Year 10 Knowledge Organiser

Core

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Table of Contents

ENGLISH

English – Year 10 – HT1 – An Inspector Calls (Part 1)

Summary- Position in the Curriculum

Set in 1912 but written in 1945, *An Inspector Calls* opens with the Birling family celebrating the engagement of their daughter, Sheila, to Gerald Croft. The father, Arthur Birling, makes a series of speeches outlining his views on the marriage and also his views on social responsibility. Birling is interrupted by the arrival of Inspector Goole, who reveals that a girl has committed suicide that afternoon by drinking disinfectant. This girl is Eva Smith. The Inspector has a photograph and a diary from Eva. Inspector Goole interrogates the characters and we learn that Eva Smith used to work for Birling before being sacked after taking part in strike action. She then was employed at a shop called Milwards, but she lost that job after a customer (who we find out was Sheila) complained about her. Eva Smith changed her name to Daisy Renton and became Gerald's lover, but the affair came to an end.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Capitalism	A system whereby trade and industry are controlled by private owners for profit.	J.B. Priestley was ideologically **Left Wing** and was interested in the experiences of the **working classes** – he wrote a travelogue about the life of working classes during the Great Depression.	1. *What are the differences between Left Wing and Right Wing political ideologies?*
Socialism	A system whereby the means of production and distribution are owned by the state / community.	The play is set in 1912 but was written in 1945. During that period there were two **World Wars** and the **Beveridge report**, which outlined what was needed to rid poverty from Britain.	2. *What do Arthur Birling's opening speeches show about his character and his views on social responsibility – and how does he use language to persuade?*
Responsibility	Being answerable or accountable for something within your power.	As an upper-middle-class man in 1912, **Arthur Birling** would have had significant power and influence. He is a man who cares about his social position and demonstrating his power.	3. *In what ways are Arthur Birling and the Inspector initially contrasted? How does Arthur Birling try to intimidate the Inspector? How does the Inspector speak to the family?*
Dramatic Irony	The situation when an audience of a play know something that the characters do not.	Although **Sheila Birling** seems immature and selfish at the beginning of the play, she does demonstrate empathy for factory workers and expresses remorse for her actions.	4. *What did Arthur Birling do to Eva Smith and why? How does his behaviour reveal his Capitalist ideology? Does he express any remorse?*
Remorse	Deep regret coming from a sense of guilt at past wrongs.	**Gerald Croft** is involved in his father's business and shares some of the values of Birling –his marriage to Sheila seems like an advantageous business opportunity for Mr Birling.	5. *What are your first impression of Sheila? How does she react to the news of Eva Smiths' death? What was her role and how does she react when she realises this?*

Key Quotations: *'I speak as a hard-headed business man'* (Birling) * *'and every luxury – and unsinkable, absolutely unsinkable'* (Birling) * *'as if we're all mixed up together like bees in a hive – community and all that nonsense'* (Birling) * *'Well it's my duty to keep labour costs down'* (Birling) * *'We let them all come back – at the old rates – except the four or five ringleaders'* (Birling) * *'But these girls aren't cheap labour – they're people'* (Sheila) * *'Old Joe Meggarty, half drunk and goggle-eyed, had wedged her into a corner with that obscene fat carcase of his'* (Gerald) * *'She looked young and fresh and all together out of place'* (Gerald) * *'You were the wonderful Fairy Prince'* (Sheila) *'She was young and pretty and warm-hearted – and intensely grateful* (Gerald) **'Your daughter isn't living on the moon.'* (Inspector)

Arthur Birling	Sheila Birling	Gerald Croft	Karl Marx	J.B. Priestley
				

English – Year 10 – HT2 – An Inspector Calls (Part 2)

Summary- Position in the Curriculum

The Inspector now turns his attention to Mrs Birling, who we learn volunteers at the Brumley Women's Charity Organisation. It is supposed to support women in distress, but when Eva Smith arrives under the name Mrs Birling and reveals that she is pregnant and alone, she is treated with contempt and snobbery from Sybil Birling - and any charity is refused. The father of the chid was of a higher social class and was wild – and through foreshadowing it becomes clear to all but Sybil that Eric is the father. Eric returns and makes his confession: he was drunk, aggressive and forced himself on Eva Smith. He later stole money but she refused to take it. When Eric realises his mother's role, he again becomes aggressive. Inspector Goole makes a speech about social responsibility and then departs. Gerald returns and questions the authenticity of the Inspector and Eva, leaving the family thinking there has been a hoax – until a final twist!

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Snobbery	A unattractive belief that you are inherently better than others due to your social class.	Sheila develops as an **Everyman** character, learning the **moral message** about social responsibility from the Inspector and Priestley.	1. *How is Sybil Birling presented during her 'confession'? How do we know that she is a prejudiced and dishonest character? Can we understand her behaviour at all?*
Condescend	Acting in a superior way and patronising others.	J.B Priestley read books and attended lectures about **time travel**, which could support one reading of the **mysterious ending** of the play.	2. *In what ways could Eric's treatment of Eva Smith / Daisy Renton be said to be the most problematic of all the characters in the play?*
Hoax	A trick or deception.	**Sybil Birling** is a dishonest snob who is **prejudiced** and believes that working class people lack integrity. Whilst she learns some things about family, she learns little about social responsibility.	3. *What is the message of Inspector Goole's parting speech and how does he use language to persuade? How does his speech contrast with Arthur Birling's speeches?*
Foreshadowing	Advance hints or clues of what is to come later in the story.	**Eric Birling** is awkward and embarrassed and a heavy drinker. He is aggressive and forceful. However, he **accepts responsibility** and is appalled by his parent's refusal to do so.	4. *When the Inspector has departed, why do they doubt him and Eva Smith? What evidence do they have? Who leads the investigation in to his identity?*
Everyman Character	In a morality play, a character who learns the moral message – in this case social responsibility.	We never meet **Eva Smith**, but learn about her through others. She represents the **working class female** experience in 1912 and her **class and gender disenfranchisement**.	5. *Which characters seem most changed due to this experience? How do the different generations react when they think the Inspector might not be real?*

Key Quotations: *'You admit being prejudiced against her case?'* (Inspector Goole) * *'She was giving herself ridiculous airs'* (Sybil Birling) * *'As if a girl of that sort would ever refuse money'* (Sybil Birling) * *'I was in that state when a chap easily turns nasty – and I threatened to make a row'* (Eric) * *'Because you're not the kind of father a chap could go to when he's in trouble'* (Eric) * *'We don't live alone. We are members of one body. We are responsible for each other'* (Inspector Goole) * *'They will be taught it in fire and blood and anguish'* (Inspector Goole) * [bitterly] *'I suppose we're all nice people now'* (Sheila) * *'The famous younger generation who know it all – and they can't even take a joke.'* (Birling)

Sybil Birling	Eric Birling	Eva Smith	Staging	Morality Play
				

English – Year 10 – HT3 – Jekyll and Hyde (Part 1)

Summary- Position in the Curriculum

Written in 1886 by Robert Louis Stevenson, the novel opens with Utterson taking his Sunday walk with friend Enfield. In a well-kept street they stumble upon a derelict doorway, which prompts Enfield to tell a story. Late at night he had seen a man trample a small girl. There was something very disturbing about the man and Enfield gives his name as Hyde. Later Utterson reads over his friend Jekyll's will. It says if he dies or disappears all his possessions will go to Hyde. Disturbed, Utterson visits Dr Lanyon, who says he no longer speaks to Jekyll. After troubled dreams, Utterson decides to meet Hyde for himself. He finds him repellent. Utterson visits Jekyll, who does not want to discuss Hyde or the will. A year later, the murder of Danvers Carew is told through the story of a maid who witnessed it. Half a broken cane and a letter to Utterson were found near the body. Utterson and Newcomen (the police officer) search Hyde's rooms. They find burned papers, the other part of the cane and a burned cheque book. At the bank they find Hyde has several thousand pounds.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Victorian Gothic	A style of writing that includes psychological terror, mystery, the supernatural and doubles.	Utterson is the **narrative focaliser**. He seems a reliable choice as he is a lawyer and a **Victorian Gentleman** – but he has **dual sides** to his personality, including curiosity and imagination.	1. *How does Stevenson present the theme of duality in Chapter One? How do we see duality in Utterson, his friendship with Enfield and the different settings?*
Duality	Having two conflicting, sides – for example, within a person.	Hyde is a strange, repugnant man who looks faintly pre-human. He is **violent** and **cruel** and anybody who sees him describes him as **ugly** and **deformed** – though no-one can say why.	2. *In Chapter Two Utterson has a nightmare. Which elements of the nightmare are based on Enfield's tale, and which does he invent himself?*
Atavism	A regression to more primitive life forms – almost the opposite of evolution.	**Evil** is personified in Hyde in the novel. He is entirely selfish, indulging in his own appetites without regard for others. Good is shown in the novel as being generous and kind.	3. *Utterson meets Hyde in Chapter Two. How does Stevenson use language to present a terrifying character in both Utterson and Enfield's descriptions?*
Victorian Gentleman	Was expected to behave in a certain way, repress their desires and be humble.	Jekyll is a **'good'** religious man and a 'good' friend when not under the influence of Hyde. Although he is a respected man, he has a mysterious past and mysterious will.	4. *What do we learn about the appearance and personality of Jekyll in Chapter Three? How does he react when Utterson tries to discuss Hyde?*
Narrative Focaliser	The character whose perspective the narrative follows.	**London** was a dirty, smoggy, dark and dangerous city at the time of writing. Sometimes covered in a brown fog from the factories of the **Industrial Revolution**. Riddled with **crime** which went largely unsolved by a relatively new and ineffective police force.	5. *What is the theory of atavism? How did scientists like Lombroso believe you could identify someone regressing? How do descriptions of Hyde during the murder of Carew suggest that he is regressing?*

Key Quotations:

*'lean, long, dusty, dreary and yet somehow loveable' * 'The door, which was equipped with neither bell nor knocker, was blistered and distained' * 'It was like some damned Juggernaut' * 'something displeasing, something down-right detestable' * 'such unscientific balderdash' * 'If he be Hyde,' he had thought, I shall be Mr Seek' * 'Mr Hyde shrank back with a hissing intake of breath' * 'Mr Hyde was pale and dwarfish' * 'with ape-like fury, he was trampling his victim underfoot and hailing down a storm of blows.'*

Victorian Gentleman	Atavism	Murder of Carew	Utterson	R.L. Stevenson
				

English – Year 10 – HT4 – Jekyll and Hyde (Part 2)

Summary- Position in the Curriculum

Utterson visits Jekyll and finds him pale with illness. Jekyll says he will have no more to do with Hyde, and gives Utterson a letter signed by Hyde. Utterson later shows it to his clerk, Guest, who notices that Jekyll and Hyde have very similar handwriting – Utterson wonders if Jekyll forged it. Hyde has gone missing, and for two months Jekyll returns to his old self and is sociable. He then refuses to see Utterson, so Utterson visits Dr Lanyon. Dr Lanyon is physically changed and is dying from shock, but he won't say what has caused this – but it is clear it is connected to Jekyll. He dies two weeks later but leaves a letter for Utterson, which he can only open when Jekyll disappears or dies. On another Sunday walk Utterson and Enfield see Jekyll at his window, but something strange happens to him. Poole visits Utterson and asks for help. Poole thinks Hyde has murdered Jekyll. Utterson breaks down the door to Jekyll's laboratory and finds the body of Hyde twitching in clothes too big for him. They can't find Jekyll. Jekyll has left a letter, which Utterson leaves to read. This letter, and the letter from Dr Lanyon, explain the mystery.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Repression	The restraint, prevention or inhibition of a feeling or thought or desire.	**Dr Lanyon** is a respected lawyer. He represents rationality, reason and science. He serves as a contrast to Jekyll's mysticism. His death represents the victory of the supernatural.	1. *How has Lanyon changed in Chapter 6? How does this description contrast with the description in Chapter 2?*
Restraint	A measure to keep an action or behaviour under control.	**Poole** is a working-class character but intensely loyal and discreet. Utterson tries to patronise Poole in Chapter 8, but Poole fights for his master.	2. *How does Stevenson use pathetic fallacy and Gothic conventions in the opening of the chapter 8? What mood is created?*
Subconscious	Existing in the mind but beyond or beneath consciousness.	In Victorian times, **Science** was exciting but people were terrified of the possibilities and concerned about the conflict with traditional religion.	3. *Create a timeline of events for Chapter 8? How does Utterson behave throughout – when meeting Poole and charging in to the room? How is Hyde described?*
Reputation	The beliefs or opinions that are generally held about someone.	Victorians were **religious** and feared what went on 'behind closed doors.' This included sexual desires and temptations. To maintain reputations, many Victorian **repressed** desires.	4. *In Chapter 9, How does Stevenson present science as something that is both terrifying and fascinating? How is language used to describe the transformation?*
Vice	Immoral or wicked behaviour	An **epistolary** novel is one that uses letters to tell the story. Stevenson uses many letters, which is a trope of Gothic fiction. Most of these letters are given to Utterson who hides them in his safe – he seems to withhold evidence!	5. *Summarise Chapter 10. Why did Jekyll begin his experiments? What obstacles did he face? What went wrong towards the end? What new information are we given?*

Key Quotations:

*'For more than two months the doctor was at peace' * 'He had his death-warrant written legibly upon his face. The rosy man had gown pale; his flesh had fallen away' * 'If I am the chief of sinners, I am the chief of sufferers also' * 'God forgive us, God forgive us' * 'Sir if that was my master, why had he a mask upon his face? If it was my master, why did he cry out like a rat?' * 'Your master, Poole, is plainly seized by one of those maladies that both torture and deform the sufferer' * 'I shall consider it my duty to break in that door' * 'for there before my eyes – pale and shaken, and half fainting, and groping before him with his hands, like a man restored from death – there stood Jekyll' * ''Man is not truly one, but truly two.'*

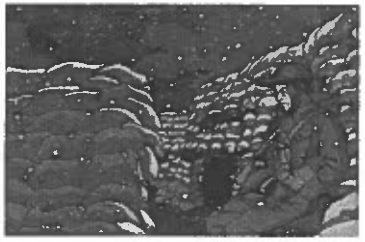
Epistolary	Dr Lanyon	Transformation	The Last Night	Science Laboratory
				

English – Year 10 – HT5 – Power and Conflict Poetry (Part 1)

Summary- Position in the Curriculum

A selection of the *Power and Conflict* poems for English Literature Paper 2, focusing on the following themes: reality of war / suffering / patriotism / nature / bravery / shame / childhood

Poem	Content	Context	Form, Language and Structure	Preparing for Assessment
Bayonet Charge *Ted Hughes*	An anonymous soldier is struggling on the battlefield. His previous feelings of **patriotism** are replaced with an overriding sense of fear.	Published in 1957 but most likely set in WWI. Draws a contrast between the idealism of patriotism and the reality of fighting and death.	The poem starts in **media res** to convey shock and pace - and **enjambment** maintains the momentum of the charge. Time stands still in the second stanza and there are **contrasts** between **visual** and **aural imagery** of battle with soldier's inner thoughts.	1. *What imagery does Hughes employ to convey the horrors of the battlefield and the loss of patriotism?*
Charge of the Light Brigade *Tennyson*	Describes a cavalry charge against Russians in the Crimean war, who shoot at the lightly armed British with canons. Many soldiers died.	Tennyson was **poet laureate** and had a responsibility to inspire the nation. He glorifies the soldiers, but does recognise that the commander made a mistake.	This is in **ballad** form to remember the courage of the soldiers. There are **six verses**, each representing 100 of the men who took part. **Dactylic dimeter** (DUM-de-de-) mirrors the galloping horses. Lots of **repetition** and **anaphora** to mirror the horrors of battle.	2. *How does Tennyson use personification to show how dangerous the battlefield was?*
Remains *Armitage*	The **narrative persona** is a soldier who has killed a looter and is struggling with guilt. At first he seems nonchalant, but later is not.	Based on Guardsman Tromans, who fought in Iraq in 2003. The poem coincided with awareness of PTSD among the military.	A monologue told in the **present tense** to convey a flashback. The poem opens with **colloquial language** and **sport imagery** which presents the event almost as a game, but there is a clear **volta** and we realise the mental suffering. **Repetition** of 'possibly armed...'	3. *How is language used to describe the death of the looter in an unsympathetic way?*
Exposure *Owen*	The speaker describes war as a battle against the weather. Imagery of cold and warm reflect the delusional mind of the dying man.	Written in 1917. Owen fought in WWI but died in battle in 1918. Although he highlighted the tragedy of war, he had a deep sense of duty.	The **rhyme scheme ABBA** and **hexameter** emphasises the monotony of war. The **pararhymes** only barely hold the poem together, like the men. There is a **semantic field** of weather, presenting weather as the enemy.	4. *How does Owen use personification to present the weather as the enemy?*
Kamikaze *Garland*	This poem explores a Kamikaze pilot's journey towards battle, his decision to return and how he is shunned when he returns.	In WWII, Japanese Kamikaze pilots would fly manned missiles in to targets. Cowardice or surrender was a great shame in wartime Japan.	The **narrative** and **speaker** is **third person**, representing the distance between her, her family, and his rejection by society. The first five stanzas are **ordered** (whilst flying on set mission) and there is only **one full stop** – when he makes his decision to return.	5. *Why are images of nature significant in the poem?*
War Photographer *Duffy*	Tells the story of a war photographer developing photos at home in England, being reminded of the horrors of war.	Duffy was inspired by her friendship with a war photographer. She conveys the brutality of war and the indifference of the public viewing the photos in papers.	The **enjambment** reinforces the idea that the world is out of order and confused. The **rhyme** reinforces that he is trying to bring order to chaos by creating understanding. There are **contrasts** between rural England and war zones.	**Annotating poems:** Read at least twice Establish speaker, tense, addressee Establish narrative and theme Establish tone and mood Annotate structural devices Annotate language devices Consider the title
Poppies *Weir*	Focuses on a mother whose son has gone to war. She helps him prepare and sends him off. His fate is ambiguous – does he die?	Set around the time of the Iraq and Afghan wars, but the conflict is ambiguous to give timeless relevance. Hints of criticism of the military.	This poem is an **elegy**, a poem of mourning. There is a strong sense of form despite the **free verse stream of consciousness** addressing her son directly. Nearly half the lines have **caesura** – she is trying to hold it together, but can't speak fluently.	

Trench Warfare	Crimean War	Exposure	Guardsman Tromans	Kamikaze pilots
				

English – Year 10 – HT5 – Power and Conflict Poetry (Part 2)

Summary- Position in the Curriculum

A selection of the *Power and Conflict* poems for English Literature Paper 2, focusing on the following themes: Power, control, inequality, loss, pride, fear, identity, anger, nature.

Poem	Content	Context	Form, Language and Structure	Preparing for Assessment
Ozymandias *Shelley*	The narrator meets a traveller who tells him about a forgotten and decayed statue in a desert that was of the ancient king, Ozymandias.	Shelley was a Romantic poet who was interested in emotion and nature and disliked the concept of monarchy and the oppression of ordinary people.	A **sonnet** but with an unconventional structure – the structure is normal until a turning point **(volta)**, reflecting how human structures can be destroyed or decayed. The **iambic pentameter** **rhyme scheme** is also disrupted.	1. *How does Shelly explore the idea that human power is only temporary? How is irony employed?*
My Last Duchess *Browning*	A Duke confesses to having his previous wife killed because he believed that she was flirtatious and ungrateful.	Browning may have been inspired by the story of an Italian Duke, Duke of Ferrara, whose wife died in suspicious circumstances. She was maybe poisoned.	A **Dramatic Monologue** in **iambic pentameter** written in **couplets** – no breaks or gaps or weaknesses, like the Duke. However, heavy use of **caesura** suggests stuttering and frustration and anger. The **enjambment** makes it seem conversational, but it is one-sided.	2. *How is the Duke shown to be obsessed with power and control – but also as an unstable man?*
London *Blake*	The narrator describes a walk around London and how he is saddened by the sights and sounds of poverty and loss of innocence.	Published in 1794, a time of great poverty in London. Blake focuses on how innocence is lost and society is corrupt, including the Church and Government.	A **Dramatic Monologue** where a **1st person narrator** speaks passionately about what he sees. A simple **ABAB rhyme scheme** shows the unrelenting misery of the city and his footsteps as he treads around.	3. *What is the meaning of the metaphor 'mind forged manacles'? How does Blake use sensory imagery?*
Storm on the Island *Heaney*	The narrator describes how a rural community prepare for a storm. When the storm hits they are shocked by its power.	Seamus Heaney was Northern Irish. One possible reading of this poem is that it is a metaphor for the political storm that was building during the Irish Troubles.	The poem is split in to three sections: confidence, violence of the storm, and fear. There is a **volta** in line 14 'But no' – the **monosyllabic** phrase and the **caesura** reflects the final calm before the storm. The use of 'we' creates a sense of community.	4. *How does Heaney use war imagery to describe the storm? How is personification employed?*
Extract from the Prelude *Wordsworth*	The story of a boy's love of nature and a night-time adventure in a rowing boat that instils a fearful respect for nature's power.	Wordsworth was a Romantic poetry and his poetry explores themes of nature, human emotion and how humans are shaped through interaction with nature.	The poem is split in to three sections: carefree and confident rowing, dark and fearful with the appearance of the mountain, reflective and troubled in the following days. Nature is **personified** as a powerful beast and is **contrasted** with the boy's panic.	5. *How does Wordsworth use language to present the mountain as a terrifying beast?*
Checking Out Me History *Agard*	Represents the voice of a Caribbean man who is frustrated by the Eurocentric history curriculum.	Agard was born in the Caribbean in 1949 and moved to the UK in the 1970s. His poetry challenges racism and prejudice.	**Stanzas** concerning Eurocentric history **(normal font)** are interspersed with stanzas on black history **(in italics** to represent separateness and rebellion**). Lack of punctation, free verse, irregular rhyme scheme** and **phonetic spelling** show rebellion.	**Personal Research** Tissue (Imtiaz Dharker)
The Emigree *Rumens*	A speaker describes her memories of a home city that she was forced to flee. Despite citing problems, she has positive memories.	The home country of the speaker is not revealed – this ambiguity gives the poem a timeless and universal relevance.	The last line of each stanza is the same **(epistrophe)** 'sunlight', reinforcing the positivity of the city and of the poem. The first two **stanzas** have a lot of **enjambments**, conveying freedom, while the final stanza has **full stops**, conveying that she is now trapped.	

Ozymandias	London	Storm on the Island	The Lake District	John Agard
				

Maths

Year 10 Maths Knowledge Organiser: Autumn 1 – Similarity (Chapter 1)

By the end of this half-term, you should be able to:

1.1 – Congruence, similarity & enlargement

- Enlarge by a positive scale factor
- Enlarge by a negative and fractional scale factor
- Identify similar shapes
- Work out missing sides and angles in similar shapes
- Use parallel lines to find missing angles
- Understand similarity and congruence

1.2 – Trigonometry

- Work fluently with the hypotenuse, opposite and adjacent sides
- Use the sine, cosine and tangent ratio to find missing side lengths
- Use the sine, cosine and tangent ratio to find missing angles
- Select the appropriate method (Pythagoras' or trigonometry) to solve right-angled triangle problems
- Work with key angles in right-angled triangles

Keywords

Centre of enlargement: the point the shape is enlarged from.

Similar: when one shape can become another with a reflection, rotation, enlargement or translation.

Congruent: the same size and shape.

Corresponding: items that appear in the same place in two similar situations.

Parallel: straight lines that never meet (equal gradients).

Preparing for Assessment

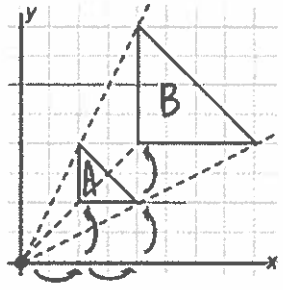
- Login to **Maths Watch** and complete your independent tasks each week. Attempt all questions and aim to get at least 80% correct. Remember, you can watch the videoclip attached to each question to help you understand the topic better.
- Use **'Read, Cover, Write, Check'** to test your understanding on the key words and core knowledge in this organiser.

Core Knowledge

Positive scale factors (R)

Enlargement from a point

Enlarge shape A by SF 2 from (0,0)



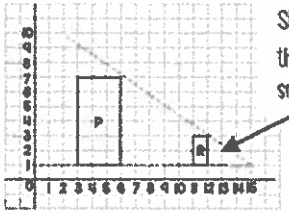
The shape is enlarged by 2

The distance from the point enlarges by 2

Fractional scale factors (R)

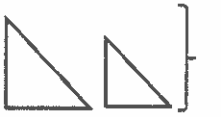
Fractions less than 1 make a shape SMALLER

R is an enlargement of P by a scale factor $\frac{1}{3}$ from centre of enlargement (15,1)



SF $\frac{1}{3}$ - R is three times smaller than P

Identify similar shapes



Angles in similar shapes do not change.
e.g. if a triangle gets bigger the angles can not go above 180°

Similar shapes

Scale Factor:
Both sides on the bigger shape are 1.5 times bigger

Compare sides: 6 : 9 = 2 : 3 ; 8 : 12 = 2 : 3

Both sets of sides are in the same ratio

Enlarge: to make a shape bigger (or smaller) by a given multiplier (scale factor).

Scale Factor: the multiplier of enlargement.

Constant: a value that remains the same.

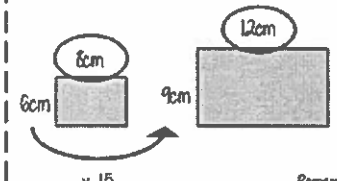
Cosine ratio: the ratio of the length of the adjacent side to that of the hypotenuse. The sine of the complement.

Sine ratio: the ratio of the length of the opposite side to that of the hypotenuse.

Tangent ratio: the ratio of the length of the opposite side to that of the adjacent side.

Inverse: function that has the opposite effect.

Information in similar shapes



Compare the equivalent side on both shapes

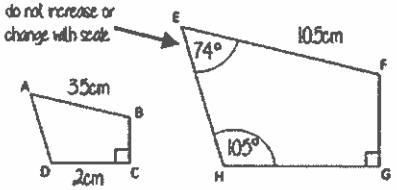
Scale Factor is the multiplicative relationship between the two lengths

Shape ABCD and EFGH are similar

Notation helps us find the corresponding sides

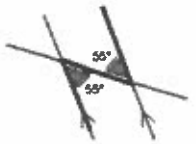
AB and EF are corresponding

Remember angles do not increase or change with scale



Angles in parallel lines (R)

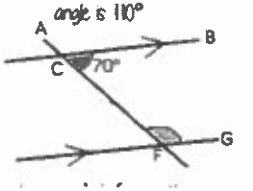
Alternate angles



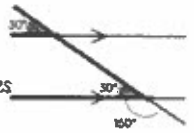
Because alternate angles are equal the highlighted angles are the same size

Co-interior angles

Because co-interior angles have a sum of 180° the highlighted angle is 110°



Corresponding angles



Because corresponding angles are equal the highlighted angles are the same size

Os angles on a line add up to 180° co-interior angles can also be calculated from applying alternate/ corresponding rules first

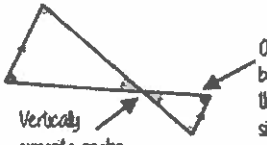
Similar triangles

Shares a vertex

Because corresponding angles are equal the highlighted angles are the same size

Parallel lines – all angles will be the same in both triangle

Os all angles are the same this is similar – it only one pair of sides are needed to show equality

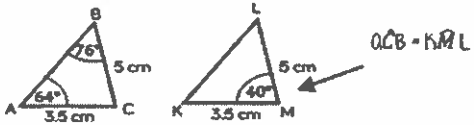


All the angles in both triangles are the same and so similar

Vertically opposite angles

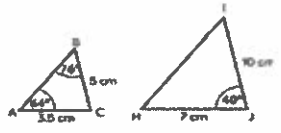
Congruence and Similarity

Congruent shapes are identical – all corresponding sides and angles are the same size



AĈB = KM̂L

Because all the angles are the same and AC=KM BC=LM triangles ABC and KLM are congruent



Because all angles are the same, but all sides are enlarged by 2 ABC and HIJ are similar

Conditions for congruent triangles

Triangles are congruent if they satisfy any of the following conditions

Side-side-side

All three sides on the triangle are the same size

Angle-side-angle

Two angles and the side connecting them are equal in two triangles

Side-angle-side

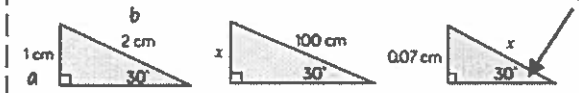
Two sides and the angle in-between them are equal in two triangles (it will also mean the third side is the same size on both shapes)

Right-angle-hypotenuse-side

The triangles both have a right angle, the hypotenuse and one side are the same

Ratio in right-angled triangles

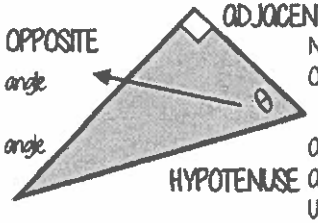
When the angle is the same the ratio of sides a and b will also remain the same



a : b	a : b	a : b
1 : 2	x : 100	0.07 : x
$\frac{a}{b} = \frac{1}{2}$	50 : 100	0.07 : 0.14

Hypotenuse, adjacent and opposite

ONLY right-angled triangles are labelled in this way



Always opposite an acute angle
Useful to label second
Position depend upon the angle in use for the question

Next to the angle in question
Often labelled last

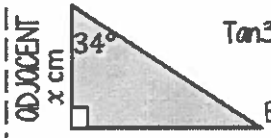
Always the longest side
Always opposite the right angle
Useful to label this first

Hypotenuse: longest side of a right-angled triangle. It is the side opposite the right-angle.

Tangent ratio: side lengths

$\tan\theta = \frac{\text{opposite side}}{\text{adjacent side}}$

Substitute the values into the tangent formula



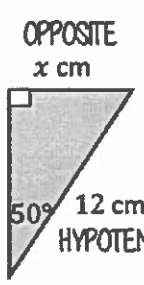
$\tan 34 = \frac{10}{x}$

Equations might need rearranging to solve

$x \times \tan 34 = 10$

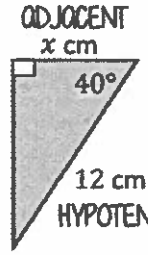
$x = \frac{10}{\tan 34} = 14.8\text{cm}$

Sin and Cos ratio: side lengths



$\sin\theta = \frac{\text{opposite side}}{\text{hypotenuse side}}$

NOTE
The $\sin(x)$ ratio is the same as the $\cos(90-x)$ ratio

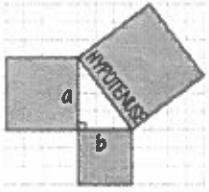


$\cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse side}}$

Substitute the values into the ratio formula

Equations might need rearranging to solve

Pythagoras theorem (R)



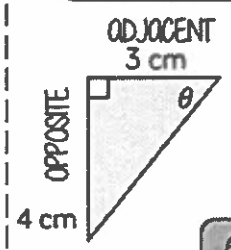
$\text{Hypotenuse}^2 = a^2 + b^2$

This is commutative – the square of the hypotenuse is equal to the sum of the squares of the two shorter sides

Places to look out for Pythagoras
- Perpendicular heights in isosceles triangles
- Diagonals on right angled shapes
- Distance between coordinates
- Any length made from a right angles

Sin, Cos, Tan: Angles

Inverse trigonometric functions



Label your triangle and choose your trigonometric ratio

Substitute values into the ratio formula

$\tan\theta = \frac{3}{4}$

$\theta = \tan^{-1}\frac{3}{4}$

$\theta = 36.9°$

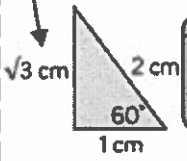
$\theta = \tan^{-1}\frac{\text{opposite side}}{\text{adjacent side}}$

$\theta = \sin^{-1}\frac{\text{opposite side}}{\text{hypotenuse side}}$

$\theta = \cos^{-1}\frac{\text{adjacent side}}{\text{hypotenuse side}}$

Key angles

This side could be calculated using Pythagoras

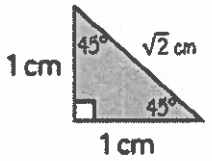


Because trig ratios remain the same for similar shapes you can generalise from the following statements

$\tan 30 = \frac{1}{\sqrt{3}}$ $\quad \tan 60 = \sqrt{3}$

$\cos 30 = \frac{\sqrt{3}}{2}$ $\quad \cos 60 = \frac{1}{2}$

$\sin 30 = \frac{1}{2}$ $\quad \sin 60 = \frac{\sqrt{3}}{2}$

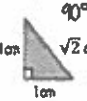


$\tan 45 = 1$ $\quad \cos 45 = \frac{1}{\sqrt{2}}$ $\quad \sin 45 = \frac{1}{\sqrt{2}}$

Key angles 0° and 90°

$\tan 0 = 0$ $\quad$ ~~$\tan 90$~~

This value cannot be defined – it is impossible as you cannot have two 90° angles in a triangle



$\sin 0 = 0$ $\quad \sin 90 = 1$

$\cos 0 = 1$ $\quad \cos 90 = 0$

Year 10 Maths Knowledge Organiser: Autumn 1 – Developing Algebra (Chapter 2)

By the end of this half-term, you should be able to:

2.1 – Representing solutions of equations & inequalities

- Form and solve equations and inequalities
- Represent and interpret solutions on a number line as inequalities
- Draw straight line graphs and find solutions to equations
- Form and solve equations and inequalities with unknowns on both sides

2.2 – Simultaneous equations

- Determine whether (x,y) is a solution
- Solve by substituting a known variable and an expression
- Solve graphically and by elimination
- Form and solve linear simultaneous equations

Keywords

Solution: a value we can put in place of a variable that makes the equation true.

Variable: a symbol for a number we don't know yet.

Equation: an equation says that two things are equal – it will have an equals sign =.

Expression: numbers, symbols and operators grouped together to show the value of something.

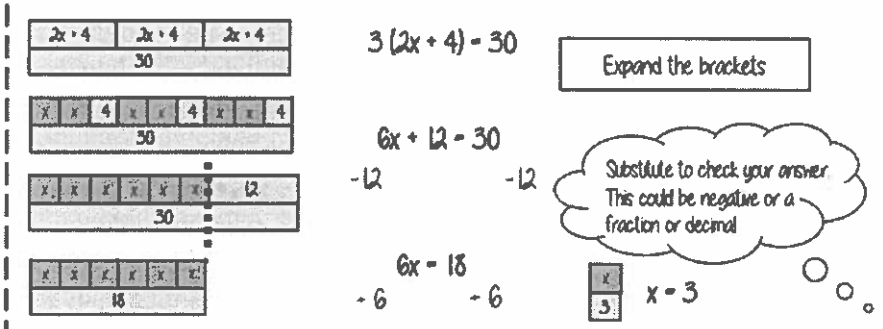
Identity: An equation where both sides have variables that cause the same answer includes ≡.

Preparing for Assessment

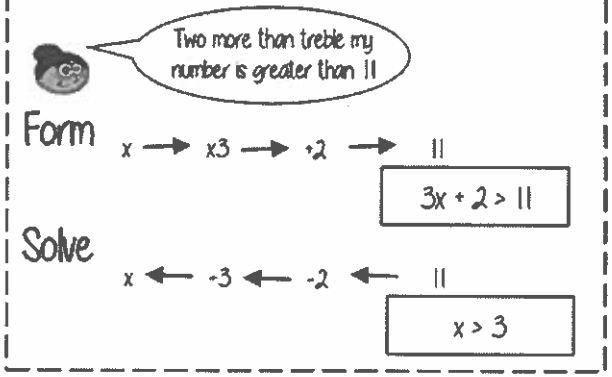
- Login to **Maths Watch** and complete your independent tasks each week. Attempt all questions and aim to get at least 80% correct. Remember, you can watch the videoclip attached to each question to help you understand the topic better.
- Use **'Read, Cover, Write, Check'** to test your understanding on the key words and core knowledge in this organiser.

Core Knowledge

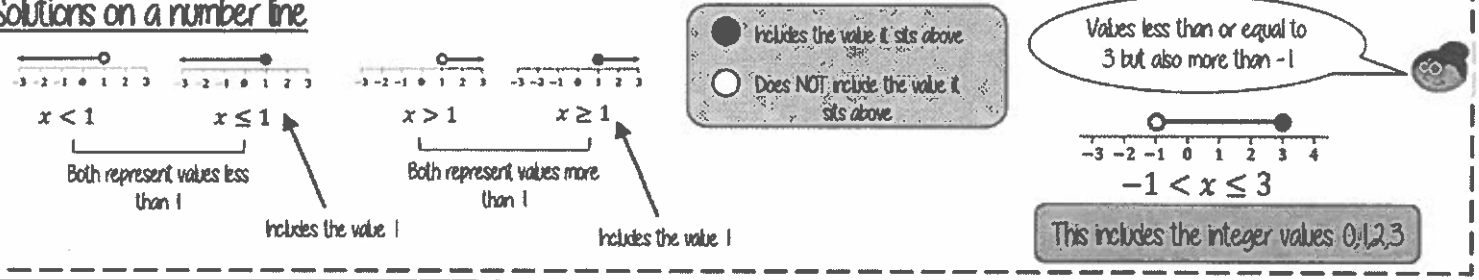
Solve equations (R)



Form and solve inequalities (R)



Solutions on a number line



Linear: an equation or function that is the equation of a straight line.

Intersection: the point that two lines meet.

Inequality: an inequality compares two values showing if one is greater than, less than or equal to another.

Substitute: replace a variable with a numerical value.

LCM: lowest common multiple - the first time the times table of two or more numbers match.

Eliminate: to remove Expression: a maths sentence with a minimum of two numbers and at least one math operation (no equals sign)

Coordinate: a set of values that show an exact position.

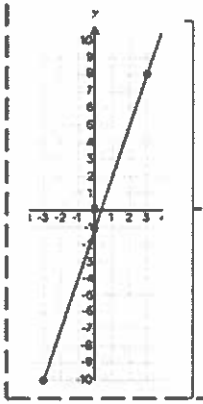
Plotting straight line graphs (R)

$y = 3x - 1$ → 3 x the x coordinate then − 1

x	-3	0	3
y	-10	-1	8

Draw a table to display this information

This represents a coordinate pair (-3, -10)



You only need two points to form a straight line

Plotting more points helps you decide if your calculations are correct (if they do make a straight line)

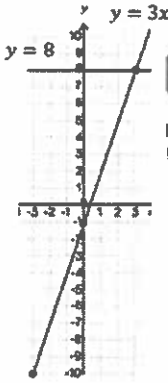
Remember to join the points to make a line

Find solutions graphically

For linear equations there is only one point the graph meets the x value

$x = 2$
$y = 4$

These two lines will cross at (2,4) because they are just x= and y= they are parallel to axes and meet in one place



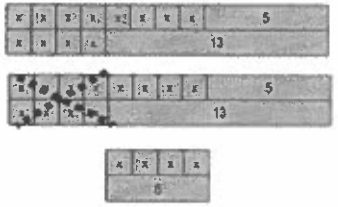
$3x - 1 = 8$

Remember equation of a line format is $y = mx + c$

The solution is the point the two lines meet (3,8)

Equations: unknown on both sides (R)

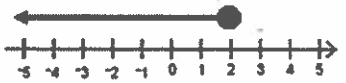
$8x + 5 = 4x + 13$



$8x + 5 = 4x + 13$
$-4x \quad -4x$
$4x + 5 = 13$
$-5 \quad -5$
$4x = 8$
$\div 4 \quad \div 4$
$x = 2$

Inequalities: unknown on both sides

$8x + 5 \leq 4x + 13 \rightarrow x \leq 2$



Only value 2 or less will satisfy this inequality

Is (x, y) a solution?

x and y represent values that can be substituted into an equation

Does the coordinate (1,8) lie on the line $y=3x+5$?

This coordinate represents x=1 and y=8

$y = 3x + 5$

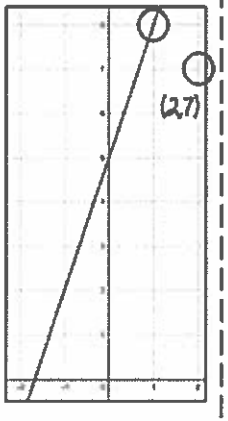
$8 = 3(1) + 5$

As the substitution makes the equation correct the coordinate (1,8) IS on the line $y=3x+5$

Is (2,7) on the same line?

$7 \neq 3(2) + 5$

No 7 does NOT equal 6+5



Substituting known variables

A line has the equation $3x + y = 14$

Two different variables, two solutions

Stephanie knows the point x = 4 lies on that line. Find the value for y

$x = 4$

$3x + y = 14$

$3(4) + y = 14$

$12 + y = 14$
$-12 \quad -12$
$y = 2$

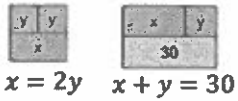
Substituting in an expression

$x = 2y$

$x + y = 30$

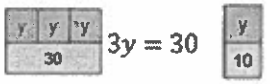
Pair of simultaneous equations (two representations)

Substitute 2y in place of the x variable as they represent the same value



$x = 2y$

$x + y = 30$



$3y = 30$

$3y = 30$
$\div 3 \quad \div 3$
$y = 10$

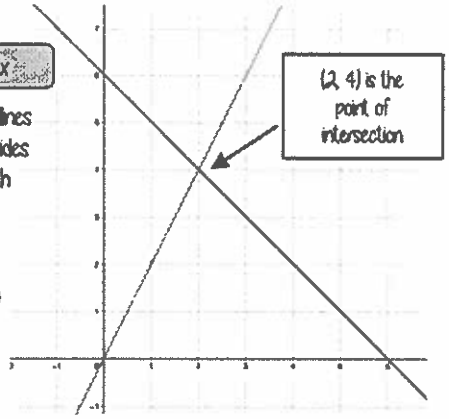
$x = 2y$

$x = 20$

Solve graphically

$x + y = 6$ $y = 2x$

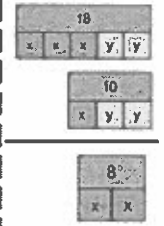
Linear equations are straight lines
The point of intersection provides the x and y solution for both equations



The solution that satisfies both equations is

$x = 2$ and $y = 4$

Solve by subtraction

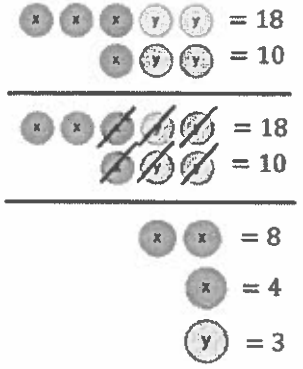


$x = 4$
$y = 3$

$3x + 2y = 18$
$-\ x + 2y = 10$

$2x = 8$
$\div 2 \quad \div 2$
$x = 4$

$x + 2y = 10$
$(4) + 2y = 10$
$-4 \quad -4$
$2y = 6$
$\div 2 \quad \div 2$
$y = 3$



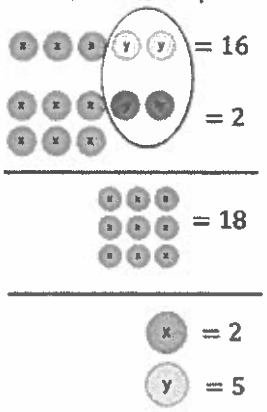
Solve by addition

$3x + 2y = 16$
$+\ 6x - 2y = 2$

$9x = 18$
$\div 9 \quad \div 9$
$x = 2$

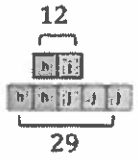
$3x + 2y = 16$
$3(2) + 2(y) = 16$
$6 + 2y = 16$
$-6 \quad -6$
$2y = 10$
$y = 5$

Addition makes zero pairs



Solve by adjusting one

$h + j = 12$ No equivalent values
$2h + 2j = 29$

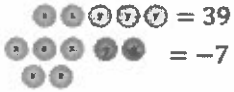


$2h + 2j = 24$
$2h + 2j = 29$

By proportionally adjusting one of the equations – now solve the simultaneous equations choosing an addition or subtraction method

Solve by adjusting both

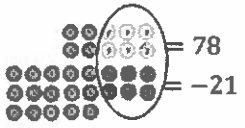
$2x + 3y = 39$
$5x - 2y = -7$



Use LCM to make equivalent x OR y values
Because of the negative values using zero pairs and y values is chosen choice

$4x + 6y = 78$
$15x - 6y = -21$

Now solve by addition



Addition makes zero pairs

Year 10 Maths Knowledge Organiser: Spring 1 – Geometry (Chapter 3)

By the end of this half-term, you should be able to:

3.1 – Angles & bearings	3.2 – Working with circles	3.3 – Vectors
• Understand and represent bearings • Measure and read bearings • Make scale drawings using bearings • Calculate bearings using angle rules • Solve bearings problems using Pythagoras and trigonometry	• Recognise and label parts of a circle • Calculate fractional parts of a circle • Calculate the length of an arc • Calculate the area of a sector • Understand and use for volume/surface area of a cone, cylinder and sphere	• Understand and represent vectors • Use and read vector notation • Draw and understand vectors multiplied by a scalar • Draw and understand addition of vectors • Draw and understand addition and subtraction of vectors

Keywords

Cardinal directions: the directions of North, South, East, West

Angle: the amount of turn between two lines around their common point

Bearing: the angle in degrees measured clockwise from North.

Perpendicular: where two lines meet at 90°

Parallel: straight lines always the same distance apart and never touch. They have the same gradient.

Preparing for Assessment

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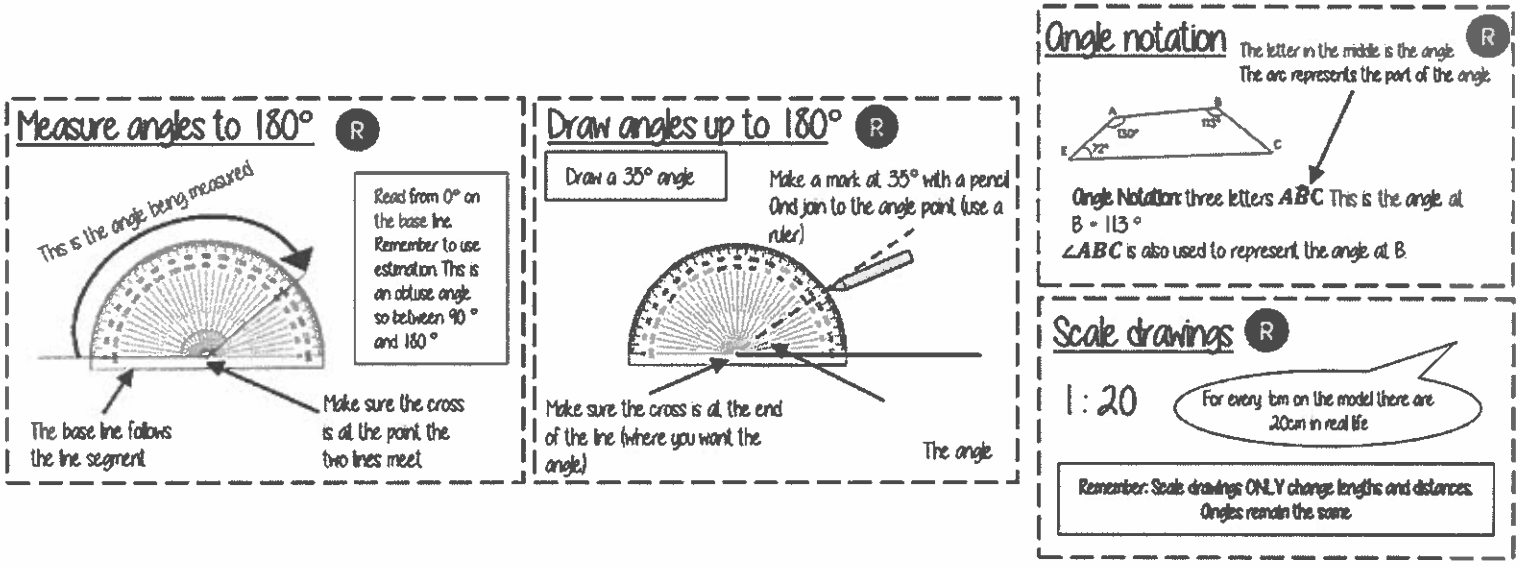
- Use **'Read, Cover, Write, Check'** to test your understanding on the key words and core knowledge in this organiser.

Core Knowledge



Clockwise: moving in the direction of the hands on a clock.

Construct: to draw accurately using a compass, protractor and or ruler or straight edge.

Scale: the ratio of the length of a drawing to the length of the real thing.

Protractor: an instrument used in measuring or drawing angles.

Circumference: the length around the outside of the circle – the perimeter

Area: the size of the 2D surface

Diameter: the distance from one side of a circle to another through the centre

Radius: the distance from the centre to the circumference of the circle

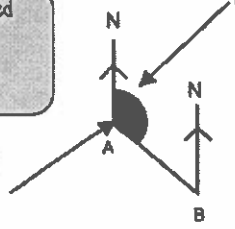
Tangent: a straight line that touches the circumference of a circle

Understand and represent bearings

- A bearing is always measured from NORTH
- It is always given as three figures

The angle indicated starts from the North line at A and joins the path connecting A to B

This angle shows the bearing of B from A



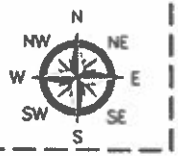
The bearing of B from A is calculated by measuring the highlighted angle

The sentence... "Bearing of ____ from ____" is really important in identifying the bearing being represented

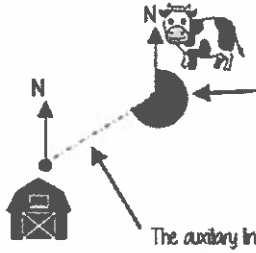
Using estimation it is clear this angle is between 090° and 180°

Directions

Clockwise Anti-Clockwise



Measure and read bearings



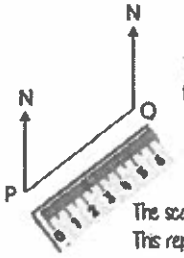
The bearing of the cow to the barn

This angle is measured from NORTH
It is measured in a clockwise direction
Estimation indicates this angle is between 180° and 270°
Use a protractor to measure accurately
Remember bearings are written as three figures

The auxiliary line is drawn to help you measure and draw the angle that is measured to represent the bearing

Scale drawings using bearings

Remember – angles DO NOT change size in scaled drawings



The bearing measurements do not change from "real life" to images

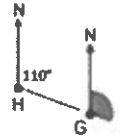
The units in the ratio scale are the same

The scale may need to be calculated from the image. This represents 30km from P to Q

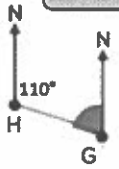
6cm = 30km
6:3,000,000

Bearings with angle rules

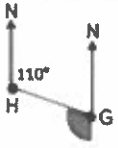
Because two North lines are PORALLEL....



They form corresponding angles and therefore are the same size



They form co-interior angles and add up to 180°

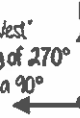


They form alternate angles and therefore are the same size

Bearings with right-angled geometry

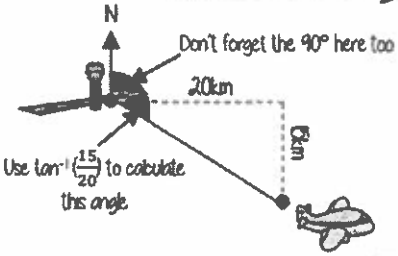
Look for Right-angles:
Pythagoras
Trigonometry (Sin, Cos, Tan)

"Due West" bearing of 270° makes a 90° angle



"Due East" bearing of 090° makes a 90° angle

A plane flies East for 20km then turns South for 15km
Find the bearing of the plane from where it took off



Use $\tan^{-1}\left(\frac{15}{20}\right)$ to calculate this angle

Chord: a line segment connecting two points on the curve

Frustrum: a pyramid or cone with the top cut off

Hemisphere: half a sphere

Surface area: the total area of the surface of a 3D shape.

Direction: the line our course something is going

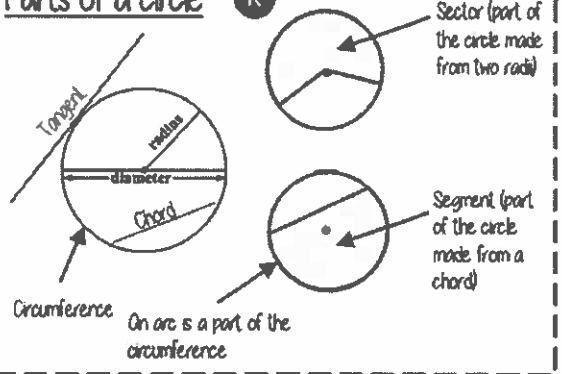
Magnitude: the magnitude of a vector is its length

Scalar: a single number used to represent the multiplier when working with vectors

Column vector: a matrix of one column describing the movement from a point

Resultant: the vector that is the sum of two or more other vectors

Parts of a circle



Fractional parts of a circle

A circle is made up of 360°

Formula to remember
Area of a circle = πr^2
Circumference of a circle = πd or $2\pi r$

30° represents $\frac{30}{360}$ of a full circle

$\frac{30}{360} = \frac{1}{12}$

$\frac{270}{360}$ of a full circle (in degrees)

$\frac{6}{8}$ of a full circle (in equal parts)

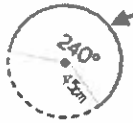
$\frac{3}{4}$ of a full circle

The fraction of the circle is as $\frac{\theta}{360}$

θ represents the degrees in the sector

Arc length

Remember an arc is part of the circumference
Circumference of the whole circle = $\pi d = \pi \times 9 = 9\pi$



Arc length = $\frac{\theta}{360} \times$ circumference

$= \frac{240}{360} \times 9\pi$

$= \frac{2}{3} \times 9\pi = 6\pi$

Perimeter

Perimeter is the length around the outside of the shape
This includes the arc length and the radii that encloses the shape

Perimeter = $\frac{\theta}{360} \times$ circumference $+ 2r$ $= 6\pi + 9$

Sector area

Remember a sector is part of a circle
Area of the whole circle = $\pi r^2 = \pi \times 6^2 = 36\pi$

Sector area = $\frac{\theta}{360} \times$ area of circle

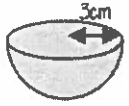
$= \frac{120}{360} \times 36\pi$

$= \frac{1}{3} \times 36\pi = 12\pi$

Volume of a sphere

Volume Sphere = $\frac{4}{3}\pi r^3$

NOTE: This is now a cubed value



Volume Sphere = $\frac{4}{3}\pi r^3$

$= \frac{4}{3} \times \pi \times 3^3$

$= \frac{4}{3} \times \pi \times 27 = 36\pi$

A hemisphere is half the volume of the overal sphere $= 36\pi \div 2$

$= 18\pi$

Look out for hemispheres being placed on other 3D shapes, e.g cones and cylinders

Volume of a cone and a cylinder

Volume Cylinder = $\pi r^2 h$

A cylinder is a prism – cross section is a circle

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

A cone is a pyramid with a circular base

$V = \pi r^2 h$

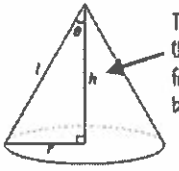
$= \pi \times 42 \times 10$

$= \pi \times 160$

$= 160\pi$ cm^2

Give your answer in terms of π means NOT in terms of pi

$= 502.7$cm^2

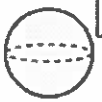


The height of a cone is the perpendicular height from the vertex to the base

Look out for trigonometry or Pythagoras theorem – the radius forms the base of a right-angled triangle

Surface area of a sphere

Surface area = $4\pi r^2$



Radius = 5cm

Surface area = $4\pi r^2$

$= 4 \times \pi \times 5^2$

$= 4 \times \pi \times 25$

$= 100\pi$

The curved surface area of a sphere

A hemisphere has the curved surface AND a flat circular face

$= 100\pi \div 2 = 50\pi$

$= 50\pi + \pi \times 5^2$

Hemisphere $= 75\pi$

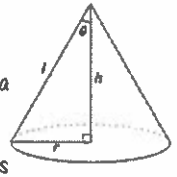
Surface area of cones and cylinders

Surface area cylinder = $2\pi r^2 + \pi dh$

The area of two circles (top and bottom face) + the area of the curved face

The length of shape B is the circumference of the circles

Curved surface area Cone = πrl



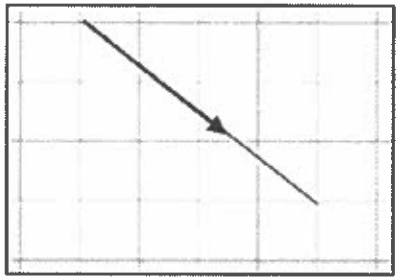
Look out for the use of Pythagoras to calculate the length l

Total surface area = curved face + circle face (area of base)

Understand and represent vectors

Column vectors have been seen in translations to describe the movement of one image onto another

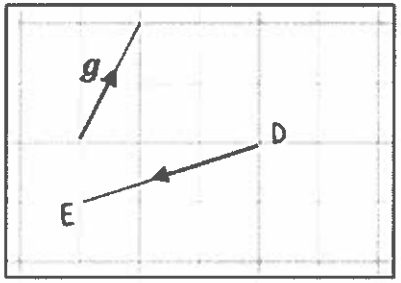
Movement along the x-axis → $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ ← Movement along the y-axis



Vectors show both direction and magnitude

The arrow is pointing in the direction from starting point to end point of the vector	The direction is important to correctly write the vector
The magnitude is the length of the vector (This is calculated using Pythagoras theorem and forming a right-angled triangle with auxiliary lines)	The magnitude stays the same even if the direction changes

Understand and represent vectors



Vector notation $\overrightarrow{DE}$ is another way to represent the vector joining the point D to the point E

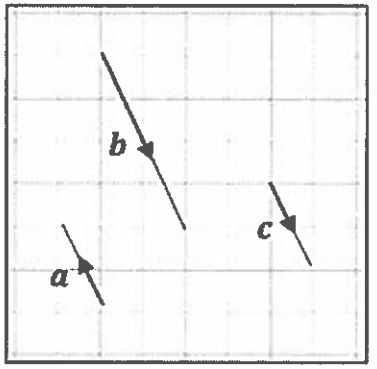
$\overrightarrow{DE} = \begin{pmatrix} -3 \\ -1 \end{pmatrix}$

The arrow also indicates the direction from point D to point E

Vectors can also be written in bold lower case so $\boldsymbol{g}$ represents the vector $\boldsymbol{g} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$

Vectors multiplied by a scalar

Parallel vectors are scalar multiples of each other



$\boldsymbol{a} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$ $\boldsymbol{b} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$ $\boldsymbol{c} = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$

$\boldsymbol{b} = 2 \times \boldsymbol{c} = 2\boldsymbol{c}$

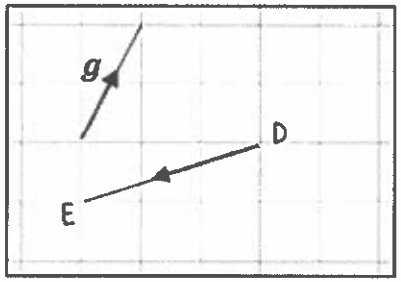
Multiply $\boldsymbol{c}$ by 2 this becomes $\boldsymbol{b}$. The two lines are parallel

$\boldsymbol{a} = -1 \times \boldsymbol{c} = -\boldsymbol{c}$

The vectors $\boldsymbol{a}$ and $\boldsymbol{c}$ are also parallel A negative scalar causes the vector to reverse direction

$\boldsymbol{b} = -2 \times \boldsymbol{a} = -2\boldsymbol{a}$

Understand and represent vectors



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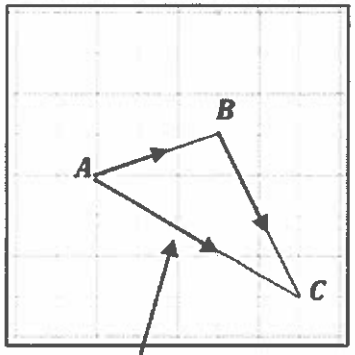
The arrow also indicates the direction from point D to point E

Vectors can also be written in bold lower case so $\boldsymbol{g}$ represents the vector $\boldsymbol{g} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$

Addition of vectors

$\overrightarrow{AB} = \begin{pmatrix} 3 \\ 1 \end{pmatrix}$ $\overrightarrow{BC} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$



The resultant

$$\overrightarrow{AB} + \overrightarrow{BC}$$

$$= \begin{pmatrix} 3 \\ 1 \end{pmatrix} + \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

$$= \begin{pmatrix} 3+2 \\ 1+-4 \end{pmatrix}$$

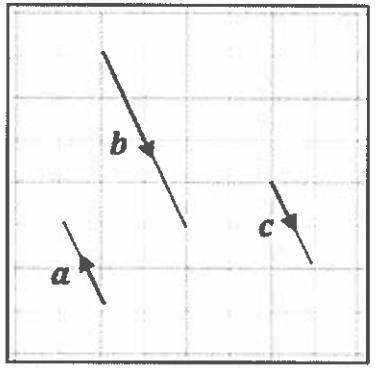
$$\overrightarrow{AC} = \begin{pmatrix} 5 \\ -3 \end{pmatrix}$$

Look how this addition compares to the vector $\overrightarrow{AC}$

$$\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AC} = \begin{pmatrix} 5 \\ -3 \end{pmatrix}$$

Vectors multiplied by a scalar

Parallel vectors are scalar multiples of each other



$\boldsymbol{a} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$ $\boldsymbol{b} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$ $\boldsymbol{c} = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$

$\boldsymbol{b} = 2 \times \boldsymbol{c} = 2\boldsymbol{c}$

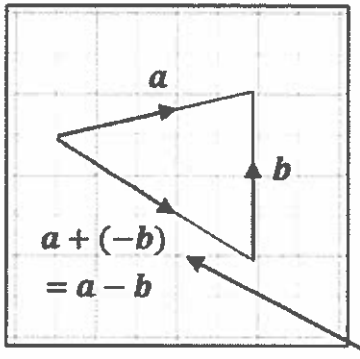
Multiply $\boldsymbol{c}$ by 2 this becomes $\boldsymbol{b}$. The two lines are parallel

$\boldsymbol{a} = -1 \times \boldsymbol{c} = -\boldsymbol{c}$

The vectors $\boldsymbol{a}$ and $\boldsymbol{c}$ are also parallel A negative scalar causes the vector to reverse direction

$\boldsymbol{b} = -2 \times \boldsymbol{a} = -2\boldsymbol{a}$

Addition and subtraction of vectors



$\boldsymbol{a} = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$ $\boldsymbol{b} = \begin{pmatrix} 0 \\ 4 \end{pmatrix}$

$$\boldsymbol{a} + (-\boldsymbol{b}) = \begin{pmatrix} 5 + -0 \\ 1 + -4 \end{pmatrix} = \begin{pmatrix} 5 \\ -4 \end{pmatrix}$$

The resultant is $\boldsymbol{a} - \boldsymbol{b}$ because the vector is in the opposite direction to b which needs a scalar of -1

Year 10 Maths Knowledge Organiser: Spring 2 – Proportions & proportional change (Chapter 4)

By the end of this half-term, you should be able to:

4.1 – Ratios & fractions

- Compare quantities using ratio
- Link ratios and fractions and make comparisons
- Share in a given ratio
- Link ratio and scales and graphs
- Solve problems with currency conversions
- Solve 'best buy' problems
- Combine ratios

4.2 – Percentages & interest

- Convert and compare FDP
- Work out percentages of amounts
- Increase/ decrease by a given percentage
- Express one number as a percentage
- Calculate simple and compound interest
- Calculate repeated percentage change
- Find the original value
- Solve problems with growth and decay

4.3 – Probability

- Add, Subtract and multiply fractions
- Find probabilities using likely outcomes
- Use Venn diagrams and frequency trees
- Use sample space diagrams
- Calculate probability for independent events
- Use tree diagrams

Keywords

Ratio: a statement of how two numbers compare.

Equivalent: of equal value.

Proportion: a statement that links two ratios.

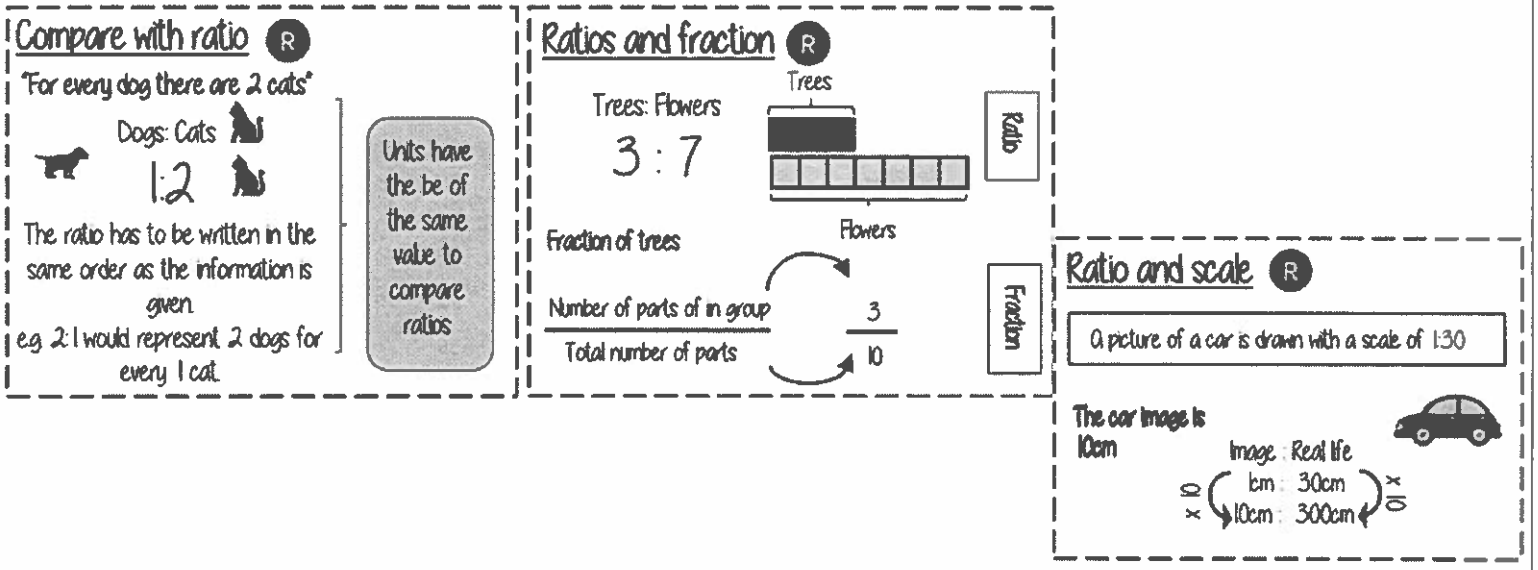
Integer: whole number, can be positive, negative or zero.

Fraction: represents how many parts of a whole.

Preparing for Assessment

- Login to **Maths Watch** and complete your independent tasks each week. Attempt all questions and aim to get at least 80% correct. Remember, you can watch the videoclip attached to each question to help you understand the topic better.
- Use **'Read, Cover, Write, Check'** to test your understanding on the key words and core knowledge in this organiser.

Core Knowledge



Denominator: the number below the line on a fraction. The number represent the total number of parts.

Numerator: the number above the line on a fraction. The top number represents how many parts are taken.

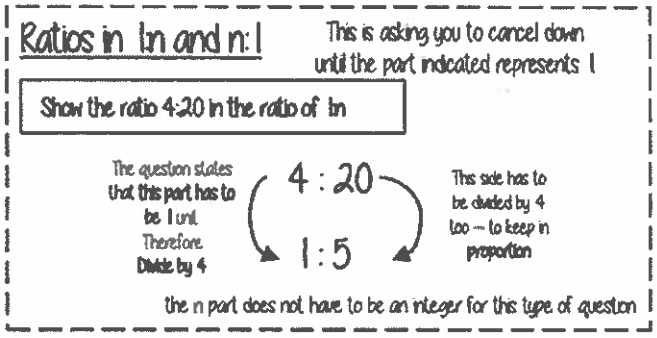
Origin: (0,0) on a graph. The point the two axes cross.

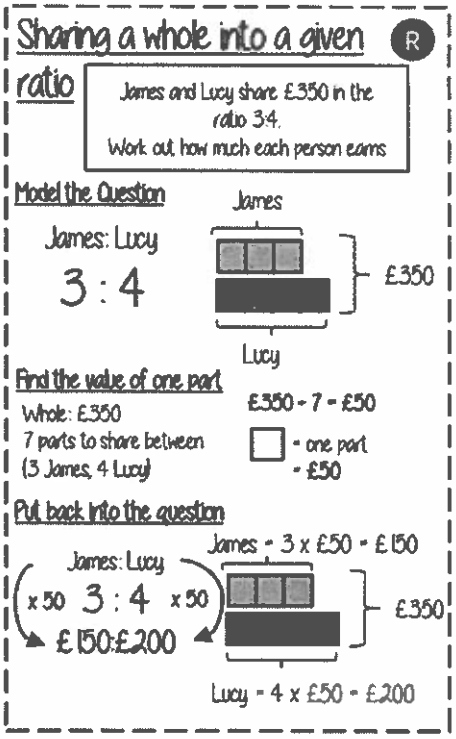
Gradient: The steepness of a line representing the rate of change.

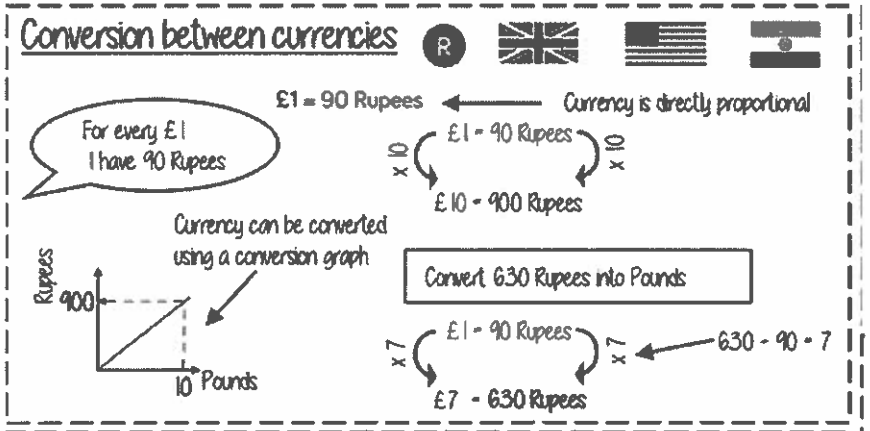
Exponent: how many times we use a number in multiplication. It is written as a power.

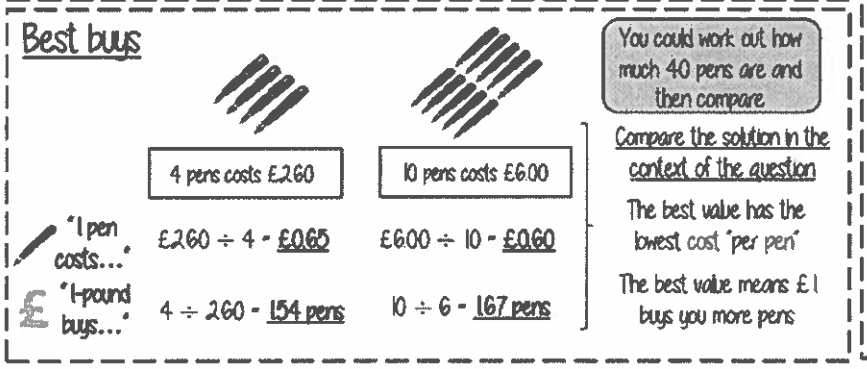
Compound interest: calculating interest on both the amount plus previous interest.

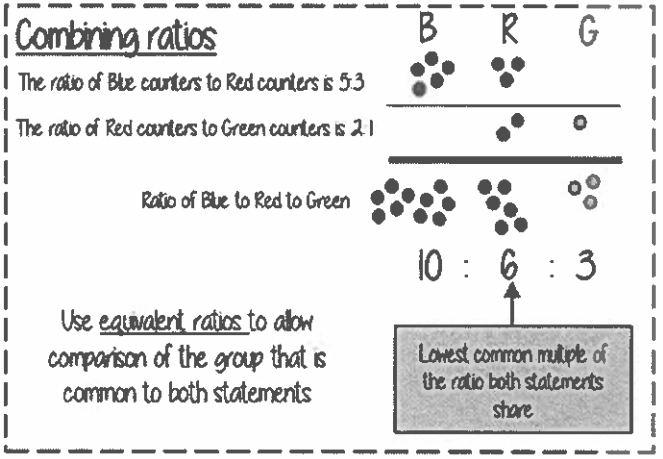
Depreciation: a decrease in the value of something over time.











Growth: where a value increases in proportion to its current value such as doubling.

Decay: the process of reducing an amount by a consistent percentage rate over time.

Multiplier: the number you are multiplying by.

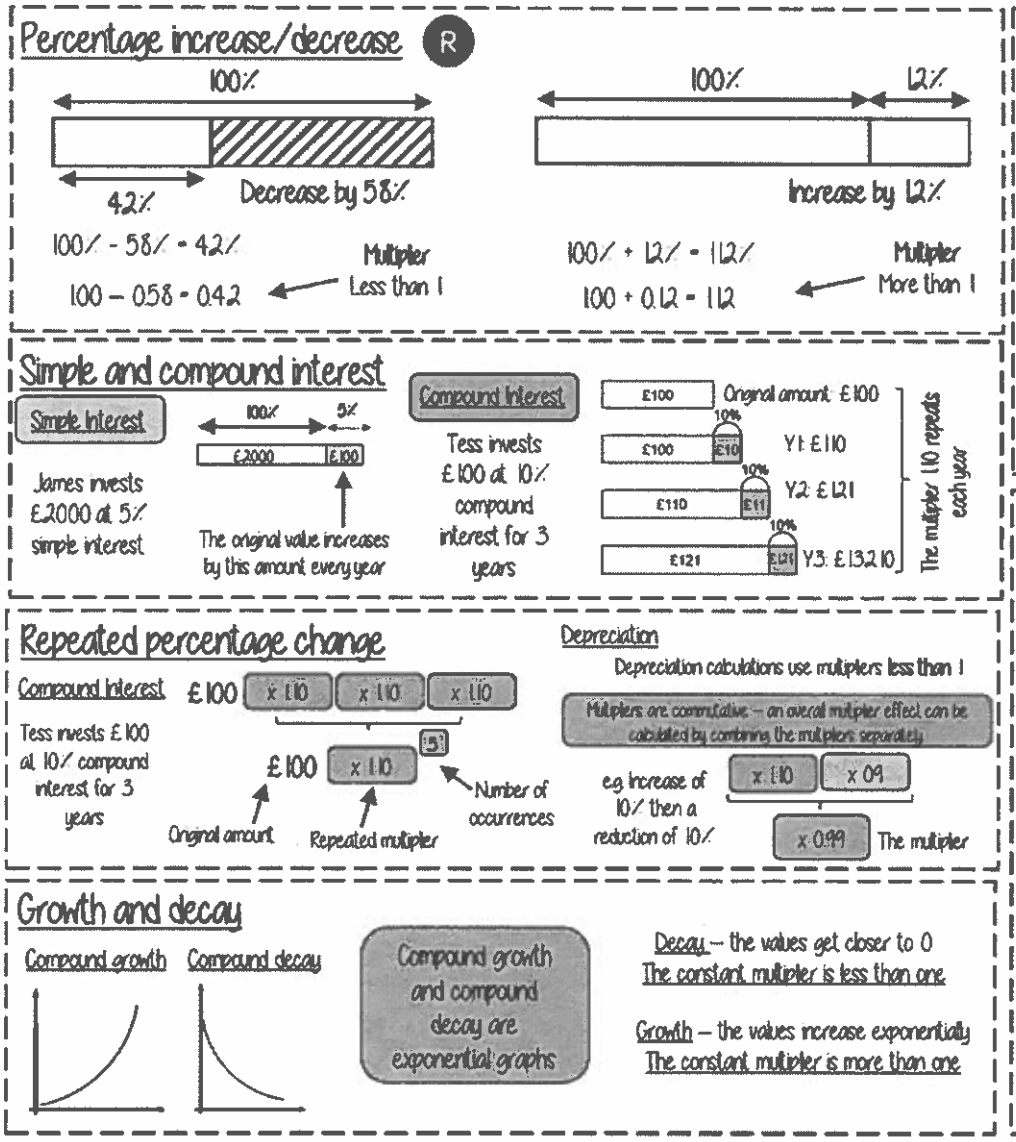
Event: one or more outcomes from an experiment.

Outcome: the result of an experiment. Intersection: elements (parts) that are common to both sets.

Union: the combination of elements in two sets.

Expected Value: the value/ outcome that a prediction would suggest you will get.

Universal Set: the set that has all the elements.



Systematic: ordering values or outcomes with a strategy and sequence.

Product: the answer when two or more values are multiplied together.

Experimental data

Theoretical probability — What we expect to happen

Experimental probability — What actually happens when we try it out

The more trials that are completed the closer experimental probability and theoretical probability become

The probability becomes more accurate with more trials.
Theoretical probability is proportional

Sample space

The possible outcomes from rolling a dice

The possible outcomes from tossing a coin

	1	2	3	4	5	6
H	1H	2H	3H	4H	5H	6H
T	1T	2T	3T	4T	5T	6T

P (Even number and tales) = $\frac{3}{12}$

Independent events

The outcome of two events happening. The outcome of the first event has no bearing on the outcome of the other

$P(A \text{ and } B) = P(A) \times P(B)$

Tree diagram for independent event

Isobel has a bag with 3 blue counters and 2 yellow. She picks a counter and replaces it before the second pick.

Because they are replaced the second pick has the same probability

3 out of 5 are blue

2 out of 5 are yellow

$P(BB) = \frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$

$P(BY) = \frac{3}{5} \times \frac{2}{5} = \frac{6}{25}$

$P(YB) = \frac{2}{5} \times \frac{3}{5} = \frac{6}{25}$

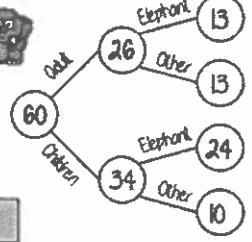
$P(YY) = \frac{2}{5} \times \frac{2}{5} = \frac{4}{25}$

Sum of probabilities = 1

Tables, Venn diagrams, Frequency trees

Frequency trees

60 people visited the zoo one Saturday morning. 26 of them were adults. 13 of the adult's favourite animal was an elephant. 24 of the children's favourite animal was an elephant.



Frequency trees and two-way tables can show the same information

The total columns on two-way tables show the possible denominators

P(Adult) = $\frac{26}{60}$

P(Child with favourite animal as elephant) = $\frac{23}{37}$

Two-way table

	Adult	Child	Total
Elephant	13	24	37
Other	13	10	23
Total	26	34	60

Venn diagram

in set A AND set B — $P(A \cap B)$

in set A OR set B — $P(A \cup B)$

in set A — $P(A)$

NOT in set A — $P(A')$

Dependent events

The outcome of the first event has an impact on the second event

Tree diagram for dependent event

A sock drawer has 5 black and 4 white socks. Jamie picks 2 socks from the drawer

Pick first sock

A white sock has been removed

$P(BB) = \frac{5}{9} \times \frac{4}{8} = \frac{20}{72}$

$P(BW) = \frac{5}{9} \times \frac{4}{8} = \frac{20}{72}$

$P(WB) = \frac{4}{9} \times \frac{5}{8} = \frac{20}{72}$

$P(WW) = \frac{4}{9} \times \frac{3}{8} = \frac{12}{72}$

Sum of probabilities = 1

NOTE: as 'socks' are removed from the drawer the number of items in that drawer is also reduced ∴ the denominator is also reduced for the second pick.

Year 10 Maths Knowledge Organiser: Summer 1 – Collecting, representing & interpreting data (Chapter 5) and Using number (Chapter 6)

By the end of this half-term, you should be able to:

5.0 – Collecting, representing & interpreting data

- Construct and interpret frequency tables and polygons, two-way tables, line, bar, & pie charts
- Find and interpret averages from a list and a table
- Construct and interpret time series graphs, stem and leaf diagrams and scatter graphs

6.1 – Non-calculator methods

- Use mental./written methods for the four number operations
- Use four operations for fractions
- Round to decimal places and significant figures and estimate solutions
- Understand limits of accuracy
- Understand financial maths

Keywords

Population: the whole group that is being studied.

Sample: a selection taken from the population that will let you find out information about the larger group.

Representative: a sample group that accurately represents the population.

Random sample: a group completely chosen by change. No predictability to who it will include.

Bias: a built-in error that makes all values wrong by a certain amount.

Preparing for Assessment

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- Use **'Read, Cover, Write, Check'** to test your understanding on the key words and core knowledge in this organiser.

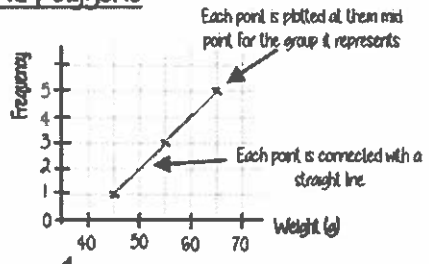
Core Knowledge

Frequency tables and polygons

x Weight(g)	Frequency
$40 < x \leq 50$	1
$50 < x \leq 60$	3
$60 < x \leq 70$	5

We do not know from grouped data where each value is placed so have to use an estimate for calculations

MID POINTS
Mid-points are used as estimated values for grouped data The middle of each group



Mid-point
Start point + End point
2

Two way tables R

60 people visited the zoo one Saturday morning. 26 of them were adults 13 of the adult's favourite animal was an elephant. 24 of the children's favourite animal was an elephant

Extract information to input to the two-way table

Subgroups each have their own heading

	Adult	Child	Total
Elephant	13	24	37
Other	13	10	23
Total	26	34	60

Needs subgroup totals — Overall total

Draw and interpret Pie Charts R

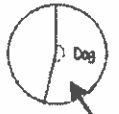
Type of pet	Dog	Cat	Hamster
Frequency	32	25	3

There were 60 people asked in this survey (Total frequency)

$\frac{32}{60}$ "32 out of 60 people had a dog"

This fraction of the 360 degrees represents dogs

$\frac{32}{60} \times 360 = 192°$



Use a protractor to draw This is 192°

Multiple method
Os 60 goes into 360 – 6 times
Each frequency can be multiplied by 6 to find the degrees (proportion of 360)

Comparing Pie Charts:
You NEED the overall frequency to make any comparisons

Primary data: data collected from an original source for a purpose.

Secondary data: data taken from an external location. Not collected directly.

Outlier: a value that stands apart from the data set.

Truncate: to shorten, to shorten a number (no rounding), to shorten a shape (remove a part of the shape).

Round: making a number simpler but keeping its place value close the what it originally was.

Credit: money that goes into a bank account.

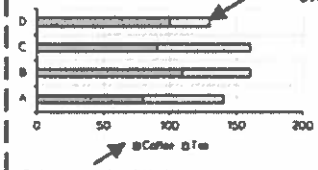
Debit: money that leaves a bank account.

Profit: the amount of money after income – costs.

Bar and line charts

Compare the bars green compared to yellow. The size of each bar is the frequency. Overall total easily comparable.

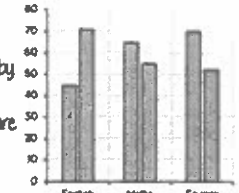
Composite bar charts



Categories clearly indicated

Dual bar charts

Bars are compared side by side. Easier to compare subgroups.



Categories clearly indicated

Averages from a table R

Non-grouped data

Number of Siblings	0	1	2
Frequency	6	8	6
Subtotal	0	8	12

Overall Frequency: 20

Total number of siblings: 20

The data in a list: 0,0,0,0,0,0,1,1,1,1,1,1,1,1,2,2,2,2,2,2

Mean: $\frac{\text{total number of siblings}}{\text{Total frequency}} = 1$

Grouped data

x Weight(g)	Frequency	Mid Point	MP x Freq
$40 < x \leq 50$	1	45	45
$50 < x \leq 60$	3	55	165
$60 < x \leq 70$	5	65	325

Overall Frequency: 9

Overall Total: 565

Mean: 62.8g

The data in a list: 45, 55, 55, 55, 65, 65, 65, 65, 65

Averages from lists R

The Mean

A measure of average to find the central tendency... a typical value that represents the data

24, 8, 4, 11, 8

Find the sum of the data (add the values)

55

Divide the overall total by how many pieces of data you have

$55 \div 5$

Mean = 11

The Mode (The modal value)

This is the number OR the item that occurs the most (it does not have to be numerical)

24, 8, 4, 11, 8

This can still be easier if it the data is ordered first

Mode = 8

The Median

The value in the center (in the middle) of the data

24, 8, 4, 11, 8

Put the data in order: 4, 8, 8, 11, 24

Find the value in the middle: 4, 8, 8, 11, 24

Median = 8

NOTE: If there is no single middle value find the mean of the two numbers left

For Grouped Data

The modal group – which group has the highest frequency

Tax: money that the government collects based on income, sales and other activities.

Balance: The amount of money in a bank account.

Overestimate: Rounding up – gives a solution higher than the actual value.

Underestimate: Rounding down – gives a solution lower than the actual value.

Stem and leaf

A way to represent data and use to find averages

This stem and leaf diagram shows the age of people in a line at the supermarket

0	7 9
1	4 5 6 8 8
2	1 3
3	0

Key: 1|4 Means 14 years old

Stem and leaf diagrams:
Must include a key to explain what it represents
The information in the diagram should be ordered

Back to back stem and leaf diagrams

Girls		Boys
5	14	
7, 5, 5, 5, 4	15	3, 8, 9
8, 4, 2, 1, 0	16	2, 5, 7, 7, 7, 8, 8, 9
9, 8, 7, 6, 6, 4, 2, 1, 1, 0, 0	17	0, 2, 3, 6, 6, 7, 7
	18	0, 1, 4, 5

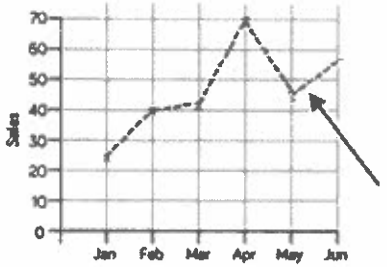
15 | 3
Means 153 cm tall

Back to back stem and leaf diagrams:
Allow comparisons of similar groups
Allow representations of two sets of data

Time-Series

R

This time-series graph shows the total number of car sales in £1000 over time



Look for general trends in the data. Some data shows a clear increase or a clear decrease over time.

Readings in-between points are estimates (on the dotted lines). You can use them to make assumptions.

Comparing distributions

Comparisons should include a statement of average and central tendency, as well as a statement about spread and consistency

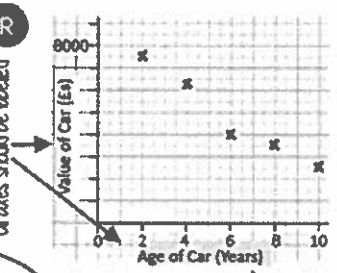
Mean, mode, median – allows for a comparison about more or less average.
Range – allows for a comparison about reliability and consistency of data

Draw and interpret a scatter graph

R

Age of Car (Years)	2	4	6	8	10
Value of Car (£s)	7500	6250	4000	3500	2500

- This data may not be given in size order
- The data forms information pairs for the scatter graph
- Not all data has a relationship



Both axes should be labelled

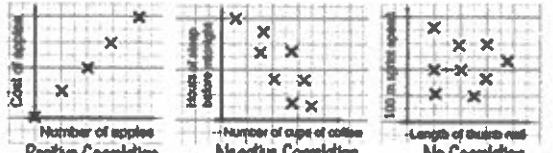
The axis should fit all the values on and be equally spread out

"This scatter graph shows as the age of a car increases the value decreases"

The link between the data can be explained verbally

Linear Correlation

R



Positive Correlation

As one variable increases so does the other variable

Negative Correlation

As one variable increases the other variable decreases

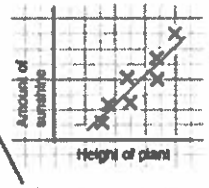
No Correlation

There is no relationship between the two variables

The line of best fit (R)

The Line of best fit is used to make estimates about the information in your scatter graph

Things to know
- The line of best fit DOES NOT need to go through the origin (The point the axes cross)
- There should be approximately the same number of points above and below the line (It may not go through any points)
- The line extends across the whole graph



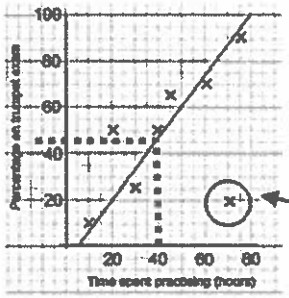
It is only an estimate because the line is designed to be an average representation of the data

It is always a straight line.

Using a line of best fit (R)

Interpolation is using the line of best fit to estimate values inside our data point

e.g 40 hours revising predicts a percentage of 45

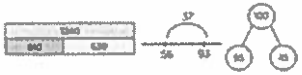


Extrapolation is where we use our line of best fit to predict information outside of our data

This is not always useful – in this example you cannot score more that 100%. So revising for longer can not be estimated

This point is an "outlier"
It is an outlier because it doesn't fit this model and stands apart from the data

Addition/ Subtraction



Modelling methods for addition/ subtraction
- Bar models
- Number lines
- Part/ Whole diagrams

Addition is commutative

6 + 3 = 3 + 6

The order of addition does not change the result

Subtraction the order has to stay the same

360 – 147 = 360 – 100 – 40 – 7

- Number lines help for addition and subtraction
- Working in 10's first aids mental addition/ subtraction
- Show your relationships by writing fact families

Formal written methods (R)

	H	T	O
	1	8	7
+	5	4	2

	H	T	O
	4	2	7
–	2	4	9

Remember the place value of each column
You may need to move 10 ones to the ones column to be able to subtract

Decimals have the same methods remember to align the place value

Division methods

3584 ÷ 7 = 512

Short division

$$7 \overline{)\,3\,{}^{3}5\;8\;{}^{1}4}\quad 5\;1\;2$$

Complex division

÷ 24 = ÷ 6 ÷ 4

Break up the divisor using factors

Division with decimals

The placeholder in division methods is essential – the decimal lines up on the dividend and the quotient

24 ÷ 0.02 ⟶ 24 ÷ 0.2 ⟶ 240 ÷ 2

Oil give the same solution as represent the same proportion
Multiply the values in proportion until the divisor becomes an integer

(R)

Multiplication methods

Long multiplication (column)

Grid method

Repeated addition

Less effective method especially for bigger multiplication

Multiplication with decimals (R)

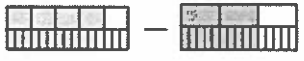
Perform multiplications as integers
e.g 0.2 x 0.3 ⟶ 2 x 3

Make adjustments to your answer to match the question: 0.2 x 10 = 2
0.3 x 10 = 3
Therefore 6 ÷ 100 = 0.06

Four operations with fractions

Addition and Subtraction

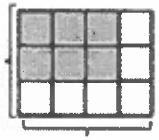
$\frac{4}{5} - \frac{2}{3}$



$\frac{12}{15} - \frac{10}{15} = \frac{2}{15}$

Multiplication

$\frac{3}{4} \times \frac{2}{3}$



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

Division

$\frac{2}{5} \div \frac{3}{4}$

$\frac{2}{5} \times \frac{4}{3}$

Multiplying by a reciprocal gives the same outcome

$= \frac{8}{15}$

R

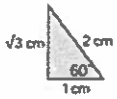
Exact Values

Leave in terms of π

$= \frac{120}{360} \times 36\pi$

$= \frac{1}{3} \times 36\pi = 12\pi$

Leave as a surd



$\tan 30 = \frac{1}{\sqrt{3}}$

Rounding R

2.46192 (to 12dp) - is this closer to 246 or 247

246 | 247

2.46 | 192

This shows the number is closer to 246

Significant Figures

370 to 1 significant figure is 400
37 to 1 significant figure is 40
3.7 to 1 significant figure is 4
0.37 to 1 significant figure is 0.4
0.00000037 to 1 significant figure is 0.0000004

SF: Round to the first non-zero number

Estimation R

Round to 1 significant figure to estimate

$21.4 \times 3.1 \approx 20 \times 3 \approx 60$

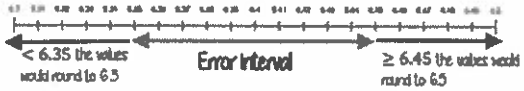
The equal sign changes to show it is an estimation

This is an underestimate because both values were rounded down

It is good to check all calculations with an estimate in all aspects of maths – it helps you identify calculation errors

Limits of accuracy

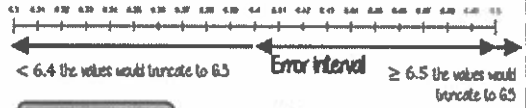
A width w has been rounded to 6.4cm correct to 1dp



The error interval $6.35 \leq w < 6.45$

Any value within these limits would round to 6.4 to 1dp

A width w has been truncated to 6.4cm correct to 1dp



$6.4 \leq w < 6.5$

Any value within these limits would truncate to 6.4 to 1dp

Year 10 Maths Knowledge Organiser: Summer 2 – Using number (Chapter 6) and Expressions (Chapter 7)

By the end of this half-term, you should be able to:

6.2 – Types of number & sequences	6.3 – Indices & roots	7.0 – Manipulating expressions
• Understand factors and multiples • Express numbers as a product of primes • Find the HCF and LCM • Describe and continue sequences • Explore sequences • Find the nth term of a linear sequence	• Identify square and cube numbers • Calculate higher powers and roots • Understand powers of 10 and standard form • Know the addition and subtraction rule for indices • Understand power zero and negative indices • Calculate with numbers in standard form	• Simplify algebraic expressions • Add and subtract simple algebraic fractions • Multiply and divide simple algebraic fractions • Solve equations with algebraic fractions

Keywords

Factor: numbers we multiply together to make another number.

Multiple: the result of multiplying a number by an integer.

HCF: highest common factor. The biggest factor that numbers share.

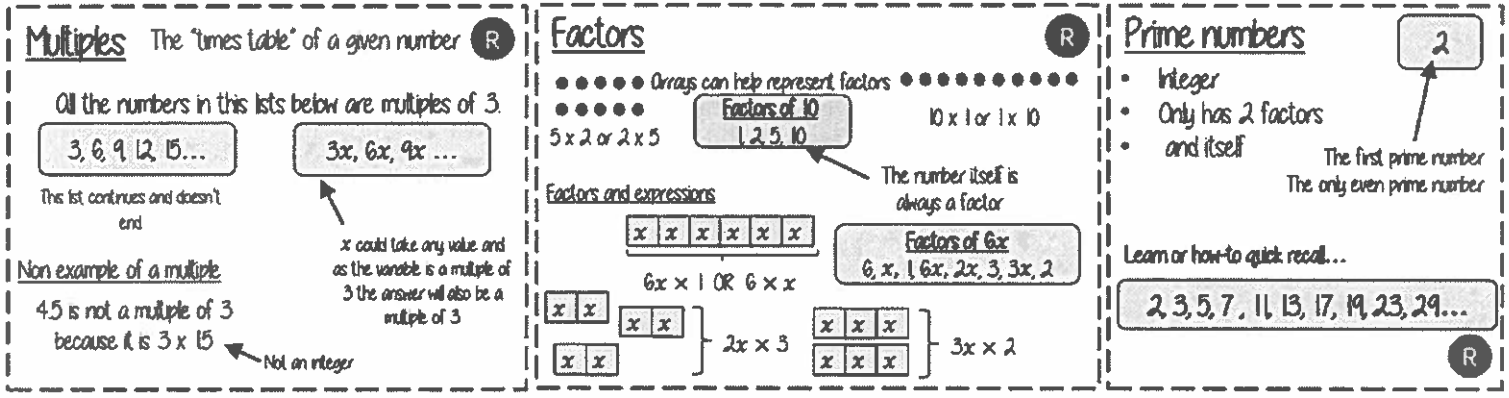
LCM: lowest common multiple. The first multiple numbers share.

Arithmetic: a sequence where the difference between the terms is constant.

Preparing for Assessment

- Login to **Maths Watch** and complete your independent tasks each week. Attempt all questions and aim to get at least 80% correct. Remember, you can watch the videoclip attached to each question to help you understand the topic better.
- Use **'Read, Cover, Write, Check'** to test your understanding on the key words and core knowledge in this organiser.

Core Knowledge



Geometric: a sequence where each term is found by multiplying the previous one by a fixed nonzero number.

Sequence: items or numbers put in a pre-decided order.

Standard (index) Form: A system of writing very big or very small numbers.

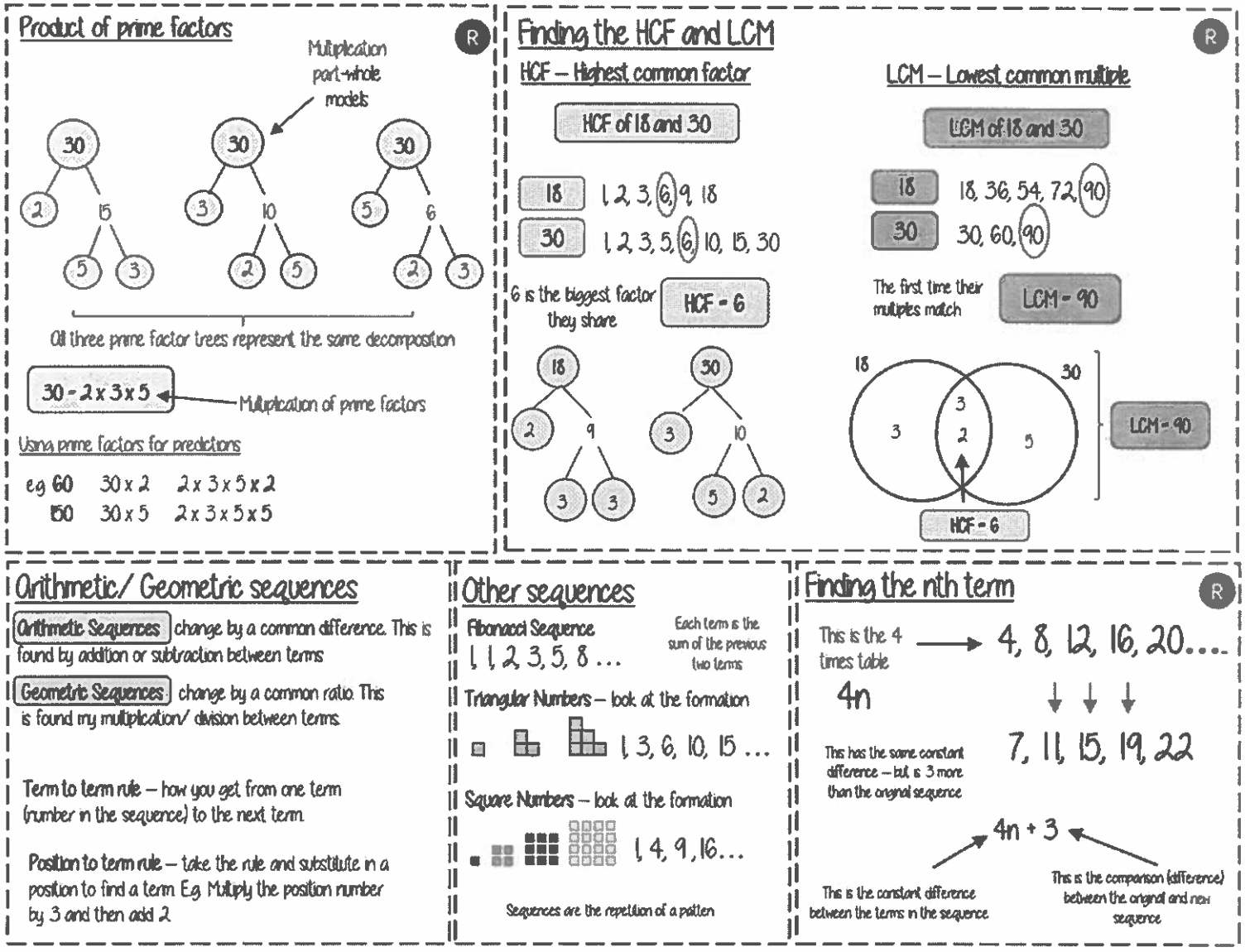
Commutative: an operation is commutative if changing the order does not change the result.

Base: The number that gets multiplied by a power.

Power: The exponent – or the number that tells you how many times to use the number in multiplication.

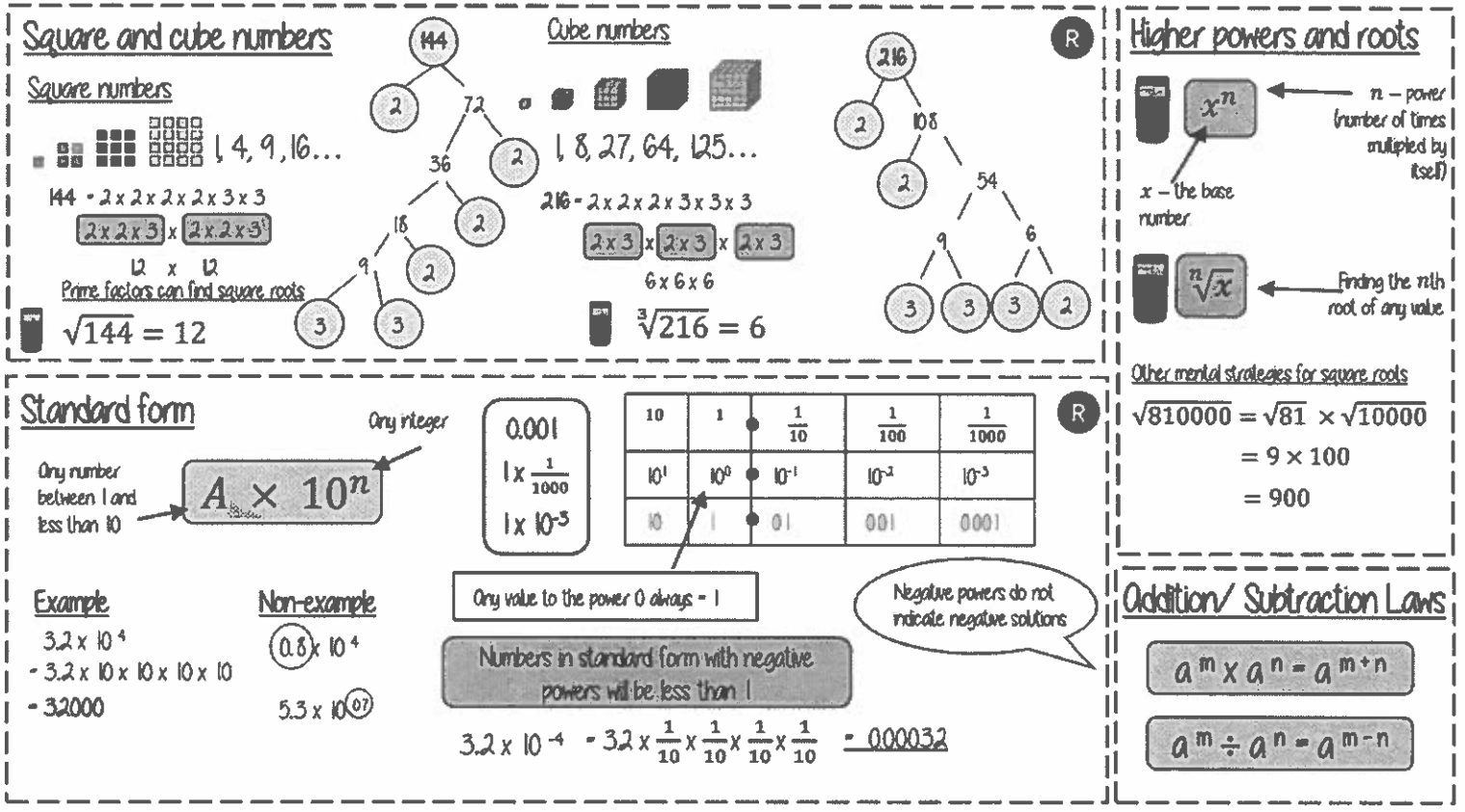
Exponent: The power – or the number that tells you how many times to use the number in multiplication.

Indices: The power or the exponent.



Negative: A value below zero.

Coefficient: The number used to multiply a variable.



Zero and negative indices

$$x^0 = 1$$

Any number divided by itself = 1

$$\frac{a^6}{a^6} = a^6 \div a^6$$

$$= a^{6-6} = a^0 = 1$$

Negative indices do not indicate negative solutions

$2^2 = 4$
$2^1 = 2$
$2^0 = 1$
$2^{-1} = \frac{1}{2}$
$2^{-2} = \frac{1}{4}$

Looking at the sequence can help to understand negative powers

Powers of powers

$$(x^a)^b = x^{ab}$$

$$(2^3)^4 = \underbrace{2^3 \times 2^3 \times 2^3 \times 2^3}$$

The same base and power is repeated. Use the addition law for indices

$$(2^3)^4 = 2^{12} \leftarrow a \times b = 3 \times 4 = 12$$

NOTICE the difference

$$(2x^3)^4 = \underbrace{2x^3 \times 2x^3 \times 2x^3 \times 2x^3}$$

The addition law applies ONLY to the powers. The integers still need to be multiplied

$$(2x^3)^4 = 16x^{12}$$

Standard form calculations

R

Addition and Subtraction

Tip: Convert into ordinary numbers first and back to standard from at the end

$6 \times 10^5 + 8 \times 10^5$

Method 1

- 600000 + 800000
- 1400000
- 1.4×10^5

Method 2

- $(6 + 8) \times 10^5$
- 14×10^5
- $1.4 \times 10^1 \times 10^5$
- 1.4×10^5

This is not the final answer

Multiplication and division

$\frac{1.5 \times 10^5}{0.3 \times 10^3}$ ← Division questions can look like this

$(1.5 \times 10^5) \div (0.3 \times 10^3)$

$(1.5 \div 0.3) \times 10^5 \div 10^3$

$= 5 \times 10^2$

For multiplication and division you can look at the values for N and the powers of 10 as two separate calculations

Science

Physics 3 – Particle model of matter

Summary- Position in the Curriculum

The particle model is widely used to predict the behaviour of solids, liquids and gases and this has many applications in everyday life. It helps us to explain a wide range of observations and engineers use these principles when designing vessels to withstand high pressures and temperatures, such as submarines and spacecraft. It also explains why it is difficult to make a good cup of tea high up a mountain!

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Density	It is the mass per unit volume of a substance	The **density** of a material is defined by the equation: density = mass volume ρ = m V density, ρ, in kilograms per metre cubed, kg/m3 mass, m, in kilograms, kg volume, V, in metres cubed, m3	Revision and self-study questions are below. Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research.
Internal energy	Internal energy is the total kinetic energy and potential energy of all the particles (atoms and molecules) that make up a system.	The **particle model** can be used to explain the different states of matter and the differences in density. When substances change state (melt, freeze, boil, evaporate, condense or sublimate), mass is conserved. **Changes of state** are physical changes which differ from chemical changes because the material recovers its original properties if the change is reversed.	*1.* Describe how the equipment in Figure 1 can be used to find the density of the irregular shaped object.
The specific latent heat	The specific latent heat of a substance is the amount of energy required to change the state of one kilogram of the substance with no change in temperature.	**Heating** changes the energy stored within the system by increasing the energy of the particles that make up the system. This either raises the temperature of the system or produces a change of state **Specific latent heat of fusion** – change of state from solid to liquid **Specific latent heat of vaporisation** – change of state from liquid to vapour	*2* A plumber uses a blowtorch to melt a 0.5 kg bar of soft solder whilst making solder joints. The amount of energy supplied to melt the bar of soft solder is 22 500J. Calculate the latent heat of fusion of soft solder
Pressure	Force per unit cross-sectional area for a force acting on a surface at right angles to the surface. The unit is the pascal (Pa) or N/m^2	**Energy for a change of state** = mass × specific latent heat E = m L energy, E, in joules, J mass, m, in kilograms, kg specific latent heat, L, in joules per kilogram, J/kg	**2.** An ice cube at 0°C is placed in a beaker of water to cool the water down. Describe the energy changes of the particles of the ice and the water that takes place.
Temperature	A measure of the kinetic energy of particles	The **molecules of a gas** are in constant random motion. Changing the temperature of a gas, held at constant volume, changes the **pressure** exerted by the gas.	*4* Describe how a gas causes pressure on the wall of the container it is in.
Melting point	Temperature at which a pure substance melts or freezes (solidifies)	A **heating curve** or a **cooling curve** shows the temperature change of a substance over time, including changes of state. The changes of state are shown by a horizontal line as there are **no temperature changes** during a change of state	*5* Explain using the kinetic theory of matter, why liquids and solids are much denser than gases.

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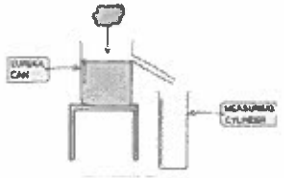
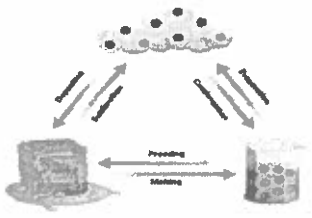
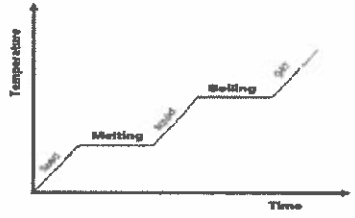
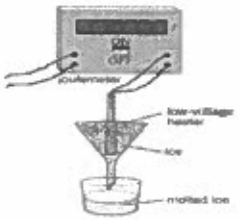
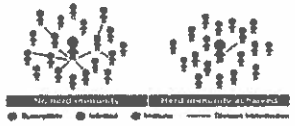
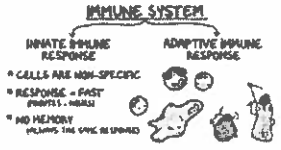
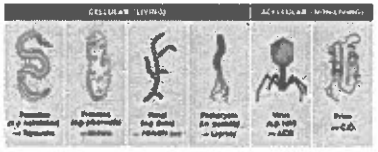
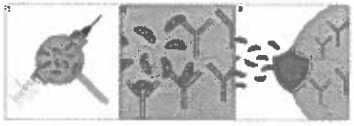
 Fig 1			

Biology B3- Infection and response

Summary- Position in the Curriculum

Pathogens are microorganisms that cause infectious diseases in animals and plants. They depend on their host to provide the conditions and nutrients that they need to grow and reproduce. They produce toxins that damage tissues. This topic covers the causes and effects of communicable diseases, the body's defense mechanisms against pathogens, and how diseases can be treated and prevented. It explores bacterial, viral, fungal, and protist diseases, the immune system, vaccination, and the use of drugs to treat disease.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Pathogen	A microorganism that causes disease	Types of pathogens: Bacteria, viruses, fungi, and protists. Pathogens cause disease through direct damage to cells or by producing toxins. Examples of Diseases are: bacterial- tuberculosis, salmonella, viral- influenza, HIV/AIDS, measles, fungal: athlete's foot, ringworm, protist: malaria.	Revision and self-study questions are below. Answer 1 per week for Self- Study. You can draw on your notes, this organiser, your memory and own research.
Communicable Disease	An infectious disease transmissible by direct contact with an affected individual or their discharges.	Good hygiene through regular hand washing, sanitisation, and safe food practices can prevent spreading of the communicable diseases. Other methods include quarantine and isolation, that is limiting contact with infected individuals. By vector control organisms that transmit diseases can be managed or eliminated (e.g., mosquitoes for malaria).	*1. Give examples of diseases caused by bacteria, viruses, fungi, and protists. What are the potential consequences of antibiotic resistance? Explain the importance of hygiene in preventing the spread of communicable diseases.*
Immune System	The body's defense against infectious organisms and other invaders.	First line of defense: skin, mucus, and stomach acid prevent pathogen entry. Second line of defense: white blood cells (phagocytes) engulf and destroy pathogens. Third line of defense: lymphocytes produce antibodies specific to antigens on pathogens. Memory cells: retain information about pathogens for faster response upon re-infection.	*2. Explain how the body's first line of defense works to prevent infection. What are the roles of white blood cells in defending the body against pathogens?*
Vaccination	The administration of a vaccine to stimulate an immune response for protection against specific diseases.	Vaccines introduce a harmless form of the pathogen to stimulate an immune response without causing the disease. They provide immunity, help achieve herd immunity, reduce spread of infectious diseases.	*3. How do vaccines help protect against disease?*
Herd Immunity	Resistance to the spread of a contagious disease within a population because a high percentage of individuals are immune, typically through vaccination		*4. What is herd immunity and why is it important?*
Antibiotic, antiviral	A type of antimicrobial drug used to treat bacterial infections. A type of medication used specifically for treating viral infections. 	**Antibiotics**: Treat bacterial infections but are ineffective against viruses. **Antivirals**: Treat viral infections by inhibiting virus development. **Painkillers**: Relieve symptoms but do not kill pathogens. Traditionally drugs were extracted from plants and microorganisms. Most new drugs are synthesised by chemists. However, the starting point may still be a chemical extracted from a plant.  	*5. Discuss how antibiotics work and why they are not effective against viruses.* 

Physics 4 – Atomic structure

Summary- Position in the Curriculum

Ionising radiation is hazardous but can be very useful. Although radioactivity was discovered over a century ago, it took many nuclear physicists several decades to understand the structure of atoms, nuclear forces and stability. Early researchers suffered from their exposure to ionising radiation. Today radioactive materials are widely used in medicine, industry, agriculture and electrical power generation.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Isotopes	Atoms with the same number of protons and different numbers of neutrons	In **an atom** the number of electrons is equal to the number of protons in the nucleus. Atoms have no overall electrical charge. The number of protons in an atom of an element is called its **atomic number**. The total number of protons and neutrons in an atom is called its **mass number**.	Revision and self-study questions are below. Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research.
Activity	The number of unstable atoms that decay per second in a radioactive source. Activity is measured in becquerel (Bq)	Some atomic nuclei are unstable. The nucleus gives out radiation as it changes to become more stable. This is a random process called **radioactive decay**.	***1.*** Describe the differences between the plum pudding model of the atom and the nuclear model of the atom.
Half-life	Average time taken for the number of nuclei of the isotope (or mass of the isotope) in a sample to halve	The nuclear radiation emitted may be: • **an alpha particle** (α) – this consists of two neutrons and two protons; it is the same as a helium nucleus • **a beta particle** (β) – a high-speed electron ejected from the nucleus as a neutron turns into a proton • **a gamma ray** (γ) – electromagnetic radiation from the nucleus • **a neutron** (n)	***2*** The bone contains traces of carbon-14, a radioactive isotope of carbon. Only 1/4 of the C-14 is left not decayed in the bone. The half-life of C-14 is 5730 years. Calculate the age
Irradiated	An object that has been exposed to ionising radiation, but it does no become radioactive.	**Alpha decay** causes both the mass and charge of the nucleus to decrease. **Beta decay** does not cause the mass of the nucleus to change but does cause the charge of the nucleus to increase. The emission of a **gamma ray** does not cause the mass or the charge of the nucleus to change.	***3*** Complete the alpha decay equation $^{242}_{95}Am \longrightarrow$
Radioactive Contamination	The unwanted presence of materials containing radioactive atoms on other materials	**Alpha, beta and gamma radiation** ionise substances they pass through. Ionisation in a living cell can damage or kill the cell. Damage to the genes in a cell can be passed on if the cell generates more cells.	***4*** Explain why ionising radiation is dangerous. Explain how you would use a Geiger counter to find the range of the radiation from a source of alpha.
Count rate	The number of counts per second detected by a Geiger counter	**Radioactive contamination** is the unwanted presence of materials containing radioactive atoms on other materials. The hazard from contamination is due to the decay of the contaminating atoms. The type of radiation emitted affects the level of hazard.	***5*** Explain why the mass of a He nucleus is 4 times the mass of a hydrogen nucleus and its charge is only twice as much as the charge of a H nucleus.

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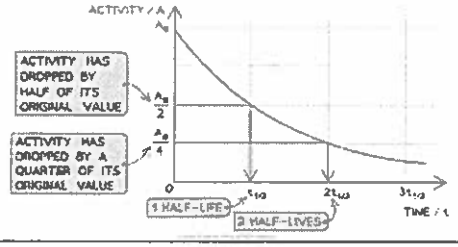
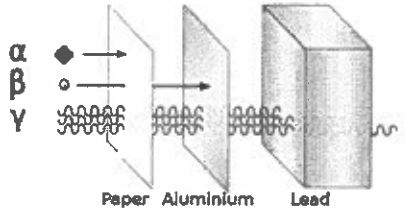
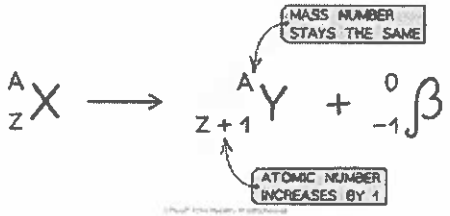
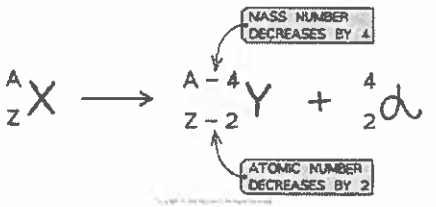
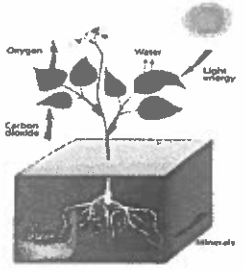
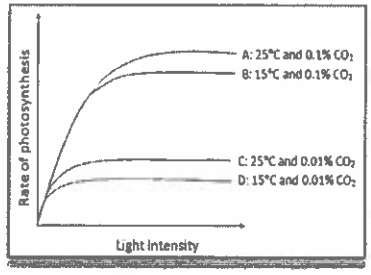
			

AQA B4 Bioenergetics Knowledge Organiser

Summary- Position in the Curriculum

In Bioenergetics we explore how plants harness the Sun's energy in photosynthesis in order to make food. This process liberates oxygen which has built up over millions of years in the Earth's atmosphere. Both animals and plants use this oxygen to oxidise food in a process called aerobic respiration which transfers the energy that the organism needs to perform its functions. Conversely, anaerobic respiration does not require oxygen to transfer energy. During vigorous exercise the human body is unable to supply the cells with sufficient oxygen and it switches to anaerobic respiration. This process will supply energy but also causes the build-up of lactic acid in muscles which causes fatigue.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Photosynthesis	Photosynthesis is a chemical reaction which takes place in plants. It converts carbon dioxide and water into glucose and oxygen. It uses light energy to power the chemical reaction, which is absorbed by the green pigment chlorophyll.	Plants acquire the carbon dioxide via diffusion through the stomata of their leaves. The water is absorbed from the soil through the roots and transported to the cells carrying out photosynthesis, via the xylem. $6CO_2$ Carbon dioxide + $6H_2O$ Water —(Light, Chlorophyll)→ $C_6H_{12}O_6$ Glucose + $6O_2$ Oxygen The glucose made in photosynthesis is used for respiration, stored as starch, fat or oils, used to produce cellulose or used to produce amino acids for protein synthesis.	Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research. 1. Describe the process of photosynthesis with word and balanced symbolic equations.
limiting factor	A limiting factor is something which stops the photosynthesis reaction from occurring at a faster rate. Temperature, light intensity and carbon dioxide level are all limiting factors.	Increasing the temperature of the surroundings will increase the rate of reaction, but only up to around 45°C. At around this temperature, the enzymes which catalyse the reaction become denatured. Increasing the light intensity will increase the rate of reaction because there is more energy to carry out more reactions. Increasing the carbon dioxide concentration will also increase the rate of reaction because there are more reactants available.	2. *Describe how commercial farmers improve the environmental conditions to maximise photosynthesis and ensure they make a profit.*
Respiration	Respiration is the chemical reaction which occurs inside the mitochondria of all living cells to release energy for living functions and processes.	Subatomic Particles and Atomic Structure: The atom comprises protons with positive charges and neutrons with no charge in the nucleus, and electrons with negative charges in orbits. The number of protons determines an element's atomic number. Respiration can be either aerobic (using oxygen) or anaerobic (without using oxygen). In anaerobic respiration, the glucose is not completely oxidised. This means that there is less energy released than in aerobic respiration.	3. *Photosynthesis is affected by limiting factors. Describe what is meant by the term 'limiting factor'?*
Metabolism	Metabolism is the combination of all the reactions in a cell or in the body	Energy released during respiration is used during metabolic processes to synthesise new molecules: Glucose is converted to starch, glycogen and cellulose. Glycerol and three fatty acids are joined to form a lipid molecule. Glucose and nitrate ions are joined to form amino acids.	4. *Describe the process of respiration with word and balanced symbolic equations* 5. *Describe the importance of metabolism.*
		glucose + oxygen → carbon dioxide + water + energy $C_6H_{12}O_6 + 6O_2 \Rightarrow 6CO_2 + 6H_2O + ATP$	

Chemistry – Quantitative Chemistry

Summary- Position in the Curriculum

Quantitative chemistry allows chemists to calculate the quantities of reactants and products in chemical reactions. This helps in determining the yield of reactions, monitoring purity, and ensuring the efficient use of resources. Understanding these calculations is fundamental for various applications in laboratory and industrial settings.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Mole	The amount of substance that contains the same number of entities as there are atoms in 12 grams of carbon-12.	**Mass Changes**: When a gas is a reactant or product, the total mass may appear to change if the gas escapes or is absorbed from the surroundings.	Revision and self-study questions are below. Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research.
Relative Formula Mass (Mr)	The sum of the relative atomic masses of the atoms in the formula of a compound.	**Calculations with Moles**: Determine the mass of a substance using its molar mass (mass of one mole). Molar mass is equivalent to the relative formula mass expressed in grams.	1. Define and calculate the relative atomic mass and relative formula mass.
Concentration	The amount of a substance (solute) present in a certain volume of solution.	**Balanced Equations and Moles**: Use the coefficients in balanced equations to relate the moles of reactants to moles of products.	2. Explain the law of conservation of mass and apply it to chemical reactions
Limiting Reactant	The reactant that is completely consumed in a reaction, thus determining the maximum amount of product formed.	**Limiting Reactants**: Identify the reactant that limits the amount of product formed. Calculate the remaining amounts of other reactants.	3. Understand and calculate percentage yield and its significance in industrial chemistry.
Percentage Yield	The ratio of the actual yield to the theoretical yield, expressed as a percentage.	**Concentration of Solutions**: Calculated as the amount of solute divided by the volume of the solution (mol/dm^3). Important for reactions in solution.	4. Explain and use the mole concept to calculate the number of particles in a given mass.
Avogadro's Constant	Number of atoms, molecules, or ions in one mole of a substance $6.022X10^{23}$	**Conservation of Mass**: In a chemical reaction, the total mass of the products equals the total mass of the reactants. No atoms are lost or gained, only rearranged.	5. Determine the limiting reactant in a chemical reaction and calculate the amount of product formed.

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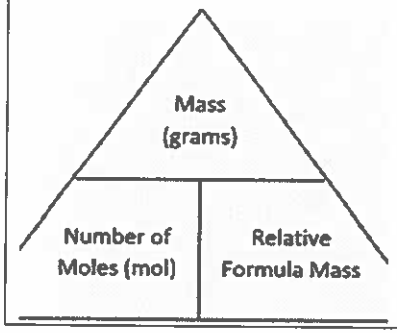
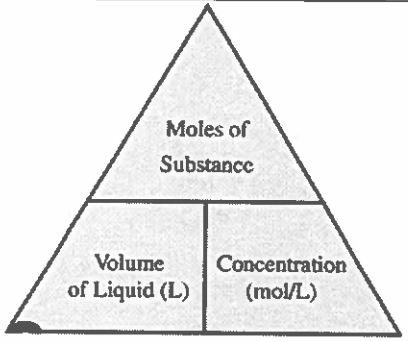
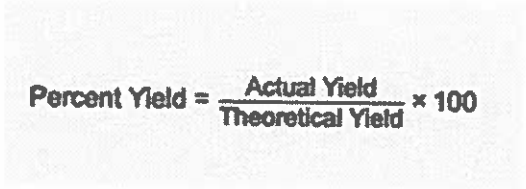
		$MgCl_2$ $(1x24)+(2x35.5)$ $24+71$ $=95$	

Chemistry – Chemical Changes

Summary- Position in the Curriculum

Understanding chemical changes is crucial in chemistry as it involves the study of reactions and how substances transform into different substances. This knowledge is fundamental in predicting reaction outcomes, developing new materials, and extracting valuable resources. It also provides insights into biochemical processes and industrial applications.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Reactivity Series	A series of metals arranged in order of their reactivity from highest to lowest.	**Neutralisation and Salt Production**: Acids react with bases to form salts and water. For example, sulfuric acid reacts with sodium hydroxide to produce sodium sulphate and water.	Revision and self-study questions are below. Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research.
Oxidation	The process in which a substance gains oxygen or loses electrons.	**Soluble Salts**: Soluble salts can be prepared by reacting acids with solid insoluble substances like metals, metal oxides, hydroxides, or carbonates.	1. Explain the reactivity series and predict the outcomes of metal reactions.
Electrolysis	A process that uses electricity to cause a chemical change, usually the decomposition of a compound into its elements.	**The Process of Electrolysis**: Electrolysis involves passing an electric current through a substance to cause a chemical change. It is used to decompose ionic compounds.	2. Describe oxidation and reduction in terms of oxygen and electrons and Explain the reactivity series and predict the outcomes of metal reactions
Displacement Reaction	A reaction in which a more reactive element displaces a less reactive element from its compound.	**Electrolysis of Molten Ionic Compounds**: Molten ionic compounds can be electrolyzed to produce elements. For example, electrolyzing molten sodium chloride produces sodium and chlorine.	3. Explain the process of electrolysis and its applications in extracting metals.
Neutralisation	A chemical reaction in which an acid and a base react to form a salt and water.	**Extraction of Metals**: Electrolysis is used to extract metals that are too reactive to be extracted by reduction with carbon, such as aluminium.	4. Predict the products of electrolysis of molten and aqueous ionic compounds.
Salt	A compound formed when the hydrogen ion in an acid is replaced by a metal ion or another positive ion.	**Electrolysis of Aqueous Solutions**: Electrolysis of aqueous solutions involves the discharge of ions depending on their reactivity. For example, electrolyzing brine produces hydrogen, chlorine, and sodium hydroxide.	5. Explain the process of making salts and provide examples.

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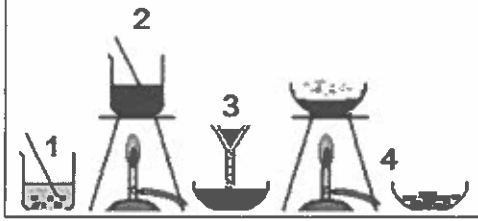	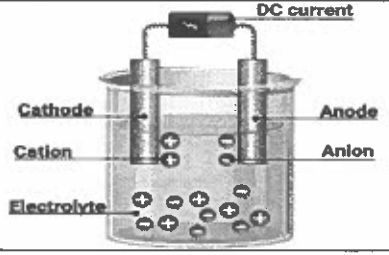		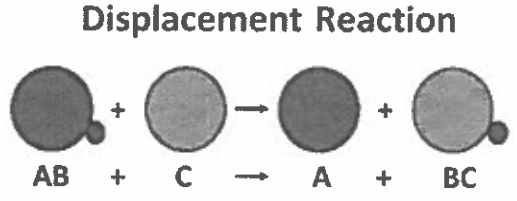

Physics 4 – Forces

Summary- Position in the Curriculum

Engineers analyse forces when designing a great variety of machines and instruments, from road bridges and fairground rides to atomic force microscopes. Anything mechanical can be analysed in this way. Recent developments in artificial limbs use the analysis of forces to make movement possible.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Vector	A vector is a physical quantity, such as displacement or velocity, that has a magnitude and a direction (unlike a scalar which has magnitude only)	The **weight** of an object may be considered to act at a single point referred to as the object's 'centre of mass'. Weight = mass × gravitational field strength $W = m \times g$ W = weight in Newtons, N, m = mass in Kg and g = gravitational field strength, N/Kg When a force causes an object to move through a distance **work is done** on the object. Work done = force × distance $W = F \times S$ 1 Joule – 1 Newton-metre	Revision and self-study questions are below. Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research.
A free-body diagram	A diagram that shows the forces acting on an object without any other objects or forces shown	A force that stretches (or compresses) a spring does work and elastic potential energy is stored in the spring. Provided the spring is not **inelastically deformed**, the **work done** on the spring and the **elastic potential energy** (Ee) stored are equal. Force (F) = Spring constant (k) × extension(e) $Ee = \frac{1}{2} \times k \times e^2$	***1.*** A Parachutist of mass 70 kg supported by a parachute of mass 20 kg reaches a constant speed. Explain why?
Conservation of momentum	In a closed system, the total momentum before an event is equal to the total momentum after the event.	Average acceleration can be calculated using: acceleration = change in velocity/time $a = \Delta v/t$ a=acceleration, m/s^2 Δv=change in velocity, m/s t = time, s An object that slows down is **decelerating. Uniform acceleration** is calculated using: $(\text{final velocity})^2 - (\text{initial velocity})^2 = 2 \times \text{acceleration} \times \text{distance}$	2.When an aeroplane is at cruising altitude, its engine produces a force of 25000N towards North. A wind blows with a force of 5000N due East. Draw a vector diagram to calculate the resultant force and its direction.
Inertia	The tendency of an object to stay at rest or to continue in uniform motion	**Newton's laws 1st law** - If the resultant force acting on an object is zero and: • the object is stationary, the object remains stationary • the object is moving, the object continues to move at the same speed and in the same direction. So, the object continues to move at the same velocity.	***3.*** A car is travelling along a straight road. The driver suddenly observes that the road ahead is flooded and applies the brakes. Describe what happens to the car and the brakes.
Terminal velocity	The velocity reached by an object when the drag force on it is equal and opposite to the force making it move	**2nd law** -resultant force = mass × acceleration F = m a force, F, in newtons, N mass, m, in kilograms, kg acceleration, a, in metres per second squared, m/s2 **3rd law** -Whenever two objects interact, the forces they exert on each other are equal and opposite	***4.*** Calculate the extension of a guitar string pulled by a force of 13N. The spring constant of the guitar string is 20000 N/m
Stopping distance	The distance travelled by the vehicle in the time it takes for the driver to think and brake	**Momentum** is defined by the equation: momentum = mass × velocity $p = m v$ momentum, p, in kilograms metre per second, kg m/s mass, m, in kilograms, kg velocity, v, in metres per second, m/s	***5.*** Write experimental methods to investigate how easily a spring stretches by hanging weights and how steepness of a runway affects a trolley's motion.

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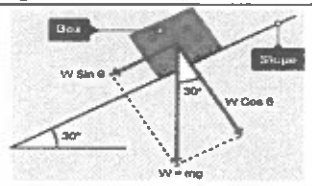	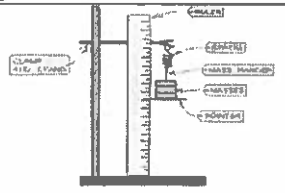	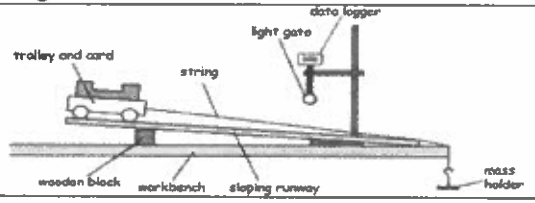	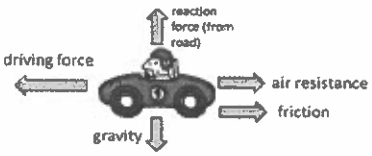

Chemistry – Energy Changes

Summary- Position in the Curriculum

Energy changes are an essential part of chemical reactions. Understanding how energy is transferred during chemical reactions helps in predicting the feasibility of reactions, designing energy-efficient processes, and developing new technologies. Exothermic reactions release energy to the surroundings, while endothermic reactions absorb energy.

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Exothermic Reaction	A chemical reaction that releases energy to the surroundings, usually in the form of heat.	**Energy Level Diagrams**: These show the relative energies of reactants and products, the activation energy, and the overall energy change. They help in identifying whether a reaction is exothermic or endothermic	Revision and self-study questions are below. Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research.
Endothermic Reaction	A chemical reaction that absorbs energy from the surroundings.	**Energy Transfer**: Energy is conserved in chemical reactions. The total energy of the reactants is equal to the total energy of the products plus any energy transferred to the surroundings.	1. Draw and interpret reaction profiles for exothermic and endothermic reactions.
Activation Energy	The minimum amount of energy required for reactants to undergo a chemical reaction.	**Activation Energy**: The minimum energy needed for a reaction to occur. Represented as the peak of the energy curve in a reaction profile.	2. Explain the concept of activation energy and its role in chemical reactions.
Reaction Profile	A diagram showing the energy changes during the course of a reaction, indicating the activation energy and the overall energy change.	**Bond Energy Calculations**: Calculate the energy needed to break bonds in the reactants and the energy released when bonds are formed in the products. The difference gives the overall energy change of the reaction.	3. Calculate energy changes in reactions using bond energies.
Bond Energy	The amount of energy needed to break one mole of a particular bond in a gaseous molecule.	**Exothermic Reactions**: More energy is released from forming new bonds than is needed to break existing bonds.	4. Evaluate the uses and applications of exothermic and endothermic reactions given appropriate information.
Catalyst	A substance that increases the rate of a chemical reaction without being consumed in the process	**Endothermic Reactions**: More energy is needed to break existing bonds than is released from forming new bonds.	5. Distinguish between exothermic and endothermic reactions based on temperature changes.

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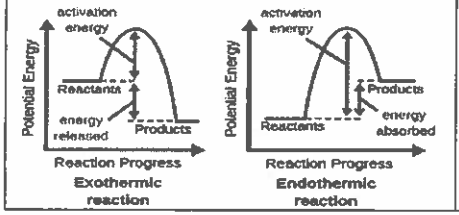

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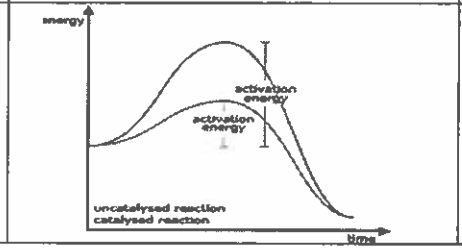

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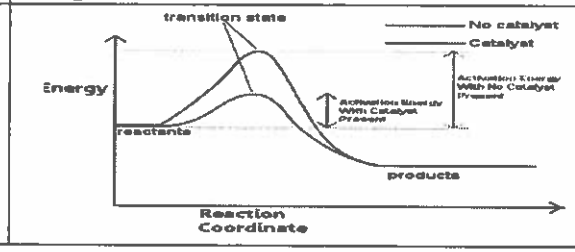

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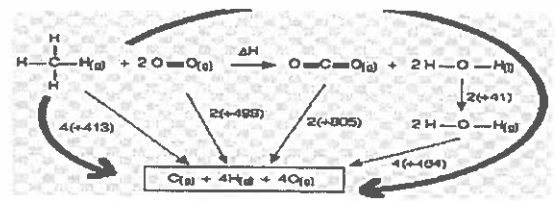


Triple Science – Chemistry – chemical Calculations

Summary- Position in the Curriculum

Terminology	Definitions	Core Knowledge	Preparing for Assessment
theoretical yield	The mass of a product that you expect to be produced in a chemical reaction	Even though no atoms are gained or lost during a chemical reaction, it is not always possible to obtain the theoretical yield because • some of the product can be lost when it is separated from the reaction mixture • there can be unexpected side reactions between reactants that produce different products • the reaction may be reversible	Revision and self-study questions are below.
Excess and limiting reactants	In a chemical reaction between two or more reactants, often one of the reactants will run out before the others. You then have some of the other reactants left over. The reactant that is left over is in excess. The reactant that runs out first is the limiting reactant.	To work out which reactants are in excess and which is the limiting reactant, you need to: 1 write the balanced symbol equation for the reaction 2 pick one of the reactants and its quantity as given in the question 3 use the ratio of the reactants in the balanced equation to see how much of the other reactant you need 4 compare this value to the quantity given in the question 5 determine which reactant is in excess and which is limiting.	Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research.
Percentage yield	The yield is the amount of product that you actually get in a chemical reaction.	Percentage yield is the actual yield as a proportion of the theoretical yield: percentage yield = actual yield theoretical yield × 100	1. *List the factors that affect the yield in a reaction and explain why the yield will never be 100%*
Avogadro's constant	One mole of a substance contains 6.02 × 1023 atoms, ions, or molecules. This is Avogadro's constant.	One mole of a substance has the same mass as the Mr of the substance. For example, the Mr (H2 O) = 18, so 18g of water molecules contains 6.02 × 1023 molecules, and is called one mole of water. You can write this as: moles = mass Mr	2. *What is the theoretical yield of a reaction and explain why the actual yield is usually less than the theoretical yield.*
Titration	Titration is an experimental technique to work out the concentration of an unknown solution in the reaction between an acid and an alkali.	Use a pipette to extract a known volume of the solution with an unknown concentration. A pipette measures a fixed volume only. 2 Add the solution of unknown concentration to a conical flask. Put the conical flask on a white tile to see the colour change better. 3 Add a few drops of a suitable indicator to the conical flask. 4 Add the other solution with a known concentration to the burette. 5 Carry out a rough titration to find out approximately what volume of solution in the burette needs to be added to the solution in the conical flask. Add the solution from the burette to the solution in the conical flask 1cm3 at a time until the end point is reached. 6 The end point is when the indicator just changes colour. 7 Record the volume on the burette at the end point as your rough value. 8 Repeat steps 1–7 three times, but as you approach the end point add the solution drop-by-drop. Swirl the conical flask in between drops. 9 Record the volume on the burette at the end point each time.	3. *Calculate the number of moles of gas present in 36dm³ of carbon dioxide* 4. *Ammonia gas is made by heating the gases Nitrogen and Hydrogen with and iron catalyst under pressure. The equation is shown below:* $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ *Calculate the percentage yield if 7.0g of nitrogen are reacted with excess hydrogen and 1.8g of ammonia is collected*

Using balanced equations H

In a balanced symbol equation the sum of the M_r of the reactants equals the sum of the M_r of the products.

If you are asked what mass of a product will be formed from a given mass of a specific reactant, you can use these steps to calculate the result:

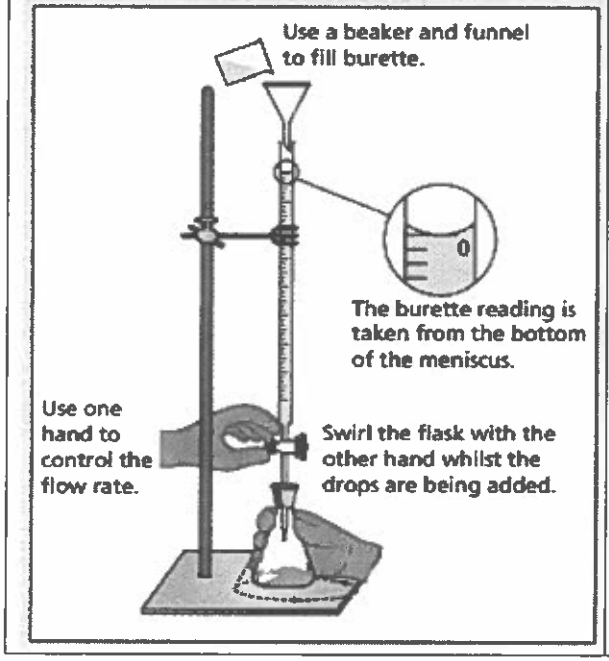
1 balance the symbol equation
2 calculate moles of the substance with a known mass using: $\text{moles} = \frac{\text{mass}}{M_r}$
3 using the balanced symbol equation, work out the number of moles of the unknown substance
4 calculate the mass of the unknown substance using mass = moles × M_r

If you are asked to balance an equation, given the masses of reactants and products you can use these steps to work out the answer:

1 work out M_r of all the substances
2 calculate the number of moles of each substance in the reaction using: $\text{moles} = \frac{\text{mass}}{M_r}$
3 convert to the simplest whole-number ratio
4 balance the symbol equation

5. Name 2 pieces of equipment used to measure volume during a titration and describe the correct way to read volume from these pieces of equipment. Describe what is meant by the "end point in a titration and explain the process of adding solution from the burette when we near the "end point".

Titration



Atom economy calculations

Atom economy

The **atom economy** of a reaction tells you the proportion of atoms that you started with that are part of *useful* products.

High atom economies are more sustainable, as they mean fewer atoms are being wasted in products that are not useful.

The percentage atom economy is calculated by:

$$\text{atom economy} = \frac{M_r \text{ of useful product}}{M_r \text{ of } \textit{all} \text{ products}} \times 100$$

Concentration calculations

Concentration

Concentration is the amount of solute in a volume of solvent.

The unit of concentration is g/dm³. Concentration can be calculated using:

$$\text{concentration (g/dm}^3\text{)} = \frac{\text{mass (g)}}{\text{volume (dm}^3\text{)}}$$

Sometimes volume is measured in cm³, and you can convert it to dm³ using:

$$\text{volume (dm}^3\text{)} = \frac{\text{volume (cm}^3\text{)}}{1000}$$

- lots of solute in little solution = high concentration
- little solute in lots of solution = low concentration

Calculating moles in gases

Moles of gases H

At any given temperature and pressure, the same number of moles of a gas will occupy the same volume.

At room temperature (25 °C) and pressure (1 atm), one mole of *any* gas will occupy 24 dm³.

To calculate the number of moles of a gas:

$$\text{moles of a gas} = \frac{\text{volume (dm}^3\text{)}}{24\,\text{dm}^3}$$

or

$$\text{moles of a gas} = \frac{\text{volume (cm}^3\text{)}}{24000\,\text{cm}^3}$$

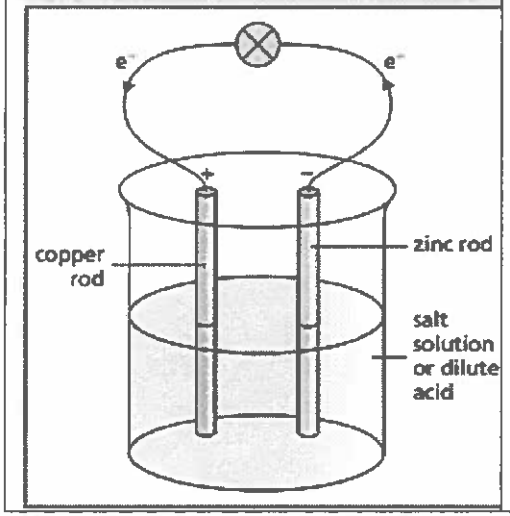
Triple Science – Chemistry – Energy changes

Summary- Position in the Curriculum

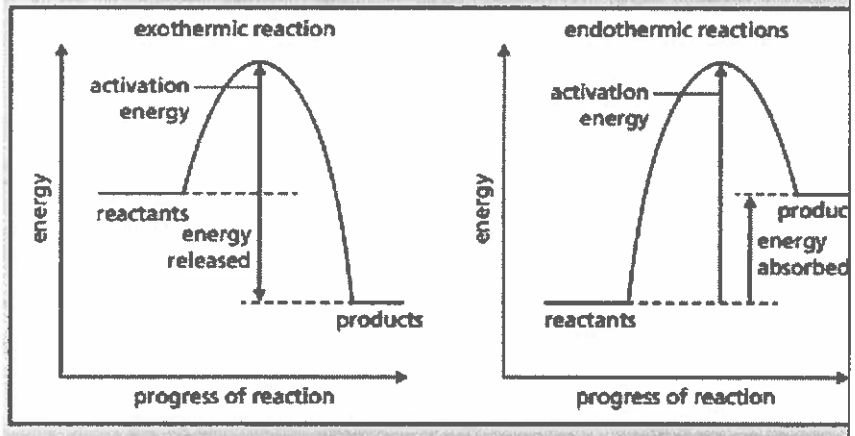
Terminology	Definitions	Core Knowledge	Preparing for Assessment
Reaction profiles	shows how the energy changes in a reaction, and shows whether a reaction is exothermic or endothermic.	The products in an exothermic reaction have a lower energy than the reactants, so energy is released during the reaction. Products in endothermic reactions have a higher energy than the reactants, so energy is taken in during the reaction. The activation energy is the minimum amount of energy that particles must have to react when they collide.	Revision and self-study questions are below.
Bonds	Atoms are held together by strong chemical bonds. In a reaction, these bonds are broken and new ones are made between different atoms to make the products	• Breaking a bond requires energy so is endothermic. • Making a bond releases energy so is exothermic Different bonds require different amounts of energy to be broken (their bond energies). To work out the overall energy change of a reaction, you need to work out: 1 how much energy is required to break all the bonds in the reactants 2 how much energy is released when making all the bonds in the products. Then, calculate the overall energy change of the reaction using: overall energy transferred = energy required to break bonds – energy required to make bonds • A positive number means an endothermic reaction. • A negative number means an exothermic number.	Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research.
Chemical cells	A chemical cell is made by connecting two different metal electrodes in a solution (electrolyte).	In a metal displacement reaction, one metal is oxidised – it loses electrons. These electrons are transferred to another metal, which gains the electrons and so is reduced. By using a chemical cell to conduct this reaction, the electron's movement generates a current. The electrons travel through the circuit to the copper electrode, causing the lamp to light up. Once at the copper electrode, a copper ion from the solution will pick the electrons up and become a metal atom. The greater the difference in reactivity between the two metals in the cell, the greater the potential difference produced.	1. *In terms of bond making and breaking, describe endothermic and exothermic reactions*
Battery	A battery is formed of two or more cells connected in series.	• Some batteries are rechargeable. An external electric current is applied, which reverses the reaction. • Some batteries, like alkaline batteries, are not rechargeable because the reaction is not reversible. Once the reactants are used up, the chemical reaction stops and no more electricity can be produced.	2. *Explain why some cells can be recharged and others cannot*
Le Châtelier's principle	At equilibrium, the amount of reactants and products is constant.	In order to change the amounts of reactant and product at equilibrium, the conditions of the reaction must be changed. The closed system will then counteract the change by favouring either the forward reaction or the reverse reaction.	3. *Give two advantages and two disadvantages of fuel cells and compare this to the advantages and disadvantages of chemical cells*

dynamic equilibrium	a point in time when the forward and reverse reactions have the same rate.	At dynamic equilibrium: • the reactants are still turning into the products • the products are still turning back into the reactants • the rates of these two processes are equal, so overall, the amount of reactants and products are constant. At dynamic equilibrium, the amount of reactant and product are constant, but not necessarily equal. You could have a mixture of reactants and products in a 50:50 ratio, in a 75:25 ratio, or in any ratio at all. The conditions of the reaction are what change that ratio.	4. *What is the effect of increasing pressure on a reaction at dynamic equilibrium? What is the effect of increasing the concentration of reactants on a reaction at dynamic equilibrium? What is the effect of increasing temperature on a reaction at dynamic equilibrium?*
			5. Explain how using a catalyst affects the activation energy in a reaction.

Chemical cells



Reaction profiles



Fuel cells

Hydrogen fuel cells

Fuel cells use a fuel and oxygen from the air to generate a potential difference.

Hydrogen fuel cells generate electricity from hydrogen and oxygen. The overall reaction is:

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$$

The hydrogen is oxidised to produce water.

Advantages
- the only waste is water
- do not need to be electrically recharged

Disadvantages
- hydrogen is highly flammable and difficult to store
- hydrogen is often produced from non-renewable sources

Half equations

H

There are different types of hydrogen fuel cell. In alkaline fuel cells, the half equations are:

$$2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O(l) + 4e^-$$
$$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$$

Triple Science – Physics - Forces

Summary- Position in the Curriculum

Terminology	Definitions	Core Knowledge	Preparing for Assessment
Momentum	Momentum is a property of moving objects. It is a vector quantity. Momentum depends on the mass and velocity of an object, and is defined by the equation: momentum, p (kg m/s) = mass, m (kg) × velocity, v (m/s) p = mv	The Law of Conservation of Momentum says that in a closed system, the total momentum before an event (a collision or an explosion) is equal to the total momentum after the event. If two moving objects collide, the law of conservation can be written as: m1 u1 + m2 u2 = m1 v1 + m2 v2 m1 = mass of object 1 m2 = mass of object 2 u1 = initial velocity of object 1 u2 = initial velocity of object 2 v1 = final velocity of object 1 v2 = final velocity of object 2 Momentum is conserved in explosions because: • the total momentum before is zero • the total momentum after is also zero, because the different parts of the object travel in different directions, and so the momentum of each part will cancel out with the momentum of another part. If two moving objects recoil from each other, they start off with a total momentum of zero and end up moving away from each other with velocities v1 and v2. In this case, the law of conservation can be written as: m1 v1 + m2 v2 = 0	Revision and self-study questions are below.
Impact forces	Impact force $F = \frac{m\Delta v}{t}$ where $m\Delta v$ is the change of momentum. For the same change in momentum the shorter the impact time, the greater the impact force.	The longer the impact time, the more the impact force is reduced. When two vehicles collide, they exert equal and opposite impact forces on each other at the same time. Therefore, the change of momentum of one vehicle is equal and opposite to the change of momentum to the other vehicle.	Answer 1 per week for Self-Study, you can draw on your notes, this organiser, your memory and your own research.
Changes in momentum	If an object is moving or is able to move, an unbalanced force acting on it will change its momentum.	Since F = ma and a = Δv t , we can write: F = mΔv t where mΔv is the change in momentum of an object. The greater the time taken for the change in momentum of an object: • the smaller the rate of change of momentum • the smaller the force it experiences. This means the force acting on an object is equal to the rate of change of momentum of the object. Vehicle safety features increase the time taken for the change in momentum, e.g.: • air bags, seat belts, and crumple zones in cars • cycling helmets • crash mats used for gymnastics	1. *How is the force acting on an object related to its momentum?*
Pressure	Pressure is the force acting per square metre on a surface. The unit of pressure is the pascal (Pa), which is equal to one newton per square metre.	When a force acts over a: • large surface area, the pressure is reduced (e.g., caterpillar tracks on a tank) • small surface area, the small is increased (e.g., the edge of a knife). When the particles of a fluid collide with a surface, such as in a container, they exert a force at right angles (normal) to the surface. The pressure in a liquid increases with the depth of the liquid because: • the pressure at any point in a liquid is due to the weight of the liquid above that point • the weight of a liquid depends on its density	2. *Why does the pressure in a liquid increase with depth? Why does the pressure in a liquid depend on the density of the liquid?*

Deformation	a change in the shape of an object caused by stretching, squashing (compressing), bending, or twisting.	More than one force has to act on a stationary object to deform it, otherwise the force would make it move. Elastic deformation – the object can go back to its original shape and size when the forces are removed. Inelastic deformation – the object does not go back to its original shape or size when the forces are removed	3. *What are examples of everyday safety features that work by increasing the time taken for the change in momentum?*
Terminal velocity	the constant velocity a falling object reaches when the frictional force acting on it is equal to its weight.	For an object falling through a fluid: • there are two forces acting – its weight due to gravity and the drag force • the weight remains constant • the drag force is small at the beginning, but gets bigger as it speed up • the resultant force will get smaller as the drag force increases • the acceleration will decrease as it falls • if it falls for a long enough time, the object will reach a final steady speed	4. *What is elastic and inelastic deformation?*
			5. Why does atmospheric pressure decrease with increased altitude?

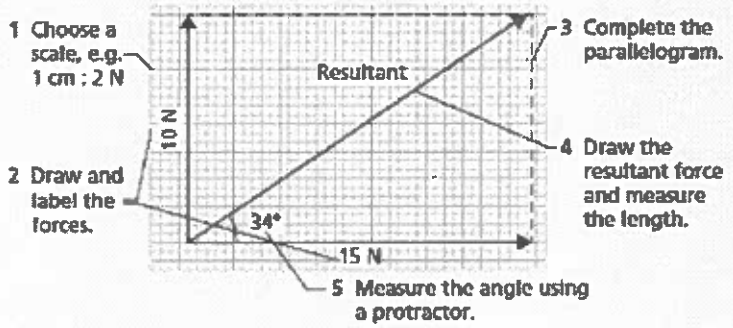
Parallelogram of Forces

Maths

Worked example 1

The tension in a dog lead causes a horizontal force of 15 N forward and a vertical force upwards of 10 N on the person holding the lead. Draw a vector diagram to determine the magnitude of the tension force in the lead and the direction of the force.

Solution

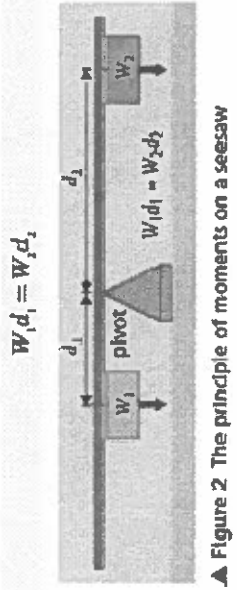


▲ Figure 3

Resultant force is 9 cm long so 9 × 2 N = 18 N

So, the resultant force is **18 N at 34° above the horizontal**.

Moments and equilibrium



▲ Figure 2 The principle of moments on a seesaw

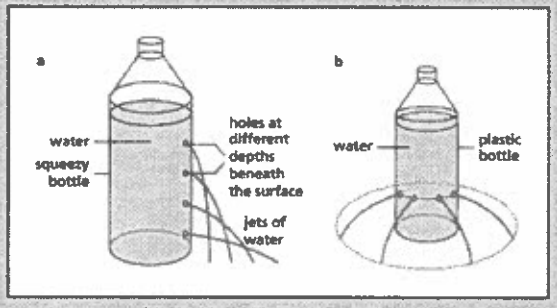
Calculating pressure in vertical columns

The pressure caused by a column of liquid can be calculated using:

pressure (Pa) = height of the column (m) × density of the liquid (kg/m³) × gravitational field strength (N/kg)

$$p = h\rho g$$

To calculate the difference in pressure at different depths in a liquid, calculate the pressure at each depth (h) and subtract the smaller value from the larger one.



a) Pressure increases with depth b) Pressure is the same at the same depth

Notes

	Monday	Tuesday	Wednesday	Thursday	Friday
Form					
P1					
P2					
P3					
P4					
P5					