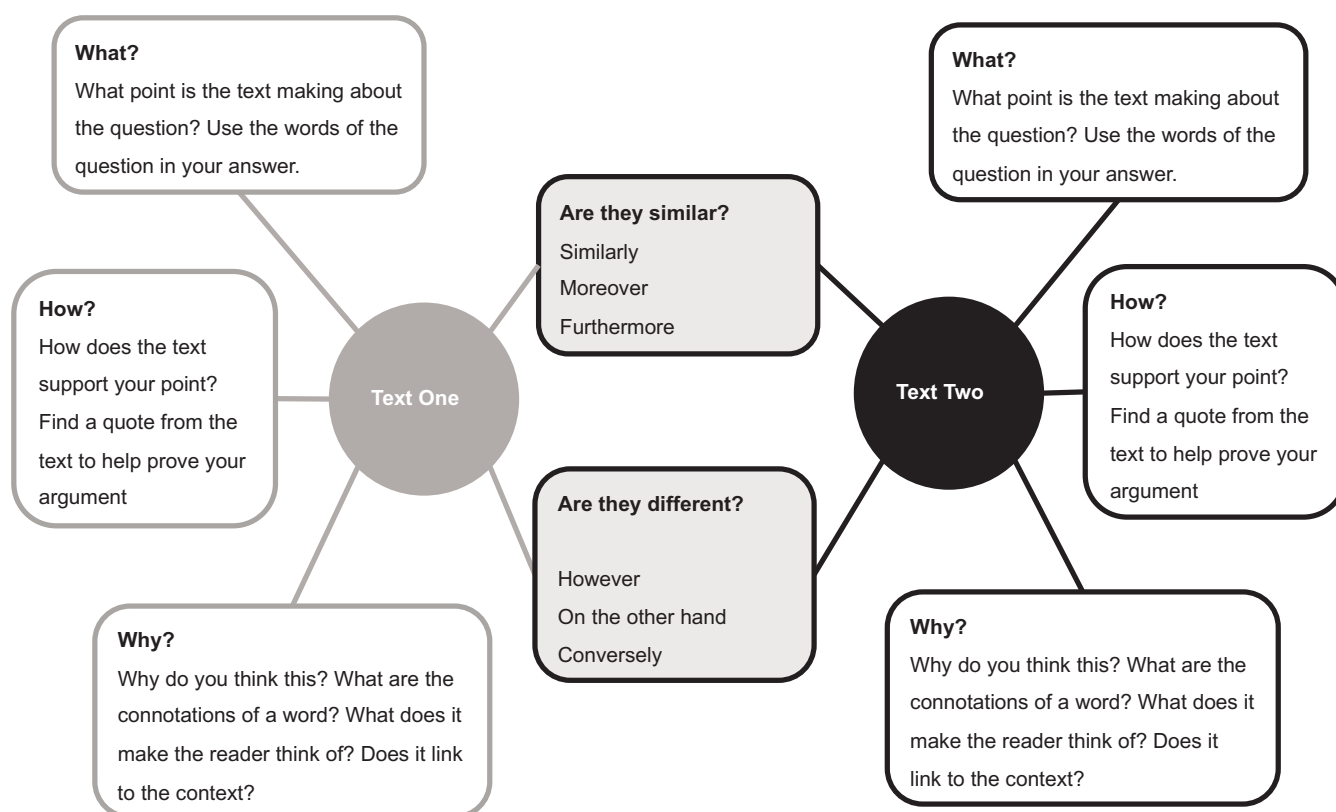
TIER TWO VOCABULARY

WORD	DEFINITION
Aspirational	Having a strong desire to achieve something.
Dependent	Relying on something or someone else.
Destiny	The hidden power believed to control future events; fate.
Ethical	Morally right or acceptable.
Empower	Make (someone) stronger and more confident, especially in controlling their life and claiming their rights.
Idealist	A person who is guided more by ideals than by practical considerations.
Innocent	Not guilty of a crime or offence.
Justice	Just behaviour or treatment.
Loneliness	Having no friends or company; isolation.

WORD	DEFINITION
Marginalised	To make a group feel isolated or unimportant.
Naïve	Showing a lack of experience, wisdom, or judgement.
Ostracised	Exclude from a society or group.
Pragmatic	Dealing with things sensibly and realistically in a way that is based on practical rather than theoretical considerations.
Segregation	The action or state of setting someone or something apart from others.
Racism	Prejudice against a person or people on the basis of their membership of a particular racial or ethnic group, typically one that is a minority or marginalised.
Secluded	Not seen or visited by many people; sheltered and private
Solitary	Done or existing alone.

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COMPARING TWO TEXTS



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Civil Rights

American civil rights movement, **mass protest movement against racial segregation and discrimination in the southern United States** that came to national prominence during the mid-1950s. This movement had its roots in the centuries-long efforts of African slaves and their descendants to resist racial oppression and abolish the institution of slavery.



Racial Inequality

Racial inequality is a **disparity in opportunity and treatment that occurs as a result of someone's race**. This type of discrimination is clearly the **domination of one race over another**, which frequently results in favoritism and bias towards people from their race or ethnicity.



Equity and Equality

Equity is **what builds an anti-racist future**. The concept of racial equity recognises that not all races are starting from the same place. Some people and groups have different circumstances and need different resources and opportunities to succeed. Equity is about providing those particular resources to the groups who need them.



Black Lives Matter

Black Lives Matter (BLM) is a decentralised political and social movement that seeks to highlight racism, Discrimination, and inequality experienced by black people. When its supporters come together, they do so primarily to protest incidents of police brutality and racially motivated violence against black people.

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Nonfiction Reading



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COMMON RHETORICAL DEVICES

	Direct address	Referring to the reader directly using the pronouns 'we' or 'you'.		Opinion	A belief which cannot be proven to be true.
	Alliteration	The repetition of the same sound in a sequence of words beginning with the same letter.		Rhetorical question	Any question in a piece of writing which does not require an answer.
	Repetition	Where a word or phrase is used more than once across a text		Emotive language	Words which elicit a powerful emotional response.
	Knowledge	Knowing the topic/subject you are writing or speaking about.		Similes and metaphors	A simile directly compares one object to another using 'like' or 'as'. A metaphor compares two things by stating one is the other.
	Facts	Something which can be proven to be true.		Triplets	Lists of three things in a sentence.

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ADVANCED RHETORICAL DEVICES

	Allusion	A reference to an event, place, literary work or person. Example: "I can't get changed that quickly, I'm not Superman! "		Hypophora	A figure of speech in which a writer raises a question, and then immediately answers it. Example: "What should young people do with their lives today? Many things, obviously. "
	Anaphora	The repetition of a word or phrase at the start of successive phrases. Example: " If you prick us, do we not bleed? If you tickle us, do we not laugh?"		Hyperbole	An exaggeration. Example: "I have done this a thousand times "
	Anecdote	A short amusing or interesting story about a real incident or person. Example: "When I was your age, I ..."		Parallelism	The use of words or phrases with a similar structure. Example: "Like father, like son"
	Epistrophe	The repetition of a word or expression at the end of successive phrases, clauses, sentences, or verses especially for rhetorical or poetic effect. Example: "of the people , by the people , for the people "		Oxymoron	A combination of contradictory or unsuitable words. Example: "It is a cruel kindness"

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ARISTOTLE'S THREE PILLARS OF PERSUASION

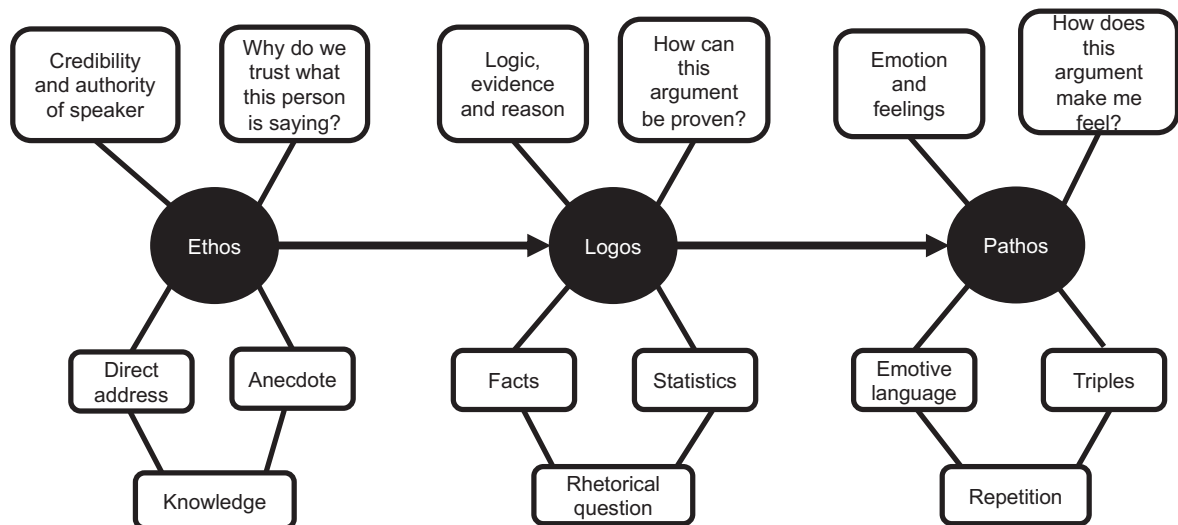


Aristotle

Born in Greece, Aristotle lived from 384 BC to 322 BC.

Instructed on how to best persuade people.

Aristotle was a student of Plato (another Greek philosopher).



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HOW AN ARGUMENT IS STRUCTURED



Make your position clear. What is your point of view on how?



Introduce the topic you are writing about. Still make your opinion clear.



Offer your first point through a topic sentence and identify one issue. Explain your point.



Offer your second point through a topic sentence and identify one issue. Explain your point.



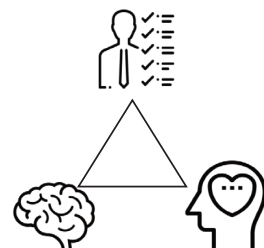
Acknowledge the opposing point of view but then challenge it. Why are those critics wrong and you're right?



Offer solutions for the points you raised: How can we avoid these issues? What are the benefits? Create a sense of urgency.



Repeat your position. This is the last message you want your reader/listener to leave with.



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Othello



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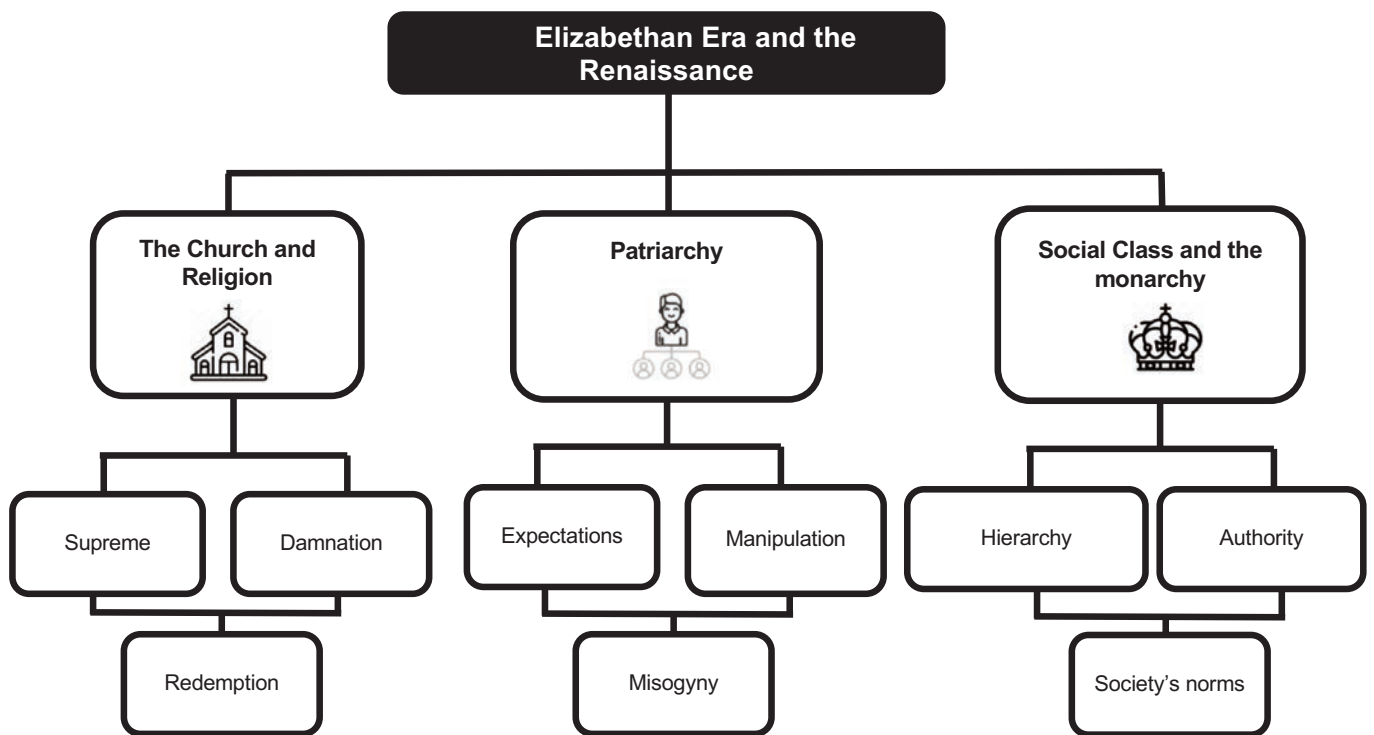
Page 37 Characters

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TIER TWO VOCABULARY

WORD	DEFINITION
Artifice	Clever or cunning devices to trick or deceive others.
Bigotry	Extreme prejudice against a particular person or group often based on their race or religion.
Bellicose	Demonstrating aggression and willingness to fight.
Chaos	Complete disorder and confusion.
Confidante	A person with whom one shares a secret or private matter, trusting them not to repeat it to others.
Culpable	Deserving of blame.
Exploitative	Making use of a situation or treating others unfairly in order to gain an advantage or benefit.
Fiendish	Extremely cruel or unpleasant.
Guileful	Having or showing cunning and sly intelligence.
Gullible	Easily persuaded to believe something.

WORD	DEFINITION
Incandescent	Full of passionate emotion, usually extreme anger.
Infidelity	The action or state of being unfaithful to a spouse or other sexual partner.
Machiavellian	Cunning, scheming, and unscrupulous, especially in politics.
Manipulation	Having control or clever techniques to make someone do what you want them to.
Motivation	A reason for acting or behaving in a certain way.
Noble	Having fine personal qualities, high moral principles.
Resentment	Feeling extremely bitter at being treated unfairly.
Self-effacing	Not wanting attention for achievements, modest.
Submissive	Willing to be obedient without question.
Turmoil	A state of great disturbance, confusion, or uncertainty.



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OTHELLO CONTEXT

The Patriarchal Society



Elizabethan society was patriarchal, meaning that men were considered the leaders and women their inferiors. Women were regarded as "the weaker sex", not just in terms of physical strength, but emotionally too. Women were expected to be ruled by men. Men saw women as possessions and fathers expected to choose husbands for their daughters. They were believed to be intellectually inferior to men, incapable of rational thought and rarely received an education.

Assertive and argumentative women were seen as a threat to social order and were often punished. Shakespeare included a large number of parts for strong women in his plays.

Race in Othello



Racism was widespread in Elizabethan England. Black people were an unusual sight and were viewed with suspicion. Elizabeth 1st issued an order that they be removed from England in 1601. Many believed that they were only fit to be slaves. Elizabethans were against mixed race marriage.

Throughout the play Othello is called 'Moor' and there are also many references to the colour of his skin. The term 'Moor' was derived from the name of the North African country Mauritania or possibly the Greek word 'Mauros' meaning dark. The word Moor not only had connotations of race and ethnicity but also an otherness in terms of religion. Prejudice focussed on this perceived sense of otherness. Despite being honoured for his services to the State, Othello experiences this racism when he marries Desdemona who is white.

Venice and historical conflicts



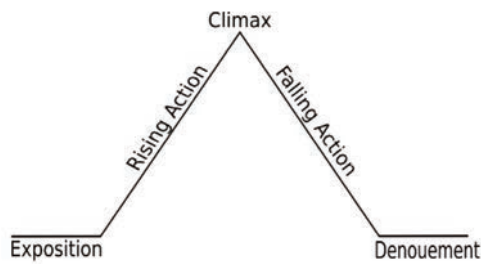
Venice was an important trading city. It was a cultural meeting point and was considered multicultural as traders from across the world met there. It was a popular setting for plays about intrigue, love affairs and revenge. It had a reputation for sophistication and wealth but was also seen as a city of loose morals.

Othello is set during the wars that happened between Venice and Turkey in the latter part of the sixteenth century. Much of the action takes place in Cyprus which was an important outpost for the Turkish Navy at this time.

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OTHELLO STRUCTURE AND THEMES

Othello follows a traditional 5 act structure. The story line follows Freytag's Pyramid.



Exposition: The effects of Othello and Desdemona's marriage are felt.

Rising Action: Iago puts his plan to convince Othello that Desdemona is having an affair into action.

Climax: Othello decides he must kill Desdemona.

Falling Action: The aftermath of Othello's murder of Desdemona.

Denouement: Othello kills himself.

THEMES



Prejudice

The main form of prejudice is **racism**, as several characters treat Othello as an outsider or animalistic as he is black. We also see **misogyny** within the play as women are judged.



Jealously

Jealously is a driving motive- Iago and Roderigo's jealousy cause their actions. Othello's jealousy causes him to act out of character, lose all reason and murder the woman he loves.



Deception

Deception drives the plot- Desdemona deceives her father to marry Othello, Iago deceives Othello to gain revenge and Othello is deceived by his own emotions.



Gender

Masculinity is focused strongly on honour- Othello feels emasculated when he believes Desdemona was unfaithful. Women are initially presented as either a Madonna or a whore. We see later in the play that women are more complicated and these are male enforced stereotypes.

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OTHELLO ACT 1



Othello and Desdemona have secretly married. Iago, resentful that he didn't get a promotion, encourages Roderigo to tell Desdemona's father, Brabantio, about the marriage and cause trouble. Brabantio is furious and seeks out Othello.



Iago arrives at Othello's house and warns him about Brabantio. A group of men approach, but it is a summons from the Duke. Brabantio then arrives and Othello agrees to put the case before the Duke,



Brabantio makes his complaint against Othello and accuses him of enchantment. Othello explains Desdemona fell in love with him due to his stories.



Desdemona enters and confirms she loves him. The Duke sends Othello to fight the Turks. Desdemona insists on going with him.



Roderigo is manipulated by Iago to raise money and follow the army. Iago plans to use him to get his revenge on Othello. He promises Roderigo to help him win Desdemona.

PLOT

KEY QUOTES

"I follow him to serve my turn upon him"

Iago

Act 1 i

"Damn'd as thou art, thou hast enchanted her"

Brabantio Act 1 ii

"She loved me for the dangers I had pass'd, And I loved her that she did pity them."

Othello Act1 iii

"That I did love the Moor to live with him"

Desdemona Act 1 iii

"Hell and night Must bring this monstrous birth to the world's light."

Iago Act 1 iii

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OTHELLO ACT 2

					
PLOT	A storm delays arrival in Cyprus. Desdemona, Iago and Emilia arrive first. Iago criticises all women as deceptive. Cassio takes Desdemona aside to speak to her about Othello	Iago sees this conversation and plots to frame Cassio and Desdemona as having an affair. He resents Cassio as he got the promotion Iago wanted. Othello arrives and he announces a celebration .	Iago persuades Roderigo that Desdemona will choose Cassio after she is bored of Othello. He convinces him to start a fight with Cassio that evening, hoping this will make Cassio lose Othello's favour.	Iago gets Cassio drunk while on guard duty. Roderigo comes and starts a fight. Cassio stabs Montano	Othello breaks up the fight and dismisses Cassio from his service. Iago persuades Cassio to petition Desdemona to get his job back.
KEY QUOTES	"You rise to play and go to bed to work" Iago Act 2 i	"with as little a web as this will I ensnare as great a fly as Cassio" Iago Act 2 i	"I'll have our Michael Cassio on the hip, Abuse him to the Moor in the rank garb" Iago Act 2 i	"Zounds, I bleed still; I am hurt to the death." Montano Act 2 iii	"I will beseech the virtuous Desdemona to undertake for me" Cassio Act 2 iii

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OTHELLO ACT 3

					
PLOT	Desdemona promises Cassio to help him get his position back. Othello enters so Cassio leaves. Iago remarks he looks guilty. Desdemona asks Othello to forgive Cassio.	Iago implies Desdemona and Cassio are having an affair. Othello fears she no longer loves him. Desdemona drops a handkerchief Othello gave her and Emilia gives it to Iago. He plants it in Cassio's room.	Othello is enraged about the possibility of an affair. Iago lies that he saw Cassio use the handkerchief. Othello swears revenge and promotes Iago .	Othello speaks to Desdemona and demands to see the handkerchief. She cannot produce it which angers Othello. Emilia speculates that Othello is jealous.	Cassio asks about his case; Desdemona goes to speak to Othello. Bianca, Cassio's lover appears. He asks her to copy the embroidery from a handkerchief he found in his room. She gets angry and thinks he has another lover.
KEY QUOTES	"I will have my lord and you again As friendly as you were." Desdemona Act 3 iii	"She's gone. I am abused; and my relief Must be to loathe her" Othello Act 3 iii	"Arise, black vengeance, from thy hollow cell!" Othello Act 3 iii	"Is not this man jealous?" Emilia Act 3 iv	"My lord is not my lord; nor should I know him" Desdemona Act 3 iv

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OTHELLO ACT 4

					
PLOT	Othello falls into a fit from anger. Iago arranges for Othello to overhear Cassio talk about sleeping with Desdemona. However, he tricks them and talks to Cassio about Bianca instead.	Bianca enters with the handkerchief. Othello is even more enraged and vows to kill Desdemona. Iago promises to arrange Cassio's death,	Desdemona enters with Lodovico, with orders for Othello to leave Cyprus. Desdemona appears happy so Othello hits her and calls her a whore. This shocks Lodovico; he wonders if Othello is mad.	Othello confronts Emilia and Desdemona; both protest innocence. Iago convinces Roderigo the only way to win Desdemona is to kill Cassio.	Desdemona fears her fate and asks Emilia to bury her in her wedding sheets. They discuss adultery and Emilia blames women's disloyalty on the ill treatment of men. Desdemona goes to bed.
KEY QUOTES	"For I will make him tell the tale anew...when He hath, and is again to cope your wife" Iago Act 4 i	"Ay, let her rot, and perish, and be damned to-night; for she shall not live" Othello Act 4 i	"Is this the noble Moor whom our full senate Call all in all sufficient?" Lodovico Act 4 i	"I took you for that cunning whore of Venice That married with Othello." Othello Act 4 ii	"But I do think it is their husbands' faults If wives do fall" Emilia Act 4 iii

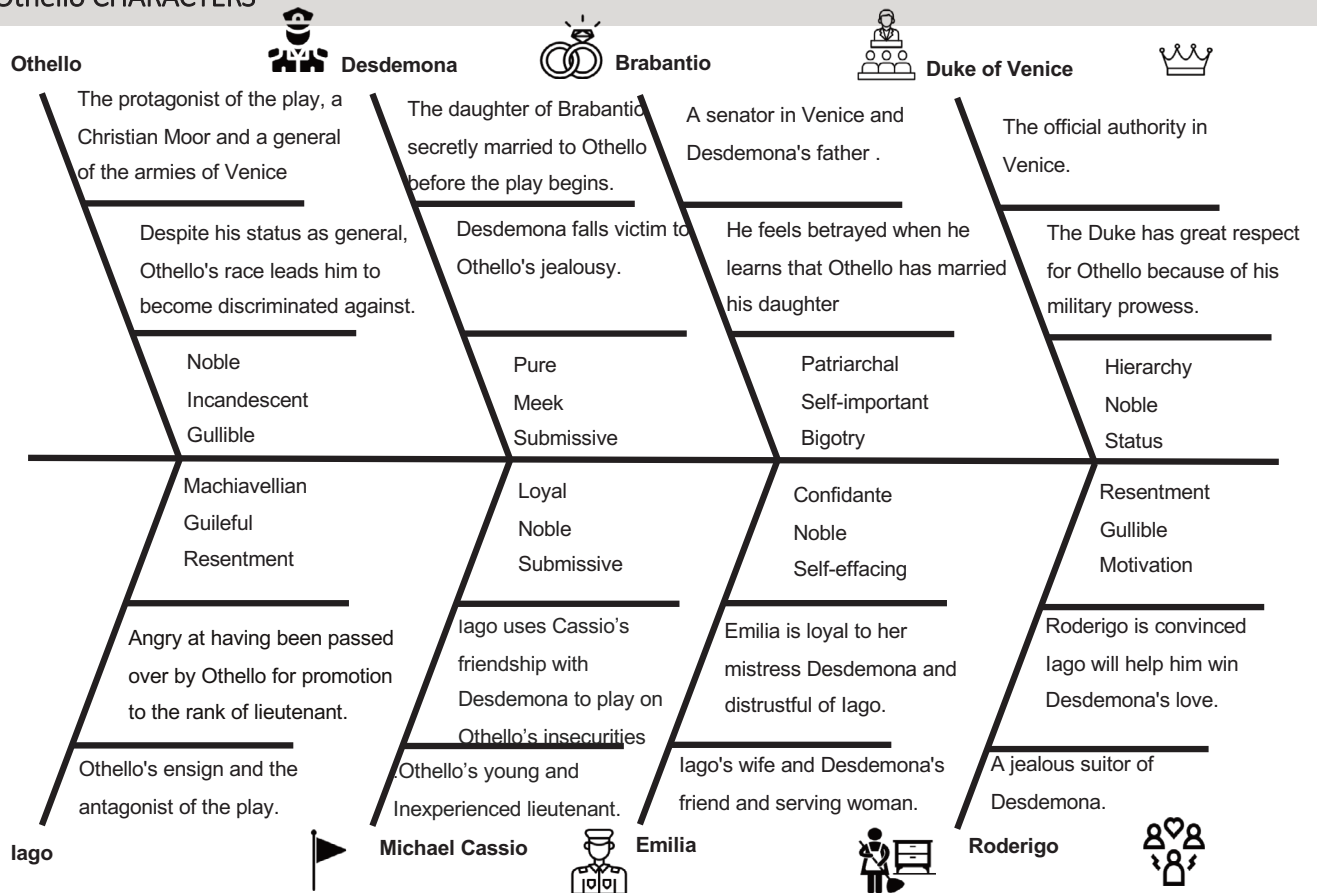
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OTHELLO ACT 5

					
PLOT	Roderigo and Iago ambush Cassio. He is only wounded. Iago then kills Roderigo. He blames the events on Bianca and has her arrested. He sends Emilia to tell Othello what has happened.	Othello prepares to kill Desdemona. She wakes and denies his charges of infidelity. He tells her Cassio is dead and then smothers her. Emilia enters and informs them Cassio is alive; Desdemona wakes for long enough to absolve Othello then dies.	Emilia calls for help. Montano, Graziano and Iago arrive. Emilia reveals the full story and Iago's role in manipulating Othello. Iago stabs her and she dies.	Othello lunges at Iago and stabs him. Iago refuses to talk or to confess his crimes. A letter is found on Roderigo that proves his guilt though. Othello reconciles with Cassio.	Othello, faced with arrest, asks that he be remembered as he was. He then kills himself with a dagger. Iago is sentenced to execution.
KEY QUOTES	"Iago? O, I am spoil'd, undone by villains! Give me some help" Cassio Act 5 i	"A guiltless death I die." Desdemona Act 5 ii	"For thou hast kill'd the sweetest innocent That e'er did lift up eye." Emilia Act 5 ii	"Demand me nothing: what you know, you know: From this time forth I never will speak word." Iago Act 5 ii	"Speak of me as I am" Othello Act 5 ii

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Othello CHARACTERS



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'Be who God meant you to be'



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TIER TWO VOCABULARY

WORD	DEFINITION
Adolescence	The period during which a young person develops from a child into an adult.
Discrimination	The unjust or prejudicial treatment of different categories of people.
Egalitarian	Believing in the principle that all people are equal and deserve equal rights and opportunities.
Equality	The state of being equal, especially in status, rights, or opportunities:
Feminism	The advocacy of women's rights on the basis of the equality of the sexes:

WORD	DEFINITION
Legislation	The process of making or enacting laws.
Masculinity	Qualities or attributes regarded as characteristic of men or boys:
Misogyny	Ingrained prejudice against women:
Prejudice	A preconceived opinion that is not based on reason or actual experience:
Social stratification	A system by which a society ranks categories of people in a hierarchy.
Sexuality	a person's identity in relation to the gender or genders to which they are typically attracted;

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TIER TWO VOCABULARY

WORD	DEFINITION
Social stratification	A system by which a society ranks categories of people in a hierarchy.
Subordinate	To be lower in rank or position.

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ARISTOTLE'S THREE PILLARS OF PERSUASION

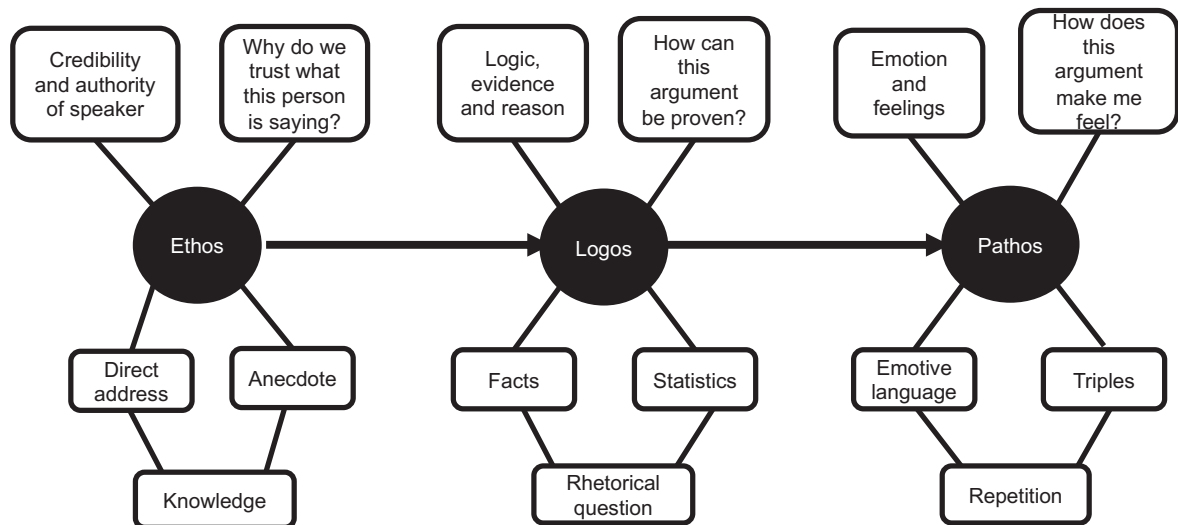


Aristotle

Born in Greece, Aristotle lived from 384 BC to 322 BC.

Instructed on how to best persuade people.

Aristotle was a student of Plato (another Greek philosopher).



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Women's Voices

THEMES IN THE TEXTS

Stereotypes: Both men and women have faced stereotypes regarding how they are to present themselves in society since the beginning of time. Stereotypes are limiting beliefs about individuals and groups of people.

Patriarchy: We exist in a society that is built upon patriarchal ideals. Ingrained social ideas are that men hold greater power than women. Women continue to fight against these perceptions.

Feminism: Over the past 400 years women have fought tirelessly to make a place for women in society. Gaining greater equality, suffrage and access to positions of power.

Misogyny: Women face being disliked, judged and physically or emotionally harmed due to their gender. Attitudes to women, especially in positions of power or who defy society's expectations are particularly negative.

SOJOURNER TRUTH, AIN'T I A WOMAN

A speech by African-American and women's rights activist Sojourner Truth about the plight of women seeking equality in the 19th century.

QUEEN ELIZABETH I, TILBURY SPEECH

A speech by the final Tudor monarch, Queen Elizabeth I. She calls her troops to fight for their country, queen and God in the Spanish Armada.

JULIA GILLARD, AUSTRALIAN PARLIAMENT

A speech by the former Australian Prime Minister, Julia Gillard. She speaks out against her party opponent for his misogynistic and sexist comments and double standards.

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THEMES IN THE TEXTS

Stereotypes: Both men and women have faced stereotypes regarding how they are to present themselves in society since the beginning of time. Stereotypes are limiting beliefs about individuals and groups of people.

Machismo: There is an ingrained ideology facing men that they have to appear overtly masculine, show strength and bravado in their behaviour and actions to fit social expectations.

Masculinity: Masculinity is a spectrum, there is no right or wrong way to appear masculine or manly. However, each society has its own ideals and norms regarding what it inherently means to be masculine.

Mental Health: Mental health is an area that impacts everyone, however for men it is often overlooked, laughed off or suppressed. Men too need to be able to speak about their feelings and the difficulties and challenges they face.

GARETH SOUTHGATE, YOUNG MEN'S CHALLENGES

A speech by the former England Men's football manager where he discusses the current social challenges and influences on young men.

LZ GRANDERSON, THE GAY AGENDA

A speech by LZ Granderson where he discusses his sexuality and how he feels about his place in society as a gay man.

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THEMES IN THE TEXTS

Race: Race is an inherent part of our identity. It refers to the colour of our skin, our cultural affiliation and how we identify ourselves. It could be related to where we are from and what nationality we have.

Racism: The belief that different races possess distinct characteristics, abilities, or qualities, especially in viewing them as inferior or superior to one another. There are different forms of racism: casual, institutional, unconscious.

Violence: Linking to racism and prejudice, violence is inherently tied to social groups, affiliations and bias. Police brutality is an area we will explore, as well as violence among peer groups.

Prejudice: Prejudice is a negative assumption or opinion about someone based on their group membership. This can be based on any form of difference, inequality or separation within society or social groups.

DAVE, BLACK

A song by British rapper Dave about the experience of being black. It covers the societal stereotypes, personal perceptions and prejudices facing marginalised individuals.

CALEB FEMI, THIRTEEN

A poem that explores the experience of young black men in society and their relationship with law enforcement. The key theme is institutional racism.

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THEMES IN THE TEXTS

Adolescence: The transitory phase between childhood and adulthood is fraught and can bring with it challenges around identity, fitting in, taking risks and deciding upon your future.

Subcultures: Subcultures often have beliefs or interests that are different with those of the larger culture. In the past, teens have identified with subcultures as a means to form their own sense of self.

Disillusion: Considering the future can be daunting or disappointing; trying to distinguish your place in society at such a pivotal age can be overwhelming, and young people don't always feel they have all the answers.

SAM FENDER, HYPERSONIC MISSILES

A song by British singer/songwriter Sam Fender that looks at 21st century society and how young people have become voiceless and are losing their individuality.

GRETA THUNBERG, CLIMATE ACTION

A speech given by the teenage environment activist and campaigner, Greta Thunberg to the UN at the Climate Action summit in 2019.

COMMON RHETORICAL DEVICES

**Direct address**

Referring to the reader directly using the pronouns 'we' or 'you'.

**Alliteration**

The repetition of the same **sound** in a sequence of words beginning with the same letter.

**Repetition**

Where a word or phrase is used more than once across a text

**Knowledge**

Knowing the topic/subject you are writing or speaking about.

**Facts**

Something which can be proven to be true.

**Opinion**

A belief which cannot be proven to be true.

**Rhetorical question**

Any question in a piece of writing which does not require an answer.

**Emotive language**

Words which elicit a powerful emotional response.

**Similes and metaphors**

A **simile** directly compares one object to another using 'like' or 'as'. A **metaphor** compares two things by stating one is the other.

**Triplets**

Lists of three things in a sentence.

	Allusion A reference to an event, place, literary work or person. Example: "I can't get changed that quickly, I'm not Superman!"	Hypophora A figure of speech in which a writer raises a question, and then immediately answers it. Example: ""What should young people do with their lives today? Many things, obviously."
	Anaphora The repetition of a word or phrase at the start of successive phrases. Example: "If you prick us, do we not bleed? If you tickle us, do we not laugh?"	Hyperbole An exaggeration. Example: "I have done this a thousand times"
	Anecdote A short amusing or interesting story about a real incident or person. Example: "When I was your age, I ..."	Parallelism The use of words or phrases with a similar structure. Example: "Like father, like son"
	Epistrophe The repetition of a word or expression at the end of successive phrases, clauses, sentences, or verses especially for rhetorical or poetic effect. Example: "of the people, by the people, for the people"	Oxymoron A combination of contradictory or unsuitable words. Example: "It is a cruel kindness"

HOW TO STRUCTURE AN ARGUMENT



Make your position clear. What is your point of view on how?



Introduce the topic you are writing about. Still make your opinion clear.



Offer your first point through a topic sentence and identify one issue. Explain your point.



Offer your second point through a topic sentence and identify one issue. Explain your point.



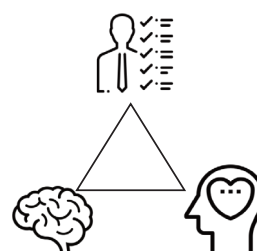
Acknowledge the opposing point of view but then challenge it. Why are those critics wrong and you're right?



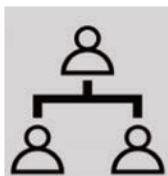
Offer solutions for the points you raised: How can we avoid these issues? What are the benefits? Create a sense of urgency.



Repeat your position. This is the last message you want your reader/listener to leave with.



An Inspector Calls



Capitalistic
Society



Social
Responsibility



Guilt and
morality

CONTENT

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Page 58	Characters- Gerald Croft, Eva Smith and Inspector Goole

TIER TWO VOCABULARY

Word	Definition	Word	Definition
Capitalism	Wealthy individuals are the sole owners of goods. Every man for himself.	Welfare State	A system whereby the state undertakes to protect the health and well-being of its citizens, especially those in financial or social need, by means of grants, pensions and other benefits.
Socialism	Goods and businesses should be owned by as a community. All for one and for all.	Playwright	The writer of the play.
Patriarchy	A society or family that is run and governed by male lines. Men are in charge.	Social class	The division of society based on wealth and class.
Bourgeoisie	Belonging to the middle or upper class. Extreme wealth and material assets.	Omniscient	Knowing everything. God-like.
Proletariat	Belonging to the lower classes. Labour and manual workers primarily.	Hubris	An exaggerated state of one's own importance or abilities.

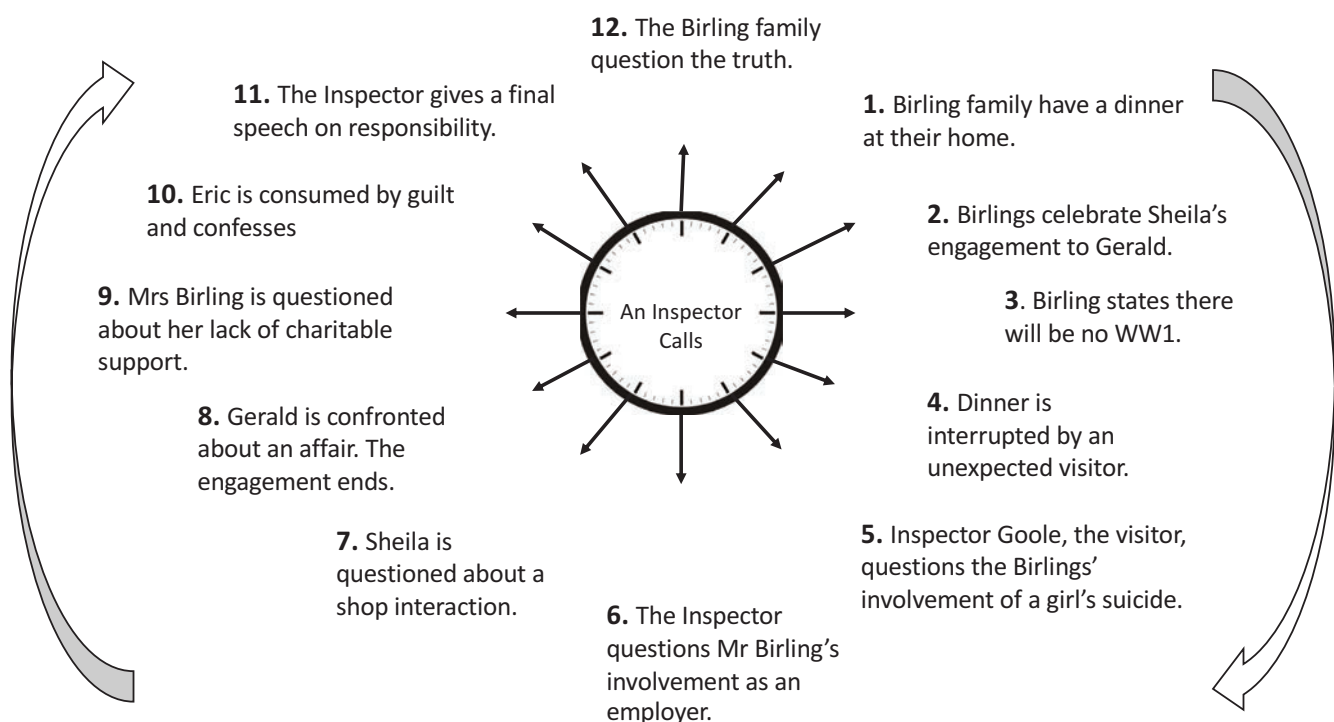
TIER TWO VOCABULARY

Word	Definition
Misogynist	A hatred towards women leading to prejudice against them.
Guileless	An innocent or young person with the inability to lie.
Rancour	Bitterness or resentment that builds to hate.
Amorous	Demonstrating feelings or reacting to desire.
Lament	To feel deep sorrow at the loss of something.
Predicament	A difficult or embarrassing situation.
Authoritative	Commanding and self-confident; likely to be respected and obeyed.

Word	Definition
Impetuous	Acting without thought or care.
Objectify	To degrade something or someone to the status of a mere object.
Culpable	Deserving of blame.
Disparage	To speak down to another in an insulting and rude manner.
Virtuous	Having a high degree or morality.
Privileged	Granted a special right, advantage or immunity available only to a particular person or group.
Arbitrate	To act between parties to settle differences.

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AN INSPECTOR CALLS KEY EVENTS



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AN INSPECTOR CALLS CONTEXT, PRIESTLEY AND EVENTS



Historical Context

Context	Where in the Play
Setting: Set in Brumley, England 1912, Edwardian Era where there was stark class divisions between the upper and the lower class. Upper were privileged and living in excess where the poor struggled in poverty with little rights.	Act 1: the stage setting focuses on the dining room of the Birlings' middle-class life with furniture and choice of alcohol.
Social Inequality: There was no welfare state in 1912, and the poor had little protection against exploitation and unemployment.	Eva Smith, referred to throughout the play , is symbolic to the struggles and moral corruption that the lower class faced.
Women's Rights: The play recognises the limited roles and opportunities to women during 1912. The expectation was housewives and mothers. The suffragette movement was gaining momentum, but the right to vote was not won until 1918.	Act 1 explores Sheila's limitations and expectations of a woman in a conventional middle-class life. Act 3 symbolises the liberation and need for women's rights.



Political Context

Context	Where in the Play
Socialism: The play is set in 1912 where Britain is predominantly a capitalist society in which the rich upper class are favoured. The lower classes are left struggling with few rights and opportunities.	Priestley embodies his belief in socialism through the character Inspector Goole. As the play unfolds the audience see how a lack of socialist belief can cause damage to individuals who are neglected as represented by Eva Smith.
Dramatic Irony: This technique is used throughout the play. The audience are aware of the outcomes before the characters realise it. Priestley crafts this technique to encourage his audience to reflect how society continues to form.	Priestley wrote the play in 1945 and set in 1912. This was deliberately crafted knowing that the audience had lived through the pre-World War One capitalist society and then the struggles during and post war. The audience watched the play knowing the faults of society.

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AN INSPECTOR CALLS: Act One



Stage Direction

Prior to the play starting, Priestley gives specific details to the setting including the room and lighting. It is The Birling family home. The stage is focused in their dining room filled with middle-class wealthy furniture and food.

Key Quotes:

not cosy and homelike
 (description of the room)

brighter and harder
 (change of lights once the Inspector arrives)



Celebration

Mr Birling hosts a family meal. Everyone is happy and they are celebrating Sheila's engagement to Gerald Croft. Mr Birling makes a speech reflecting his capitalist views which foreshadows the play's purpose to highlight social responsibility.

Key Quotes:

'I speak as a hard-headed business-man' (Birling's view on society)

'Unsinkable. Absolutely unsinkable' (Birling's view on Titanic)



Last Summer

Birling's children are both in their early twenties. Eric is slowly becoming tipsy whilst Sheila teases her fiancé, Gerald Croft, for seeming to disappear last summer. Her mother advises her to not question a busy man but to accept it.

Key Quotes:

'You're squiffy!' (Sheila to Eric about his drinking)

'...when you never came near me...' (Sheila to Gerald about his disappearance)



Goole v. Birling

Inspector Goole unexpectedly arrives. He explains Eva Smith has taken her own life. He has a picture of the girl who he shows to only one person at a time. Mr Birling is first accused of firing her after a pay rise request. He feels no shame.

Key Quotes:

'If we were responsible . . . it would be very awkward, wouldn't it?' (Birling to Goole)

'A chain of events' (Goole's social concern)



Goole v. Sheila

Goole then questions Sheila. He shows her the picture. She recognises being served in a shop by the girl in the picture. Sheila had her fired after feelings of jealousy. Goole confirms Eva changes her name to Daisy. Gerald admits to her he had an affair.

Key Quotes:

'So I'm really responsible?' (Sheila takes accountability)

'We can keep it from him.' (Gerald confirms the affair but refuses to be involved with the investigation.)

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AN INSPECTOR CALLS: Act Two



Gerald's Confession

Act Two begins with Gerald and Sheila arguing. He confesses to her family about an affair with a poor girl called Daisy Renton who is also Eva Smith. He met her at bar where prostitutes go. He helped her after and then began an affair.

Key Quotes:

'A favourite haunt' (Description of where Gerald met Daisy)

'I didn't feel about her as she felt about me.' (Gerald speaks of Daisy)



The Engagement is over

Sheila gives the engagement ring back to Gerald and calls off their future wedding. Her father stresses she has made a poor decision and Gerald leaves the family home feeling sad and ashamed.

Key Quotes:

'I've a right to know' (Sheila addresses Gerald.)

'I think you better take this with you' (she hands him the ring)



Mrs Birling's charity

Goole questions Mrs Birling. Her charity is to support women in need but confesses she refused to help a pregnant and unemployed woman because she said her name was Mrs Birling. This shamed the real Mrs Birling. She put her reputation first.

Key Quotes:

'I used my influence to have it refused. And I am glad.' (Mrs Birling prioritises her social status)

'Go and look for the father of the child.' (Mrs Birling shifts responsibility away)



Sheila realises

Sheila quickly realises the woman who her mother refuses to help is Eva / Daisy and she gave the false name Mrs Birling because the father is Eric Birling. Sheila begs her mother to stop shaming the father and realise who she is blaming.

Key Quotes:

'Mother, - stop, stop!' (Sheila begs her mum to stop blaming the father.)

'If he is, we know what to do, don't we? Mrs Birling has just told us.' (Goole secures blame and consequence)



Eric returns

Mr and Mrs Birling are flabbergasted at the realisation of Eric's involvement. Mrs Birling struggles to comprehend what blame she has put on the father. Eric returns looking distressed and exhausted.

Key Quotes:

Eric enters looking extremely pale and distressed. He meets their inquiring stares. (stage direction just before the curtain falls on act two.)

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AN INSPECTOR CALLS: Act Three



Eric's Confession

Act Three begins with Eric confesses getting Daisy pregnant. He also confesses how he stole money from his father, but Daisy refused it. He confronts his parents with an emotional attack and finally shows he can be assertive.

Key Quotes:

'I was in that state when a chap easily turns nasty' (Eric recalls how he spoke to Daisy)

'You're not the type of father a chap can go to' (Eric confronts his father)



The Inspector leaves

The Inspector has finished questioning the family. He makes a final speech about the importance of social responsibility then leaves the family in shock and disarray.

Key Quotes:

'Millions of Eva Smiths and John Smiths still left with us' (Goole's reminder of the symbolism of Eva Smith)

'Taught it in fire and bloody and anguish' (Goole's final words about responsibility)



Arguments and fact checking

Gerald returns after his walk. He sees the family arguing about blame. He interrupts to say he thinks they have been hoaxed. He believes Goole is a fraud and the infirmary confirm no one of the name Eva Smith has been brought in.

Key Quotes:

'I was almost certain for a Knighthood.' (Birling argues why Eva's death threatens him.)

'We've been had.' (Gerald tells of hoax reasons)



Older vs. Younger

Mr and Mrs Birling celebrate that it was a hoax and no one to blame. They mock their children for being serious. Eric and Sheila argue they should still accept poor responsibility and change for the better.

Key Quotes:

'It makes all the difference.' (Birling detaches from responsibility)

'The fact remains I did what I did.' (Eric still reflects on his lack of responsibility)



The phone call

Just as the Birlings believe they are not to blame, the house phone rings. It is a policeman confirming an officer is coming to the Birling's house to question them. A woman has died after drinking disinfectant. The curtain falls and the audience are left to consider responsibility.

Key Quotes:

'A girl has just died.' (Birling takes a phone call from the police)

They stare guiltily and dumbfounded, the curtain falls (stage direction)

5
6

An Inspector Calls Characters: The Birlings

Mr Arthur Birling	Mrs Sybil Birling	Sheila Birling	Eric Birling
Patriarch of the Birling family.	Wife of Mr Birling, she is his social superior.	The eldest child, who initially is materialistically driven.	The younger child who initially is immature and a drunk.
Middle class and wealthy capitalist of the 20 th Century	From an upper-class family and heavily influential with charities	Becomes aware of the need for social change	Feels shy and awkward; Learns to be assertive
Pompous Authoritarian Disdainful	Haughty Arrogant Cold	Reflective Assertive Young	Reckless Remorseful Naive
Capitalism	Status – Conscious	Transformation	Culpability
Older generation's resistance to change	Adheres strictly to social etiquette and traditional gender roles	Stands for the empathy and progression	Struggle between privilege and moral responsibility
Symbolic of: need of social change	Symbolic of: upper class ignorance	Symbolic of: the ability for society to reflect and change	Symbolic of: redemption

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An Inspector Calls CHARACTERS

Gerald Croft	Eva Smith / Daisy Renton	Inspector Goole
Son of Sir George and Lady Croft making him part of the aristocracy. Engaged to Sheila Birling.	Girl in the photograph Goole shows the Birlings and Gerald.	Interrupts the Birling's family home to question about the death of Eva Smith.
The engagement strengthens Birling's reputation, status and wealth.	Working class, exploited by Birlings and Gerald in multiple ways	A moral compass and authoritative voice for the audience
Elitism Manipulative Upper class	Moral integrity Victim of circumstance Exploited	Omniscient Socially responsible Controlling
Strategic alliance	Interconnectedness within society	A powerful voice to the audience about responsibility
Hypocrisy and entitlement of his class	Tragic fate delivered by the hands of a cruel class system	The challenge to a hierarchal and capitalist society.
Symbolic of: cost of exploitation	Symbolic of: struggles of working class and inequality	Symbolic of: critique of capitalism

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Vocabulary Bank



Full academic year

CONTENTS

Page 70	William Blake and Women's Literature
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YEAR 7 TIER TWO VOCABULARY RECALL

William Blake

WORD	DEFINITION
Inequality	A lack of equality.
Revolution	A forcible overthrow of a government or social order, in favour of a new system.
Childhood	The state of being a child.
Industrial	Relating to or characterised by industry.
Morality	Principles concerning the distinction between right and wrong or good and bad behaviour.
Poverty	The state of being extremely poor.
Vengeance	Getting revenge on someone who has wronged you
Romanticism	An artistic and philosophical movement that redefined the ways people think about themselves and the world.
Misogyny	A hatred towards women.

Women's Literature

WORD	DEFINITION
Empowerment	The process of becoming stronger and more confident, especially in controlling one's life and claiming one's rights.
Prejudice	A preconceived opinion that is not based on reason or actual experience.
Society's norms	The informal rules that govern behaviour in groups and societies.
Suffrage	The right to vote.
Feminism	The belief in women's rights on the ground of the equality of the sexes
Discrimination	The unjust or prejudicial treatment of different categories of people, especially on the grounds of race, age, sex, or disability
Equality	The state of being equal, especially in status, rights, or opportunities
Patriarchy	A society where men have more power than women

60

YEAR 7 TIER TWO VOCABULARY RECALL

Private Peaceful

WORD	DEFINITION
Justice	Fair behaviour or treatment.
Society	People living together in a more or less ordered community.
Alliance	A union or association formed for mutual benefit, especially between countries
Nationalism	A person who strongly identifies with their own nation and supports its interests to the exclusion of other nations
Patriotism	A person who has or expresses devotion to and support of their country
Conflict	A serious disagreement or argument.
Cowardice	A lack of bravery.
Nostalgia	A sentimental longing or wistful affection for a period in the past.

Much Ado About Nothing

WORD	DEFINITION
Gender	Gender is the range of characteristics relating to, and differentiating between, femininity and masculinity.
Patriarchy	A society in which men hold more power than women.
Expectation	A strong belief that something will happen or be the case.
Hierarchy	A system in which members of an organisation or society are ranked according to relative status or authority.
Stereotype	A widely held but fixed and oversimplified image or idea of a particular type of person or thing.
Renaissance	The revival of European art and literature under the influence of classical models in the 14th–16th centuries.

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YEAR 8 TIER TWO VOCABULARY RECAP

Pride Not Prejudice

WORD	DEFINITION
Memory	Something remembered from the past.
Morality	The difference between right and wrong.
Mother tongue	The language which a person has grown up speaking from early childhood.
Nationality	The status of belonging to a particular nation.
Region	An area, especially part of a country or the world having definable characteristics, but not always fixed boundaries.
Revolution	A forcible overthrow of a government or social order, in favour of a new system.

WORD	DEFINITION
Patriarchy	A society where men hold more power than women.
Sexuality	A person's sexual orientation or preference.
Society's norms	The informal rules which govern people's behaviour in groups.
Stereotypes	A widely held but fixed and oversimplified image or idea of a particular type of person or thing.
Tradition	The transmission of customs or beliefs from generation to generation, or the fact of being passed on in this way.

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Pride Not Prejudice

WORD	DEFINITION
Bilingual	The ability to speak two languages fluently.
Culture	The ideas, customs, and social behaviour of a particular people or society.
Discrimination	The unfair or prejudicial treatment of people and groups based on characteristics such as race, gender, age or sexual orientation.
Empowerment	The process of becoming stronger and more confident.
Ethnicity	The state of belonging to a social group that has a common national or cultural tradition.
Expectations	A strong belief that something will happen or be the case.

	DEFINITION
Family	A group of people related by blood or marriage.
Gender	The range of characteristics pertaining to, and differentiating between, masculinity and femininity.
Hierarchy	A system in which members of an organisation or society are ranked according to relative status or authority.
History	The whole series of past events connected with a particular person or thing.
Justice	Fair behaviour or treatment.
Language	The method of human communication, either spoken or written, consisting of the use of words in a structured and conventional way.

Life, Labour and Loss

WORD	DEFINITION
Labour	Employment in an industry or business.
Malnutrition	Lacking proper nutrition.
Neglect	The failure to provide care for property.
Oppression	The prolonged cruel or unjust treatment or exercise of authority.
Pauper	A recipient of relief under the provisions of the Poor Law or public charity.
Poverty	The state of being extremely poor.

WORD	DEFINITION
Redemption	The action of saving or being saved from sin, error or evil.
Reform	Make changes in (something, especially an institution or practice) in order to improve it.
Superiority	Higher ranking in status or quality.
Voracious	Wanting great quantities of food.
Welfare	The statutory procedure and social effort designed to promote the basic physical and material well-being of people in need.

Life, Labour and Loss

WORD	DEFINITION
Capitalism	An economic or political system where a country's trade and industry is controlled by private owners for profit not the state.
Capital Punishment	The legally authorised killing of someone as punishment for a crime.
Charity	The voluntary giving of help, typically in the form of money, to those in need.
Child Labour	The employment of children in an industry or business.
Control	The power to influence or direct people's behaviour or the course of events.
Corporal Punishment	Physical punishment, such as caning or flogging.
Despair	The complete loss or absence of hope.

WORD	DEFINITION
Desperation	A state of despair, typically one which results in rash or extreme behaviour.
Despondent	In low spirits from a loss of hope or courage.
Destitution	Extremely poor and lacking the means to provide for oneself.
Dilapidated	In a state of disrepair or ruin as a result of age or neglect.
Exploitation	The action or fact of treating someone unfairly in order to benefit from their work.
Industrial	Economic activity concerned with the processing of raw materials and manufacture of goods in factories.
Inequality	Lack of equality.

TIER TWO VOCABULARY Richard III

WORD	DEFINITION
Misdirection	the action or process of directing someone to the wrong place or in the wrong direction:
Motive	a reason for doing something: a driving force or desire.
Obsequious	obedient or attentive to an excessive or servile degree:
Paranoia	unjustified suspicion and mistrust of other people or their actions:
Portent	a sign or warning that a momentous or calamitous event is likely to happen:
Remorse	deep regret or guilt for a wrong committed:
Sanctuary	refuge or safety from pursuit, persecution, or other danger:
Sycophant	a person who acts obsequiously towards someone important to gain advantage.
Sovereign	a supreme ruler, especially a monarch:
Treachery	betrayal of trust or the quality of being deceptive.
Unscrupulous	Having no friends or company; isolation
Machiavellian	Cunning and scheming

WORD	DEFINITION
Artifice	Clever or cunning devices to trick or deceive others
Betrayal	Violation of a person's trust or moral standard
Conscience	a person's moral sense of right and wrong, viewed as acting as a guide to one's behaviour:
Corrupt	having or showing a willingness to act dishonestly in return for money or personal gain.
Cunning	having or showing skill in achieving one's ends by deceit or evasion.
Despotism	the exercise of absolute power, especially in a cruel and oppressive way.
Ego-centric	thinking only of oneself, without regard for the feelings or desires of others; self-centred.
Emancipator	someone who frees others from bondage
Favour	approval, support, or liking for someone or something:
Hamartia	A fatal flaw leading to the downfall of a tragic hero
Hubris	Excessive pride or self- confidence
Hypocrisy	the practice of claiming to have higher standards or more noble beliefs than is the case.

TIER TWO VOCABULARY The Lie Tree

WORD	DEFINITION
Curiosity	A strong desire to know or learn something.
Femme Fatale	An attractive and seductive woman, especially one who is likely to cause distress or disaster for a man who becomes involved with her.
Gothic	A genre of literature and film that combines fiction and horror, death and, at times, romance.
Grotesque	Comically or repulsively ugly or distorted.
Injustice	Lack of fairness or justice.
Isolation	Being on your own away from others.

WORD	DEFINITION
Monstrous	Having the ugly or frightening appearance of a monster.
Neglect	Failure to care for property or people.
Paranormal	Denoting to events or phenomena which are beyond the scope or normal scientific understanding.
Resurrection	The action or fact of rising from the dead.
Supernatural	Manifestations or events considered to be of supernatural origin, such as ghosts.
Telepathic	Able to read the minds of other people.

Knowledge Book Maths

Year 9

1

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

2

Multiplication

X	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

3



4

Ten Thousandths	
Thousandths	
Hundredths	
Tenths	
Decimal Point	●
Units	
Tens	
Hundreds	
Thousands	

Two signs together		Replace with
+	+	+
-	-	+
+	-	-
-	+	-

Multiplication and Division Rule	
Signs of Two Numbers	Sign of the Answer (Product or Quotient)
the same	positive (+)
different	negative (−)

7

Brackets

Indices

Divide

Multiply

Add

Subtract

B
I
D
M
A
S



8

Factors and Multiples

Factor: An integer that a number can be divided by to leave no remainder.

It will be the same size or lower than the given number.

Multiple: An integer that a number will multiply into.

It will be found in the number's times table.

It will be the same size or greater than the given number.

9

Prime Numbers

Prime

A number with exactly 2 factors

Primes:

2, 3, 5, 7,
11, 13, 17,
19, 23, 29,
31, 37, 41,
43, 47, 53,
59, 61, 67,
71, 73, 79,
83, 89, 97

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

10

Notation: Signs

=

Equal to

≠

Not equal to

≈

Approximately
equal to

≡

Equivalent to

<

Smaller than

>

Greater than

≤

Smaller than or equal to

≥

Greater than or equal to

Notation

$a + b$

a plus b

$3 + b$

3 plus b

$a - b$

a minus b

$a - 3$

a minus 3

ab

a times b

$3b$

3 times b

$\frac{a}{b}$

a divide by b

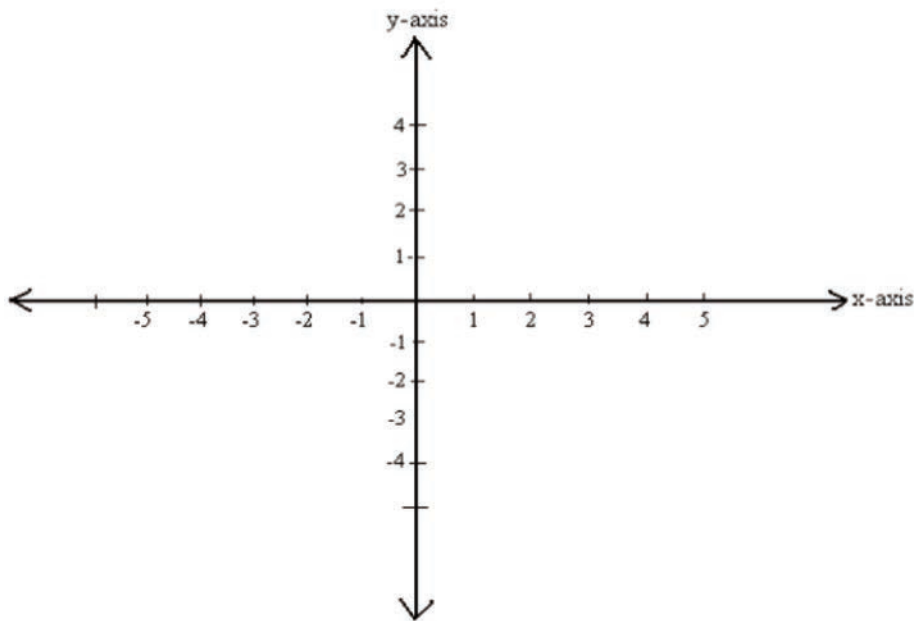
$\frac{3}{b}$

3 divide by b

Coordinates and Axes

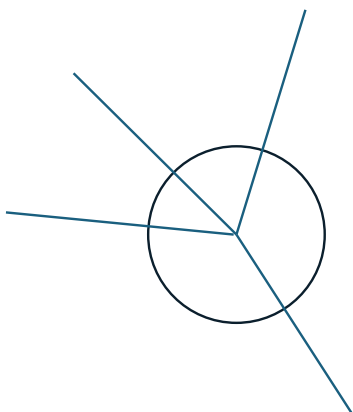
Coordinate

(x, y)

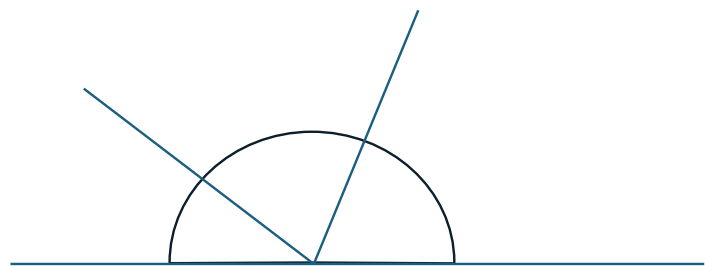


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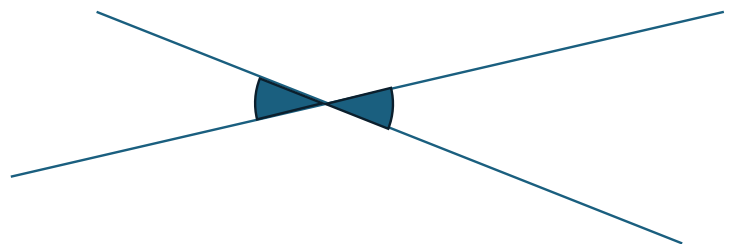
Angle Facts



Angles around a point add up to 360°



Angles on a straight line add up to 180°

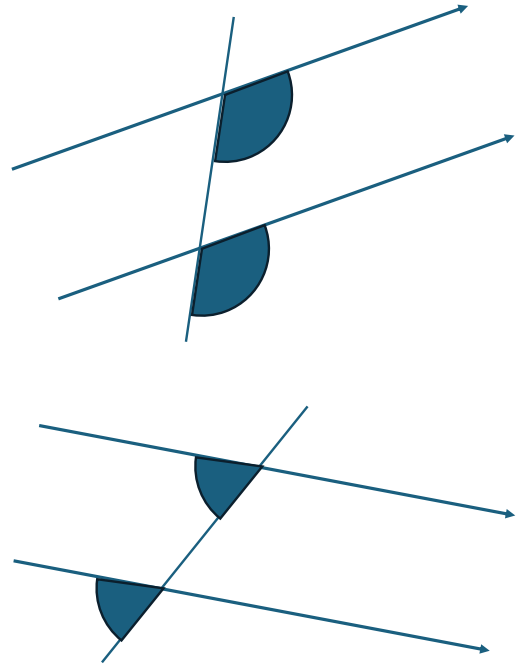
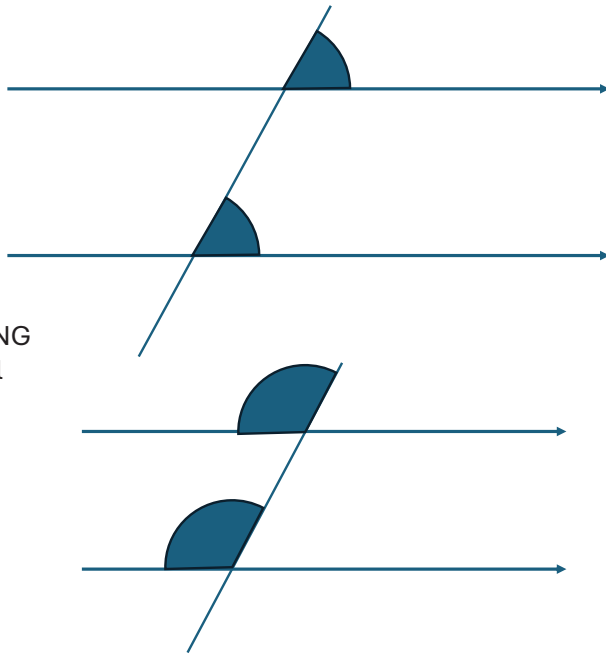


Vertically Opposite Angles are Equal

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Angles on Parallel Lines

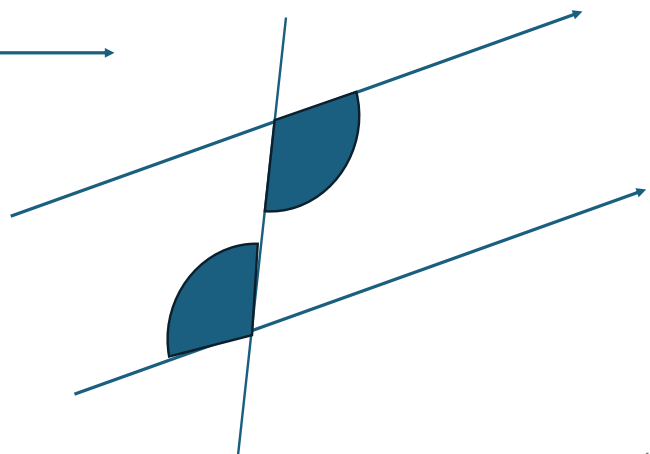
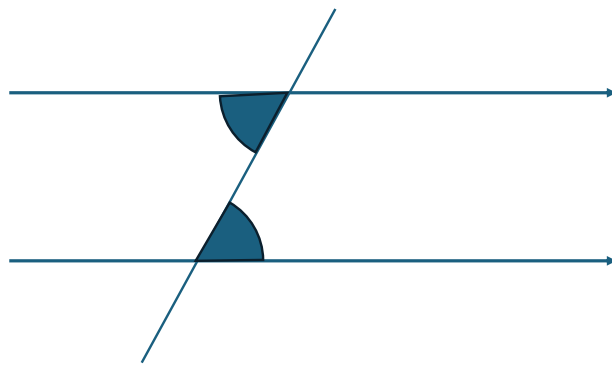
CORRESPONDING
Angles are Equal



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Angles on Parallel Lines

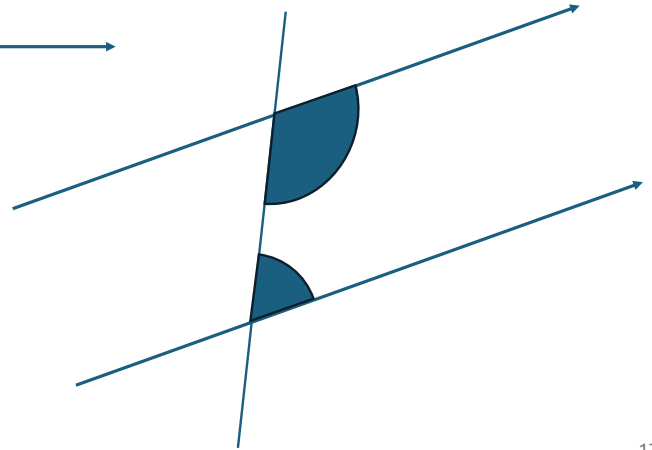
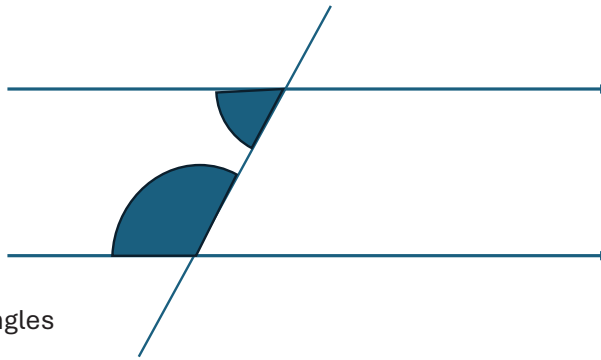
ALTERNATE
Angles are Equal



16

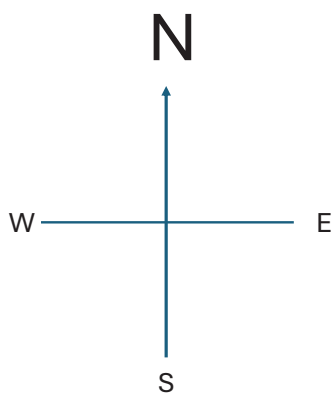
Angles on Parallel Lines

CO-INTERIOR Angles
add up to 180°



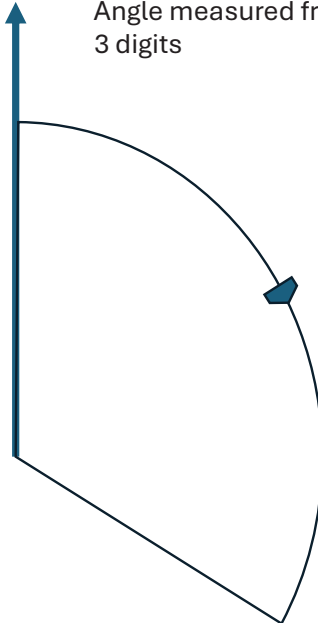
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Bearings



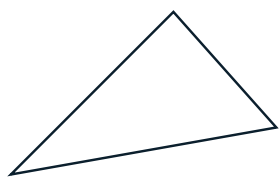
N

Angle measured from North
3 digits

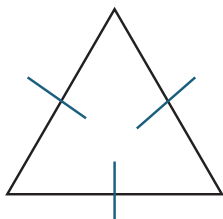


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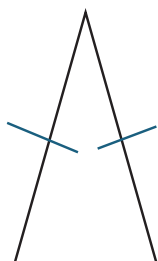
Triangles



Scalene: No sides the same, no angles the same



Equilateral: All sides are equal. All interior angles are equal



Isosceles: Two sides are equal. Base angles are equal

19

Quadrilaterals

 Square	Two pairs of parallel sides. All sides are equal. Four 90° angles. Diagonals are equal and bisect each other.	 Trapezium	One pair of parallel sides
 Rectangle	Two pairs of parallel sides. Opposite sides are equal. Four 90° angles. Diagonals bisect each other.	 Kite	Two pairs of equal sides. A pair of equal angles
 Rhombus	Two pairs of parallel sides. All sides are equal. No right angles. Diagonally opposite angles are equal.	 Arrowhead	Two pairs of equal sides. One reflex interior angle.
 Parallelogram	Two pairs of parallel sides. Opposite sides are equal. No right angles. Diagonally opposite angles are equal	 Irregular	No equal sides. No equal angles.

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Other Polygons

Polygon – a straight sided shape with any number of sides.

Regular – all sides equal, all angles equal.

Pentagon: 5 sides

Hexagon: 6 sides (a regular hexagon is made up of 6 equilateral triangles)

Heptagon: 7 sides

Octagon: 8 sides

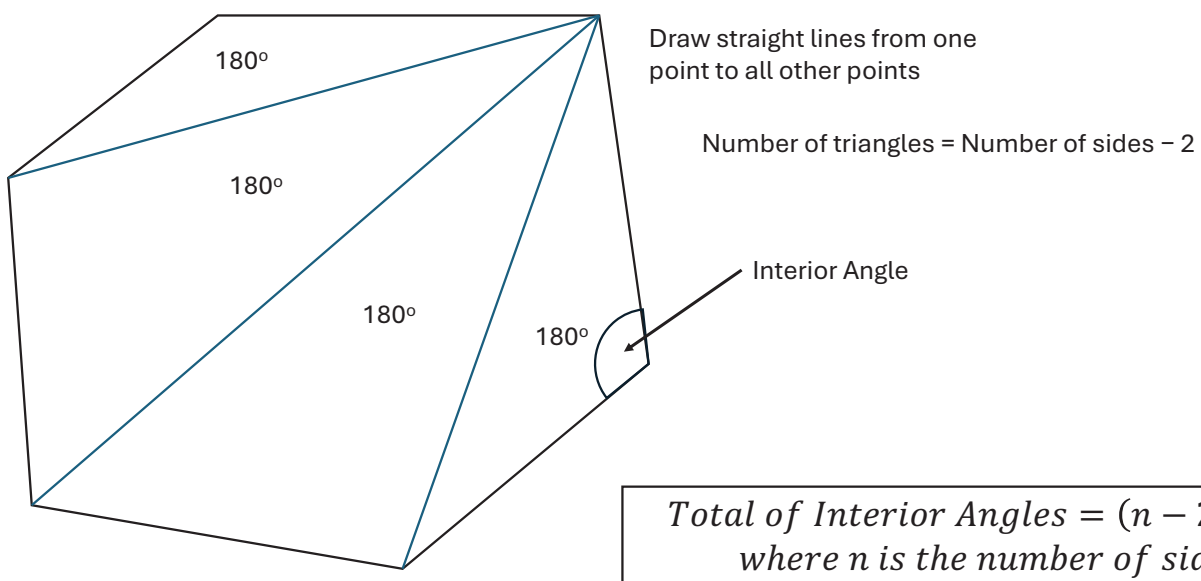
Nonagon: 9 sides

Decagon: 10 sides

Dodecagon: 12 sides

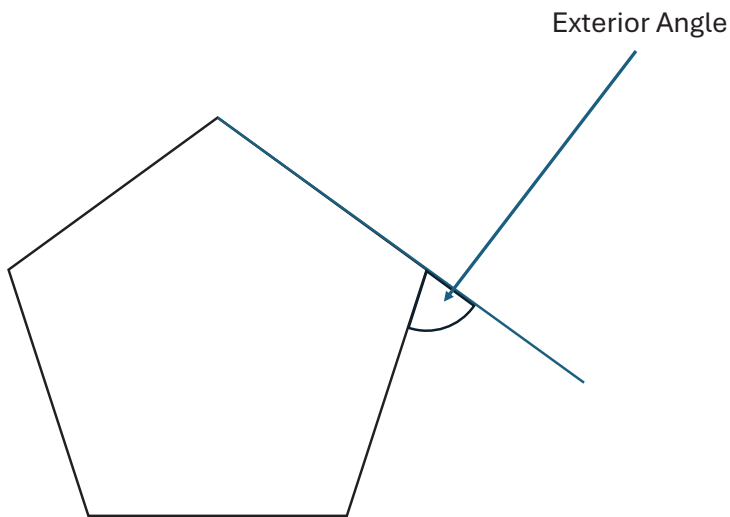
21

Interior Angles of Polygons



22

Exterior Angles



*For **any** polygon*

Total of Exterior Angles = 360°

Interior + Exterior = 180°

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Square Numbers

The result when a number is multiplied by itself.

Square Numbers



$1 \times 1 = 1$
 $2 \times 2 = 4$
 $3 \times 3 = 9$
 $4 \times 4 = 16$
 $5 \times 5 = 25$
 $6 \times 6 = 36$
 $7 \times 7 = 49$
 $8 \times 8 = 64$
 $9 \times 9 = 81$
 $10 \times 10 = 100$
 $11 \times 11 = 121$
 $12 \times 12 = 144$
etc

Cube Numbers

The result when a number is multiplied by itself and then by itself again

Cube Numbers



$1 \times 1 \times 1 = 1$
 $2 \times 2 \times 2 = 8$
 $3 \times 3 \times 3 = 27$
 $4 \times 4 \times 4 = 64$
 $5 \times 5 \times 5 = 125$

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Square Roots

Inverse of calculating a square

$$\begin{aligned}\sqrt{1} &= 1 \\ \sqrt{4} &= 2 \\ \sqrt{9} &= 3 \\ \sqrt{16} &= 4 \\ \sqrt{25} &= 5 \\ \sqrt{36} &= 6 \\ \sqrt{49} &= 7 \\ \sqrt{64} &= 8 \\ \sqrt{81} &= 9 \\ \sqrt{100} &= 10\end{aligned}$$

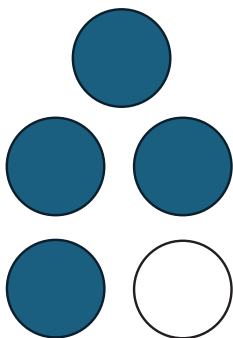
Other Roots

Inverse other powers

e.g. $\sqrt[3]{64} = 4$

25

Fractions are



Part of a whole

$$\begin{array}{r} 1 \\ \hline 5 \end{array}$$



Numbers on a number line

$$\begin{array}{r} 5 \overline{) 1} \end{array}$$

Division

26

Fractions

4

← Numerator

5

← Denominator

7

2

3

2

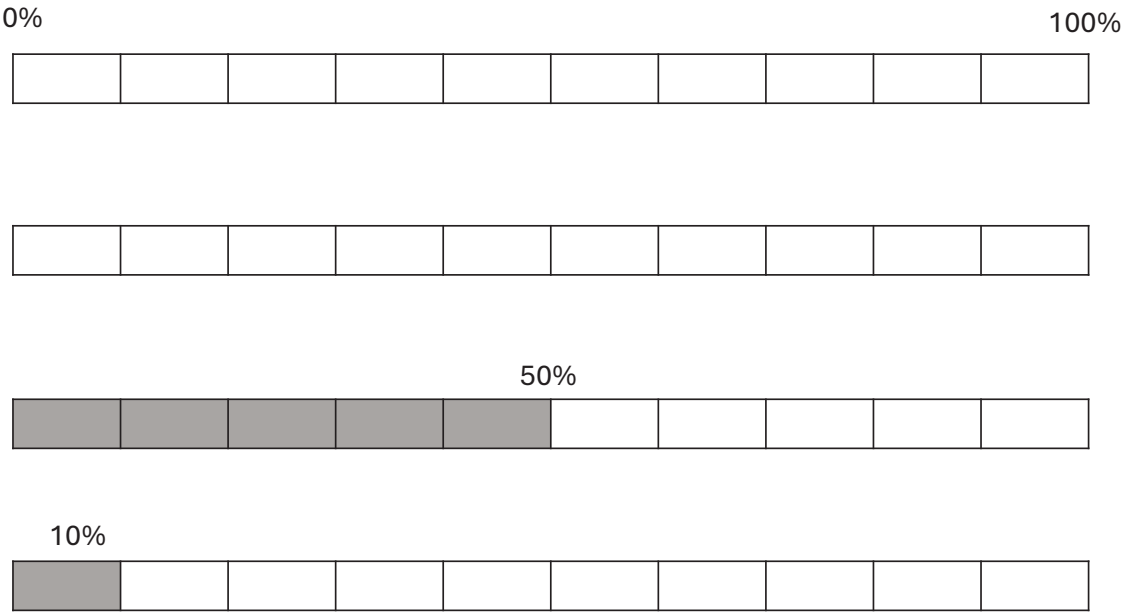
9

Proper Fraction
Numerator < Denominator

Improper Fraction
Numerator > Denominator

Mixed Number

Percentage



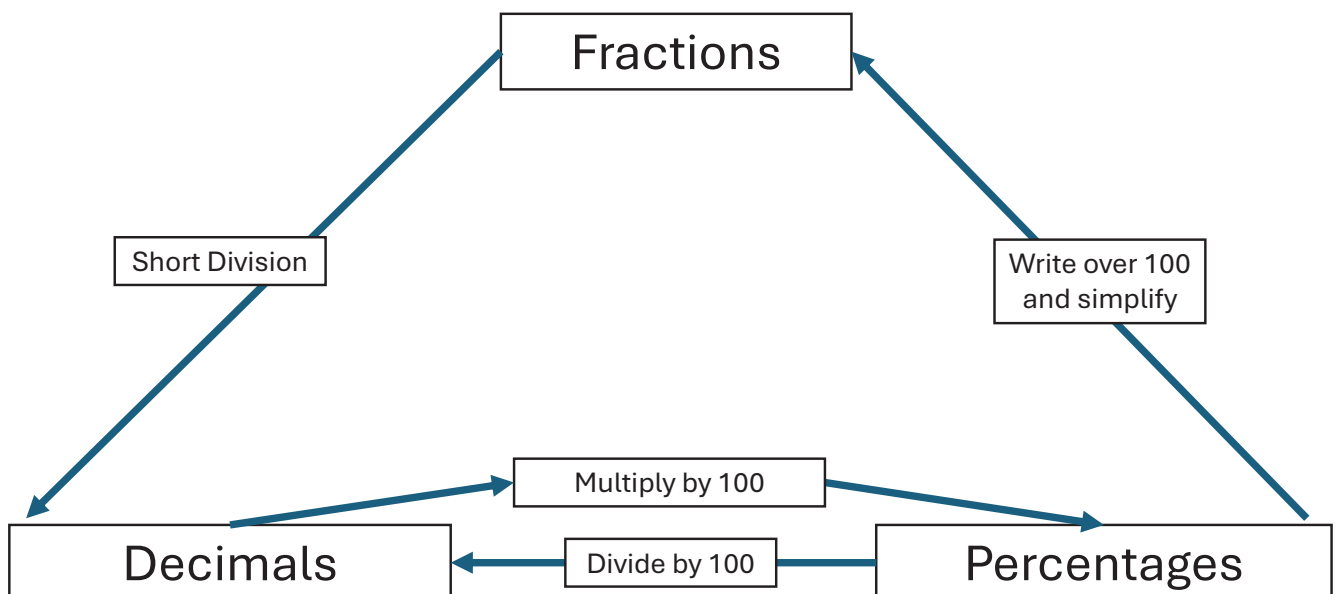
Fractions Decimals and Percentages

Need to know

Fraction	Decimal
$\frac{1}{2}$	0.5
$\frac{1}{4}$	0.25
$\frac{1}{5}$	0.2
$\frac{1}{10}$	0.1
$\frac{1}{3}$	$0.\dot{3}$

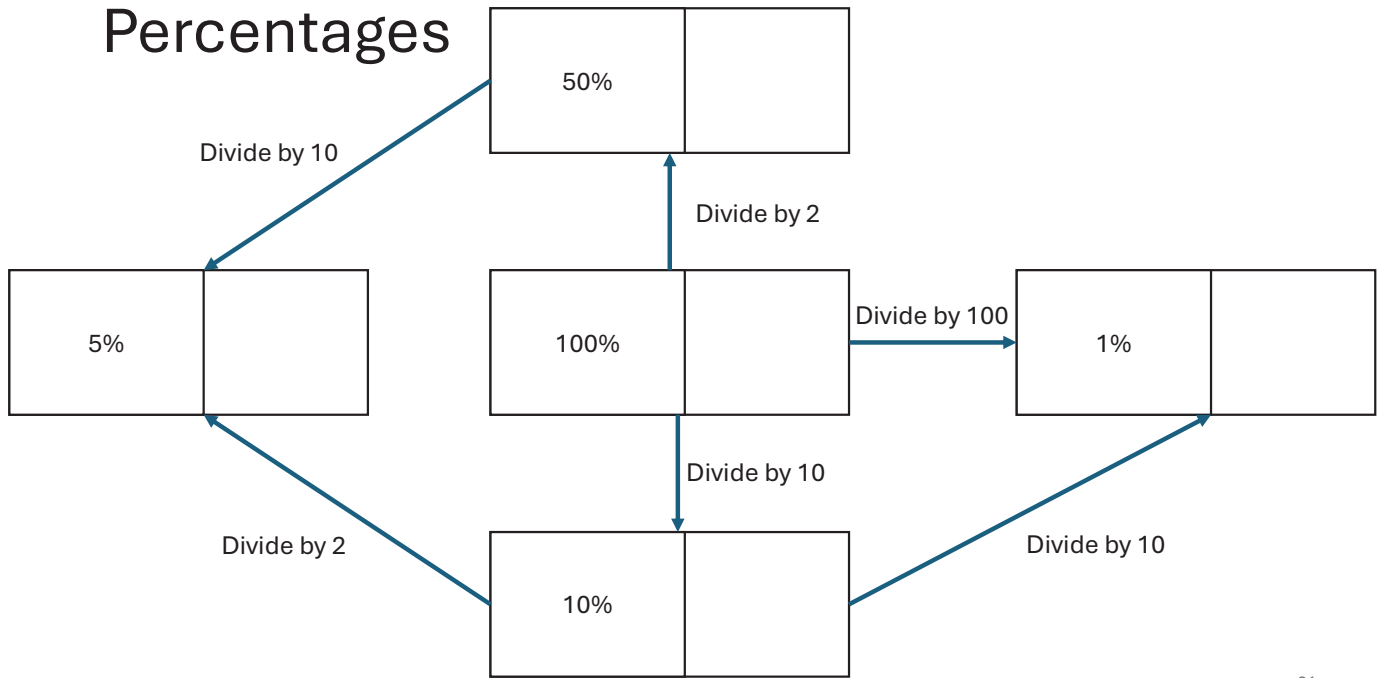
29

Fractions, Decimals and Percentages



30

Percentages



31

Percentages on a Calculator

$$\frac{\text{Percentage}}{100} \times \text{Amount}$$

$$\text{Percentage multiplier} \times \text{amount}$$

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Percentage Change

$$\text{New Amount} = \text{Percentage Multiplier} \times \text{Original Amount}$$

Repeated Percentage Change

$$\text{Final Amount} = \text{Percentage Multiplier} \times \text{Original Amount}^{\text{Time}}$$

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Reverse a percentage change

Rearrange the original calculation

$$\text{New Amount} = \text{Percentage Multiplier} \times \text{Original Amount}$$

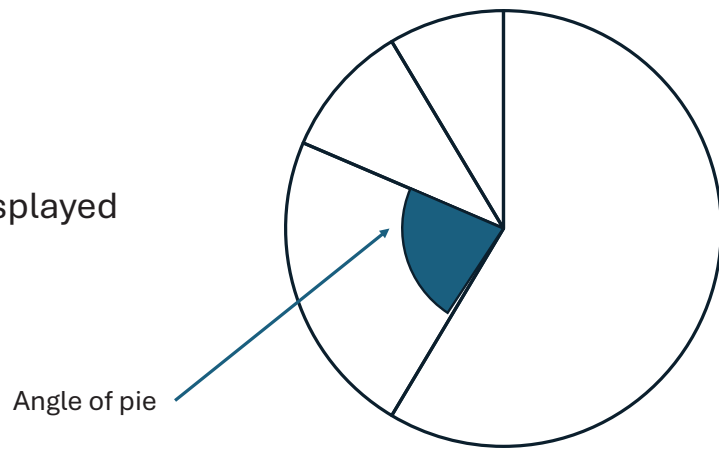
To

$$\text{Original Amount} = \frac{\text{New Amount}}{\text{Percentage Multiplier}}$$

34

Pie Charts

Frequency not displayed
Proportion of Total Frequency Displayed
Displayed as a sector of circle



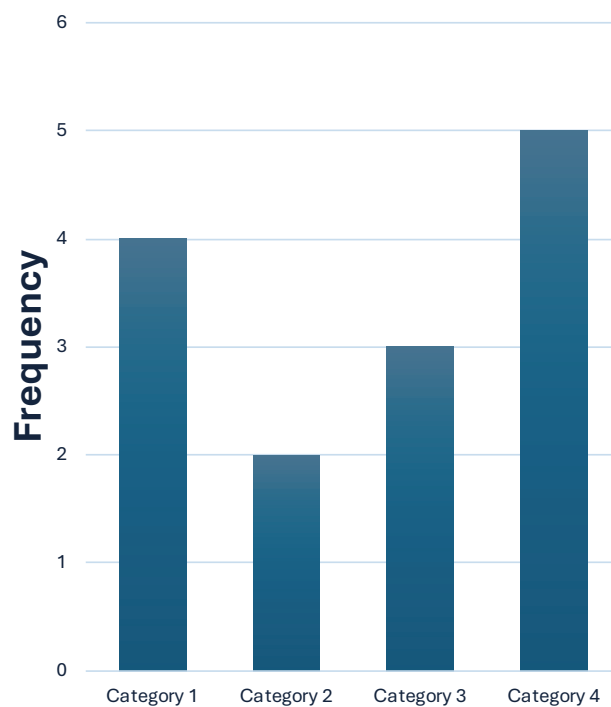
$$Proportion = \frac{Frequency}{Total\ Frequency} = \frac{angle\ of\ pie}{360}$$

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Bar Chart

Frequency displayed as
Bar Height

Bars of same width
Gap between bars

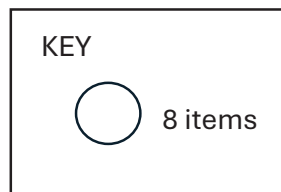


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Pictogram

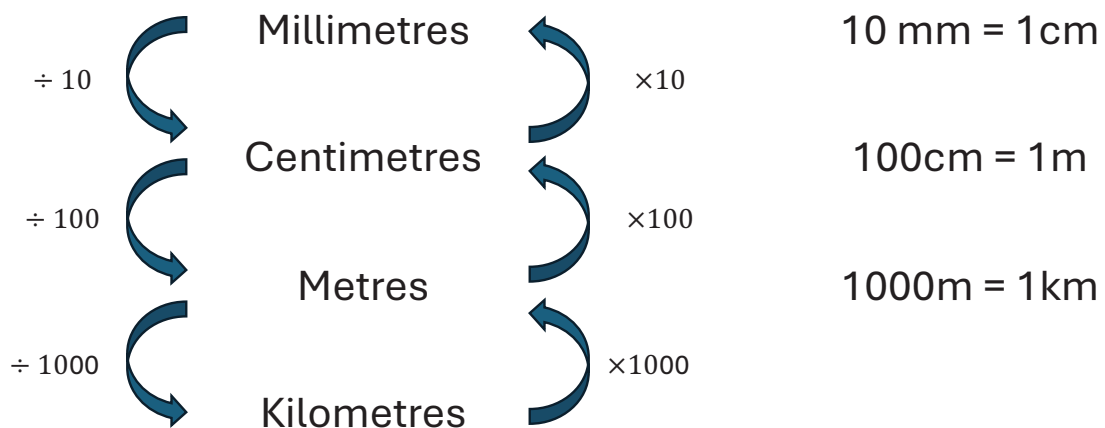
Frequency displayed by pictures or icons

Category 1	  
Category 2	 
Category 3	 



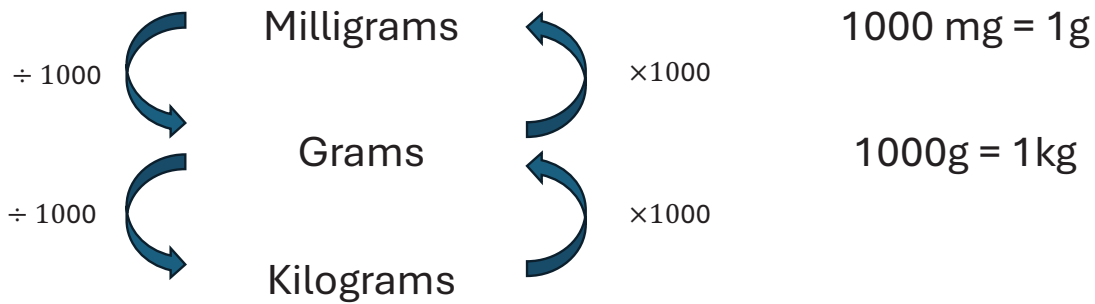
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Converting Metric Units of Length



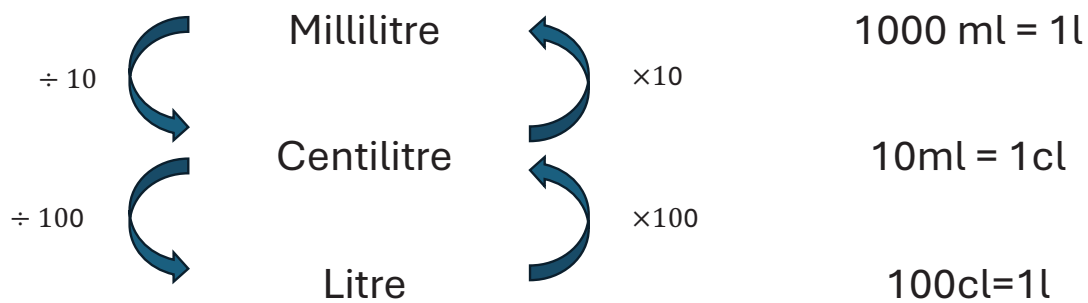
38

Converting Metric Units of Mass



39

Converting Metric Units of Mass

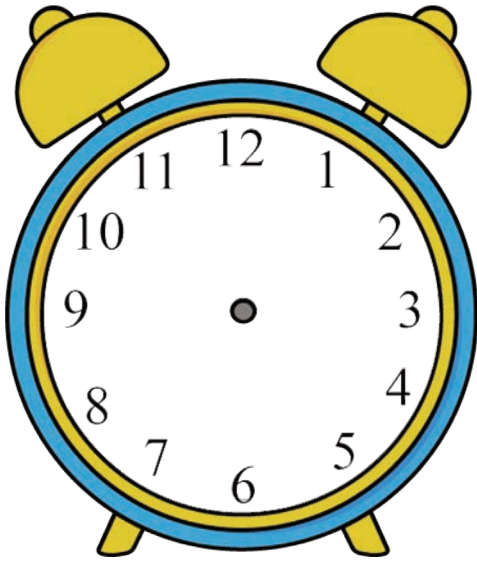


$$1 \text{ Litre} = 1000 \text{ cm}^3$$

$$1 \text{ Millilitre} = 1 \text{ cm}^3$$

40

Time



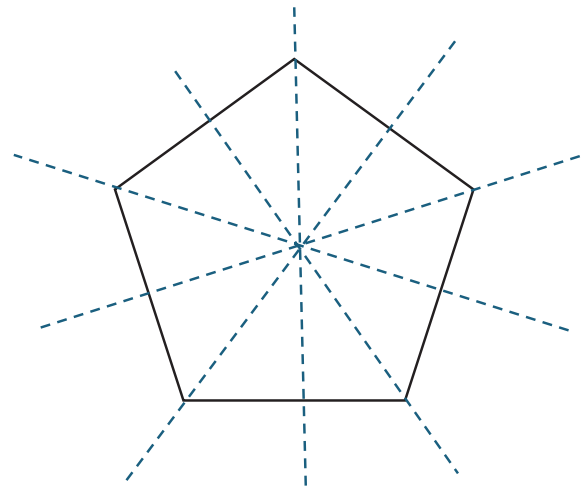
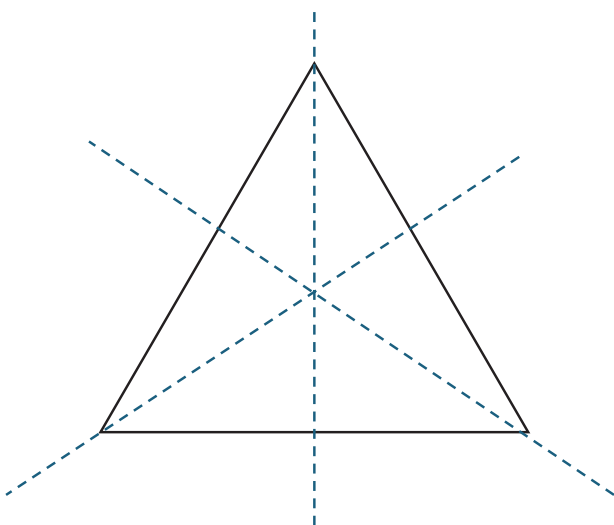
1 Year = 365 days (except leap years)
= 56 weeks

1 Week = 7 days
1 Day = 24 hours
1 Hour = 60 minutes
1 minute = 60 seconds

$\frac{1}{2}$ hour = 30 minutes 0.5 hour = 30 minutes
 $\frac{1}{4}$ hour = 15 minutes 0.25 hours = 15 minutes

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Symmetry

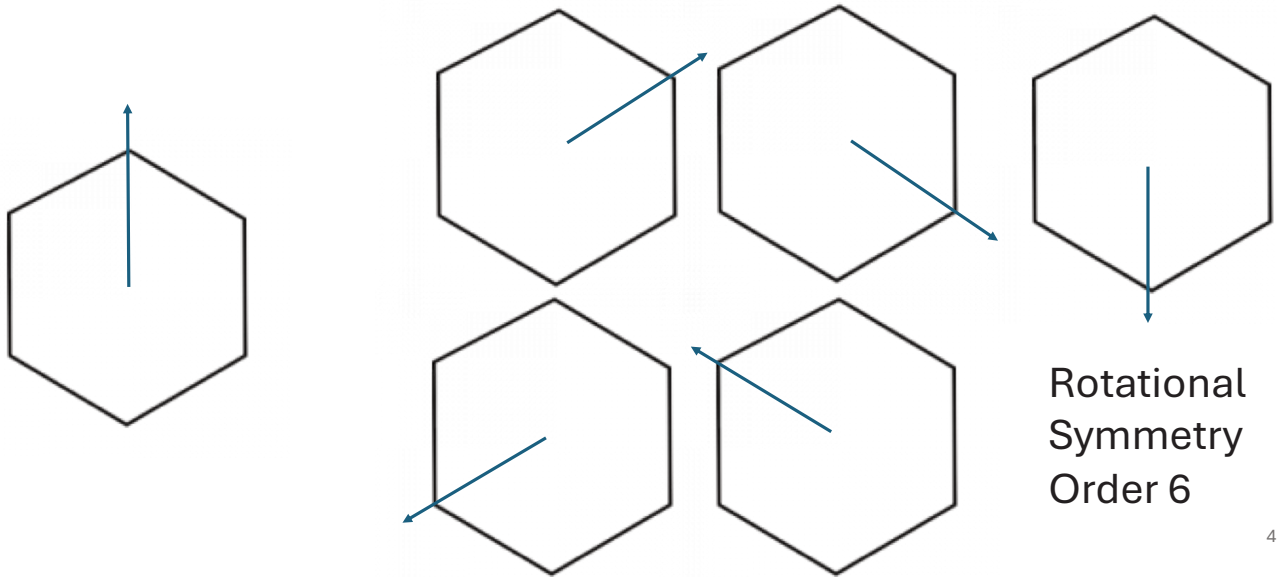


Line of Symmetry
Cuts a shape into two equal halves

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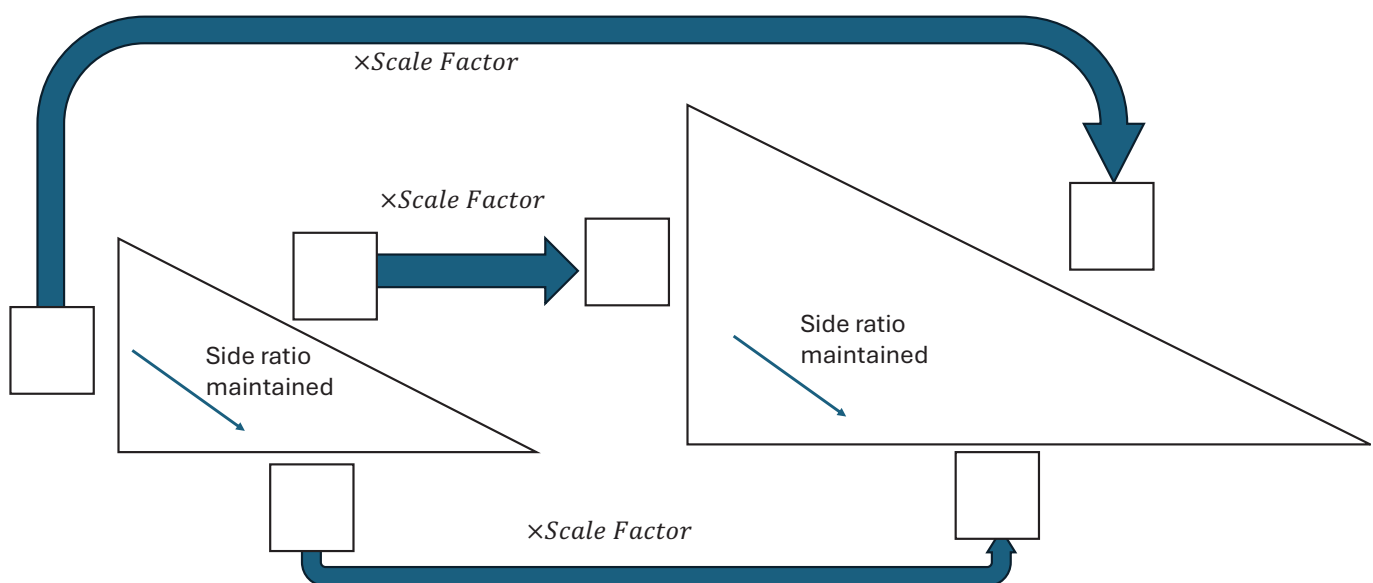
Rotational Symmetry

Order: Number of times a shape fits back onto itself during a 360° turn.



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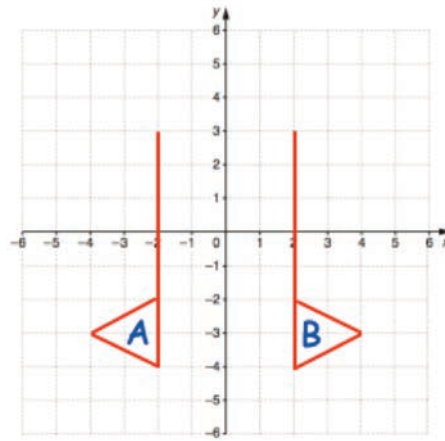
Similar Triangles



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Transformations: Reflection

Reflection plus line of reflection.

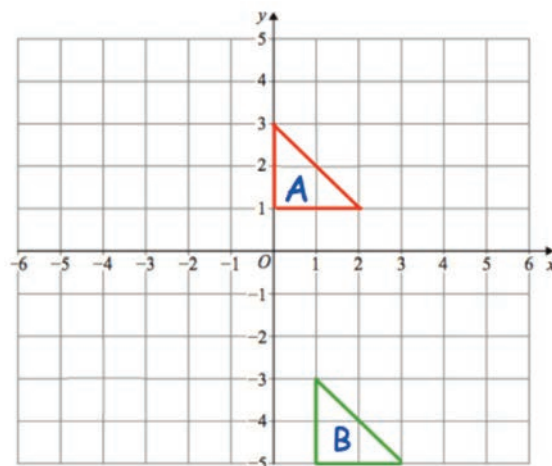


Reflection in y - axis

45

Transformations: Translation

Translation plus vector



Translation $\begin{pmatrix} 1 \\ -6 \end{pmatrix}$

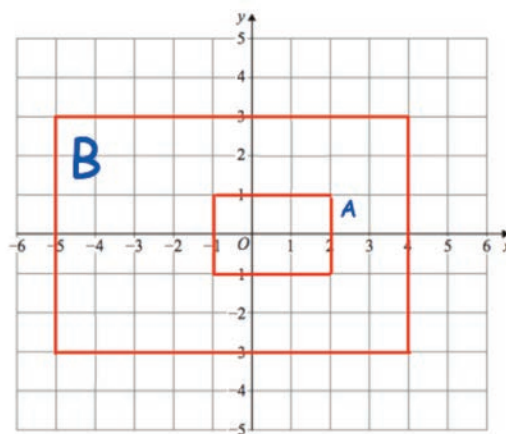
46

	Allusion A reference to an event, place, literary work or person. Example: "I can't get changed that quickly, I'm not Superman! "		Hypophora A figure of speech in which a writer raises a question, and then immediately answers it. Example: ""What should young people do with their lives today? Many things, obviously. "
	Anaphora The repetition of a word or phrase at the start of successive phrases. Example: " If you prick us, do we not bleed? If you tickle us, do we not laugh?"		Hyperbole An exaggeration. Example: "I have done this a thousand times "
	Anecdote A short amusing or interesting story about a real incident or person. Example: "When I was your age, I ..."		Parallelism The use of words or phrases with a similar structure. Example: "Like father, like son"
	Epistrophe The repetition of a word or expression at the end of successive phrases, clauses, sentences, or verses especially for rhetorical or poetic effect. Example: "of the people , by the people , for the people "		Oxymoron A combination of contradictory or unsuitable words. Example: "It is a cruel kindness"

47

Transformations: Enlargement

Enlargement plus scale factor and centre of enlargement.
(scale factor can be positive, negative and a fraction)

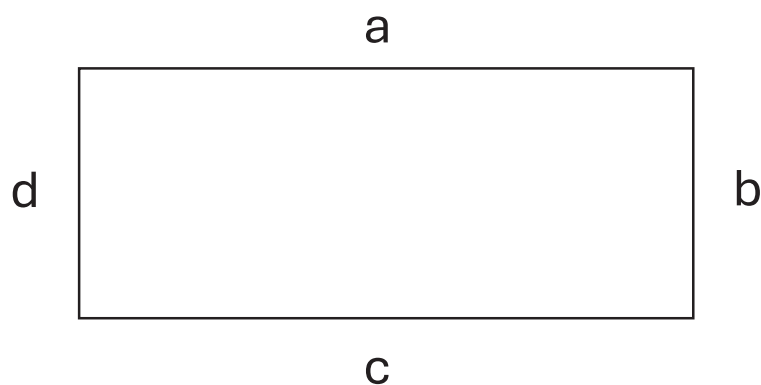


Enlargement
Scale Factor 2
Centre (0,0)

Perimeter

The distance around a shape.

Add up all the sides

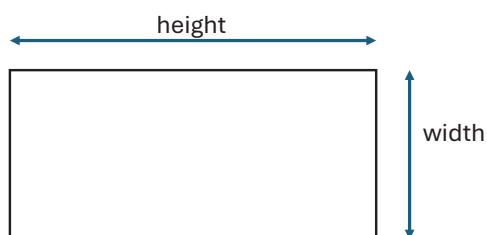


$$\text{Perimeter} = a + b + c + d$$

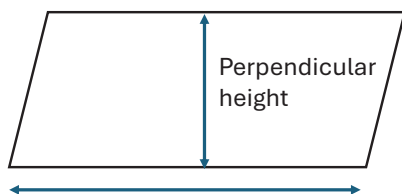
49

Area

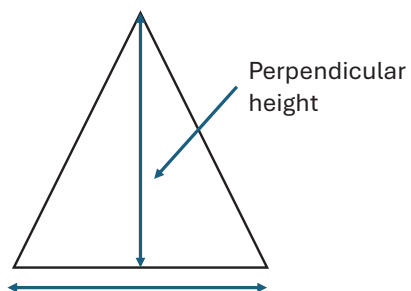
The space inside a shape



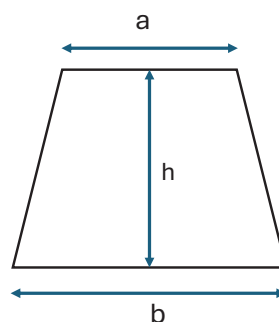
$$\text{Area} = \text{length} \times \text{width}$$



$$\text{Area} = \text{width} \times \text{perpendicular height}$$



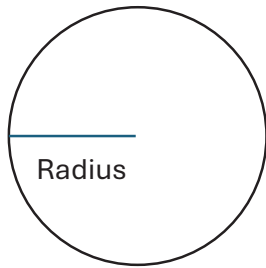
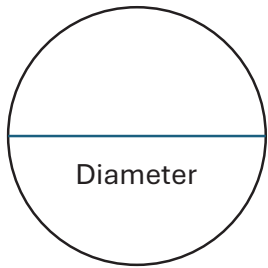
$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{perpendicular height}$$



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

50

Measures of a Circle



A Circle of radius r and diameter d

$$\text{Diameter} = 2 \times \text{Radius}$$

$$\text{Length of the Circumference} = 2\pi r$$

$$\text{Length of the Circumference} = \pi d$$

$$\text{Area of a circle} = \pi r^2$$

51

Rounding to decimal places

213.5078

1st decimal place

2nd decimal place

3rd decimal place

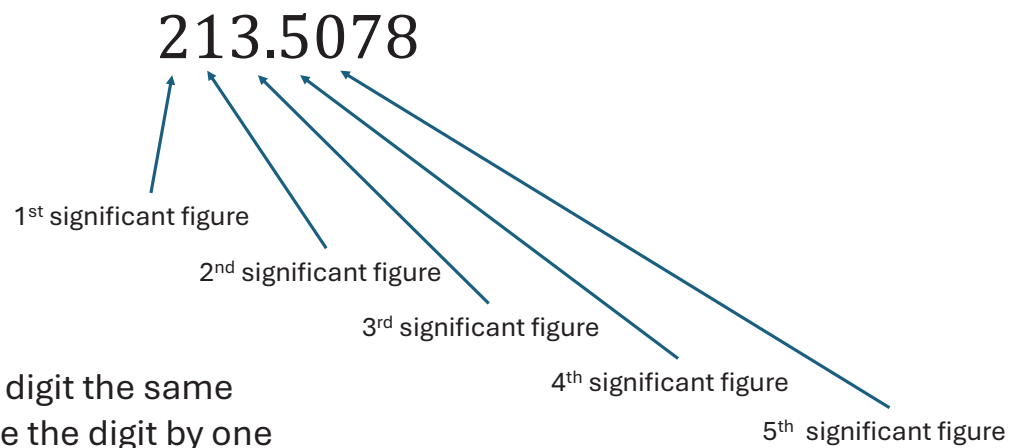
4th decimal place

0,1,2,3,4 then keep digit the same

5,6,7,8,9 then increase the digit by one

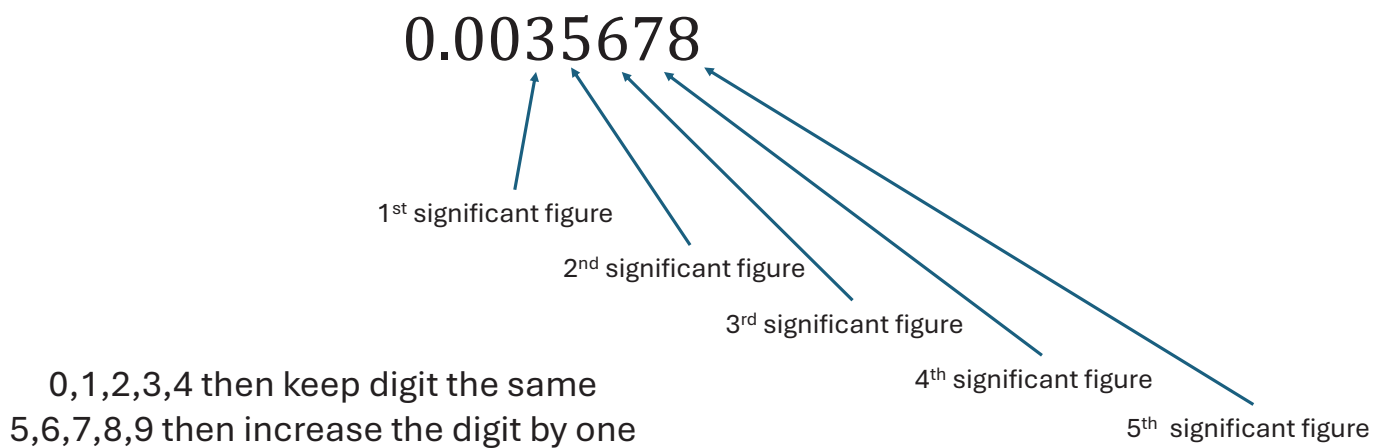
52

Rounding to significant figures



53

Rounding to significant figures



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Compound Units

$$Speed = \frac{Distance}{Time}$$

$$Density = \frac{Mass}{Volume}$$

Don't add this column

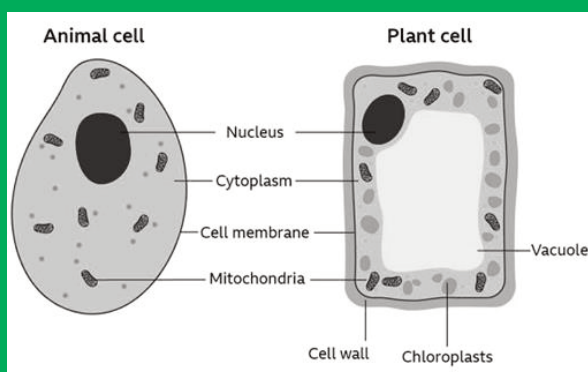
Combining
Liquids
(or speeds)

	Density =	Mass	X	Volume
A				
B				
Mixture of A and B				

Year 9 Biology

1. Cells
2. Organisation of cells
3. Eukaryotic and prokaryotic cells
4. Animal specialised cells
5. Plant specialised cells
6. Nucleus
7. Stem cells and microscopes
8. Transport in and out of cells – diffusion
9. Levels of organisation
10. Organisation of cells in the digestive system 1
11. Enzymes in the digestive system
12. Organisation of cells in the breathing system
13. Organisation of cells in the circulatory system 1
14. Organisation of cells in the circulatory system 2
15. Cross section of leaf
16. Organisation of cells in plants
17. Coronary heart disease
18. Cell cycle: Mitosis
19. Cell cycle: Mitosis and cancer
20. Communicable disease: pathogens
21. Communicable disease: viruses
22. Communicable disease: bacteria, fungi and protists
23. Required Practicals 1: Microscopy & food tests
24. Required practical 2: Enzymes

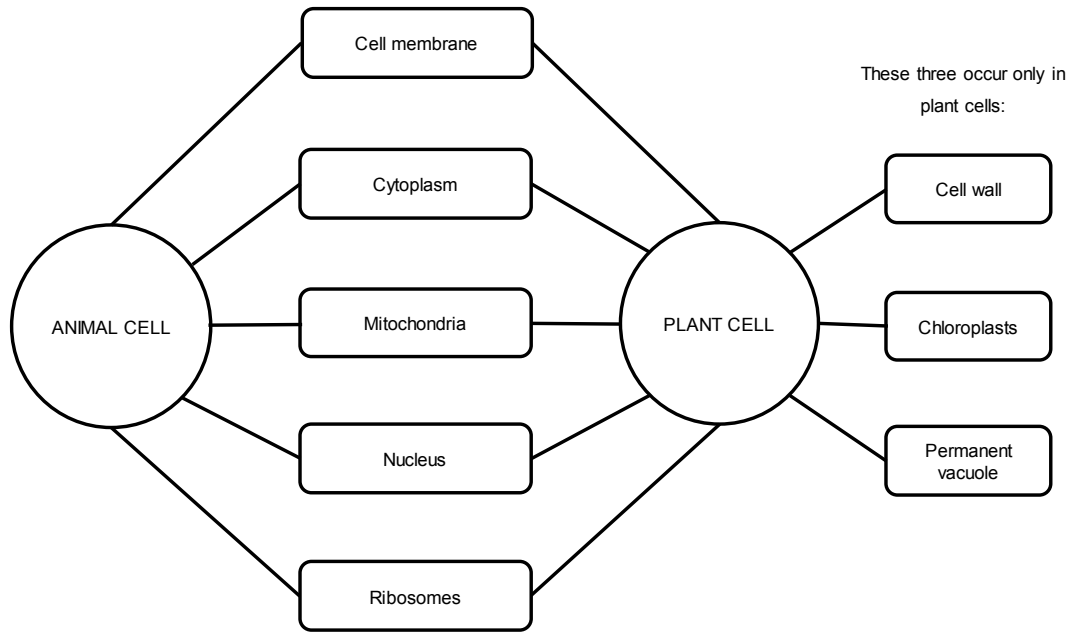
1. Cells



Both animal and plant cells contain a nucleus, cytoplasm, cell membrane, mitochondria and ribosomes. Plant cells also contain a cell wall, chloroplasts, and a permanent vacuole.

Cell organelle	Description
Cell membrane	Controls what enters and leaves the cell.
Cell wall	Made of cellulose, to strengthen the cell.
Chloroplast	The site of photosynthesis.
Cytoplasm	The site of chemical reactions.
Mitochondria	To release energy during respiration.
Nucleus	Contains chromosomes made of DNA molecules. Each chromosome carries a large number of genes.
Permanent vacuole	Filled with cell sap (a weak solution of sugars and salts).
Ribosomes	The site of protein synthesis (where proteins are made).

2. Organisation of Cells



2

3. Eukaryotic and prokaryotic cells

Eukaryotic cells contain a nucleus.

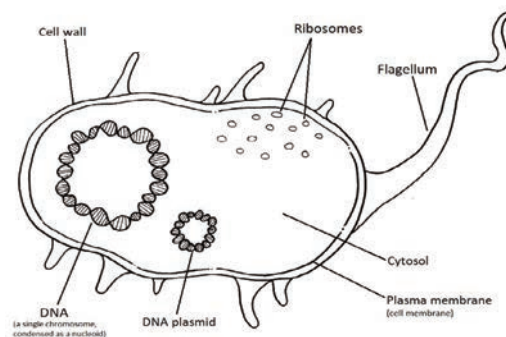
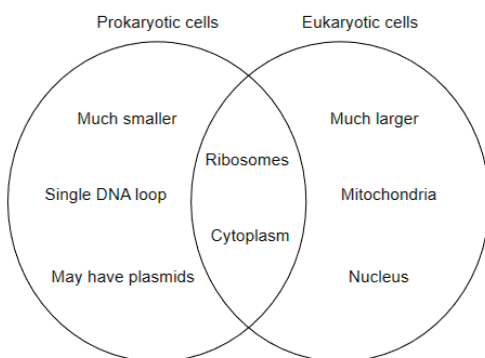
Plant cells and animal cells are eukaryotic.

Prokaryotic cells (bacteria) are much smaller than eukaryotic cells.

They do not have a nucleus.

They do not have mitochondria but do have ribosomes.

They have a single DNA loop and may also have small rings of DNA called plasmids.



1000nm (nanometres) = 1 μ m

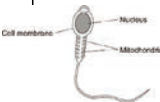
1000 μ m (micrometres) = 1mm

1000mm (millimetre) = 1m

10mm = 1cm (centimetre)

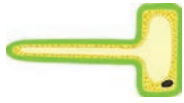
3

4. Animal Specialised Cells

Type of specialised cell	Function	Adaptations
Nerve cell 	Carry electrical impulses around the body	Lots of dendrites to make connections to other cells A very long axon that carries the electrical impulse from one place to another Contain lots of mitochondria to provide the energy needed to make special transmitter molecules, to carry impulses across gaps (synapses) between one nerve cell and the next
Muscle cells 	Contract and relax to allow movement	Contain special fibres that can slide over one another to allow the muscle to contract and relax Contain lots of mitochondria to provide energy for contraction Store glycogen which can be converted into glucose for respiration
Sperm cells 	Fertilise an egg cell	A tail for movement Middle section full of mitochondria to provide energy for tail to move Digestive enzymes in acrosome to digest a pathway into the egg A large nucleus containing half the genetic information needed to make an organism

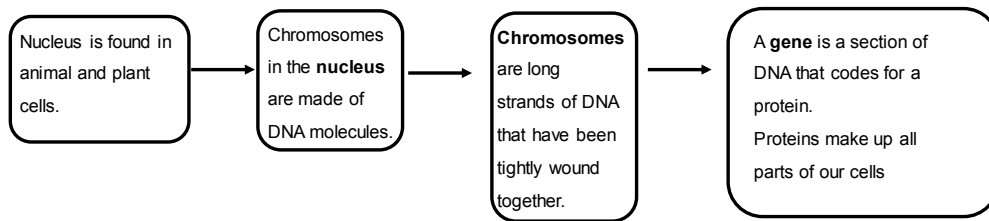
4

5. Plant Specialised Cells

Specialised cell	Function	Adaptations
Root hair cell 	Absorb water and mineral ions	Large surface area available for water to move into cell by osmosis Large permanent vacuole that speeds up osmosis Lots of mitochondria that carry out respiration to provide the energy needed for active transport of mineral ions
Xylem cells 	Transport water and mineral ions from the roots to the highest leaves and shoots - always upwards.	When first formed xylem cells are alive but due to build-up of lignin the cells die and form long hollow tubes (vessels). The lignin makes the xylem vessels very strong and helps them withstand the pressure of water moving up the plant.
Phloem cells 	Transport sugars up and down the plant	End walls between cells break down to form sieve plates that allow water carrying dissolved sugars to move up and down the phloem. Neighbouring companion cells are packed with mitochondria to provide their energy needs.

5

6. Nucleus



The nucleus contains **chromosomes** made of DNA molecules.

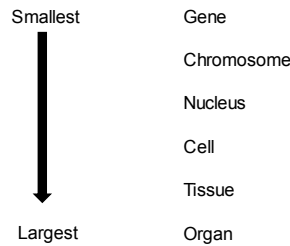
Each chromosome carries a large number of genes.

Gametes (sperm and egg cells) only have 1 set of chromosomes, so they have 23 chromosomes.

When human gametes come together in fertilisation, they form a zygote (fertilised egg cell) with 23 pairs of chromosomes (46 chromosomes).

Human body cells contain 23 pairs of chromosomes.

Biological structures in size order



6

7. Stem Cells and Microscopes

Use the EVERY model to complete calculations:

E = equation

V = values

E = enter results

R = result

Y = units



$$\text{Magnification} = \frac{\text{size of image}}{\text{size of real object}}$$

Magnification increases the size of the image.

Resolution increases the detail of the image.

Electron microscopes have higher magnification and higher resolution than **light microscopes**.

They have allowed scientists to study cells in much finer detail.

They have increased our understanding of sub-cellular structures such as mitochondria.

Type	Description
Adult stem cells	Adult cells which can form many types of cells, including blood cells.
Embryonic stem cells	Stem cells from embryos which divide and differentiate into specialised cells.
Differentiation	Specialisation of cells
Stem cells	Undifferentiated cells, capable of dividing to make lots of cells, and of differentiating to form specialised cells.
Meristem tissue	Tissue made up of stem cells in plants. It can differentiate into any type of plant cell, throughout the plant's life. Can be used to produce plant clones quickly and economically. Can be used to clone rare species. Can be used to clone plants with useful features, e.g. disease resistance.
Therapeutic cloning	Scientists can use embryo stem cells to make different types of human cells. The cells are not rejected by the patient's body, but some people have ethical or religious concerns.

7

8. Transport in and out of cells - diffusion

Diffusion: The overall movement of particles from high concentration to low concentration – they spread out.

Examples

Oxygen and carbon dioxide diffuse in and out of cells in **gas exchange**.

Urea moves out of cells into the blood plasma. It is a waste product. It goes to the kidney to be excreted.

Factors that affect the rate of diffusion

- The bigger the difference in concentrations, the faster diffusion is.
- The higher the temperature, the faster diffusion is.
- The bigger the surface area of the membrane, the faster diffusion is.

Diffusion and single celled organisms

Single celled organisms have a large surface area compared with their volume.

Diffusion is enough to get them all the molecules that they need.

Diffusion and larger organisms

Larger organisms have a small surface area compared to their volume.

They need exchange surfaces and transport systems to allow them to absorb enough oxygen and move it around the body.

Exchange surfaces in plants have:

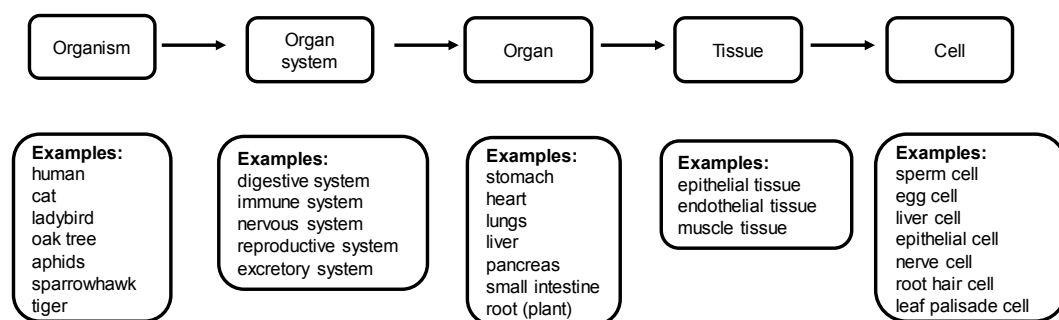
1. a large surface area.
2. thin membranes, to provide a short diffusion path.

Exchange surfaces in animals have:

1. a large surface area
2. thin membranes, to provide a short diffusion path.
3. a good blood supply
4. good ventilation (they breathe)

8

9. Levels of organisation



Basics of organisation

Cells are the building blocks of all organisms.

A tissue is a group of cells with a similar structure and function.

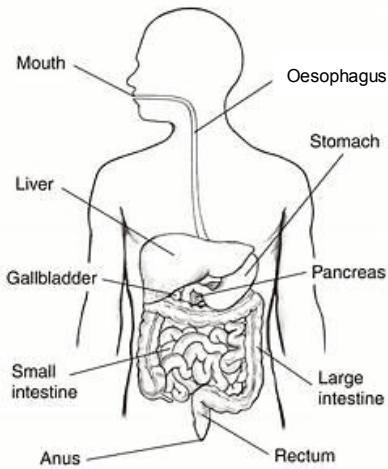
An organ is a group of tissues performing similar functions.

An organ system is a group of organs, which work together to perform a particular function.

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10. Organisation of cells in the digestive system

The **human digestive system** is an example of an organ system in which several organs work together to digest and absorb food.



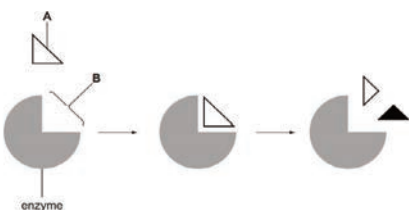
Organ	Function
Mouth	First stage of digestion, teeth break up food with mechanical digestion and salivary amylase breaks down food in chemical digestion.
Oesophagus	Transports food from the mouth to the stomach.
Stomach	Churns food and adds acid.
Small intestine	Adds digestive enzymes (amylase, lipase, and protease) and absorbs nutrients from the food.
Large intestine	Absorbs water, producing waste.
Rectum	Stores waste.
Anus	Waste passes out of the anus.
Liver	Produces bile. Bile neutralises stomach acid and emulsifies fats. Food does not pass through here.
Gall bladder	Stores bile which has been produced in the liver. Food does not pass through here.
Pancreas	Produces digestive enzymes: amylase, lipase, and protease. Food does not pass through here.

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11. Enzymes in the digestive system

Digestive enzymes break down food into small soluble molecules that can be absorbed into the blood stream.

Digestive Enzyme	Produced by	Converts...	Into...
Amylase (carbohydrase)	Mouth, small intestine, pancreas	Starch (carbohydrates)	Sugar
Lipase	Small intestine, pancreas	Lipid (fat)	Glycerol + fatty acid
Protease	Stomach, small intestine, pancreas	Protein	Amino acids



Enzymes are **specific**.

They have a specific shape (**the active site**) which works on a specific substrate – like a lock and key.

If the active site changes shape, it no longer works.

Changes in pH and temperature can **denature** – change the shape of the active site - so that it no longer works.

The products of digestion are used to build new carbohydrates, lipids and proteins.

Glucose can also be respired.

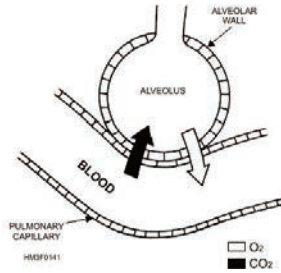
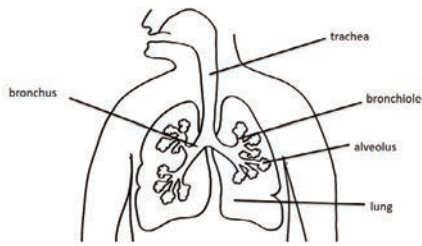
Bile is made in the liver and is stored in the gall bladder.

It is alkaline and neutralises the hydrochloric acid from the stomach.

It emulsifies fat to form small droplets, increasing the surface area. This makes fat digestion quicker.

11

12. The breathing system



The lungs provide a good exchange surface for oxygen:

1. **Large surface area** provided by alveoli.
2. **Thin walls** of alveoli (one cell thick) and blood supply (capillary), providing a short diffusion distance.
3. **Good blood supply** to transport the oxygen away from the lungs.
4. **Well ventilated** to supply more oxygen.

Air enters the body through the **mouth** and **nose**.



Air enters the **trachea**.



The trachea divides into two **bronchi**. One **bronchus** enters each lung.



Each bronchus branches out into smaller tubes called **bronchioles**.
Air travels through these bronchioles.



At the end of the bronchioles, the air enters one of the many millions of **alveoli** where gaseous exchange takes place

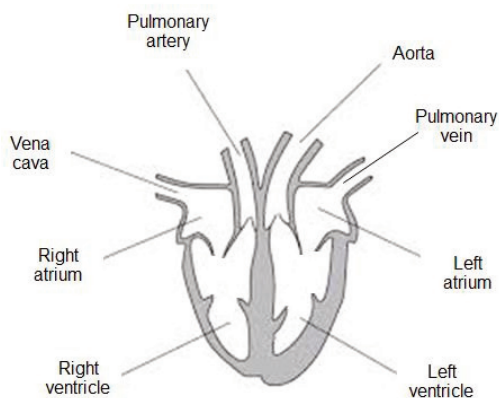
12

13. Organisation of cells in the circulatory system 1

The heart is an **organ**.

The function of the heart is to pump blood around the body.

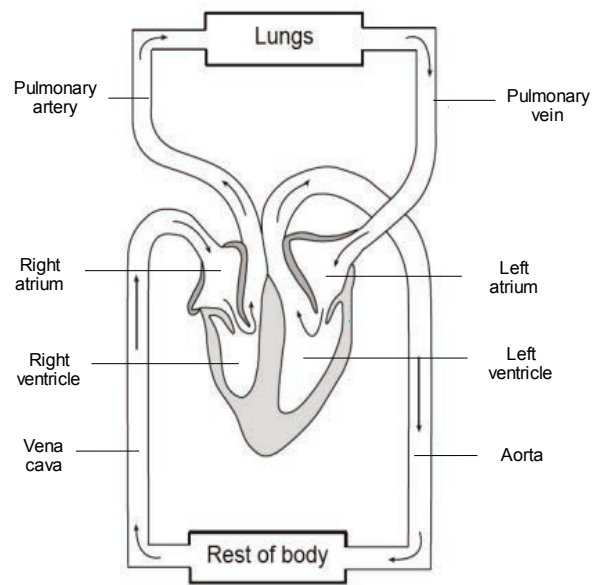
Humans have a **double circulatory system**, which means that blood must pass through the heart **twice** to complete a full circuit of the body.



Organ	Function
Heart	Organ that pumps blood around the body in a double circulatory system.
Vena cava	Vein which brings blood from the body to the right atrium of the heart.
Right ventricle	Chamber which pumps blood to the lungs where gas exchange takes place.
Pulmonary artery	Artery takes blood from the right ventricle to the lungs.
Left ventricle	Chamber which pumps blood around the rest of the body
Pulmonary vein	Vein which brings blood from the lungs to the left atrium of the heart.
Aorta	The aorta takes blood from the left ventricle to the body.
Pacemaker	In the wall of the right atrium, controls heart rate.

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14. Organisation of cells in the circulatory system 2

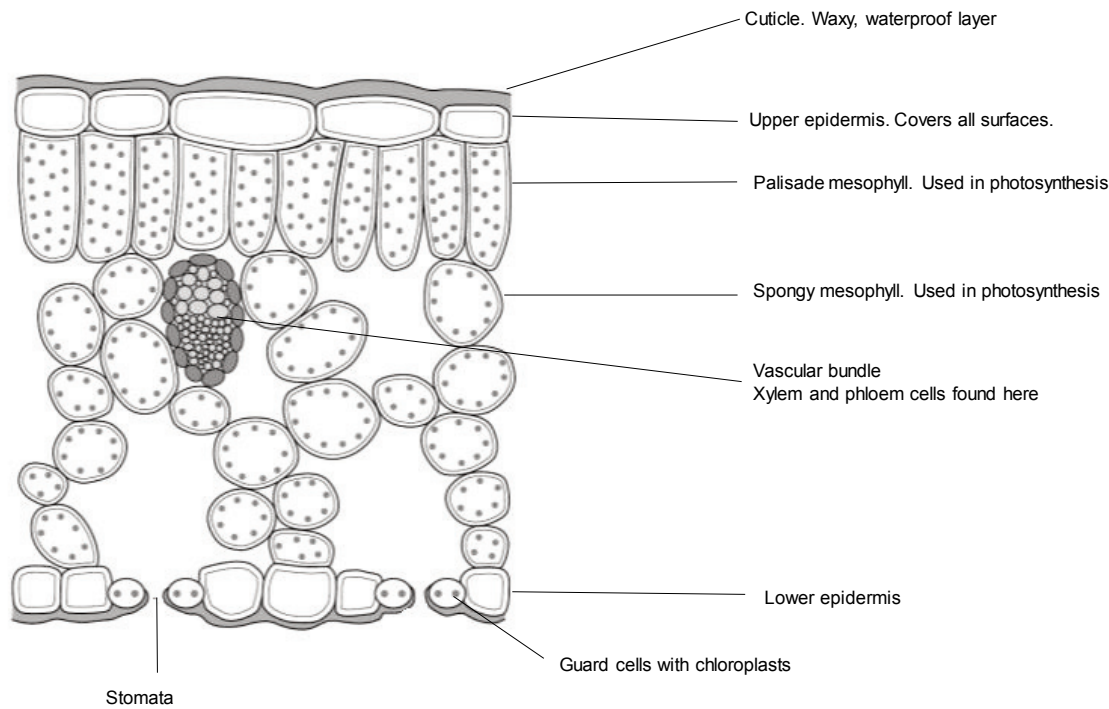


The blood is a tissue.

Blood component	Role
Plasma	Solution in which cells are suspended; carries dissolved food and hormones around the body
Red blood cells	Carry oxygen
White blood cells	Involved in immune response to fight pathogens
Platelets	Involved in blood clotting

Blood vessel	Role	Description
Artery	Carry blood away from heart	Walls contain lots of strong elastic tissue to withstand pressure
Capillary	Allow substances to diffuse into and out of the blood	Walls are one cell thick and include small holes to allow substances to move in and out easily
Vein	Carry blood to the heart	Have valves to keep blood flowing in one direction only

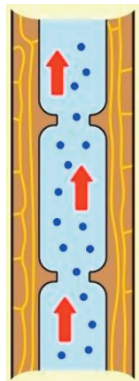
15. Cross section of a leaf



16. Organisation of cells in plants

Water is absorbed (by osmosis) by **root hair cells** that have a large surface area.
The root hair cells also absorb mineral ions (by active transport).

Xylem Cells

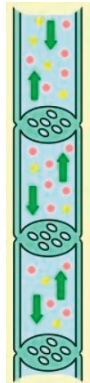


Transports **water and mineral ions** from the roots to the stems and leaves.
Made of hollow tubes, strengthened by lignin.

Transpiration is the transport of water and minerals up the xylem of a plant, and the evaporation of water through the stomata. Transpiration is increased by

- Increased temperature
- Increased air movement
- Increased light intensity
- Decreased humidity

Phloem Cells



Translocation is the transport of sugars in the phloem, to all parts of the plant.

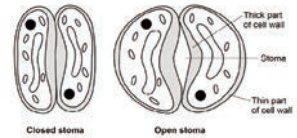
The leaves make sugars through photosynthesis.

The **phloem** transports dissolved sugars from the leaves to the rest of the plant for respiration or for storage of starch.

Phloem is made of tubes of elongated cells.

Cell sap (dissolved sugars) moves from one phloem cell to the next through pores in the end walls.

Stomata and Guard Cells



The **stomata** (small holes in the underside of the leaf) are needed for gas exchange in the leaf.

Water is also lost to the surroundings through the stomata. To reduce water loss, **guard cells** can change the size of the stomata.

16

17. Coronary Heart Disease

Term	Definition
Disease	dis-ease (not at ease; something in our body or mind is not working correctly)
Coronary Heart Disease	a non-communicable disease (you can't catch it)
Coronary arteries	supply the heart muscle with oxygen and glucose
Coronary heart disease	The coronary arteries have layers of fatty material building up in them. They get narrower. Less blood can flow through the coronary arteries, so the heart muscle lacks oxygen.

Treatment	Description
Statins	Tablets used to reduce blood cholesterol. They slow down the rate of fatty material build up.
Stents	Used to keep the coronary arteries open.
Heart valve replacement	Valves keep blood flowing through the heart in the right direction. Sometimes the valves don't open fully or become leaky. This prevents blood flowing through the heart properly. The patient becomes out of breath and lacks energy. Faulty heart valves can be replaced with new biological valves (from a donor) or mechanical valves.
Heart failure	Can be treated with a new heart and lungs. The heart would come from a donor. Mechanical hearts can be used to keep the patient alive whilst waiting for a heart transplant.

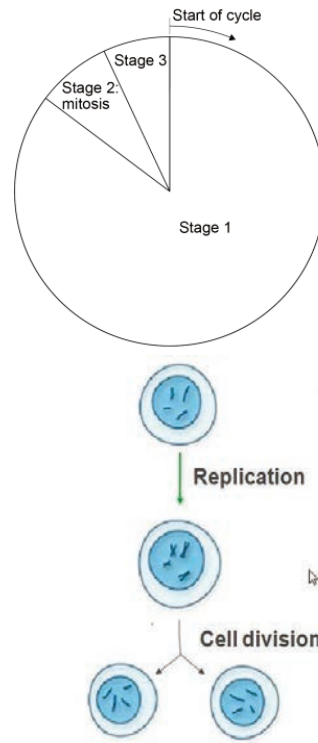
17

18. Cell Cycle: Mitosis

Stage of the cell cycle	Events
1	The cell grows. The DNA replicates to form two copies of each chromosome. New mitochondria and ribosomes are made.
2	Mitosis: one set of chromosomes is pulled to each end of the cell. The nucleus divides.
3	The cytoplasm and cell membranes divide. There are now two identical cells.

Uses of cell division by mitosis

1. Growth
2. Repair of tissues
3. Asexual reproduction



18

19. Cell Cycle: Mitosis and Cancer

Stage of the cell cycle	Events
1	The cell grows. The DNA replicates to form two copies of each chromosome. New mitochondria and ribosomes are made.
2	Mitosis: one set of chromosomes is pulled to each end of the cell. The nucleus divides.
3	The cytoplasm and cell membranes divide. There are now two identical cells.

Uses of cell division by mitosis

1. Growth
2. Repair of tissues
3. Asexual reproduction

Cancer is the result of uncontrolled growth and division of cells. This is caused by a change in the genetic material of the cell.

Benign tumours are growths of abnormal cells.

They are contained in one area, usually within a membrane. They do not invade other parts of the body.

Malignant tumour cells are cancers.

They invade neighbouring tissues and spread around the body in the blood, where they form secondary tumours.

Lifestyle factors and genetic factors can be risk factors for cancers.

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20. Communicable diseases: pathogens

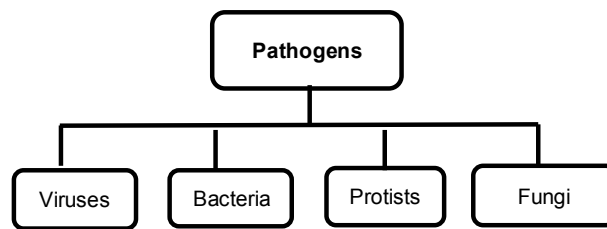
Communicable diseases are diseases caused by pathogens – they can spread from one organism to another.

Pathogens are organisms that cause infectious disease.

They can be viruses, bacteria, protists or fungi.

Pathogens may infect plants or animals.

Pathogens can spread by direct contact, water or by air.



Bacteria reproduce rapidly inside the body.

Bacteria produce poisons/toxins that damage tissues and make us feel ill.

Viruses reproduce rapidly inside the body.

Viruses live and reproduce inside cells, causing cell damage.

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21. Communicable diseases: viruses

Pathogen	Disease	Transmission	Symptoms	Treatment or prevention
Virus	Measles	Sneezing and coughing produces droplets containing the virus; these droplets can be inhaled by others.	Fever and red skin rash. It can be fatal if there are complications.	Most young children are vaccinated against measles.
Virus	HIV/AIDS	Sexual contact or exchange of body fluids such as blood.	Flu-like illness, which then attacks the body's immune cells. Late stage HIV, known as AIDS, happens when the immune system is so damaged that it cannot deal with infections or cancers	treated with antiretroviral drugs.
Virus	Tobacco mosaic virus (TMV)	By direct contact	A distinctive mosaic pattern of discoloration on the leaves. The leaves can't photosynthesise as well, which affects the growth of the plant.	Remove infected plants; wash hands when handling plants to prevent transfer from one to another

21

22. Communicable diseases: bacteria, fungi and protists

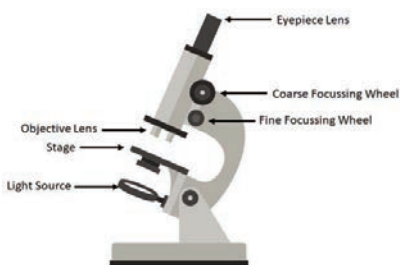
Pathogen	Disease	Transmission	Symptoms	Treatment or prevention
Bacterium	Salmonella (food poisoning)	Undercooked chicken, or contamination of surfaces from raw chicken	Fever, abdominal cramps, vomiting and diarrhoea, caused by the bacteria and the toxins from the bacteria.	Poultry (chicken, turkey and ducks) are vaccinated against salmonella to control the spread
Bacterium	Gonorrhoea	sexually transmitted disease	Thick yellow or green discharge from the vagina or penis; as well as pain when urinating.	Antibiotics, although there are many resistant strains. Barrier methods of contraception can reduce the spread.
Fungus	Rose black spot	by wind or water	Purple or black spots develop on leaves. The leaves turn yellow and drop off. The leaves don't photosynthesise well, which affects the growth of the plant.	Fungicides and removing and destroying the affected leaves.
Protist	Malaria	Spread by mosquito bites.	Recurrent (repeating) episodes of fever. It can be fatal.	Prevented by stopping mosquitos from breeding, and by avoiding being bitten e.g. with a mosquito net.

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23. Required Practicals 1 – Microscopy and Food Tests

Using a Microscope

1. Light on
2. Platform (stage) high
3. Lowest magnification objective lens first
4. Coarse focus first, then fine focus



Rules for Biological Drawings

- Sharp pencil
- Smooth lines
- Ruler for label lines
- No arrowheads
- Add magnification (multiply eyepiece lens by objective lens)

Food tests

Food	Test	Positive result
Starch	add iodine solution	turns black
Sugars	add Benedict's solution → heat	makes (orange) precipitate
Protein	add Biuret solution	turns purple
Fats (lipids)	add ethanol → shake → add water → shake	cloudy white emulsion

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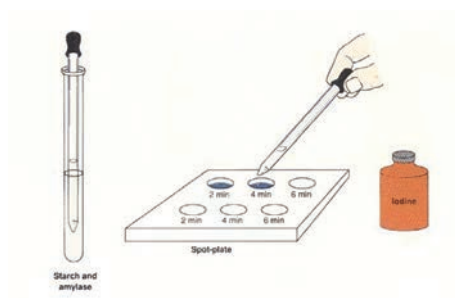
24. Required Practical 2 - Enzymes

Investigate the effect of pH on the reaction of amylase enzyme

IV: pH (change using at least 5 different buffer solutions)

DV: time taken to digest starch (measured as the time it takes for a sample of the mixture **not** to turn black when mixed with iodine solution)

CV: volume and concentration of amylase solution; volume and concentration of starch solution; temperature; time for samples



Method:

1. Place known volume of starch solution into a boiling tube.
2. Place known volume of amylase solution into the boiling tube.
3. Stir using a glass rod.
4. Take a sample of mixture and place onto a spot tile.
5. Add a drop of iodine solution to the spot tile; repeat every 30s; record the time taken for the mixture not to turn black.
6. Repeat steps 1 – 5 for at least 5 different pHs.

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Y9 Chemistry

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44. Required practicals 2 – energy changes

25. Atoms, Elements, Compounds and Mixtures

Keyword	Definition
Atom	smallest part of an element
Element	made up of only one type of atom
Compound	made from at least two elements, chemically combined
Mixture	made of two or more elements or compounds not chemically combined together

Radius of an atom = 0.1nm ($1 \times 10^{-10}\text{m}$).

Radius of a nucleus is less than $1/10\,000$ of that of an atom.
This is $1 \times 10^{-14}\text{m}$.

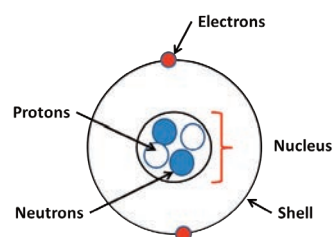
Atoms are **neutral** (no electrical charge) because:
-The number of protons and electrons are the same.
-The charges cancel out

Atomic number = Proton number

Mass number = Number of protons and neutrons

Number of electrons = Number of protons

Structure of the atom (Nuclear model)



Subatomic particle	Relative charge	Relative mass
Proton	+1	1
Neutron	0	1
Electron	-1	1/1840

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26. Structure of the Atom

7	Top number
Li	
3	Bottom number

Proton = bottom number

Electron = bottom number

Neutron = top number – bottom number

Electronic Configuration

Electrons are arranged in shells.

1st shell – maximum of 2 electrons

2nd shell – maximum of 8 electrons

3rd shell – maximum of 8 electrons

Isotopes:

Atoms of the same element that have different numbers of neutrons but the same number of protons and electrons.

They have the same chemical properties but different physical properties.

39	Ar
18	

18 protons
18 electrons
21 neutrons

38	Ar
18	

18 protons
18 electrons
20 neutrons

Calculating Relative Isotopic Abundance

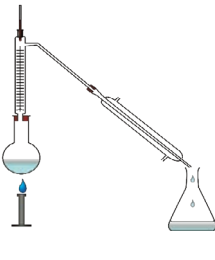
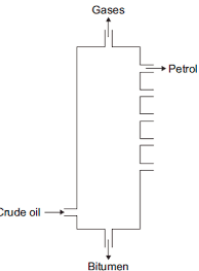
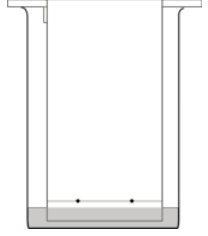
Mass number	Abundance (%)
39	93.1
41	6.9

$$= \frac{(39 \times 93.1) + (41 \times 6.9)}{93.1 + 6.9}$$

$$= 39.1$$

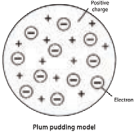
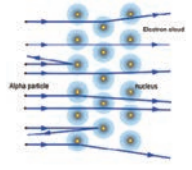
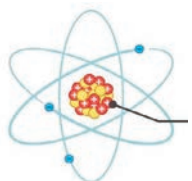
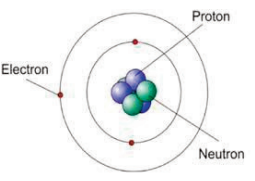
26

27. Separating Mixtures

Process	Filtration	Distillation	Fractional distillation	Chromatography
Diagram				
Physical property	Difference in solubility	Difference in boiling points	Difference in boiling points	Difference in solubility
Example	Sand and salt	Ink and water	Ink, water and oil	Different colours in dyes

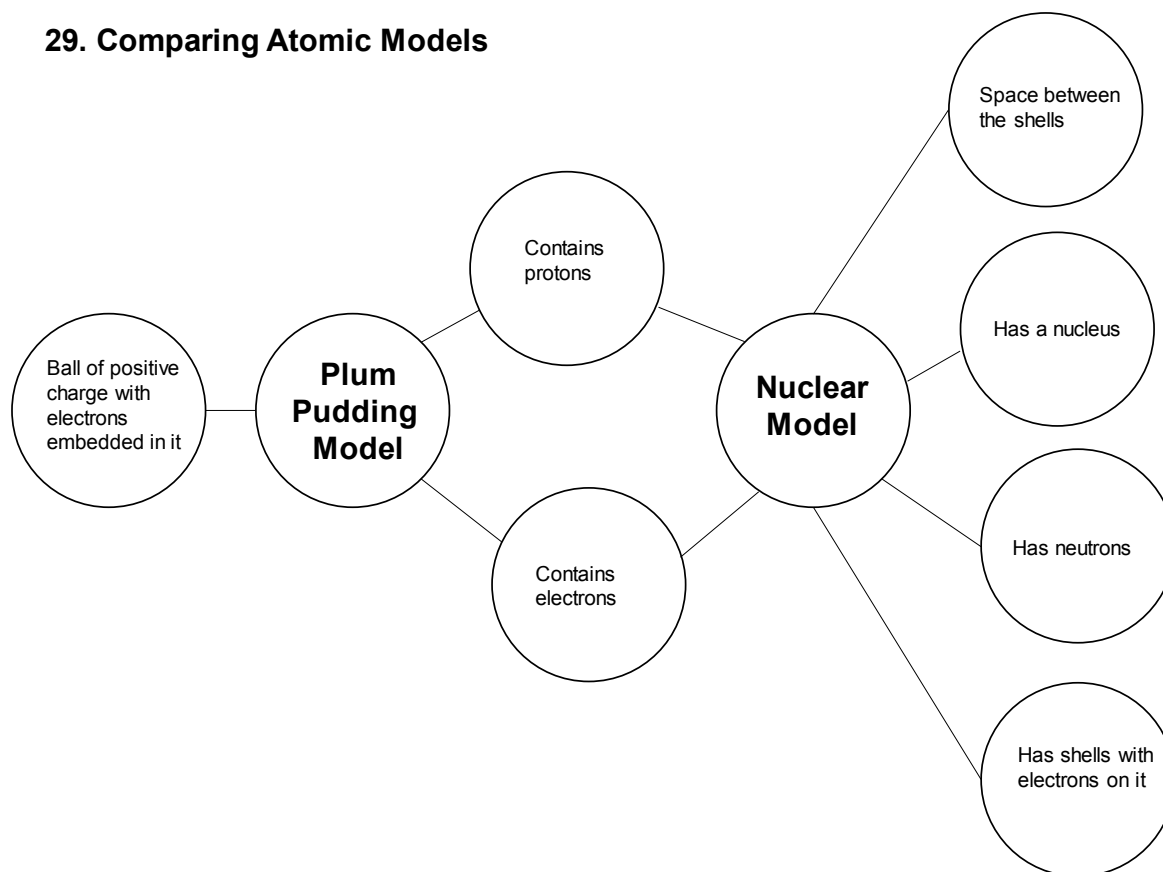
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28. History of the Atom

Atomic model	Plum pudding model	Nuclear model			
Diagram					
Discovery	Electron	Positive nucleus in the centre of the atom	Electrons occupy shells Electrons are at specific distances from the nucleus	Neutrons	- Atomic radius: 1×10^{-10} m - Radius of a nucleus is less than 1/10 000 of the radius of an atom. - Most of the mass of an atom is concentrated in the nucleus. - The electrons are arranged at different distances from the nucleus.
Description	The atom is a ball of positive charge with negative electrons embedded in it.	Positively charged alpha particles were fired at thin gold foil. Most alpha particles went straight through the foil. A few were scattered in different directions by the atoms in the foil. It showed that the mass of an atom was in the centre (the nucleus) and the nucleus was positively charged.		Proved the existence of isotopes	
Discovered by	Thompson	Rutherford	Bohr	Chadwick	

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29. Comparing Atomic Models



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30. Ionic and Covalent Bonding

Ionic Bonding (metal & non-metal)

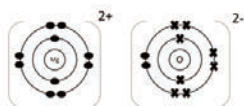
Structure: Giant ionic lattice

Electrons are lost or gained to achieve a full outer shell.

Ionic bond: Electrostatic attraction between oppositely charged ions.

Ions held in a fixed lattice.

Charge of ion: +2 (loses 2 electrons) and -2 (gains 2 electrons)



Describing the formation of an ionic compound

Example 1: NaF

Na atom loses 1 electron to form Na^{1+} ion.

F atom gains 1 electron to form F^{1-} ion.

Example 2: Na_2O

Two Na atoms each lose 1 electron to form two Na^{1+} ions.

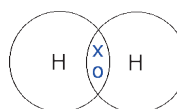
One O atom gains 2 electrons to form O^{2-} ion.

Covalent Bonding (2 x non-metals)

Covalent bond: Pairs of electrons are shared between the atoms.

Sharing one pair of electrons = single bond

Sharing two pairs of electrons = double bond



Simple Molecules

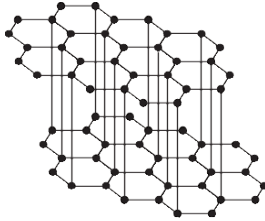
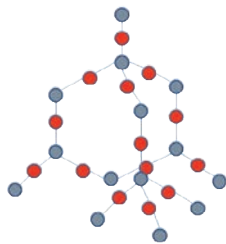
(2 x non-metals, covalent bonding)

Simple molecules (small molecules)

e.g. H_2 , Cl_2 , O_2 , N_2 , HCl , H_2O

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31. Giant Covalent Bonding

	Diamond	Graphite	Silicon dioxide
Bonding	Giant covalent	Giant covalent	Giant covalent
Made of	Carbon	Carbon	Silicon and oxygen
Structure	Each carbon atom forms four C-C covalent bonds.	Each carbon atom forms three covalent bonds with three other carbon atoms, forming layers of hexagonal rings. The 4 th electron is delocalised	Each silicon atom forms four covalent bonds with oxygen atoms
Diagram			

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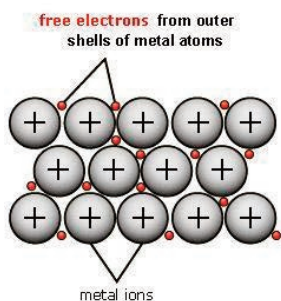
32. Metallic Bonding and Alloys

Metallic Bonding

Metallic bond: Attraction

between the positive metal ion and delocalised electrons.

Structure: Layers of metal positive ions surrounded by delocalised electrons

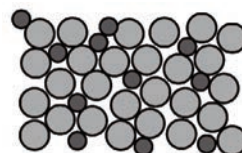


Alloy

Mixtures of metals with metals or a non-metal

e.g. stainless steel is a mixture of iron and carbon

Structure: Irregular layers



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33. Quantitative Chemistry

Relative formula mass (RFM or M_r)

This is the mass in grams of 1 mole of the substance.
 To calculate M_r (top number) you need to add up the atomic mass (A_r) of all of the atoms in the molecule.

Example 1. $NaCl = Na + Cl = 23 + 35.5 = 58.5$
Example 2. $MgF_2 = Mg + (2 \times F) = 24 + (2 \times 19) = 62$

% Mass of an Element in a compound

$$\% \text{ mass of an element} = \frac{\text{Atomic mass of element} \times \text{number of atoms}}{\text{Relative formula mass of compound}} \times 100$$

Remember: $\frac{\text{part}}{\text{whole}} \times 100$

Conservation of Mass

During a chemical reaction, no atoms are made, no atoms are destroyed.

Decrease in mass:

$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$
 Carbon dioxide is a gas which is a product
 Carbon dioxide escapes into the air.

Increase in mass:

$2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$
 Mg reacts with oxygen in the air
 Oxygen has added to the magnesium

Concentration of a solution

$$dm^3 \xrightleftharpoons[\div 1000]{\times 1000} cm^3$$

$$\text{Concentration (g/dm}^3\text{)} = \text{mass (g)} \div \text{volume (dm}^3\text{)}$$

34. Acids and Alkalis

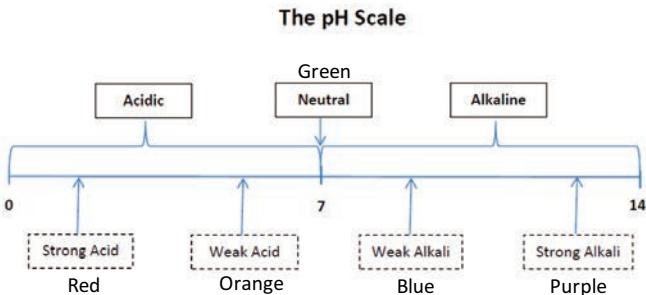
Acid	Chemical formula
Sulfuric acid	H_2SO_4
Nitric acid	HNO_3
Hydrochloric acid	HCl

Alkali	Chemical formula
Sodium hydroxide	$NaOH$
Potassium hydroxide	KOH

Acid	Salt name ending
Hydrochloric	-chloride
Nitric acid	-nitrate
Sulfuric	-sulfate

The pH Scale

It can be measured with a pH probe, or universal indicator.
 Acid: pH 0-6
 Neutral: pH 7
 Alkali: pH 8-14



Neutralisation

Acids contain hydrogen ions (H^+)
 Alkalis contain hydroxide ions (OH^-)
 acid + alkali $\rightarrow$ water
Ionic equation: $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

35. Reactions of Acids to Make a Salt (Neutralisation)

Reaction 1	Reactions of Acids with Metals (Neutralisation)						
Rule	acid	+	metal	→	salt	+	hydrogen
Example	hydrochloric acid	+	magnesium	→	magnesium chloride	+	hydrogen
Reaction 2	Reactions of Acids with Metal Oxide (Neutralisation)						
Rule	acid	+	metal oxide	→	salt	+	water
Example	sulfuric acid	+	magnesium oxide	→	magnesium sulfate	+	water
Reaction 3	Reactions of Acids with Metal Hydroxide (Neutralisation)						
Rule	acid	+	metal hydroxide	→	salt	+	water
Example	nitric acid	+	magnesium hydroxide	→	magnesium nitrate	+	water
Reaction 4	Reactions of Acids with Metal Carbonate (Neutralisation)						
Rule	acid	+	metal carbonate	→	salt	+	water + carbon dioxide
Example	nitric acid	+	magnesium carbonate	→	magnesium nitrate	+	water + carbon dioxide

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36. Strong and Weak Acids

Strong acid

Completely ionised (breaks down) in aqueous solution.



Examples: Hydrochloric acid (HCl), nitric acid (HNO₃) and sulfuric acid (H₂SO₄).

Lower pH numbers (pH 1-3)

The stronger the acid, the more it ionises in solution, and the more hydrogen ions there are in the solution.

Concentrated acid

More hydrogen ions (H⁺) per volume

Weak acid

Partially ionised (breaks down) in aqueous solution.



Examples: Ethanoic acid, citric acid and carbonic acid.

Higher pH numbers (pH 4-6)

pH

If the hydrogen ion concentration in a solution increases by a factor of 10, the pH of the solution decreases by 1.

Volume of acid (cm ³)	pH
10	3
1000	5

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37. Energy Changes

Exothermic Reaction. Energy is transferred from particles to the surroundings. Temperature increases.

Examples: Combustion, many oxidation reactions, neutralisation.

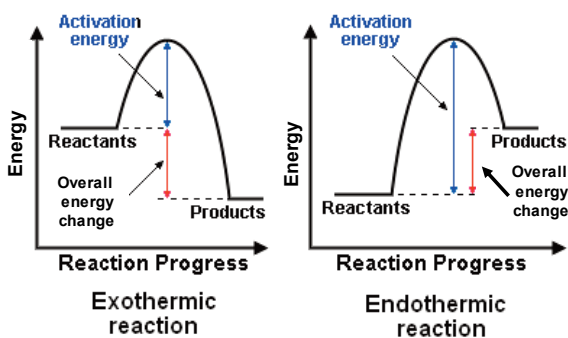
Every day uses: self-heating cans and hand warmers.

Endothermic reaction. Energy is transferred from the surroundings to the particles. Temperature decreases.

Example: Thermal decomposition and the reaction between citric acid and sodium hydrogencarbonate.

Every day uses: sports injury packs.

Activation energy: minimum amount of energy required for the reaction to start.



Exothermic energy

profile:

Reactants are **higher** in energy than the products.

Energy is released to the surroundings.

Endothermic energy

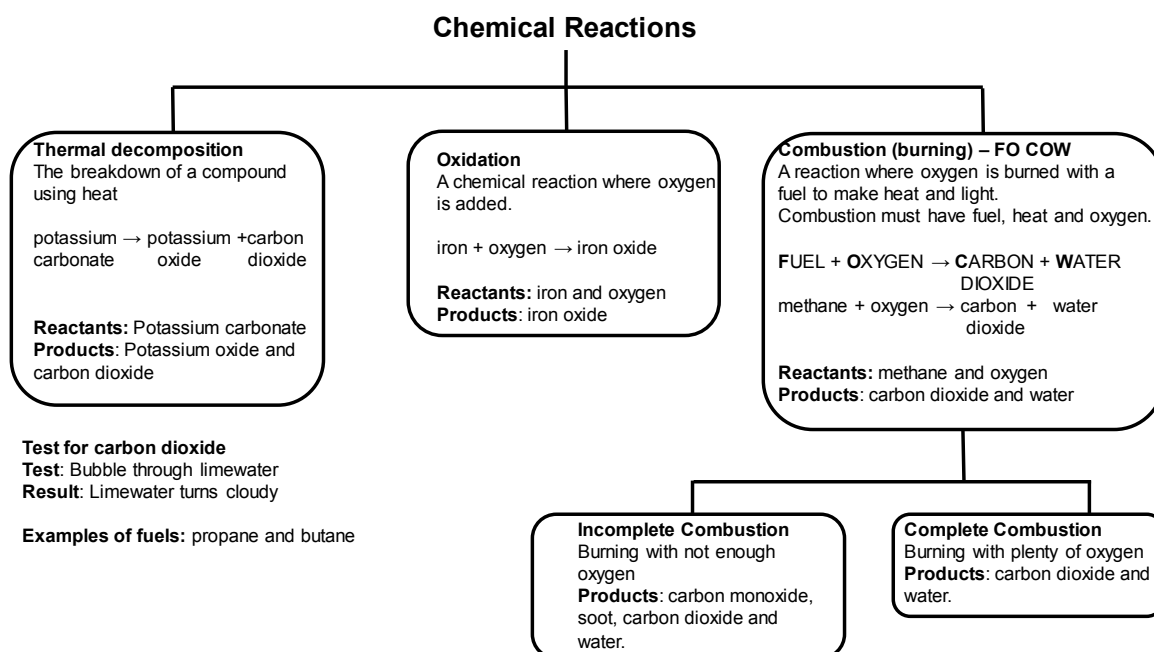
profile:

Reactants are **lower** in energy than the products.

Energy is absorbed by the surroundings.

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38. Types of Chemical Reactions



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39. Conservation of mass

In a reaction, the atoms you start with are the same as those that you make.

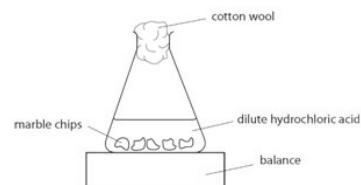
mass of the reactants = mass of the products.



Reactant side has 2 H and 2 Cl atoms.

The product side has 2 H and 2 Cl atoms.

If one side has a mass of 25g, the other side will have a mass of 25g



Loss in mass

calcium carbonate $\rightarrow$ calcium oxide + carbon dioxide

Explanation:

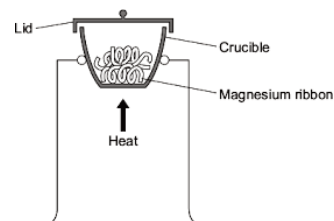
- Carbon dioxide is a gas
- It escapes into the atmosphere

Gain in mass

magnesium + oxygen $\rightarrow$ magnesium oxide

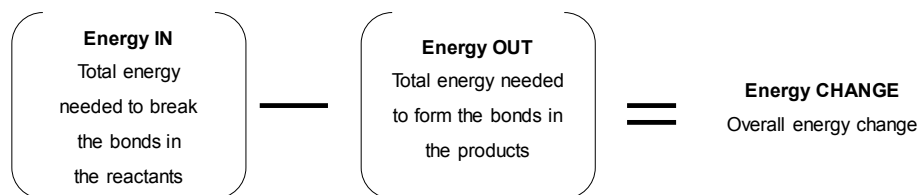
Explanation:

- Oxygen gas is added
- Oxygen comes from the air



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40. Calculating Bond Enthalpy



Exothermic reaction.

Negative value

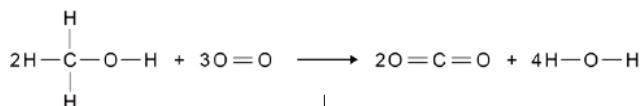
Total energy needed to break the bonds in the reactants $\left\{ \right.$ Total energy needed to form the bonds in the products

Endothermic reaction.

Positive value.

Total energy needed to break the bonds in the reactants $\left\{ \right.$ Total energy needed to form the bonds in the products

	C-H	C-O	O-H	O=O	C=O
Bond energy in kJ / mol	412	360	464	498	805



$$6 \times (\text{C-H}) = 6 \times 412 = 2472$$

$$2 \times (\text{C-O}) = 2 \times 360 = 720$$

$$2 \times (\text{O-H}) = 2 \times 464 = 928$$

$$3 \times (\text{O=O}) = 3 \times 498 = 1494$$

$$\text{TOTAL} = 5614$$

$$4 \times (\text{C=O}) = 4 \times 805 = 3220$$

$$8 \times (\text{O-H}) = 8 \times 464 = 3712$$

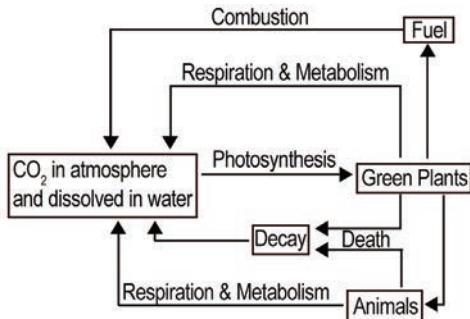
$$\text{TOTAL} = 6932$$

$$5614 - 6932 = -1318$$

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41. The Carbon Cycle

The carbon cycle shows how carbon moves through organisms and as carbon dioxide (CO₂) in the atmosphere.



Earth's atmosphere: 78 % nitrogen, 21 % oxygen, <1 % carbon dioxide, plus small amounts of other gases.

How carbon is recycled: By photosynthesis (COW GO) and respiration (GO COW).

Reasons why CO₂ levels have increased:

Human activities such burning fossil fuels (FO COW) and deforestation.

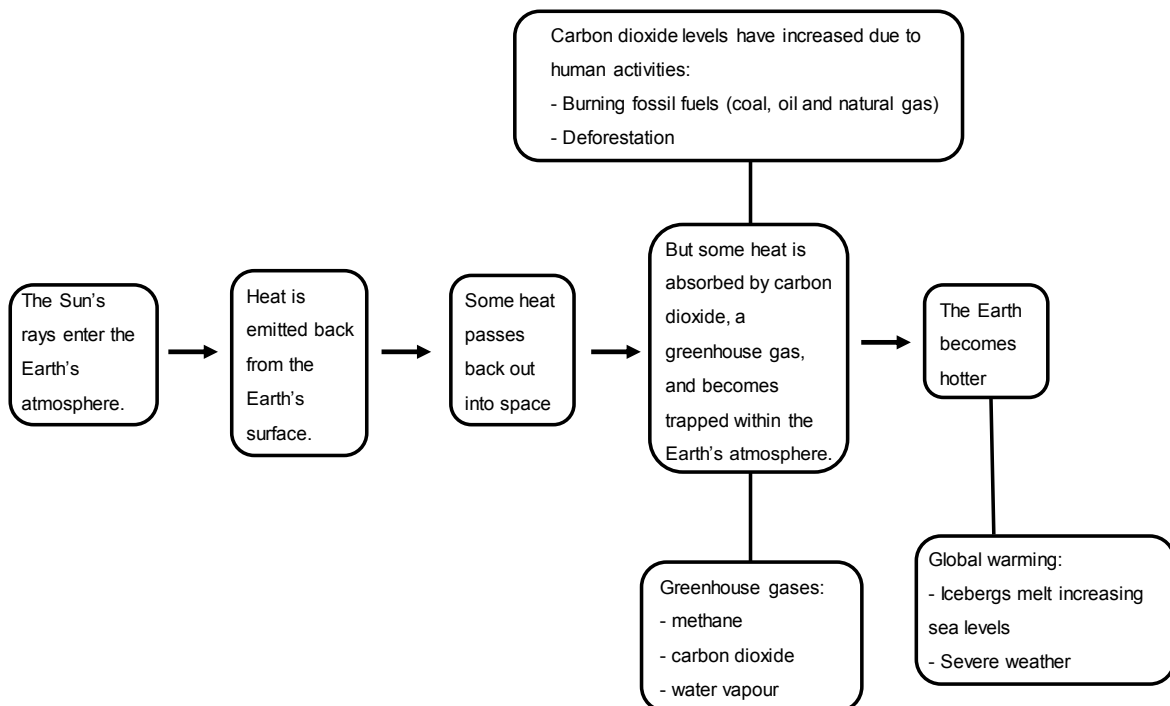
Greenhouse effect:

Greenhouse gases are carbon dioxide, methane, water vapour and ozone.

Scientists have evidence that global warming caused by human activity is causing changes in the climate.

41

42. The Greenhouse Effect



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43. Required Practical 1: Making a salt

Making a soluble salt

1. Add excess copper oxide to sulfuric acid in a beaker
2. Stir using a stirring rod
3. Filter using a funnel and filter paper into a conical flask.
4. Evaporate the water from the copper sulfate solution in an evaporating dish using gentle heat until half the volume is left.
5. Leave on windowsill to form crystals.
6. Pat dry crystals.

Reasoning for the steps

Step 1: Excess metal oxide used so that all the acid reacts.

Step 2: Reaction stirred so all the chemicals react.

Step 3: Removal of excess copper oxide. Excess copper oxide used as it is easier to remove than excess acid

Step 4: Slow this step down by using a water bath

Observations:

Black solid (copper oxide) is left in the filter paper

Colour change

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44. Required Practical 2 – Energy Changes

Reacting two solutions, e.g. acid and alkali

1. Place the polystyrene cup inside the glass beaker
2. Using a measuring cylinder, measure 25 cm³ of acid
3. Add to polystyrene cup.
4. Record the temperature of the acid using a thermometer.
5. Add 5 cm³ of alkali to the polystyrene cup and record the temperature obtained.
6. Repeat with 5 cm³ of alkali until 40 cm³ of alkali has been added

IV: Volume of alkali

DV: Temperature of reaction mixture

CV: Type of acid and alkali, volume of acid

To improve the accuracy

Use polystyrene cup

Add a lid

Repeat the experiment and calculate the mean ignoring anomalous results

Valid results: Repeat 3 times, identify the anomalous results, calculate the mean

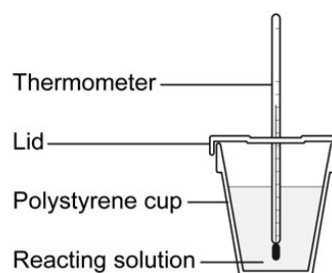
Reacting a solid with a solution, e.g. metal and solution

1. Place the polystyrene cup inside the glass beaker to make it more stable.
2. Using a measuring cylinder, measure 25 cm³ of copper sulfate solution
3. Place the solution in a polystyrene cup.
4. Record the temperature of the solution using a thermometer.
5. Using a balance, weigh out 1 g zinc powder
6. Add the zinc powder and record the temperature.
7. Repeat steps 1-6 with different masses of zinc powder

IV: Mass of metal

DV: Temperature of reaction mixture

CV: Concentration and volume of copper sulfate solution



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Y9 Physics

45. Energy stores and systems
46. Kinetic energy and elastic potential energy
47. Work done
48. Gravitational potential energy
49. Specific heat capacity and power
50. Conservation of energy
51. Efficiency
52. Methods of heat transfer overview
53. Methods of heat transfer
54. Non-renewable Energy Resources
55. Renewable Energy Resources 1
56. Renewable Energy Resources 2
57. Wave properties
58. Transverse and longitudinal waves
59. Sound waves and the speed of sound experiment
60. Sound and seismic waves
61. Reflection, transmission and absorption of waves
62. Refraction of waves
63. Space
64. Star formation
65. Creation of the universe
66. Required practical 1: Specific heat capacity
67. Required practical 2: Thermal insulation
68. Required practical 3: Speed of water waves
69. Required practical 4: Refraction of light
70. Maths in science 1
71. Maths in science 2

45. Energy stores and systems

Energy System

System:

An object or group of objects.

When a system changes there are changes in the way energy is stored within it.

Closed system:

Where neither matter nor energy enters or leaves.

Conservation of energy:

Energy is not created or destroyed but may be transferred between different energy stores.

The energy in a system can be transferred between different stores when work is done by:

- Heating
- Forces
- Current flowing
- Mechanical

Energy Store	Example
Thermal	Cup of hot tea
Kinetic	Moving car
Gravitational Potential	Water in a reservoir at the top of a mountain
Elastic Potential	Stretched bungee cord
Chemical	Battery, food
Magnetic	Two opposing north poles on bar magnet
Electrostatic	Two electrons repelling each other
Nuclear	The energy available to be released by fission when splitting an atom

46. Kinetic Energy and Elastic Potential Energy

Kinetic Energy

Kinetic energy of an object depends on the:

- mass
- speed

Kinetic energy (J) = 0.5 x mass (kg) x velocity² (m/s)

$$E_k = 0.5mv^2$$

Unit conversions:

kJ to J: x 1000
g to kg: ÷ 1000

Elastic Potential Energy

A force acting on an object may cause the shape of an object to change.

Elastic objects can store elastic potential energy if they are stretched or squashed. For example, this happens when a catapult is used or a spring is stretched.

Objects can also store elastic potential energy when they are squashed.

Elastic potential energy (J) = 0.5 x spring constant (N/m) x extension² (m)

Unit conversions:

kJ to J: x 1000
cm to m: ÷ 100

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47. Work Done

A car braking to slow down

The friction force from the brakes does work. Energy is transferred from the car's kinetic store to the thermal store of its brakes, the brakes then transfer heat to the surroundings.

Energy transferred = work done

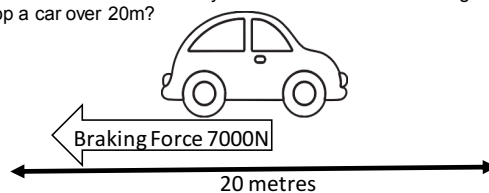
work done (J) = force (N) x distance (m)

$$W = Fs$$

Unit conversions:

kJ to J: x 1000
cm to m: ÷ 100
km to m: x 1000

Example: How much work is done by the brakes if a 7000N braking force is used to stop a car over 20m?

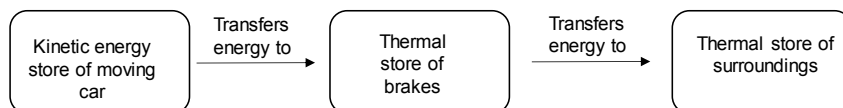


Use the EVERY model to complete calculations:

E = equation
V = values
E = enter results
R = result
Y = units

E	$W = F \times s$
V	$F = 7000 \text{ N}$ and $s = 20 \text{ m}$
E	$W = 7000 \times 20$
R	$W = 140\,000$
Y	J

$W = 140\,000 \text{ J}$ or 140 kJ



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48. Gravitational Potential Store (E_p)

Raising an object off the ground increases its gravitational potential energy store.

The amount of energy depends on the mass and height of the object and strength of the gravitational field it is in.

Gravitational potential energy store (J) = mass (kg) x gravitational field strength (N/kg) x change in height (m)

$$E_p = mgh$$

Unit conversions:

kJ to J: x 1000
cm to m: ÷ 100
km to m: x 1000
g to kg: ÷ 1000

Note: weight = mass x gravitational field strength

$$W = m \times g$$

Therefore, we have a second formula for E_p

$$E_p = \text{Weight} \times \text{change in height}$$

$$E_p = W \times \Delta h$$

Example: What is the gravitational energy required to lift a 100 kg mass up by 100 m?

Gravitational field strength = 9.81 N/kg

Use the EVERY model to complete calculations:

E = equation

V = values

E = enter results

R = result

Y = units

$$E \quad E_p = m \times g \times h$$

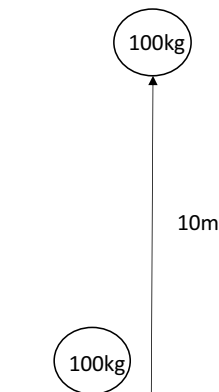
$$V \quad m = 100 \text{ kg}; g = 9.81; h = 100 \text{ m}$$

$$E \quad E_p = 100 \times 9.81 \times 100$$

$$R \quad E_p = 98100$$

$$Y \quad J$$

$$E_p = 98100 \text{ J}$$



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49. Specific Heat Capacity (c) and Power

The amount of energy needed to raise the temperature of 1 kg of a substance by 1 °C.

Change in thermal energy (J) = mass (kg) x specific heat capacity (J/kg°C) x change in temperature (°C)

$$\Delta E = mc\Delta T$$

Unit conversions:

kJ to J: x 1000
g to kg: ÷ 1000

Example: How much energy is released into the surroundings when a cup of tea holding 250g of fluid cools from 90°C to 20°C? $c = 4200 \text{ J/kg°C}$

Use the EVERY model to complete calculations:

E = equation

V = values

E = enter results

R = result

Y = units

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

$$V \quad m = 250 \text{ g} = 0.25 \text{ kg}; c = 4200; \Delta \theta = 90 - 20 = 70$$

$$E \quad \Delta E = 0.25 \times 4200 \times 70$$

$$R \quad 73500$$

$$Y \quad J$$

$$\Delta E = 73500 \text{ J or } 73.5 \text{ kJ}$$

Power

Power is the rate at which energy is transferred and is measured in watts.

1 watt = 1 joule of energy transferred per second.

$$\text{Power (W)} = \text{energy transferred (J)} \div \text{time (s)}$$

$$\text{Power (W)} = \text{work done (J)} \div \text{time (s)}$$

$$P = E \div t$$

Unit conversions:

kJ to J: x 1000

minutes to seconds: x 60

hours to seconds: x 3600

W to kW: ÷ 1000

Example. Calculate the power of a motor that uses 60,000 J of energy to lift an object in 20 seconds. Give your answer in kW.

$$E \quad P = E \div t$$

$$V \quad E = 60000 \text{ J}; t = 20 \text{ s}$$

$$E \quad P = 60000 \div 20$$

$$R \quad 3000$$

$$Y \quad W$$

$$P = 3000 \text{ W or } 3 \text{ kW}$$

A more powerful device can transfer more energy in a given time or will transfer the same amount of energy in a faster time.

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50. Conservation of Energy

Dissipation of energy	Wasting energy. More energy needs to be put into appliance to account for dissipated energy. Useful dissipation of energy example: back of a fridge Example of dissipation of energy is bad: light bulbs, engines and TV's as heat
Conservation of energy	Energy can be transferred usefully, stored or dissipated, but it cannot be created or destroyed
Heat	When an object is heated, thermal energy is being transferred to it
Temperature	A measure of hot or cold something is

Reducing Wasted Energy (dissipated energy)

Friction	Between two moving objects causes thermal energy to be dissipated. It can be reduced by lubrication.
Lubrication	Friction between two moving objects causes energy to be dissipated as sound and to the thermal store.
Insulation	Reduces energy transfer by heating
Cavity wall insulation	Fills the air gap between the inner and outer wall reducing heat loss by convection.
Loft insulation	Reduces heat loss by convection.
Double glazing	- Creates an air gap between the two panes of glass to reduce energy loss by conduction. - Gases are good insulators
Draught excluders	Reduce energy loss by convection when placed around windows and doors.
Reflective material behind radiators	To keep infrared radiation in the room

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51. Efficiency

Appliance	Useful Energy	Dissipated (wasted) Energy
Light bulb	Light	Heating the bulb and surroundings
Hair Dryer	- Kinetic energy of the fan to push air - Heating of the air	- Sound of the motor. - Heating of the dryer and surroundings
Electric Motor	- Kinetic energy of objects driven by motor. - Gravitational potential energy of objects lifted by motor	- Heating of the motor and surroundings. - Sound of the motor turning

Efficiency

An efficient device wastes less energy than a less efficient device. It can be calculated as a decimal or multiplied by 100 to give a percentage.

$$\text{Efficiency} = \frac{\text{useful energy output}}{\text{total energy output}}$$

$$\text{Efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

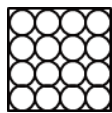
Example:. Calculate the wasted power and efficiency of a motor that has a rated power of 500W and transfers 300W usefully.

Wasted power = input power - output power = 500 – 300 = 200W

$$\text{Efficiency} = \frac{300}{500} = 0.6 \text{ Or } 60\%$$

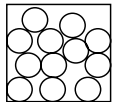
51

52. Methods of Heat Transfer Overview



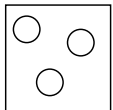
Solids

Have **strong forces** between particles or molecules, holding them close together in a **fixed, regular** arrangement. The particles can only vibrate around fixed positions.



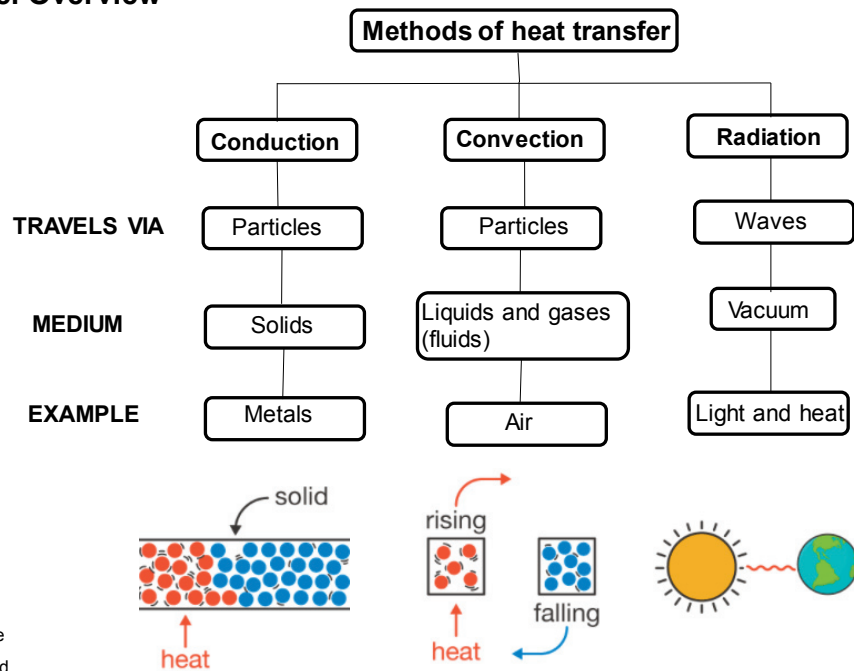
Liquids

Have **weaker forces** between particles so although the particles are close together they can **flow** over each other at low speeds in random directions.



Gases

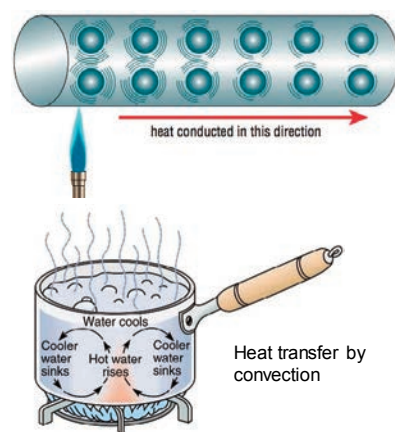
Have almost **no forces** between particles. Have **more energy** and are **free to move** in random directions and speeds.



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53. Methods of Heat Transfer

Heat Transfer Method	Description
Conduction (Occurs in solids)	When heated particles vibrate more with an increase in their kinetic energy. They collide more with surrounding particles transferring the heat
Convection (Occurs in liquids and gases)	Particles are free to move (in a liquid and gas). Increase in their kinetic store. Particles move faster. The space between the particles increases, so the density decreases. The warmer less dense region rises and the cooler, denser regions sink.
Infrared Radiation (Occurs in all objects)	The hotter an object the more infrared radiation it emits in a given time. An object at constant temperature emits and absorbs infrared radiation at the same rate A perfect black body absorbs all the infrared radiation that falls upon it and then emits it back at the same rate as it absorbs it.



Heat transfer by convection

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54. Non-Renewable Energy Resources

Renewable energy resources will never run out. It is an energy resource that can be replenished quickly.

Non-renewable resources will one day run out (fossil fuels). Fossil fuels are coal, oil and natural gas.

Energy Resource	Uses	Advantages	Disadvantages
Coal	Electricity generation, heating, steam trains in some countries	- Reliable energy resource - Low extraction costs - High energy per kg	All fossil fuels are running out. Burning fossil fuels releases carbon dioxide a greenhouse gas which causes global warming. SO ₂ found in coal leads to acid rain when burned.
Oil	Electricity generation, heating, basis for petrol and diesel	- Reliable energy resource - Low extraction costs - High energy per kg	Burning fossil fuels releases carbon dioxide a greenhouse gas which causes global warming.
Gas	Electricity generation, heating, cooking	- Reliable energy resource - Gas fired power stations can be started quickly to meet changing energy demands	Burning fossil fuels releases carbon dioxide a greenhouse gas which causes global warming.
Nuclear	Electricity generation Fuel: Uranium or plutonium	- Reliable energy resource - It has the highest energy density per kg of any fuel. - Does not require combustion and therefore does not release carbon dioxide into the atmosphere	The waste products from nuclear plants is dangerous radioactive waste which needs to be stored safely for hundreds of years.

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55. Renewable Energy Resources 1

Energy Resource	Uses	Advantages	Disadvantages
Solar Energy	- Heating domestic hot water. - Photovoltaic cells in solar cells can create electricity to charge batteries. - Electricity generation in large scale solar power plants	- No atmospheric pollution due to burning of fossil fuels - In sunny countries it is more reliable (during the day) - Useful for remote places not supplied by the national grid. - No fuel costs and minimal running costs	- Cannot increase supply to match demand - High initial costs - Unreliable due to weather - Does not work at night
Wind Power	Electricity generation	- No atmospheric pollution due to burning of fossil fuels - No fuel costs and minimal running costs - No permanent damage to the landscape when removed. - Fast start-up	- Visual and noise pollution - Cannot increase supply to match demand - High initial costs - Cannot generate electricity if there is too little wind - Unreliable
Geothermal	- Electricity generation - Heating	- Reliable - No atmospheric pollution due to burning of fossil fuels	- Few suitable locations (only possible in volcanic areas) - High cost to build power station
Bio-fuels	- Electricity generation - Heating - Fuel for transport	- Carbon neutral (plants absorb carbon dioxide that is released when the fuel is burnt). - Reliable as crops grow quickly	- High costs to refine the fuel - Space for growing food taken up - Forests cleared to make space – decay and burned vegetation release CO₂ and methane.

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56. Renewable Energy Resources 2

Energy Resource	Uses	Advantages	Disadvantages
Hydro-Electric	Electricity generation	- Can respond immediately to increased demand, fast start-up. - Reliable (except if there is a drought) - No fuel costs and minimal running costs - Potential to be used as part of pumped storage scheme	- Requires land to be flooded to create a dammed reservoir - Loss of animal habitats - Relies on rainfall to keep reservoir full unless part of pumped storage system
Tidal barrage	Electricity generation	- No atmospheric pollution due to burning of fossil fuels - No fuel costs and minimal running costs	- Visual pollution - Difficulty providing access for boats / wildlife - Initial costs are high - Environmental impact during building phase due to multiple vehicles and large amounts of concrete being used
Wave power	Electricity generation	- No atmospheric pollution due to burning of fossil fuels - Smaller solution for limited populations	- Unreliable - Few suitable locations

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57. Wave properties

Mechanical Waves travel through a medium (substance).

The particles oscillate (vibrate) and transfer energy.

The particles do not travel along in the wave.

Frequency (f) - the number of complete waves that pass a point every second.

1 wave per second has a frequency of 1Hz (hertz).

Time period (T) - the time for a complete cycle of a single wave.

Frequency (Hz) = 1 ÷ time period (s)

F = 1 ÷ T

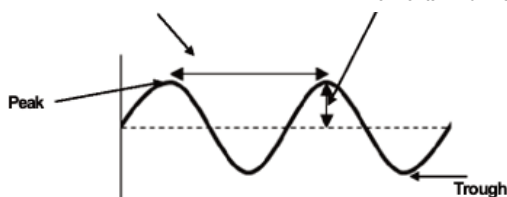
Example: What is the frequency for a wave with a time period of 0.2s

E $f = 1 \div T$
V $T = 0.2 \text{ s}$
E $f = 1 \div 0.2$
R 5
Y Hz

f = 5Hz

Wavelength - the distance between adjacent waves (i.e. from peak to peak or trough to trough)

Amplitude - the maximum displacement from the horizontal mid-line.



Wave speed (m/s) = frequency (Hz) x wavelength (m)

V = f λ

Example: How fast is a wave travelling which has a 3m wavelength and a frequency of 20Hz?

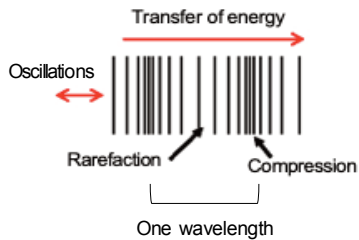
E $V = f \times \lambda$
V $f = 20 \text{ Hz}; \lambda = 3 \text{ m}$
E $V = 20 \times 3$
R $V = 60$
Y m/s

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58. Transverse and Longitudinal waves

Longitudinal Waves

The **oscillations** (vibrations causing the wave) are **parallel** to the direction of **energy transfer**.



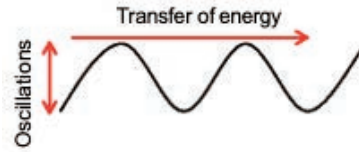
Compression: particles bunch up

Rarefaction: particles spread out

Example: Sound waves

Transverse Waves

The **oscillations** (vibrations causing the wave) are **perpendicular** (90°) to the direction of **energy transfer**.



Example: Light waves, X-rays and water waves (ripples)

All electromagnetic waves

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59. Sound Waves and Speed of Sound experiment

Sound waves are **mechanical longitudinal waves**.

They need a medium to travel through.

The speed of sound can be calculated using:

$$\text{Speed (m/s)} = \text{distance (m)} \div \text{time (s)}$$

Unit conversions:

km to m: $\times 1000$

cm to m: $\div 100$

minutes to seconds: $\times 60$

hours to seconds: $\times 3600$

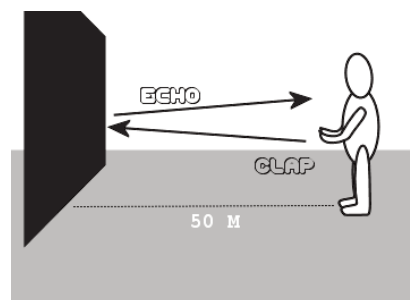
Speed of sound experiment

1. Measure the distance between the person and the wall using a metre ruler.
2. Double this distance.
3. Using a stop clock, measure the time taken from the clap being made to hearing its echo.
4. Use the equation,
$$\text{speed} = \text{distance} \div \text{time}.$$

Sound waves

Bigger the amplitude – taller the wave – louder the sound

Higher the frequency – more waves per second – higher pitch



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60. Sound and Seismic waves

Human hearing can detect sound in the frequency range of 20Hz to 20,000Hz.

Ultrasound > 20kHz

Infrasound < 20Hz

Ultrasound is used to detect the depth of the sea bed, where inclusions or other defects are found in solid metal and to image soft tissue in humans.

When ultrasound is used to measure the depth of an object, or the distance below a surface to a defect, the signal travels from the transducer to the object and is bounced back to the transducer. The total distance travelled by the sound is twice the depth of the object.

Depth of object (m) = 0.5 x speed of ultrasound (m/s) x time (s)

Seismic Wave type	Description
Primary (P-waves)	- Causes the initial Earth tremor - Longitudinal waves which push or pull on material. - Bend as they travel through the earth's mantle - Refract at boundary between mantle and core - Travels through solids and liquids
Secondary (S-waves)	- Transverse waves that travel more slowly than P-waves - Shake material from side-to-side. - Bend as they travel through the Earth's mantle - Cannot travel through liquid outer core - Travels through solids only
Long (L-waves)	- Arrive last and cause violent movements on the surface - Only happen in the Earth's crust.

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61. Reflection, transmission and absorption of waves

Reflection

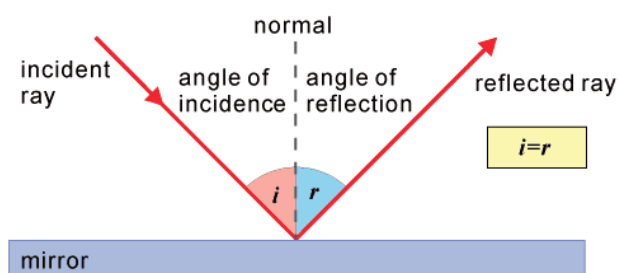
Angles are measured between the wave direction (ray) and a line at 90° to the mirror (boundary)

Normal = an imaginary line drawn at 90° to the surface

The angle of the wave approaching the boundary is called the angle of incidence (i)

The angle of the wave leaving the boundary is called the angle of reflection (r)

Angle of incidence (i) = Angle of reflection (r)



Absorption

Occurs when energy is transferred from the wave into the particles of a substance

Sound waves are absorbed by brick or concrete in houses

Light will be absorbed if the frequency of light matches the energy levels of the electrons

If an object appears red, only red light has been reflected. All the other frequencies of visible light have been absorbed

Transmission

Transmission occurs when a wave passes through a substance

The more transparent the material, the more light will pass through

For the process to count as transmission, the wave must pass through the material and emerge from the other side

When passing through a material, waves are usually partially absorbed

The transmitted wave may have a lower amplitude because of some absorption

For example, sound waves are quieter after they pass through a wall

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62. Refraction of waves

Refraction

Waves change speed when they cross a **boundary** between two materials of different density or a boundary of different depths.

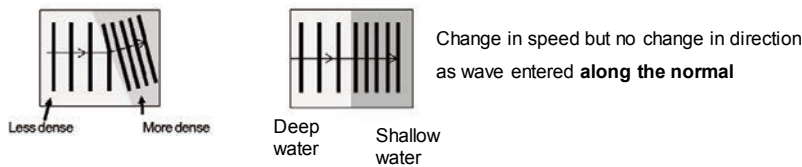
If the wave enters a medium of higher **density** at an **angle** the ray bends towards the normal (see diagram).

If it enters a medium **along the normal** then the wave does not change direction but the **wavelength** and **speed decrease**.

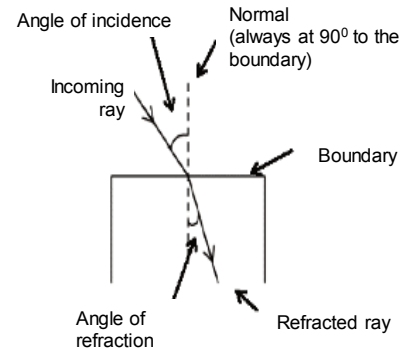
(waves closer together on diagram below but have not changed direction)

Wave Front Diagrams

The part of the wave front that enters the more dense medium first, slows down as the rest of the wave front continues at the same speed but has to travel further. The difference in distance and speed causes the wave to refract. A wave travelling from deep to shallow water also refracts.



Refraction of Light ray



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63. Space

Keyword	Description
Asteroid	A lump of rock (may or may not be orbiting anything)
Comet	A ball of ice, dust and gas orbiting a star in an elliptical orbit
Galaxy	A group of billions of stars. Earth is in the Milky Way galaxy
Meteor	A small piece of rocky matter entering Earth's atmosphere from space
Moon	A sphere of rock orbiting a planet
Planet	A sphere of rock or gas orbiting a star
Red Shift	Objects which are moving away from us are said to be red shifted because the wavelengths of light from these objects is shifted towards the red end of the spectrum. Hubble determined that the most distant galaxies are those most red shifted, meaning they are accelerating away from us. This supports the big bang theory.
Satellite	An object which orbits another. Natural (moon) or man-made (space station). They travel at a constant speed. Their orbit is determined by their speed.
Star	A sphere of (mainly) hydrogen carrying out nuclear fusion, producing heat and light
Universe	Everything that exists. Contains billions of galaxies

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64. Star formation

Process of star formation: nuclear fusion

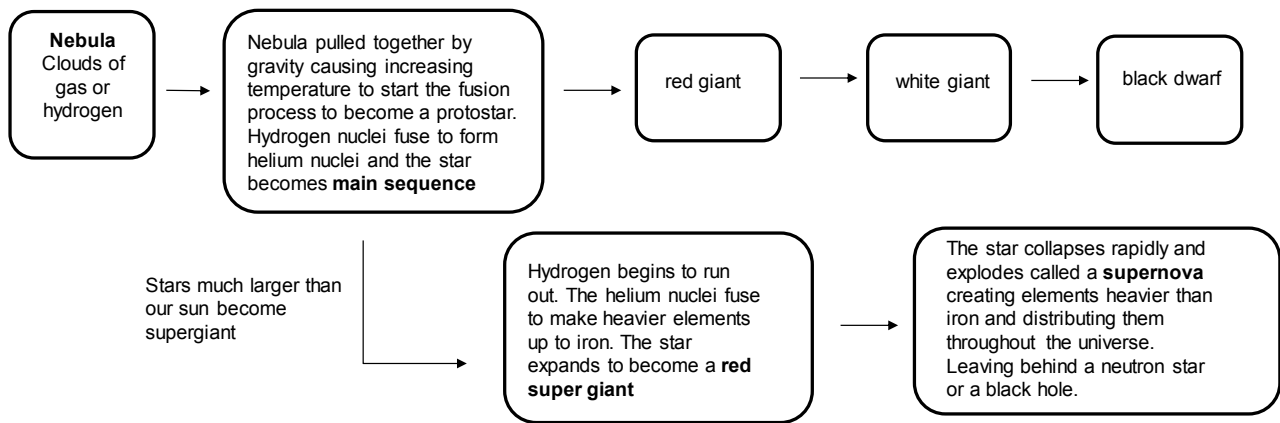
Main fuel source: Hydrogen

The Sun is a stable star. This is because the forces pulling inwards caused by gravity are in equilibrium with the forces pushing outwards caused by the energy released by nuclear fusion.

Range of wavelengths of a star depend on the temperature of the star.

A light year is the distance that light travels in a year

The life cycle of a star



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65. Creation of the Universe

Much is still unknown about the universe and galaxies spin faster than they should based on the amount of mass in them. Scientist think that the missing mass is made up of something they have named **dark matter**.

The universe is not only expanding but accelerating in its expansion. Scientists think that **dark energy** is responsible for this acceleration but like **dark matter** they have no idea what **dark energy** is.

The universe could either end in a **big crunch** where the rapid expansion stops and a rapid contraction occurs or it could expand for ever in what is called the **big yawn**.

Mid 20 th Century theories for the creation of the universe	Key points
Stay State Theory	Universe expands with a constant density, white holes leak matter into the universe to maintain the density as volume increases. Dropped after the discovery of cosmic microwave background radiation (CMBR)
Big Bang Theory	Universe expanded from an extremely small, hot, dense region creating space, time and matter

65

66. Required practical 1: Specific Heat Capacity

Method

1. Take a 1 kg block of copper.
2. Place an immersion heater in the larger hole in the block.
3. Connect the power supply to the joule meter (reset to read 0 Joules).
4. Connect the joule meter to the 12V immersion heater.
5. Place the thermometer into the other hole in the block.
6. Switch the power pack to 12 V. Turn it on.
7. After 1-minute record the temperature of the block and the reading from the joule meter.
8. Continue taking readings every minute until 10 minutes have passed.

IV - Work done – (energy transferred to block measured by joulemeter)

DV - temperature

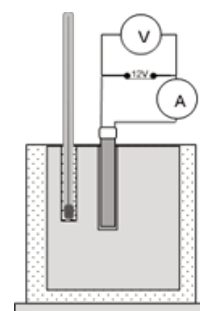
CV – Copper block of 1kg mass

Sources of Error

Heat is lost to the surroundings due to lack of insulation

The immersion heater is not fully immersed into the block

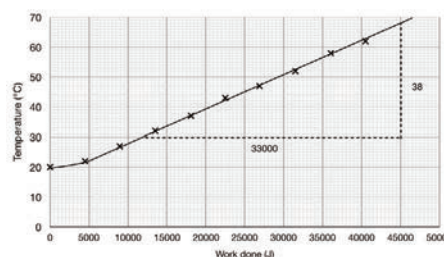
The graph may be curved at the start because it takes time for the heater and block to transfer the energy



Processing data

Plot graph work done against temperature

Specific heat capacity = $1 \div \text{gradient}$



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67. Required Practical 2: Thermal Insulation

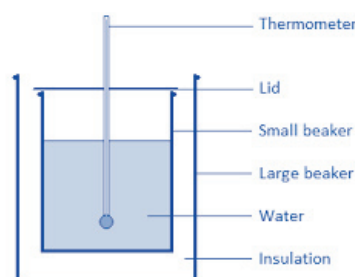
Method

1. Pour 200 cm³ of hot water into a 250 ml beaker with a single layer of insulating material around it.
2. Use a piece of cardboard as a lid for the beaker.
3. Insert the thermometer through the hole in the cardboard lid
4. Record the temperature of the water and start the stopwatch.
5. Record the temperature of the water every 30 seconds for 5 minutes.
6. Repeat steps 1–5 increasing the number of layers of insulating material wrapped around the beaker until you reach 4 layers.
7. Repeat the experiment with no insulation around the beaker.
7. Plot a graph of temperature versus time.

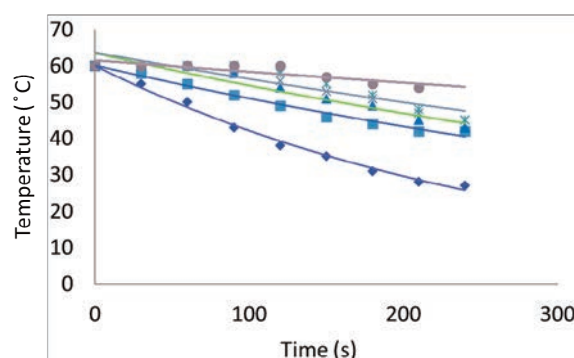
IV – Time (s)

DV – Temperature change

CV – Volume of water, material of insulation, starting temperature.



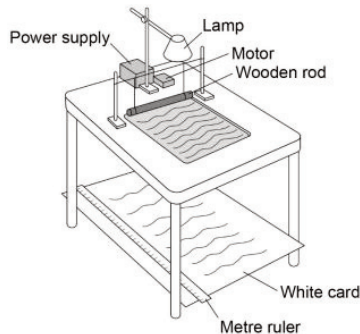
The more layers of insulation the longer it takes for the temperature to drop, indicating a better insulator.



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68. Required practical 3: Speed of water waves

1. Set up the ripple tank as shown in the diagram.
2. Make sure that there is a large sheet of white card or paper on the floor under the tank.
3. Pour water to a depth of about 5 mm into the tank.
4. Adjust the height of the wooden rod so that it just touches the surface of the water.
5. Switch on the overhead lamp and the electric motor.
6. Adjust the speed of the motor to produce low frequency water waves.
7. Adjust the height of the lamp so that the pattern of the waves can be clearly seen on the white card.



How to find the frequency of a wave using a ripple tank: count the number of ripples that pass a point in 10 seconds. Divide the number of waves by 10.

How to measure the wavelength: measure the distance across 10 gaps between the shadow lines. Divide this distance by 10.

How to calculate the speed of the wave

Wave speed (m/s) = frequency (Hz) x wavelength (m)

How to improve the method of calculating the wavelength:

Take a photo of the shadows and the ruler.

Benefit is that the waves are not being disturbed.

Reasons for using a:

Lamp: create shadows of the ripples

Metre ruler: measure the distance between 10 waves.

Signal generator: The vibration generator can have a built in signal generator so that you can directly set the frequency of paddle oscillation i.e. frequency of the ripple waves.

Deeper water means longer wavelength because velocity increases and frequency is constant

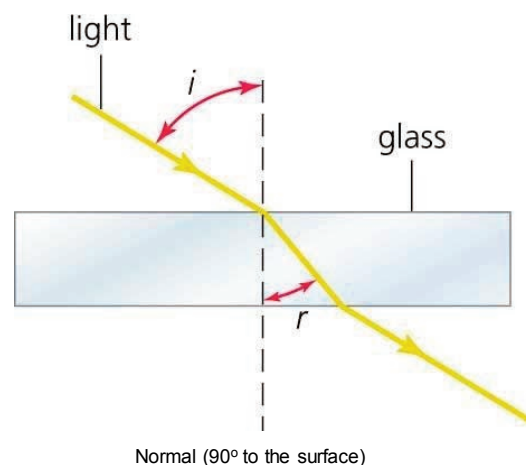
68

69. Required practical 4: Refraction of light

1. Place a glass block on a piece of paper
2. Draw around the glass block and then remove from the paper
3. Draw a line at 90° to one side of the block (the normal)
4. Use a protractor to measure and then draw a line at an angle of 20° to the normal
5. Replace the glass block
6. Using a ray box and slit point the ray of light down the drawn line
7. Mark the ray of light emerging from the block
8. Remove the block and draw in the refracted ray
9. Measure the angle of refraction with a protractor
10. Repeat the procedure for a range of values of the angle of incidence

Source of inaccuracy: The width of the light ray

Reason for inaccuracy: Makes it difficult to judge where the centre of the ray causes a large uncertainty



69

70. Maths in Science 1

Anomalous result	A number that does not fit the pattern
Mean	Adding up a list of numbers and dividing by how many numbers are in the list. Exclude the anomalous result.
Median	The middle value when a list of numbers is put in order from smallest to largest
Mode	The most common value in a list of numbers. If two values are tied then there are two modes. If more than two values are tied then there is no mode.
Range	The largest number take away the smallest value in a set of data or written as X-Y.
Uncertainty	range $\div$ 2
Surface area of a cube	(area of 1 side) $\times$ 6 sides
Volume of a cube	Width $\times$ height $\times$ depth
Area of a circle	$\pi \times (\text{radius})^2$

Prefixes

$$1 \text{ kJ} = 1 \times 10^3 \text{ J} = 1000 \text{ J}$$

$$1 \text{ pm} = 1 \times 10^{-12} \text{ m}$$

$$1 \text{ mm} = 1 \times 10^{-3} \text{ m} = 0.001 \text{ m}$$

kilo	10^3
centi	10^{-2}
milli	10^{-3}
micro	10^{-6}
nano	10^{-9}
pico	10^{-12}

5607.376

Standard form: 5.607×10^3

2 decimal places: 5607.38

3 significant figures: 5610

0.03581

Standard form: 3.581×10^{-2}

2 decimal places: 0.04

3 significant figures: 0.0358

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71. Maths in Science 2

Calculating percentage: (part $\div$ whole) $\times$ 100

e.g. Out of 90 insects, 40 of them were ladybirds. What is the % of ladybirds?

$$(40 \div 90) \times 100 = 44\%$$

Calculating percentage change:

$$(\text{difference} \div \text{starting value}) \times 100$$

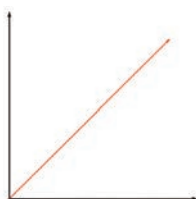
$$(0.59 \div 2.22) \times 100 = 26.6\%$$

Conc of Sucrose (M)	Mass of potato at start (g)	Mass of potato at end (g)	Change in mass (g)
0	2.22	2.81	0.59

Graphs

Proportional (α)

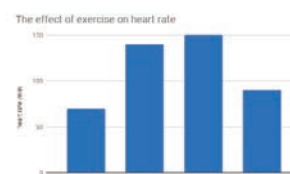
When the line passes through the origin



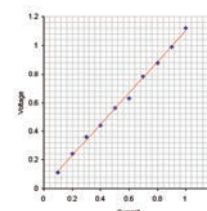
x axis = independent variable = left hand column of results table

y axis = dependent variable = right hand column of results table

Categorical data: data put into groups e.g. colour of eyes
Draw a bar chart

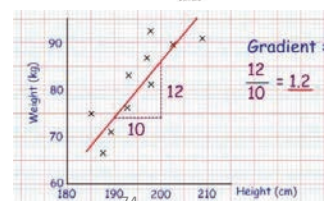


Continuous data: data that can take any value e.g. current
Draw a line graph



Gradient and Graphs

$$\text{Gradient} = \frac{\text{Change in } y}{\text{Change in } x}$$



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kinetic energy = $0.5 \times \text{mass} \times (\text{speed})^2$	$E_k = \frac{1}{2} m v^2$
elastic potential energy = $0.5 \times \text{spring constant} \times (\text{extension})^2$	$E_e = \frac{1}{2} k e^2$
gravitational potential energy = mass $\times$ gravitational field strength $\times$ height	$E_p = m g h$
change in thermal energy = mass $\times$ specific heat capacity $\times$ temperature change	$\Delta E = m c \Delta \theta$
power = $\frac{\text{energy transferred}}{\text{time}}$	$P = \frac{E}{t}$
power = $\frac{\text{work done}}{\text{time}}$	$P = \frac{W}{t}$
efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$	
efficiency = $\frac{\text{useful power output}}{\text{total power input}}$	
charge flow = current $\times$ time	$Q = I t$
potential difference = current $\times$ resistance	$V = I R$
power = potential difference $\times$ current	$P = V I$
power = (current) ² $\times$ resistance	$P = I^2 R$

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energy transferred = power $\times$ time	$E = P t$
energy transferred = charge flow $\times$ potential difference	$E = Q V$
density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$
thermal energy for a change of state = mass $\times$ specific latent heat	$E = m L$
For gases: pressure $\times$ volume = constant	$p V = \text{constant}$
weight = mass $\times$ gravitational field strength	$W = m g$
work done = force $\times$ distance (along the line of action of the force)	$W = F s$
force = spring constant $\times$ extension	$F = k e$
moment of a force = force $\times$ distance (normal to direction of force)	$M = F d$
pressure = $\frac{\text{force normal to a surface}}{\text{area of that surface}}$	$p = \frac{F}{A}$
pressure due to a column of liquid = height of column $\times$ density of liquid $\times$ gravitational field strength	$p = h \rho g$

HT

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	distance travelled = speed $\times$ time	$s = v t$
	acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$	$a = \frac{\Delta v}{t}$
	(final velocity) ² – (initial velocity) ² = 2 $\times$ acceleration $\times$ distance	$v^2 - u^2 = 2 a s$
	resultant force = mass $\times$ acceleration	$F = m a$
HT	momentum = mass $\times$ velocity	$p = m v$
HT	force = $\frac{\text{change in momentum}}{\text{time taken}}$	$F = \frac{m \Delta v}{\Delta t}$
	period = $\frac{1}{\text{frequency}}$	$T = \frac{1}{f}$
	wave speed = frequency $\times$ wavelength	$v = f \lambda$
	magnification = $\frac{\text{image height}}{\text{object height}}$	
HT	force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density $\times$ current $\times$ length	$F = B I l$
HT	$\frac{\text{potential difference across primary coil}}{\text{potential difference across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$	$\frac{V_p}{V_s} = \frac{n_p}{n_s}$
HT	potential difference across primary coil $\times$ current in primary coil = potential difference across secondary coil $\times$ current in secondary coil	$V_p I_p = V_s I_s$

[illegible]

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.



INDEPENDENCE: DIAGNOSIS – THERAPY – TEST

NAME: CLASS:

TOPIC:

DIAGNOSIS: The thing I don't understand

THERAPY: Where am I going to learn about this?

Which of the templates will I use to transform the information?

TEST: 5 questions someone can ask me about my new understanding.



INDEPENDENCE: DIAGNOSE

NAME: CLASS:

SUBJECT:

Be clear about what you know and what you don't know before you begin.

First, use a contents page or a topic list for the subject you are going to revise.

Then, fill in the following table – the topics, and how well you know them.

Next, prioritise. Which topics will you revise first? Spend time studying the topics which will make the biggest difference to your results.

Topic	Knowledge	Priority
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	
	Know it/Sort of know it/Don't know it	

Finally, use the **diagnosis – therapy – test** worksheet to plan your independent study.



INDEPENDENCE: PRIORITISE, REDUCE, CATEGORISE, EXTEND

NAME:	CLASS:
TOPIC:	

Take a section of text and do the following:

Prioritise: write out the three most important sentences. Rank 1-3 in terms of importance. Justify your decision.
Reduce: reduce the key information to 20 words.
Categorise: sort out the information into three categories. Give each category a title which sums up the information.
Extend: write down three questions you would like to ask an expert in this subject.



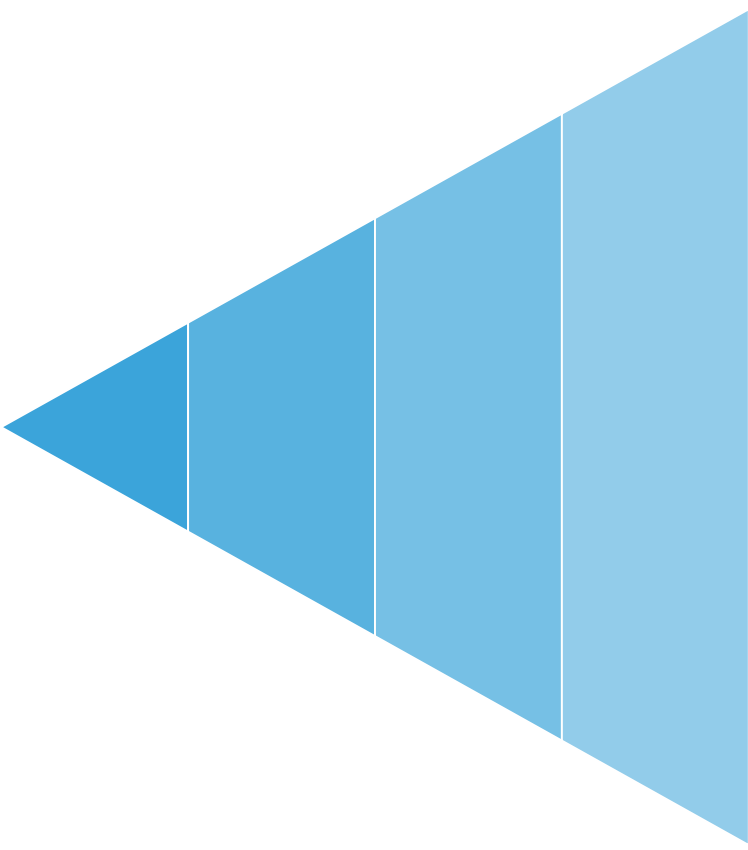
INDEPENDENCE: RANKING TRIANGLE

NAME:	CLASS:
TOPIC:	

The most important information goes at the top.

The least important information goes at the bottom.

Justify WHY. Why is it the most important? Why is it the least important?





INDEPENDENCE: QUIZZING

NAME: CLASS:

TOPIC:

Read the text and transform it into 10 questions to ask someone.

Question	Answer
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Question stems:

State...

Explain...

Suggest...

Describe...

Evaluate...

Compare...



INDEPENDENCE: BOXING UP

NAME: CLASS:

TOPIC:

Take a section of text. Read it and put your thoughts about the text into different boxes.

Needs a boost: 3 things I did not know:	
Almost there: 3 things I understand better now:	
I've got these: 3 things I already knew:	



INDEPENDENCE: OTHER IDEAS

Steps → flow chart Transform a sequence of steps into a flow chart or a diagram.

Flow chart → steps Transform a flow chart or a diagram into a sequence of steps.

Look, cover, write, check Cover a list of key words. Write them down. Check which ones you have got right. Repeat until you get them all right.

Link key words Take three words from a topic. Link them together in a sentence or a diagram. Repeat until all the key words have been linked.



INDEPENDENCE: Pictionary

NAME:

CLASS:

TOPIC:

Transform the material into 6 pictures – one per paragraph or one per key piece of information. The pictures should represent the information so that they can act as a reminder of what the text said. Underneath each picture, explain your thinking.

1.	2.	3.

4.	5.	6.

