AQA Trilogy Science

SAMUEL WARD ACADEMY TRUST

Knowledge Organisers for All Topics

The information on each page is a summary of key information needed for each topic.

It does not cover all content and is not intended as a replacement to other study resources.

Please email Mr Allen (callen@swatrust.co.uk) if you spot any mistakes or potential improvements.

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Ultimate 5-step recall revision

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Persuade your brain it's worth keeping by using different cognitive skills

1. Chunk it up

   No more than 5 things to learn at a time.

2. Write each out 5 times

   Try making flash-cards; mind-maps; or use look-cover-copy

3. Draw a simple cartoon style picture for each

   Perhaps turn the words into pictures

4. Say it out loud 5 times

   Teach someone else or do it to a mirror. As much from memory as possible

5. Relate each to you/your life/your experiences

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AQA Trilogy Science

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Paper 1 Biology topics

- Cells and organisation
  - Cell structure and transport
  - Cell division
  - Organisation and the digestive system
  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Paper 2 Biology topics

- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - Variation and evolution
  - Genetics and evolution

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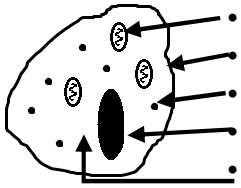
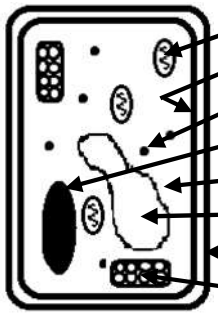
Key points to learn

1. Early light microscopes	Use light and lenses. Have magnifications of 100 to 2 000
2. Electron microscope	Modern. Use a beam of electrons. Magnifications of up to 2 000 000
3. Magnification	How much bigger an image appears than the real object eg Magnification of 100, image looks 100 times bigger than object
	$magnification = \frac{size\ of\ image}{size\ of\ object}$
4. Resolving power	Smallest size microscope can show
5. Typical Animal cell	 **M**itochondria **C**ell membrane **R**ibosomes **N**ucleus **C**ytoplasm
6. Typical Plant cell	 **M**itochondria **C**ell membrane **R**ibosomes **N**ucleus **C**ytoplasm **V**acuole **C**ell wall **C**hloroplasts
7. Photo-synthesis	Reaction plants use to make glucose from light, H_2O and CO_2
8. Specialised animal cells	1. Sperm – tail to swim 2. Nerve – carry electrical impulses 3. Muscle – contract and relax
9. Specialised plant cells	1. Root hair - absorb water and ions 2. Xylem – carry water and minerals 3. Phloem – carry glucose to cells

Key points to learn

10. Mitochondria	Perform respiration to release energy
11Cell membrane	Controls movement in/out of cell
12 Ribosomes	Makes proteins by protein synthesis
13Nucleus	Controls activities of cell. Contains genes to build new cells
14 Cytoplasm	Liquid where most reactions happen
15 Vacuole	Sack filled with sap. Keeps cell rigid
16 Cell wall	Made of cellulose. Supports cell
17 Chloroplasts	Green and full of chlorophyll
18 Chlorophyll	Absorbs light for photosynthesis
19 Eukaryotic cells	Animal cells and plant cells. Have cell membrane, cytoplasm and nucleus
20 Prokaryotic cells	Bacteria. Do not have a nucleus. Genetic material is looped
21 Diffusion	Particles spreading out in gas/liquid Move from high→low concentration
	Dissolved substances like O_2 and CO_2 move in/out of cells by diffusion
22 Factors affecting diffusion	1. Difference in concentration (concentration gradient) 2. Temperature 3. Surface area to diffuse through
23 Osmosis	Diffusion of water through partially permeable membrane (surface that only lets small particles through). Moves from dilute solution → more concentrated solution
24 Active transport	Moves substances from low→high concentration. Needs energy

Trilogy: B1 Cell structure and transport

Collins Revision Guide: Cell Biology

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
  - Cell structure and transport
  - Cell division
  - Organisation and the digestive system
  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Background

Big or small, all organisms are made of cells. Normally too small to see without a microscope, they are the building blocks of all life: animals, plants, insects, microbes and us.

Maths skills

Prefix	Meaning	Standard form
Mega (M)	x 1000000	x 10^6
kilo (k)	x 1 000	x 10^3
milli (m)	÷ 1 000	x 10^{-3}
nano (n)	÷ 1 000 000 000	x 10^{-9}

Key points to learn

1. Cell cycle	Process by which body cells divide. Three stages: 1. Copy: Two copies of chromosomes and internal cell structures 2. Mitosis: Copies of chromosomes move and form two nuclei 3. Split: cytoplasm and cell membranes split to make two identical cells
2. Mitotic cell division	Makes two identical copies of cells. Used in growth and repair
3. Asexual reproduction	Form of reproduction using mitotic cell division to make clone cells
4. Chromosome	Contains large number of genes. Made of DNA molecules
	Human body cells contain 23 pairs of chromosomes
5. Genes	Instructions for a characteristic
6. DNA	Molecules that make genes
7. Cell differentiation	Stem cells can form different types of specialised cells
	Most animal stem cells differentiate early
	Many plant stem cells can differentiate at any time
8. Clone	Genetically identical copy of a cell or organism

Key points to learn

9. Stem cells	Not differentiated. Can become any type of cell that is needed
10. Human stem cells	1. From embryos can become most types of human cell 2. From adult bone marrow can form many cells like red blood cells
	May be able to help conditions like diabetes and paralysis
	Issues with use: • Potential spread of virus or immune response • Some people have ethical or religious objections
11. Meristem cells	Plant stem cells. Can become any type of plant cell at any time
	Used to clone: • rare plants from extinction • crops with desirable features
12. Specialised animal cells	1. Sperm – tail to swim 2. Nerve – carry electrical impulses 3. Muscle – contract and relax
13. Specialised plant cells	1. Root hair - absorb water and ions from soil 2. Xylem – carry water and minerals from roots 3. Phloem – carry glucose to cells
14. Ethical objections	Related to what a person thinks is morally good or ok

Trilogy B2: Cell Division

Collins Revision Guide: Cell Biology

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
  - Cell structure and transport
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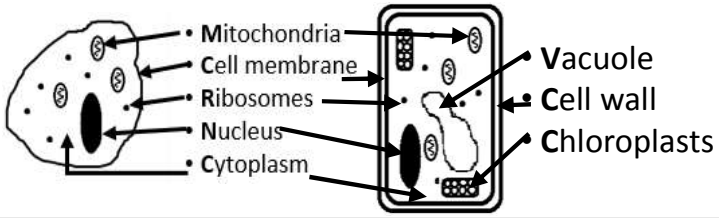
  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

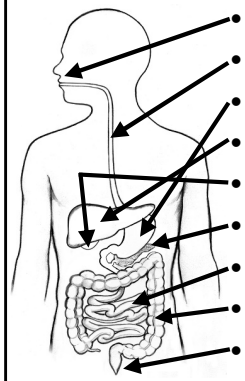
Background

Taste buds are replaced approximately every 10days, skin cells every 14 days and your lungs every 6 weeks. How can this happen and how old are we really?

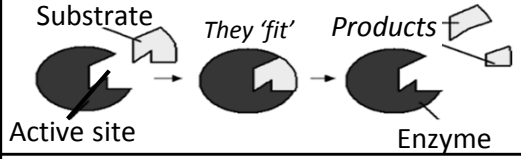
Additional information



Key points to learn

1. Specialised animal cells	1. Sperm – tail to swim 2. Nerve – carry electrical impulses 3. Muscle – contract and relax
2. Tissue	Group of similar cells
3. Organ	Group of tissues working together
4. Organ systems	Group of organs which work together in organism
5. Digestive system	A group of organs that digest and absorb food
6. Digestion	Breaking large food molecules into small soluble ones
7. Human digestive system	 • Mouth • Gullet • Stomach • Liver • Gall-bladder • Pancreas • Small intestine • Large intestine • Anus
8. Carbohydrate	Types of sugars: glucose, starch, cellulose. Used for energy
	Test: Starch turns iodine bluey black
9. Proteins	Used to make enzymes, tissues and cells. Found in meat, fish, pulses, milk
	Test: Biuret reagent turns from blue to purple
10. Lipids	Fats and oils made of fatty acids and glycerol

Key points to learn

11. Mouth	Chews food, releases saliva
12. Stomach	Churns food. Partial digestion here
13. Liver	Makes bile to be stored in gall bladder
14 Pancreas	Releases enzymes in small intestine
15. Small intestine	Majority of digestion happens here. Makes lots of enzymes
16. Large intestine	Absorbs water
17. Bile	Alkaline to neutralise stomach acid. Added at start of small intestine. Emulsifies fat into small droplets
18. Catalyst	Chemical which speeds up a reaction without being used itself
19. Enzyme	Biological catalysts Like a specific temperature and pH
20. Lock and key theory	Model showing how enzymes work. Substrates fit the enzyme active site, then react, turning into products 
21 Metabolism	The sum of all the reactions in a cell or the body of an organism
22 Protease	Enzyme breaks down protein. Made in stomach, pancreas, small intestine
23 Lipase	Enzyme breaks down lipids. Made in pancreas, small intestine
24 Amylase	Type of carbohydrase enzyme. Breaks down glucose. Made in salivary glands, pancreas, small intestine

Trilogy B3: Organisation and the digestive system

Collins Revision Guide: Organisation

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
  - Cell structure and transport
  - Cell division
  - **Organisation and the digestive system**
  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Background

Have you ever wondered why the human body temperature is 37°C or why the male testes are outside the body? The answer is enzymes. They are also crucial for digestion…

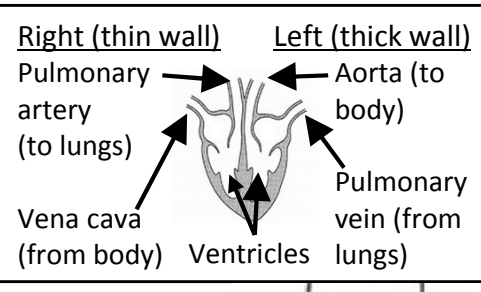
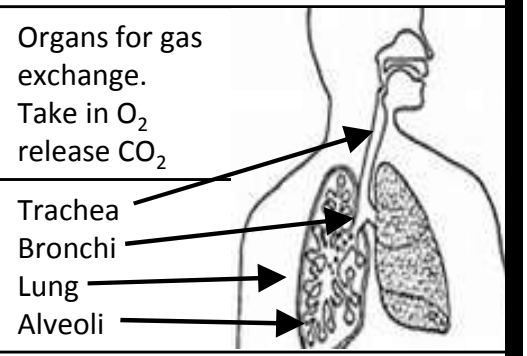
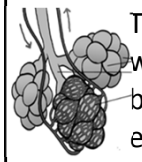
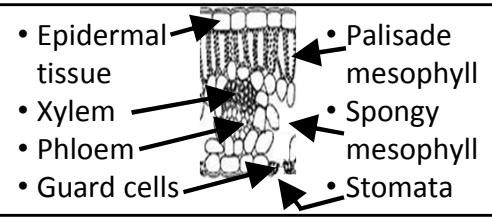
Key points to learn

25. Why you can't kill an enzyme	They are not alive so can't die.
	But they will change shape and 'denature' at the wrong temperature or acidity (pH) Each one has an ideal temperature and pH they work best at.

Key points to learn

1. Blood	A tissue of plasma, red blood cells, white blood cells and platelets
2. Plasma	Yellow liquid that transports: • Red and White Blood cells • Waste carbon dioxide to lungs • Urea from liver to kidneys • Digested nutrients to cells
3. Red blood cells	Biconcave discs with no nucleus. Packed with red haemoglobin that carries oxygen to body cells
4. White blood cells	Part of the body's defence against microorganisms
5. Platelets	Small pieces form scabs over cuts
5. Circulatory system	Transports substances to/from body cells. Made up of: • Blood • Blood vessels (arteries, veins and capillaries) • The Heart
6. Arteries	Carry blood away from your heart at high pressure
7. Veins	Carry blood back to your heart. Use valves to stop reverse blood flow
8. Capillaries	Network of tiny, thin vessels connecting to every individual cell. Substances diffuse in/out of blood
9. Coronary arteries	Blood vessels that supply heart with oxygen
10. (Aerobic) Respiration	Process by which all living things get energy from glucose and oxygen
	Glucose + Oxygen → Carbon + Water dioxide

Key points to learn

11. The Heart	Organ made of muscle that pumps blood in two loops around body
	
12. The Lungs	Organs for gas exchange. Take in O_2 release CO_2
	
13. Alveoli	 Thin sac-like structures within the lungs. Covered in blood vessels to help gas exchange
14. Plant organs	Leaf – carries out photosynthesis Stem – supports Roots – take in water and minerals
15. Leaf structure cross-section	
16. Transport within plant	• Phloem – moves sugars • Xylem – moves water and ions
17. Transpiration	Evaporation from leaf pulls water through plant xylem. Affected by temperature, humidity, wind, light

Trilogy B4: Organising animals and plants

Collins Revision Guide: Organisation

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
  - Cell structure and transport
  - Cell division
  - Organisation and the digestive system
  - **Organising animals and plants**
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Background

All living cells need glucose and oxygen for respiration. Getting these ingredients to the organism is only part of the struggle. How do you get them to the cells, keep them and get rid of waste products? This topic finds out

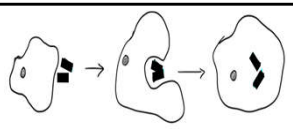
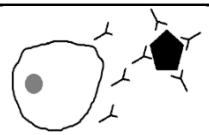
Additional information

The heart was first labelled from behind. This means the left and right sides are reversed.

Key points to learn

1. Bacteria	Large microbe Living 
	Divide by splitting in two
	May produce toxins to make us ill
	Cause: • Salmonella – food poisoning • Gonorrhoea – sexually transmitted disease (STD)
2. Viruses	Smallest microbe Not alive 
	Live and reproduce inside cells
	Cause: • Measles – can be fatal • HIV – can turn into AIDS • Tobacco mosaic virus (TMV) affects photosynthesis in plants
3. Fungi	The other type of microbe. Living
	Cause: • Rose black spot – affects photosynthesis in plants
4. Pathogens	Microbes/microorganisms that cause diseases
	Spread by air, contact and water
5. Communicable diseases	Infectious diseases that can be passed from one person to another
	Caused by pathogens
6. Malaria	Is a protist disease. Spread by mosquito bites

Key points to learn

7. Causes of ill health	Pathogens, diet, stress, life situations/conditions
8. Non-communicable diseases	Cannot be transmitted from one person to another
	Eg heart disease, arthritis
9. Ignaz Semmelweis	Doctor in mid-1850s who persuaded doctors to wash their hands
10. Louis Pasteur	Showed that microbes caused disease. Developed vaccines
11. Vaccines	An inactive form of a pathogen used to prepare your immune system
12. Human defences against pathogens	1. Skin barrier - covers your body 2. Nose - hair and mucus act as trap 3. Trachea and bronchi – covered in cilia and mucus 4. Stomach - makes acid to destroy 5. Immune system – white blood cells defend us in three ways
13. Trachea	Pipe from mouth to bronchi
14. Bronchi	Pipe into each lung
15. Cilia	Tiny hair-like cells
16. White blood cells	1. Phagocytosis ingest microbes 
	2. Produce antibodies chemicals to destroy microbes 
	3. Produce antitoxins chemicals to cancel-out toxins made by pathogens 

Trilogy B5: Communicable diseases

Collins Revision Guide: Infection and response

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
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- Disease and bioenergetics
  - **Communicable diseases**
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Background

Nobody likes getting ill. To better avoid diseases, we need to understand what causes and how our bodies try and defend us from them.

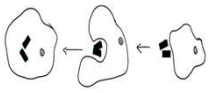
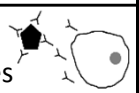
Additional information

This topic links really well with B6 which is all about how we can further defend against these diseases.

Key points to learn

1. Bacteria	Large microbe. Living
	Divide by splitting in two
	May produce toxins to make us ill
	Cause: - Salmonella - Gonorrhoea
2. Viruses	Smallest microbe. Not alive
	Live and reproduce inside cells
	Cause: - Measles - HIV - Tobacco mosaic virus (TMV)
3. Pathogens	Microbes/microorganisms that cause diseases
	Spread by air, contact and water
4. Communi-cable diseases	Infectious diseases that can be passed from person to person
	Caused by pathogens
5. Louis Pasteur	Showed that microbes caused disease. Developed vaccines
6. Painkillers	No effect on the pathogens but do reduce the symptoms of illness. Eg aspirin and paracetamol
7. Destroying viruses	Is very difficult without damaging body tissue as they live inside cells
8. Discovery of new drugs	Medicines used to be extracted from plants and microorganisms eg • Heart drug *digitalis* from foxglove • Painkiller aspirin from willow tree • Penicillin from mould
9. Placebo	A tablet with no active medicine content

Key points to learn

10. Vaccines	An inactive form of a pathogen used to prepare your immune system
	White blood cells are able to respond quickly to prevent infection
	MMR is a vaccine against mumps, measles and rubella
11. Antibiotics	Medicines that kill specific bacteria. Greatly reduced deaths from bacterial diseases
	Cannot kill viruses
	Some bacteria are becoming resistant which is very concerning
	Alexander Fleming discovered penicillin
12. Making new medicines	Need to be checked for toxicity (safety), efficacy (effectiveness) and dose
	First trials are done using cells, tissues and live animals
	Clinical trials use healthy volunteers and patient: 1. Very low doses at start of trial 2. If safe, more trials done 3. In double blind trial some patients given placebo
13. White blood cells	1. Phagocytosis ingest microbes 
	2. Produce antibodies chemicals to destroy microbes 
	3. Produce antitoxins chemicals to cancel-out toxins made by pathogens 

Trilogy: B6 Preventing and treating diseases

Collins Revision Guide: Infection and response

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
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  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - **Preventing and treating disease**
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Background

Nobody likes getting ill. To better avoid diseases, we need to understand what causes and how our bodies try and defend us from them.

Additional information

This topic links really well with B6 which is all about how we can further defend against these diseases.

Key points to learn

1. Non-communicable diseases	Cannot be transmitted from one person to another
	Eg heart disease, arthritis
2. Causes of ill health	Pathogens, diet, stress, life situations/conditions
3. Communicable diseases	Infectious diseases that can be passed from one person to another
	Caused by pathogens (microbes)
4. Coronary heart disease	Layers of fat build up inside coronary arteries, reducing blood flow and oxygen for the heart
	Stents used to keep arteries open
	Statin medicines used to reduce blood cholesterol levels which reduces rate of fatty build up
5. Heart failure	A failed heart can be replaced by a donor heart
6. Faulty heart valves	Can be replaced by biological/mechanical valves
7. Coronary arteries	Blood vessels that supply the heart
8. Cancer	Uncontrolled growth and division of cells
	Lifestyle and genetic factors can increase risks of some cancers
9. Tumour	Lump or growth in a part of the body
10. Health	State of physical and mental well-being

Key points to learn

11. Malignant tumour	Are cancers
	Invade neighbouring tissues and spread throughout body forming secondary tumours
12. Benign tumour	Not cancers
	Growths of abnormal cells in one area that do not invade other parts of the body
13. Different diseases can interact	• A defective immune system can lead to more infections • Viruses can trigger cancer • Pathogens can trigger allergies • Physical ill health can lead to depression and mental illness
14. Smoking and risk of disease	Carbon monoxide harms unborn babies
	Carcinogens increase risk of cancers
	Increases risk of coronary heart disease
	Increases risk of lung disease and lung cancer
15. Risks of diet, exercise and obesity	Increases risk of coronary heart disease and high blood pressure
	Obesity can lead to Type 2 diabetes
16. Alcohol and risk of disease	Damages the liver and carcinogens increase risk of liver cancer
	Affects brain function
	Passes to and harms unborn babies
17. Exposure to ionising radiation	EM Waves (UV rays, X-rays Gamma rays) and radioactive material
	Can increase risk of cancers

Trilogy B7: Non-communicable diseases

Collins Revision Guide: Organisation

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
  - Cell structure and transport
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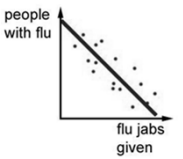
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - **Non-communicable diseases**
  - Photosynthesis
  - Respiration

Background

A reported 25% of people in the UK are now obese. Around 17% of adults smoke and many more consume alcohol. So, what are the risks of these lifestyle choices?

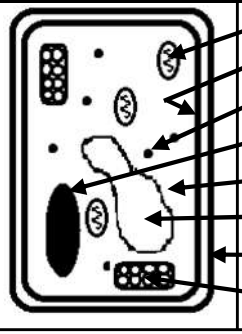
Maths skills

Use scatter diagrams to identify correlation between factors.

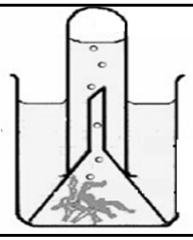
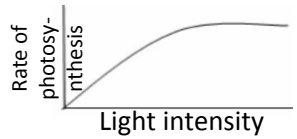
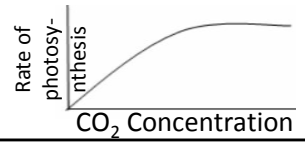
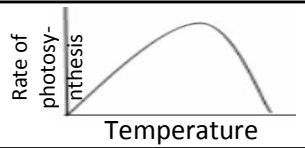


Using samples to estimate population trends

Key points to learn

1. Plant leaf cell	 • **M**itochondria • **C**ell membrane • **R**ibosomes • **N**ucleus • **C**ytoplasm • **V**acuole • **C**ell wall • **C**hloroplasts
2. Mitochondria	Perform respiration to release energy
3. Cell membrane	Controls movement in/out of cell
4. Ribosomes	Makes proteins by protein synthesis
5. Nucleus	Controls activities of cell. Contains genes to build new cells
6. Cytoplasm	Liquid where most reactions happen
7. Vacuole	Sack filled with sap. Keeps cell rigid
8. Cell wall	Made of cellulose. Supports cell
9. Chloroplasts	Green and full of chlorophyll
10 Chlorophyll	Absorbs light for photosynthesis
11. Photosynth-esis	The process of chloroplasts making their food (glucose) using light
	The reverse of respiration
	Absorbs light energy Carbon + Water → Glucose + Oxygen dioxide
	Endothermic reaction – light energy is absorbed

Key points to learn

12. Leaf adaptations for photosynth-esis	• Big surface area – to catch light • Thin - helps diffusion of gases • Chloroplasts – contain chlorophyll • Veins – bring water through xylem and move glucose through phloem • Air spaces – help diffusion of gases • Guard cells – open and close stomata to control gas movement
13. Rate of Photosynth-esis	Can be measured by using pond weed and counting number of oxygen bubbles released 
	Affected by light intensity 
	Affected by CO_2 concentration 
	Affected by temperature 
14. How plants use glucose	In respiration – provides energy Glucose + Oxygen → Carbon + Water dioxide
	Store it as insoluble starch
	Make fat or oil for storage
	Make cellulose to strengthen cell wall
	To produce amino acids for protein synthesis and making DNA
15 Nitrate ions	Also needed to make amino acids

Trilogy B8: Photosynthesis

Collins Revision Guide: Bioenergetics

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
  - Cell structure and transport
  - Cell division
  - Organisation and the digestive system
  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - **Photosynthesis**
  - Respiration

Background

Plants and algae are both amazing as they can make their own food. This process means that they are an essential part of every food chain.

Maths skills

Interpreting sketch graphs

Additional information

The photosynthesis and respiration equations are the same, but the arrow is reversed. This means you only really need to remember one of them!

Key points to learn

1.Breathing	Not the same as respiration. Method of obtaining oxygen from the air
2. Aerobic respiration	Process by which all living things get energy from glucose and oxygen
	Happens continuously in plants an animals. Provides lots of energy
	Glucose + Oxygen → Carbon + Water dioxide
	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
	Exothermic reaction - gives off heat
	Occurs within mitochondria in cells
3. Response to exercise	During exercise body needs more energy so rate of aerobic respiration increases. This needs: 1. Heart rate increases - blood carries glucose and oxygen faster 2. Breathing rate and volume increases – lungs obtain more oxygen 3. Glycogen stores turned into glucose – more glucose available
	More respiration means you get hotter and may need to cool down
4 Anaerobic respiration	Provides energy from glucose if there is not enough oxygen available
5. Anaerobic respiration in plants and yeast	Called fermentation. Used to make bread and alcohol
	Glucose → Ethanol + Carbon dioxide
6. Enzymes	Biological catalyst. Helps reactions to happen in living things

Key points to learn

7. Anaerobic respiration in animal cells	Glucose → Lactic acid
	Much less energy provided than aerobic respiration
8. Lactic acid	Leads to an oxygen debt which requires more oxygen after exercise is complete to break down the lactic acid
	Causes muscles to tire and cramp
9. Metabolism	The sum of all the reactions in a cell or the body of an organism
	Energy provided by respiration is used in these metabolic reactions to make new molecules
10. Metabolic reactions	Includes these 5 reactions: 1. Turning glucose into starch, glycogen and cellulose 2. Making lipids from glycerol and fatty acids 3. Using glucose and nitrate ions to make amino acids 4. Respiration 5. Turning excess proteins into urea
11. Metabolic rate	The rate at which reactions happen in an organism
12. Lipids	Fats and oils
13. Starch	Carbohydrate store in plants
14. Glycogen	Carbohydrate store in animals
15. Cellulose	Makes cell walls in plants
16. Urea	Waste product from liver

Trilogy B9: Respiration

Collins Revision Guide: Bioenergetics

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
  - Cell structure and transport
  - Cell division
  - Organisation and the digestive system
  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - **Respiration**

Background

It is one of the R's in MRS GREN. All living things do it, all of the time. Every single one of your 10 trillion living body cells are doing it right now. As are the 100trillion microbes living in your intestines!

Additional information

The five metabolic reactions are all covered in more detail in this course. Remember that they all use enzymes.

'Aerobic respiration' is often known as just 'respiration'. It is photosynthesis in reverse.

AQA Trilogy Science

SAMUEL WARD ACADEMY TRUST

Paper 1 Chemistry topics

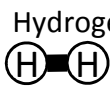
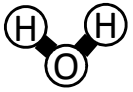
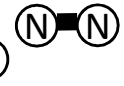
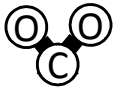
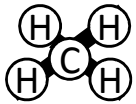
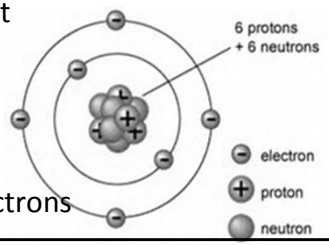
- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - Energy changes

Paper 2 Chemistry topics

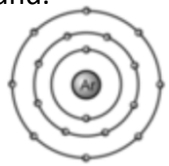
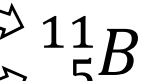
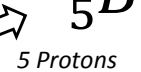
- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - Crude oil and fuels
- Analysis and the Earth's resources
  - Chemical analysis
  - The Earth's atmosphere
  - The Earth's resources

CASTLE MANOR · CHURCHILL SCHOOL · NEWMARKET ACADEMY · SAMUEL WARD · SYBIL ANDREWS ACADEMY · TGS

Key points to learn

1. Atom	Smallest part of an element that can exist
	Hydrogen atoms (4H) 
2. Molecule	Two or more atoms chemically bonded
	Hydrogen molecule (H_2)  Water molecule (H_2O) 
3. Element	Only one type or atom present. Can be single atoms or molecules
	Both examples of the Nitrogen element (N_2) (N) 
4. Compound	Two or more different elements chemically bonded
	Carbon dioxide (CO_2)   Methane (CH_4)
5. Nuclear atom model	• Electrons orbit • Protons and neutrons in nucleus • Number of protons = electrons 
6. Nucleus	The centre of the atom. Contains neutrons and protons
7. Proton	Charge of +1. Mass of 1. Found inside the nucleus
8. Neutron	Charge of 0. Mass of 1. Found inside the nucleus
9. Electron	Charge of -1. Mass of almost 0. Found orbiting around the nucleus

Key points to learn

10. Mixture	Two or more chemicals not chemically bonded
11. Separation techniques	Used to separate mixtures. Ones you need to know: Filtration - get an insoluble solid from a liquid Crystallisation - get a soluble solid from a liquid by evaporating liquid off Distillation - get a pure liquid from a mixture of liquids Chromatography - separate mixtures of coloured compounds
12. Electron energy levels	Where electrons are found. The shells can each hold this many electrons maximum: 2,8,8 
13. Periodic Table	A list of all the elements in order or atomic number. Columns called **Groups**. Rows called **Periods**
14.Conservation of mass	In a chemical reaction the total mass of reactants = total mass of products
15. Mass number	Number of neutrons + protons *6 Neutrons + 5 Protons* 
16. Atomic number	Number of protons  *5 Protons*
17. Isotope	Same number of protons different number of neutrons
18. Ion	Atom where number of protons is not equal to electrons (+'ve or –'ve)
19 Plum pudding atom model	Early model: ball of positive charge with electrons in it 

Trilogy C1: Atomic structure

Collins revision guide: Atomic structure and the periodic table

Knowledge Organiser

Big picture (Chemistry Paper 1)

- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - Energy changes

Background

Atoms are the building blocks of us, our world and our universe. Everything that we can touch is made of atoms.

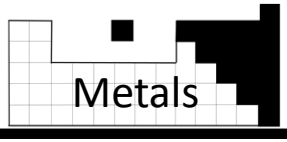
The Periodic Table organises them into a way that helps us make sense of the physical world.

Even though they make everything atoms are mostly (99.9%) empty space. If an atom was as big as Wembley, the nucleus would be pea-sized.

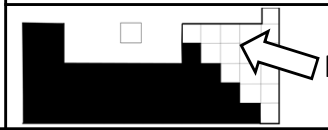
Additional information

A great deal of this topic is also covered in your Paper 1, Physics lessons during Electricity and Radioactivity.

Key points to learn

1. Chemical symbol	An abbreviated name for every element. Maximum of two letters always starts with a capital letter
2 Reactivity	How easily an element will react
3. Group	Columns in the Periodic Table. Elements in the same group have similar properties
	Tells you how many electrons that atom has in its outer shell
4. Period	Rows in the periodic table
	Tells you how many electron shells that atom has
5. Mass number	Number of neutrons + protons — *4 Neutrons + 3 Protons* ⇨ $^{7}_{3}Li$
6. Atomic number	Number of protons ⇨ *3 Protons*
7. Ion	Atom where number of protons is not equal to electrons (+'ve or –'ve)
8. Mendeleev	Scientist who placed elements in order of atomic weight but left gaps for undiscovered elements
9. Metals	Have delocalised (free) electrons that can move
	Atoms lose electrons and become positive (+'ve) ions
	

Key points to learn

10. Non-metals	Have electrons that cannot move
	Nearly always gain electrons and become (negative -'ve) ions
	
11. Group 0 Noble gases	He, Ne, Ar, Kr, Xe, Rn
	Unreactive: full outer shell
	Boiling point increases as you go down the group
12. Group 1 Alkali metals	Li, Na, K, Rb, Cs, Fr
	Very reactive: only one electron in their outer shell
	Reactivity increases as you go down the group
	React with oxygen to give metal oxides eg MgO
	React with water to give metal hydroxide (alkali) and hydrogen eg MgOH
	React with chlorine to give metal chloride eg MgCl
13. Group 7 Halogens	F, Cl, Br, I
	Melting and boiling point increase as you go down group
	Reactivity decreases as you go down the group
	A more reactive halogen will displace a less reactive one

Trilogy C2: The Periodic Table

Collins revision guide: Atomic structure and the periodic table

Knowledge Organiser

Big picture (Chemistry Paper 1)

- Atoms, molecules and moles
  - Atomic structure
  - **The periodic table**
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - Energy changes

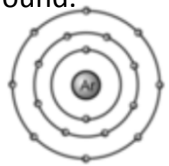
Background

The periodic table is amazing because it allows us to predict and explain the properties of elements even before they are discovered.

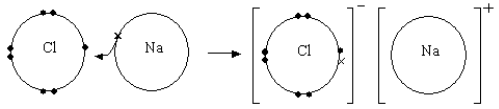
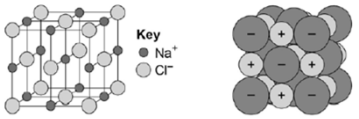
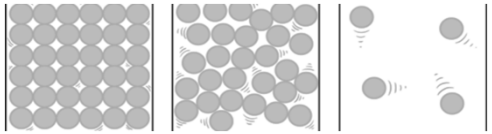
Maths skills

Losing –'ve charge makes you more +'ve.
Gaining –'ve charge makes you more –'ve.

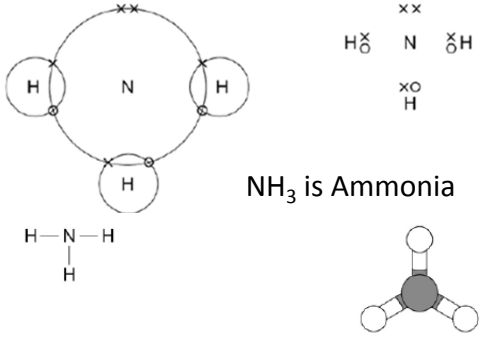
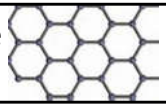
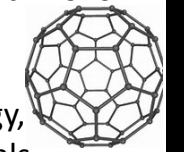
Additional information

Remember Electron energy levels	Where electrons are found. The shells can each hold this many electrons maximum: 2,8,8 

Key points to learn

1. Chemical bonds	Hold atoms together in a molecule after a reaction
2. Ionic bonding	Metal + Non metal
	Metal loses electrons and becomes a positive ion. Non metal gains the electrons and becomes a negative ion
	 $Cl + Na \rightarrow NaCl$
3. Giant ionic structures	Drawing salt (NaCl) 
	High melting and boiling points
	Conduct electricity when melted or dissolved in water
4. Metallic bonding	Metal + Metal
	Giant structures with free electrons moving throughout
5. Conductors	Metals conduct electricity because they have free electrons
6. Graphite	Non-metal that conducts electricity
7. Alloys	A mixture of different metals. Which are then harder
8. States of matter	

Key points to learn

9. Covalent bonding	Non-metal + Non metal
	Atoms share electrons
	Four different ways of drawing NH_3  NH_3 is Ammonia
10. Giant covalent structures	Examples are diamond and silicon dioxide 
	Solids. Very high melting points
11. Small molecules	Usually gases or liquids. Do not conduct electricity
12. Polymers	Long chain molecules linked by strong covalent bonds
13. Particle theory	Particles are held together by intermolecular forces that get weaker as particles gain energy
14. State symbols	(s) solid; (l) liquid; (g) gas; (aq) aqueous solution
15. Graphene	A single layer of graphite used in electronics 
16. Fullerenes	Molecules of carbon with hollow shapes  Used in nanotechnology, electronics and materials

Trilogy C3: Structure and bonding

Collins revision guide: Bonding, structure and the properties of matter

Knowledge Organiser

Big picture (Chemistry Paper 1)

- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - Energy changes

Background

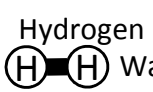
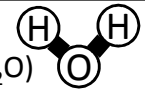
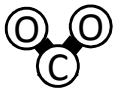
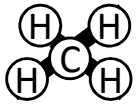
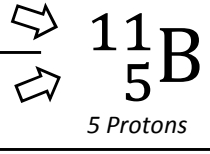
Chemical reactions are a crucial part of all our lives. Without them the Universe as we know it could not exist.

This topic considers the three type of chemical bonds. All involve atoms trying to fill or empty their outer shells. Together these bonds are responsible for the wide range of different properties we see around us.

Additional information

You need to be clear which elements are metals and non-metals (see C2: Periodic table) also a good knowledge of the electron energy levels will help (see C1: Atomic structure).

Key points to learn

1. Atom	Smallest part of an element that can exist
	Hydrogen atoms (4H) 
2. Molecule	Two or more atoms chemically bonded
	Hydrogen molecule (H_2)  Water molecule (H_2O) 
3. Element	Only one type or atom present. Can be single atoms or molecules
	Both examples of the Nitrogen element (N_2)  (N) 
4. Compound	Two or more different elements chemically bonded
	Carbon dioxide (CO_2)  Methane (CH_4) 
5. Mass number	Number of neutrons + protons *6 Neutrons + 5 Protons*
6. Atomic number	Number of protons  *5 Protons*
7. Relative Atomic Mass	A_r The mass number of an atom. Eg A_r of O is 16 and H is 1
8. Relative Formula Mass	M_r The mass of all the atoms of a molecule added together. Eg M_r of H_2O is (2 x 1) + 16 = 18
9. Mole	An amount where either the A_r or M_r is written in grams. Eg one mole of water has a mass of 18g
10. Solute	Solid that has been dissolved

Key points to learn

11. Isotope	Same number of protons different number of neutrons
12. Numbers in reaction equations	Big numbers in front of a chemical tell us how many molecules/atoms of that chemical there are
13. Balancing equations	The number of atoms in the reactants must equal the number of atoms in the products
	Steps to balance an equation 1) $Mg + O_2 \rightarrow MgO$ *Needs another O on product side* 2) $Mg + O_2 \rightarrow \mathbf{2}MgO$ *Only add big numbers in front* *Now needs more Mg on reactants* 3) $\mathbf{2}Mg + O_2 \rightarrow 2MgO$ *Only add big numbers in front*
	The table you will have drawn to help Mg: ~~1~~ 2 → ~~1~~ 2 O: 2 → ~~1~~ 2
14. Chemical reaction	Reactants → Products *'turn into'*
Conservation 15 of mass	In a chemical reaction the total mass of reactants = total mass of products
16 If mass seems to be lost/gained	Conservation of mass always applies but sometimes the mass of a gas being used/made is missed
17. Concentration	The mass of solute in a given volume of solution
	Concentration = mass of solute [g] / volume of solution [dm^3] [g/dm^3]
18. Solution	Liquid containing dissolved solute

Trilogy C4: Chemical calculations

Collins rev. guide: Quantitative chemistry

Knowledge Organiser

Big picture (Chemistry Paper 1)

- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - Energy changes

Background

Want to make enough pancakes for everyone? Then you need to know quantities. Chemical reactions are the same (cooking is a chemical reaction!). This topic explores in more detail.

Maths skills

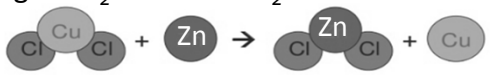
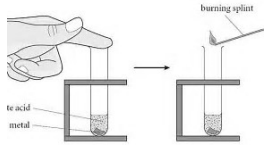
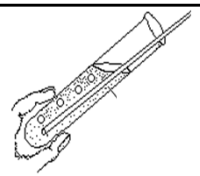
Steps to balance an equation:

1. Write down the symbols of each element then count how many are on each side of the equation
2. Leave Hydrogen and Oxygen till last if it's complicated
3. Start with an element that appears in the least molecules first (usually a metal)
4. Only add big numbers to the left of each chemical. You can't change molecules

Key points to learn

1 Chemical reaction	Reactants → Products *'turn into'*
2 Oxidation	Losing electrons (or gaining oxygen)
3 Reduction	Gaining electrons (or losing oxygen)
4. OiL RiG	Oxidation is Loss of electrons Reduction is Gain of electrons
5 Reactivity Series	List of metals with most reactive at top and least reactive at bottom The most reactive metals are most likely to lose electrons
6. Metals and oxygen	**Metal + Oxygen → Metal Oxide** Eg Iron + oxygen → iron oxide
7. Metals and water	**Metal + Water → Metal + Hydrogen hydroxide** Eg Sodium + Water → Sodium + Hydrogen hydroxide
8. Metals and acid	**Metal + Acid → Metal salt + hydrogen** Eg Zinc + Hydrochloric acid → Zinc + Hydrogen chloride
9. Metal carbonates and acids	**Metal + Acid → Metal + Water + Carbon carbonate salt dioxide** Eg Lead carbonate + Nitric acid → Lead nitrate + Water + Carbon dioxide
10. Metal salts	• Hydrochloric acid makes ...chloride • Sulfuric acid makes ….sulfate • Nitric acid makes …nitrate
11. State symbols	(s) solid; (l) liquid; (g) gas; (aq) aqueous solution

Key points to learn

12. Displacement reaction	A more reactive metal will displace a less reactive metal from a chemical compound
	Eg $CuCl_2 + Zn \rightarrow ZnCl_2 + Cu$ 
13. Ion	Atom where number of protons is not equal to electrons (+'ve or –'ve)
Neutralisation reaction	Acid + Alkali → Metal + Water salt
14	
15. pH scale	1 – Strong acid 7 – Neutral 14 – Strong alkali
16. Universal indicator	• Turns red in strong acid • Turns green in neutral • Turns purple in strong alkali
17. Acids	Contains H^+ ions. Opposite of a base
18. Base	Usually contains OH^- ions. Opposite of an acid
19. Alkali	A base that has dissolved in water
20. Test for hydrogen	Hydrogen makes a squeaky 'pop' when lit with a splint 
21. Test for carbon dioxide	If you bubble carbon dioxide through limewater it will turn milky (cloudy white)  *Clear → milky*
22. Ionic equation	Ions making neutral product Eg $Cu^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Cu(OH)_{2\ (s)}$

Trilogy C5: Chemical Changes

Collins rev guide: Chemical Changes

Knowledge Organiser

Big picture (Chemistry Paper 1)

- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - Energy changes

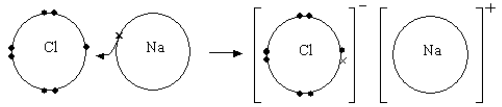
Background

In the past, scientists would discover reactions by trial and error. This was time-consuming and dangerous. Today we can use patterns to predict the outcomes of a whole range of reactions. This has allowed us to develop new materials and understand reactions that happen inside all living things.

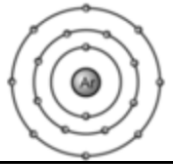
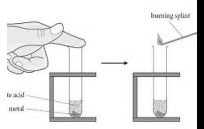
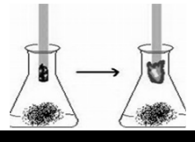
Additional information

You need to be able to work out how many electrons an atom wants to lose or gain using the periodic table group number. This will be its ion charge.

Key points to learn

1. Electrolysis	Breaking down a substance using electricity
2. Electrolyte	The ionic compound that is broken down in electrolysis.
	Must be an ionic compound in liquid form (either molten or dissolved in water)
3. Electrode	Connected to the power supply
4. Anode	The +'ve electrode
5. Cathode	The –'ve electrode
6. Ion	Atom where number of protons is not equal to electrons (+'ve or –'ve)
7. Positive (+'ve) ions	Metals and hydrogen. Collect at the cathode (-'ve electrode)
8. Negative (-'ve) ions	Non-metals except hydrogen. Collect at the anode (+'ve electrode)
9. Ionic bonding	Metal + Non metal
	Metal loses electrons and becomes a positive ion. Non metal gains the electrons and becomes a negative ion.
	 $Cl + Na \rightarrow NaCl$
10. Group	Column number in the Periodic Table. Tells you how many electrons in outer shell of atom. Used to work out charge of ion

Key points to learn

11. Half equations	Equation showing what happens to electrons at each electrode Eg Lead ions gaining 2 electrons at the cathode to be come lead atoms $Pb^{2+} + 2e^- \rightarrow Pb$
12. Oxidation	Losing electrons (or gaining oxygen)
13. Reduction	Gaining electrons (or losing oxygen)
14. OiL RiG	Oxidation is Loss of electrons Reduction is Gain of electrons
15. Electron shells	Where electrons are found. The shells can each hold this many electrons maximum: 2,8,8 
16. Aluminium	Obtained from molten bauxite ore
	Extracted by electrolysis mixed with cryolite to reduce melting temperature
17. Cryolite	Used to extract aluminium
18. Ore	Rock containing enough metal to be worth extracting
19. Brine	Salt water (sodium chloride solution)
	Can be separated using electrolysis to produce chlorine, hydrogen and sodium hydroxide
20. Test for hydrogen	Hydrogen makes a squeaky 'pop' when lit with a splint 
21. Test for oxygen	Oxygen will relight a glowing splint. 

Trilogy C6: Electrolysis

Collins rev guide: Chemical Changes

Knowledge Organiser

Big picture (Chemistry Paper 1)

- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - **Electrolysis**
  - Energy changes

Background

Electrolysis is important to our lives as allows us to obtain reactive metals from their ores. It is likely to become even more important over the next 10 years as we separate hydrogen from water for use in fuel cells.

Maths skills

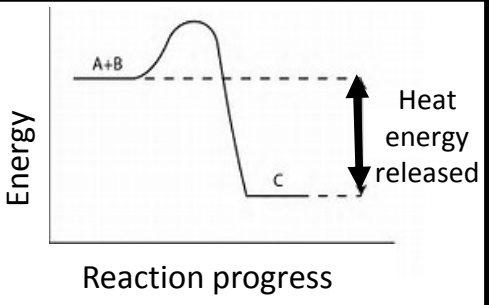
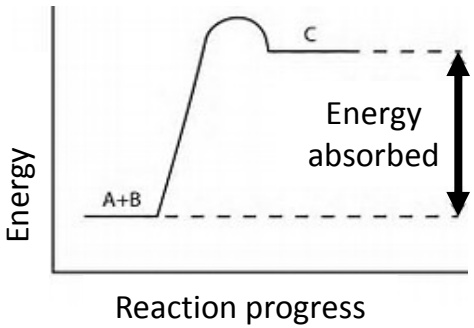
Balance the charges on both sides of a half equation. You can only add big numbers in front of the number of the electrons

eg $2O^{2-} - 4e^- \rightarrow O_2$

Additional information

You need to be able to work out how many electrons an atom wants to lose or gain using the group number. This will be its ion charge.

Key points to learn

1. Exothermic reaction	One that transfers energy to the surroundings so the temperature of the surroundings increases
	
	Used in handwarmers and self-heating cans
	Examples: combustion, respiration, oxidation, neutralisation
2. Endothermic reaction	One that absorbs energy from the surroundings so the temp. of the surroundings decreases
	
	Used in cold packs for injuries
	Examples: Photosynthesis, thermal decomposition, citric acid and sodium hydrogen carbonate

Key points to learn

3. Reactant	Used in a reaction
4. Product	Made in a reaction
5. Conservation of energy	Energy is never created or destroyed it is just transferred from one form to another
6. Activation Energy	Is the energy required to start a reaction
7. Catalyst	Chemical which speeds up a reaction without being used itself
	Reduces the activation energy required to start a reaction
8. Breaking and making bonds	This is what happens during a chemical reaction
	Require energy in to break bonds (Endothermic)
	Energy is released when bonds are made (Exothermic)
	Bonds between different atoms need different amounts of energy

Additional information

- Collision theory: chemical reactions occur when particles collide with enough energy
- Chemical reactions are all due to electrons moving or being shared
- An enzyme is a biological catalyst
- *Higher Tier content is written in italics*

Trilogy C7: Energy Changes

Collins rev guide: Energy Changes

Knowledge Organiser

Big picture (Chemistry Paper 1)

- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - **Energy changes**

Background

The interaction of particles in chemical reactions often involves transfers of energy. These produce heating or cooling effects that are used in a range of everyday applications.

Maths skills

- *Using bond energies, calculate energy difference in a reaction eg*

$2H_2 + O_2 \rightarrow 2H_2O$

Reactants bond energy (kJ/mol)

$(2x436) + 498) = 1370$

Products bond energy (kJ/mol)

$2x(2x464) = 1856$

Energy released (kJ/mol)

1370-1856 = –486 kJ/mol

Therefore exothermic

Bond	Bond energy (kJ/mol)
H-H	436
O=O	498
H-O	464

AQA Trilogy Science

SAMUEL WARD ACADEMY TRUST

Paper 1 Physics topics

- Energy and energy resources
  - Conservation and dissipation of energy
  - Energy transfer by heating
  - Energy resources
- Particles at work
  - Electric circuits
  - Electricity in the home
  - Molecules and matter
  - Radioactivity

Paper 2 Physics topics

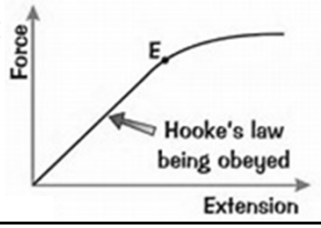
- Forces in action
  - Forces in balance
  - Motion
  - Forces and motion
- Waves and electromagnetism
  - Wave properties
  - Electromagnetic waves
  - Electromagnetism

CASTLE MANOR · CHURCHILL SCHOOL · NEWMARKET ACADEMY · SAMUEL WARD · SYBIL ANDREWS ACADEMY · TGS

Key points to learn

1. Energy stores [J]	Chemical energy
	Kinetic energy
	Gravitational potential energy
	Elastic potential energy
2. Chemical energy [J]	Transferred during chemical reactions eg fuels, foods, or in batteries
3. Kinetic energy [J]	All moving objects have it.
	k.e = 0.5 x mass x (speed)^2 E_k = ½ x m x v^2 [J] [kg] [m/s]
4 Gravitational potential energy [J]	Stored in an object lifted up.
	g.p.e = mass x g x height E_p = m x g x h [J] [kg] [N/kg] [m]
5. Elastic potential energy [J]	Energy stored in a springy object
	e.p.e = 0.5 x spring constant x (extension)^2 E_e = ½ x k x e^2 *(You are given this equation)* [J] [N/m] [m]
6. Energy can be transferred by…	Heating (thermal energy always flows from hot to cold objects)
	An electrical current flowing
	A force moving an object
7. Useful energy [J]	Energy transferred to the place and in the form we need it.
8. Wasted energy [J]	Not useful. Eventually transferred to surroundings

Key points to learn

9. Work done [J]	Equal to the energy transferred.
	When a force moves an object.
	Work done = Force x distance moved W = F x s [J] [N] [m]
10. Energy flow diagram	Show energy transfers eg for a torch lamp:
	Chemical → Light + Heat
11. Conservation of energy	Energy cannot be created or destroyed. It can only be transferred usefully, stored or dissipated.
12. Dissipated energy [J]	Wasted energy, usually spread to the surroundings as heat.
13. Hooke's Law and k the spring constant	The extension of a spring is proportional to the force on it.
	The gradient of this graph is known as k, the spring constant. 
14. Efficiency	Proportion of input energy transferred to useful energy. 100% means no wasted energy. Efficiency = useful energy ÷ total input energy
15. Power [W]	Energy [J] transferred in 1 second.
	Power [W] = Energy [J] ÷ time [s]
16. Wasted power [W]	Total power in – useful power out

Trilogy P1: Conservation and dissipation of energy

Collins revision guide: Energy

Knowledge Organiser

Big picture (Physics Paper 1)

- Energy and energy resources
  - Conservation and dissipation of energy
  - Energy transfer by heating
  - Energy resources
- Particles at work
  - Electric circuits
  - Electricity in the home
  - Molecules and matter
  - Radioactivity

Background

Energy is the capacity of something to make something happen.
The Universe and everything in it is constantly changing energy from one form into another.

Maths skills

You should be able to recall, use and rearrange all the equations on this page except number 5.

g is Earth's acceleration due to gravity. It has a constant value of approximately 9.8m/s^2

You need to remember the units for each quantity. They are in [ ] next to equations.

You should be able to calculate the gradient of a Force – extension graph.

Key points to learn

1. States of matter	 Solid Liquid Gas
2. Solid	Particles held together in fixed positions by strong forces. Least energetic state of matter.
3. Liquid	Particles move at random and are in contact with each other. More energy than solids, less than gas
4. Gas	Particles move randomly and are far apart. Weak forces of attraction. Most energetic.
5. Vacuum	No particles at all. Space is a vacuum
6. Metals	Have free electrons which makes them good conductors
7. Non-metals	Have fixed electrons which makes them good insulators
8. Conductor	Is good at carrying heat energy or electrical energy
9. Thermal conductivity	A measure of how good something is at conducting
10. Insulator	A poor conductor
11. Friction	Two surfaces rubbing together
	Causes energy to be transferred as heat
	Can be reduced by using a lubricant
12. Lubricant	Fluid (eg oil) that smooths contact points between surfaces

Key points to learn

13. More energy loss from a building	If walls are thin
	If walls have high thermal conductivity
	Big temperature difference between inside and outside
14. Reduce heat loss by	Using material with low thermal conductivity ie an insulator
	Make insulator thicker
15. Specific heat capacity, c [J/kg°C]	Amount of energy needed to change temperature of 1kg by 1°C
	$E = mc\ \theta$ *(You are given this equation)* • E: Change in energy [J] • m: mass of object • *c: specific heat capacity* • θ: change in temperature [°C]
	Objects with high specific heat capacity take a long time to heat up and cool down. They are good at storing heat energy.
16. Loft insulation	Fibreglass which traps air which is a good insulator.
17. Cavity wall insulation	Traps air pockets in gaps which is a good insulator
18. Double glazing	Traps air in gaps between glass which is a good insulator
19. Foil behind radiator	Reflects heat away from wall back into room

Trilogy P2: Energy transfer by heating

Collins revision guide: Energy

Knowledge Organiser

Big picture (Physics Paper 1)

- Energy and energy resources
  - Conservation and dissipation of energy
  - **Energy transfer by heating**
  - Energy resources
- Particles at work
  - Electric circuits
  - Electricity in the home
  - Molecules and matter
  - Radioactivity

Background

Not wasting heat energy in your home is important for the environment and for your finances. This topic will help you make more informed decisions so that you can save even more.

Maths skills

You should be able to use the specific heat capacity equation to find energy change and the specific heat capacity when given all other variables. Rearranging to make c the subject:

$$c = \frac{E}{m\ \theta}$$

Key points to learn

1.Fuel	Substance that we burn to release heat energy
	Stores chemical energy
2. Fossil fuels	Coal, oil and gas
	Remains of ancient organisms. Millions of years to form.
	Are non-renewable
	Release carbon dioxide when burnt
3. Non-renewable	Are used quicker than they are made. So will run out.
4. Renewable fuels	Made quicker than they are used. Will not run out
	These energy sources are renewable: • Biofuel • Wind and Wave • Geothermal • Hydroelectric and Tidal • Solar
5. Biofuel	Fuel made from living organisms eg vegetable oil, ethanol, wood
	Are considered carbon-neutral because CO_2 released is balanced by amount taken in by photosynthesis
	Reliable – can even be used fossil fuel power stations
	Reduces land available for food growth
	Renewable
6. Burning fuels	Releases carbon dioxide which contributes to the greenhouse effect and global warming.

Key points to learn

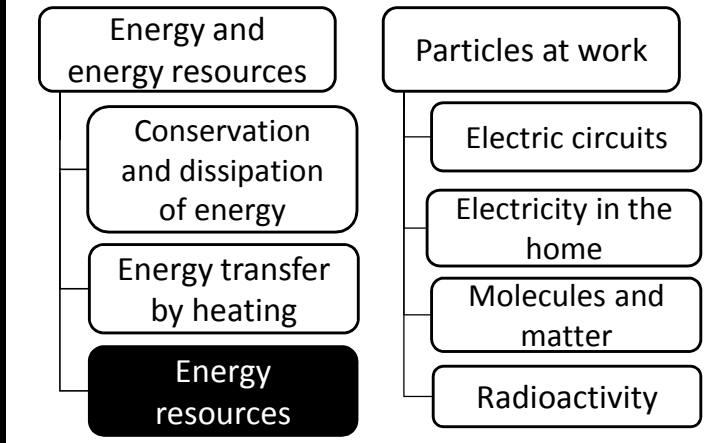
7. Decommission	Take apart and make safe at the end of its life
8. Wind and wave power	Kinetic energy of the air/water turns turbines
	Unreliable as both need wind
	Renewable
9. Geothermal power	Use heat energy from deep underground instead of fuel
	Not available everywhere
	Renewable
10. Hydroelectric and Tidal power	Water stored high up in dams then released to spin a turbine
	Very quick start-up time
	Can destroy habitats for animals
	Renewable
11. Solar power	Use light or heat energy from the Sun
	Unreliable as needs sun
	Renewable
12. Nuclear fuel	Energy stored in nucleus as nuclear energy. Uranium or Plutonium.
	Heat release in reactor core
	High energy yield
	Very slow start-up time as potentially dangerous
	Fuel and waste is radioactive
	Very expensive to set up and decommission

Trilogy P3: Energy Resources

Collins revision guide: Energy

Knowledge Organiser

Big picture (Physics Paper 1)



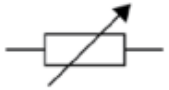
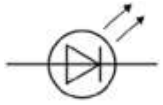
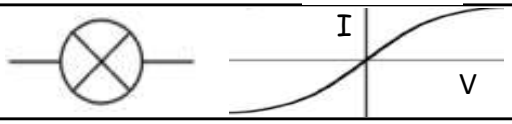
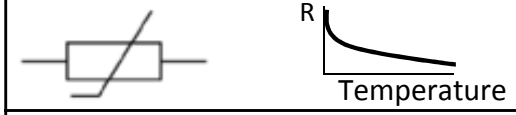
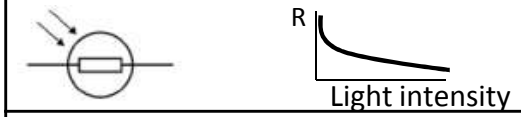
Background

It is hard to imagine a World without electricity. It reaches into every aspect of our lives. But where do we get the energy to make it from? Will they run out? Have we got a backup plan?

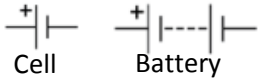
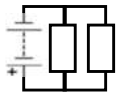
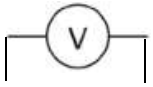
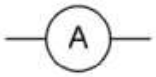
Additional

To make electricity, we usually spin a turbine which we then attach to a generator. Making that turbine spin, is the problem…
The most common way is by burning fuels to boil water, then shooting the steam at the turbine. But there are issues with this, as you will find out.

Key points to learn

1. Diode	
	Current only flows one way. Very high resistance in other direction.
2. Resistor (Ohmic conductor)	
	Resistance stays constant. Current proportional to pd.
3. Variable resistor	Resistance can be set by a human. Used in dimmer switches. 
4. LED	A diode that gives off light. 
5. Lamp	
	Resistance increases as the temperature increases.
6. Thermistor	
	Resistance decreases as the temperature increases.
	Used in thermostats.
7. LDR	
	Resistance decreases as the light intensity increases (gets brighter).
	Used in automatic lights.

Key points to learn

8. Cell and battery	Provides the potential difference (pd) and energy for a circuit. 
9. Current, I	Rate of flow of electrical charge. Measured in Amps (A)
10. Charge, Q	Measured in Coulombs (C)
11. Potential difference, V	pd. Energy transferred per unit charge. Measured in Volts (V)
12.Resistance R	Ability to slow current. Measured in Ohms (Ω)
13. Series circuit	Current has only one route.
	Current is the same all the way around. Potential difference is shared across components.
	Resistances are added together.
14. Parallel circuit	Current has different paths it could take. 
	Current is shared through each branch. Potential difference is the same across each branch.
	Total resistance is lower than the smallest single resistor.
15. Voltmeter	Measures pd across a component 
16. Ammeter	Measures current through a component 
17. Fuse	Resistor that melts if current is too high. 

Trilogy P4: Electric circuits

Collins revision guide: Electricity

Knowledge Organiser

Big picture (Physics Paper 1)

- Energy and energy resources
  - Conservation and dissipation of energy
  - Energy transfer by heating
  - Energy resources
- Particles at work
  - **Electric circuits**
  - Electricity in the home
  - Molecules and matter
  - Radioactivity

Background

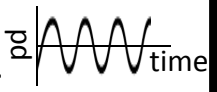
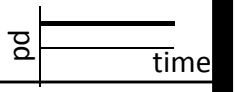
Electrical power fills the modern world with light and sound, information and entertainment, remote sensing and control. Its use was identified and explored by scientists of the 19th century but it becomes more important every day.

Maths skills

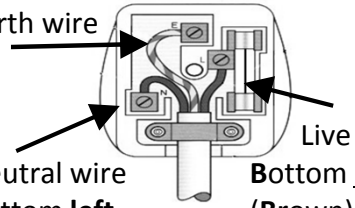
- **Q = I x t**
  Charge = Current x time
  [C] [A] [s]
- **V = I x R**
  Potential difference = Current x Resistance
  [V] [A] [Ω]

(You need to be able to remember and use these)

Key points to learn

1. ac	Alternating current Found in mains
	Has an alternating potential difference (voltage) negative to positive. 
2. dc	Direct current Found in batteries 
	Has a constant potential difference (voltage)
3. UK mains	AC supply of 230Volts and frequency of 50Hz
4. Power, P	Energy [J] transferred in one second. Measured in Watts (W)
5. Potential difference, V	Also known as voltage. Measured in volts (V)
6. Energy transferred, E	Depends on the power of the appliance and the time it is on for. Also called work done.
7. Energy transfer diagram	Energy input → Useful energy + Wasted energy
8. Work done, E	Energy transferred when current flows in a circuit.
9. National grid	System of cables and transformers.
10. Step-up transformer	Increase potential difference so that less heat energy is wasted.
11. Step-down transformer	Decrease potential difference to make electric more easily used.

Key points to learn

12. Current, I	Measured in Amps (A)
13. Resistance, R	Measured in ohms (Ω)
14. Live wire	Brown. Connects to fuse.
	Carries the alternating potential difference from the supply.
	About 230V.
15. Neutral wire	Blue wire
	Completes the circuit.
	Around 0V
16. Earth wire	Green and yellow striped wire.
	Carries current safely to Earth if there is a fault.
	Normally 0V.
17.Electrical plug	Made of plastic as it is a good insulator.
	Earth wire  Neutral wire **B**ottom **left** (**Bl**ue) Live wire **B**ottom **r**ight (**Br**own) Through fuse

- P = V x I
  power = potential difference × current
  [W] [V] [A]

- P = I^2 × R
  power = current^2 × resistance
  [W] [A] [Ω]

Trilogy P5: Electricity in the home

Collins revision guide: Electricity

Knowledge Organiser

Big picture (Physics Paper 1)

- Energy and energy resources
  - Conservation and dissipation of energy
  - Energy transfer by heating
  - Energy resources
- Particles at work
  - Electric circuits
  - **Electricity in the home**
  - Molecules and matter
  - Radioactivity

Background

We use electricity in all aspects of modern life. But how is it moved from power stations to our homes and then to our devices? This topic answers that question as well as investigating how power companies measure our electricity usage.

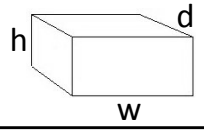
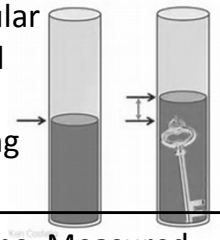
Maths skills

- E = P x t
  Work done = Power x time
  [J] [W] [s]
  [kWh] [kW] [hr]

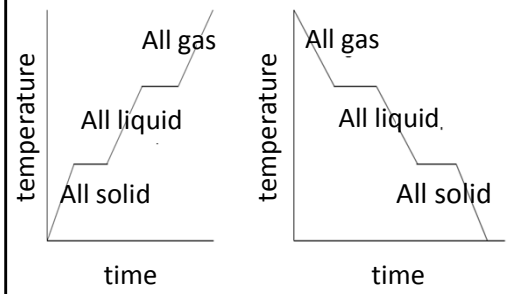
(You need to remember and be able to use all of the equations on this sheet.)

- E = Q x V
  Work done = Charge flow x potential difference
  [J] [C] [V]

Key points to learn

1. Mass, m	Amount of matter in something. Measured in kg
2. Volume, V	Amount of space something takes up. Measured in m^3
	Volume of a cuboid = w x d x h 
	Volume of an irregular object can be found by dropping in a liquid and measuring displacement. 
3. Density, ρ	Mass per unit volume. Measured in kg/m^3
	$density = \frac{mass}{volume}$
4. Floating	An object that has a lower density than the fluid will float
5. Sinking	An object that has a higher density than the fluid will sink
6 Evaporation	Happens at any temperature
7 Sublimation	Solid turns straight into gas
8. Solid	Particles held together in fixed positions by strong forces. Least energetic state of matter.
9. Liquid	Particles move at random and are in contact with each other. More energy than solids, less than gas
10. Gas	Particles move randomly and are far apart. Weak forces of attraction. Most energetic.

Key points to learn

11. Melting point	Temperature when solid turns into liquid. Same as freezing point.
12. Boiling point	Temperature when liquid turns into gas. Same as condensation point.
13. Condensation point	Temperature when gas turns into liquid. Same as boiling point.
14. Freezing point	Temperature when liquid turns into solid. Same as melting point.
15. Latent heat	Energy transferred when a substance changes state but temperature doesn't change
16. Specific latent heat of fusion	Energy needed to melt 1kg of solid into liquid
17. Specific latent heat of vaporisation	Energy needed to boil 1kg of liquid into gas
18. At state changes…	Temperature and kinetic energy of particles stays constant.
	Internal energy increases due to an increase in potential energy as particles move further apart
19. Heating and cooling curves	
20. Gas pressure	Caused by particles hitting surfaces. Increases when temperature increases

Trilogy: Molecules and matter

Collins rev guide: Particle model of matter

Knowledge Organiser

Big picture (Physics Paper 1)

- Energy and energy resources
  - Conservation and dissipation of energy
  - Energy transfer by heating
  - Energy resources
- Particles at work
  - Electric circuits
  - Electricity in the home
  - **Molecules and matter**
  - Radioactivity

Background

The particle model is widely used to predict the behaviour of solids, liquids and gases. It helps us to design vehicles from submarines to spacecraft. It even explains why it is difficult to make a good cup of tea high up a mountain!

Maths skills

$$density = \frac{mass}{Volume}$$ *(You need to remember this.)*

$[kg/m^3]$ $\rho = \frac{m}{V}$ $\frac{[kg]}{[m^3]}$

Latent heat: $Energy = \text{mass x specific latent heat}$

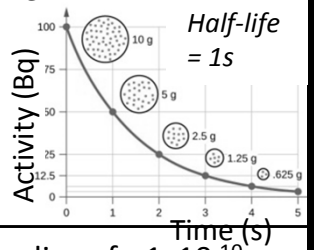
$E = m \times L$

[J] [kg] [J/kg] *(You are given this)*

Key points to learn

1. Radioactive decay	Unstable nuclei emitting a type of radiation (α, β , γ or neutron)
2. Random event	You cannot predict or change when decay might happen.
3. Ionising	The ability to charge atoms
4. Alpha particle (α) ^4_2He	Two neutrons and two protons. The same as a helium nucleus.
	Stopped by paper or skin.
	Range of a couple of cm in air
	Highly ionising: has charge of +2
	Parent atom mass drops by 4 and atomic number drops by 2.
5. Beta particle (β) $^0_{-1}e$	A high speed electron made when a neutron turns into a proton.
	Stopped by thin aluminium.
	Range of up to one metre.
	Mid ionising: has charge of -1.
	Parent atom mass remains same and atomic number rises by 1
6. Gamma ray (γ) $^0_0\gamma$	An electromagnetic wave.
	Stopped by thick lead.
	Unlimited range.
	Low ionising: has no charge.
	Parent atom mass and atomic number remains same.
7. Neutron (n)	Neutron ejected from the nucleus

Key points to learn

8. Activity	Rate of unstable nuclei decay. Measured in Becquerel (Bq)
9. Irradiated	Exposed to radiation but does not become radioactive.
10. Radioactive contamination	Unwanted presence of radioactive material.
11 Geiger counter	Nuclear radiation detector.
12. Half-life	Time it takes for the radioactive nuclei to halve. Or, the time it takes for the activity to halve. 
13. Nuclear model of the atom	Very small, radius of ≈1x10^{-10}m Most of mass in the nucleus. Number of electrons = protons
14. Mass number	Number of neutrons + protons
15. Atomic number	Number of protons ^4_2He
16. Isotope	Same number of protons different number of neutrons.
17. Ion	Atom where number of protons is not equal to electrons (+'ve or –'ve)
18. Plum pudding atom model	Early model: ball of positive charge with electrons stuck in it.
19. Bohr Model	Idea that electrons have to be at certain distances from nucleus.
20. Chadwick	Discovered neutrons

Trilogy P6: Radioactivity

Collins rev guide: Atomic Structure

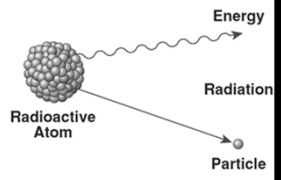
Knowledge Organiser

Big picture (Physics Paper 1)

- Energy and energy resources
  - Conservation and dissipation of energy
  - Energy transfer by heating
  - Energy resources
- Particles at work
  - Electric circuits
  - Electricity in the home
  - Molecules and matter
  - **Radioactivity**

Background

Researched by Henri Becquerel and Marie Curie around 1900 it remains mysterious and frightening.

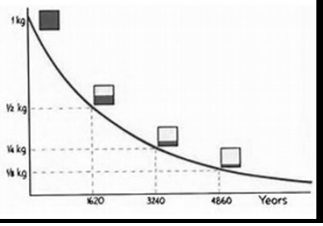


Maths skills

- *Nuclear decay equations:* Balance top and bottom numbers on RHS and LHS.

$$^{226}_{88}\text{Ra} \rightarrow {}^{4}_{2}\text{He} + {}^{222}_{86}\text{Rn}$$

- *Finding Half-life using a graph*
  Find how long It takes until you have half what you started with



AQA Trilogy Science

SAMUEL WARD ACADEMY TRUST

Paper 1 Biology topics

- Cells and organisation
  - Cell structure and transport
  - Cell division
  - Organisation and the digestive system
  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Paper 2 Biology topics

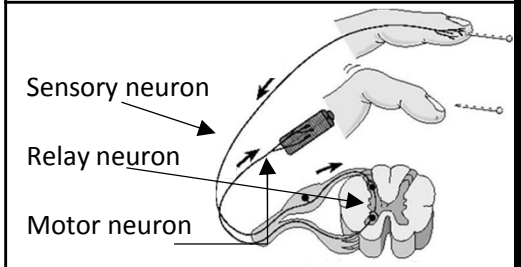
- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - Variation and evolution
  - Genetics and evolution

CASTLE MANOR · CHURCHILL SCHOOL · NEWMARKET ACADEMY · SAMUEL WARD · SYBIL ANDREWS ACADEMY · TGS

Key points to learn

1. Catalyst	Increase rate of reaction without being used up themselves
2. Enzyme	Biological catalysts. Work at a specific temperature and Ph
3. Homeostasis	Automatic control of conditions inside a cell or organism so that enzymes and cells work effectively
	In the human body it controls: 1. Blood glucose concentration 2. Body temperature 3. Water levels
	Uses receptors, coordination centres and effectors
4. Receptors	Cells that detect changes (stimuli)
5. Coordination centres	Use information from receptors
	Brain, spinal cord and pancreas
6. Effectors	Bring about response to changes
	Muscles or glands
7. Pancreas	Monitors and controls blood glucose levels
8. Glands	Make hormones which act as chemical messages in the body
9. Stimuli	A change noticed by a sensory receptor. Can be changes in: 1. Temperature 4. Sound 2. Taste 5. Light 3. Touch 6. Smell
10. Neuron	Specialised cell that carries electrical impulse in nervous system

Key points to learn

11. CNS	Central Nervous System. Brain and spinal cord
12. Reflex actions	Automatic, rapid actions that do not use conscious part of brain
	Safety mechanism for our body
	Eg. Blinking, jumping at loud sounds
13. Reflex arc	The sequence in a reflex action eg tasting something sour 1. Stimulus – sour taste 2. Receptor – taste bud cell 3. Sensory neuron – carries impulse to coordinator 4. Relay neuron in Coordinator – spinal cord 5. Motor neuron – carries impulse to effector 6. Effector – muscle in face 7. Response – muscle contracts
	
14. Synapse	Gap between two neurons. Chemicals diffuse across gap instead of electrical impulse
15. Muscle	Tissue that can contract or relax to cause movement

Trilogy B10: The human nervous system

Collins Revision Guide: Homeostasis and response

Knowledge Organiser

Big picture (Biology Paper 2)

- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - Variation and evolution
  - Genetics and evolution

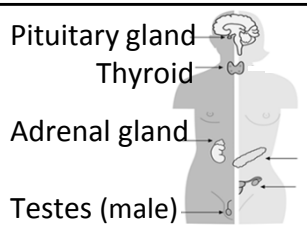
Background

Cells in the body need very specific conditions to survive and operate. How does our nervous system ensure that these conditions are monitored and controlled?

Additional information

Remember that our bodies operate at 37°C. It's so that our enzymes work best and do not denature.

Key points to learn

1. Endocrine system	Contains glands that secrete hormones into the bloodstream
	
2. Hormones	Chemical messages in the body.
3. Pituitary gland	'Master gland' that secretes hormones that act on other glands
4. Pancreas	Monitors and controls blood glucose levels
	Releases insulin hormone if blood glucose concentration too high
	Releases glucagon if blood glucose concentration too low
5. Insulin (hormone)	Causes cells to take glucose from blood. Liver and muscle cells store as glycogen
6. Glucagon (hormone)	*Converts glycogen into glucose. Interacts with insulin in negative feedback cycle to control glucose*
7. Adrenaline (hormone)	From adrenal gland. Increases heart rate in fight or flight response
8. Contraception (to stop pregnancy)	• Oral (pill) - FSH stops eggs maturing • Injection/implant – progesterone to stop maturation and release of eggs • Spermicides – chemicals kill sperm • Barrier – stop sperm reaching egg • Abstinence – No sexual intercourse • Surgical – remove/cut reproductive organs

Key points to learn

9. Type 1 diabetes	Pancreas does not produce enough insulin when glucose concentration too high. Needs insulin injections
10. Type 2 diabetes	Body no longer responds to insulin. Controlled by diet and exercise
	Obesity a risk factor for this diabetes
11. Thyroxin (hormone)	From the thyroid gland. Controls they body's metabolic rate. Important in growth and development Controlled by negative feedback
12 Oestrogen (hormone)	Main female reproductive hormone. From ovaries
13. Ovulation	Once a girls has gone through puberty she releases an egg every 28days during the menstrual cycle
14. Hormones during menstrual cycle	FSH (Follicle Stimulating Hormone) causes and egg to mature in ovary. *Stimulates ovary to make oestrogen*
	LH (Luteinising Hormone) triggers release of egg (ovulation)
	Oestrogen: causes uterus lining to grow; *stops release of FSH; starts release of LH*
	Progesterone: maintains uterus *lining; stops production of both FSH and LH*
Testosterone 15 (hormone)	Main male reproductive hormone. From testes. Starts sperm production
16. Infertility treatment (to help pregnancy)	• FSH and LH can be taken to stimulate egg development and release. • IVF (In Vitro Fertilisation) uses eggs that are removed, fertilized and re-implanted into uterus

Trilogy B11: Hormonal coordination

Collins Rev. Guide: Homeostasis and response

Knowledge Organiser

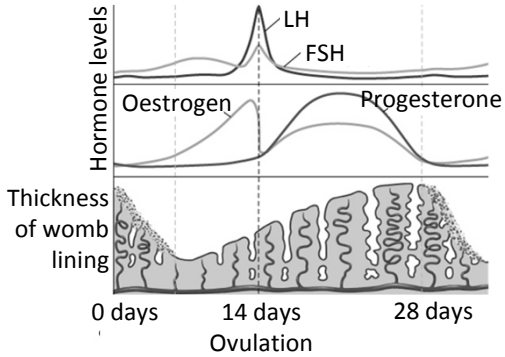
Big picture (Biology Paper 2)

- Biological response
  - The human nervous system
  - **Hormonal coordination**
    - Ecology
      - Adaptations, interdependence and competition
      - Organising an ecosystem
      - Biodiversity and ecosystems
    - Genetics and reproduction
      - Reproduction
      - Variation and evolution
      - Genetics and evolution

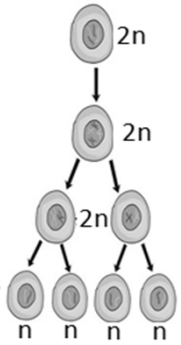
Background

The journey from a child into an adult is (adolescence) is a difficult time for all living things. It's all because of our hormones.

Here are the hormones that change and control the female menstrual cycle.



Key points to learn

1. Asexual reproduction	1. Only one parent 2. Cells divide by mitosis 3. Offspring are clones of parent
2. Sexual reproduction	1. Two parents 2. Fusing of male and female gametes which mixes genetic information from parents. 3. Variation between offspring
3. Gametes	Male and female sex cells: • Male: Sperm (animals) and pollen (plants) • Female: Egg (animals and plants)
	Half chromosomes of normal cell
4. **Mit**osis	One parent cell divides into two identical versions . **M**aking **i**dentical **t**wo. Used in growth/repair
5. Meiosis	Cell divides to make gametes (sex cells) 1. Copies genetic information 2. Cell divides into two each with full set of chromosomes 3. Two cells divide into four gametes - each with a half set of chromosomes 4. Gametes are genetically unique 
6. Fertilisation	Male and female gametes fuse together – now have full set of chromosomes for offspring
	Fusing half mothers chromosomes with half of fathers
7. Clone	Genetically identical
Characteristics	Features of an individual

Key points to learn

9. DNA	Chemical that makes chromosomes
	Polymer made of two strands. Double helix shape 
10. Gene	Small section of DNA in a chromosome. Codes for a certain amino acid to make certain protein
11. Chromosome	Made of genes. Carry all genetic information on how to make organisms what they are. Humans have 23 pairs of chromosomes
12. Genome	All the genetic material of an organism. The whole human genome has been studied and will have great importance for future medicine
13. Using the human genome	1. Search for genes related to certain diseases 2. Treating inherited disorders 3. Study human migration patterns
14. Allele	Single gene that controls one inherited characteristic eg fur colour
15. Genotype	Allele version present eg BB, Bb or bb
16. Phenotype	Characteristic displayed eg green eye
17. Dominant	Allele that wins if present eg B
18. Recessive	Allele that submits to dominant eg b
19 Heterozygous	Both alleles are identical eg BB or bb
20 Homozygous	Both alleles are different eg Bb
21 Inherited disorders	1. Polydactyl – extra fingers or toes. Caused by dominant allele 2. Cystic fibrosis - recessive allele
22. Gender	Females – XX. Males - XY

Trilogy B12: Reproduction

Collins Revision Guide: inheritance, variation and evolution

Knowledge Organiser

Big picture (Biology Paper 2)

- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - Variation and evolution
  - Genetics and evolution

Background

Why is there such variation between humans? How are some characteristics inherited from mothers and some from fathers? This topic explores.

Punnet squares

Predict outcomes of genetic crosses. Parents genotype outside. Possible offspring genotypes in middle.

Hair colour	B	B
b	Bb	Bb
b	Bb	Bb

Phenotypes: **B**rown: 100% **b**londe: 0%

	B	b
b	Bb	bb
b	Bb	bb

Phenotypes: **B**rown: 50% **b**londe: 50%

	B	b
B	BB	Bb
b	Bb	bb

Phenotypes: **B**rown: 75% **b**londe: 25%

Key points to learn

1.Variation	Differences between individuals in a species. Caused by combination of genes and environment
2. Inherited characteristics	Features from genes you inherit eg hair colour, tongue rolling
3 Environmental characteristics	Features caused from conditions you have grown up in eg accent
4. Mutations	Changes in DNA code. Occur continuously
	Responsible for all different phenotypes
5. Phenotype	Characteristic displayed due to a genetic allele eg green eye
6. Evolution	Change in inherited characteristics over time due to natural selection
7. Darwin's Theory of evolution through natural selection	All living things evolved from simple life forms over 3 billion years ago
	1. Different phenotypes in species 2. Some phenotypes are better suited to environment 3. Individuals with better suited phenotypes survive and breed 4. Successful phenotypes are passed on to next generation Mutation of gene → Better at surviving → Breed → Pass on genes
8. Genome	All genetic information in organism

Key points to learn

9. New species	Evolve such different phenotypes that they can no longer breed
10. Selective breeding (artificial selection)	Choosing parents with desired characteristics so that their offspring show those characteristics
	Takes many generations to obtain desired characteristic reliably
	Desirable characteristics include: Disease resistant crops; more milk or meat; dogs with gentle nature; large or unusual flowers
11. Inbreeding	Selective breeding can lead to this. Where breeds are prone to disease or inherited defects
12. Genetic engineering	Modifying the genome of an organism by adding a gene from another organism. Examples: 1. Bacteria to produce insulin 2. *Possibly curing human inherited disorders*
13. GM Crops	**G**enetically **M**odified crops can be resistant to disease or have higher yield
	Concerns over effect on wild plants and insects. Also long term effects on human health
14. Processes of genetic engineering	*1. Enzyme isolates gene* *2. Gene loaded into vector eg virus* *3. Vector inserts gene into cell* *4. Genes transferred at early stage of development so organism develops with desired characteristics*

Trilogy B13: Variation and evolution

Collins Revision Guide: inheritance, variation and evolution

Knowledge Organiser

Big picture (Biology Paper 2)

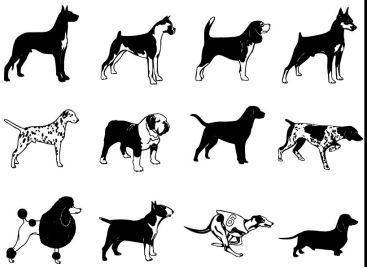
- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - **Variation and evolution**
  - Genetics and evolution

Background

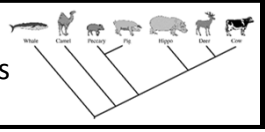
It is hard to imagine that all life on Earth shares the same ancestors. The process of evolution through natural (and artificial) selection have both been in action for a very, very long time.

This topic considers how living things have and continue to evolve.

(Italicised statements are Higher Tier Only)



Key points to learn

1. Darwin's Theory of evolution through natural selection	All living things evolved from simple life forms over 3 billion years ago	
	1. Different phenotypes in species 2. Some phenotypes are better suited to environment 3. Individuals with better suited phenotypes survive and breed 4. Successful phenotypes are passed on to next generation	Mutation of gene Better at surviving Breed Pass on genes
	Theory is now widely accepted	
2. Evidence for evolution	1. From looking at fossils 2. Antibiotic resistance in bacteria 3. Understanding of genetics	
3. Fossils	Remains of organisms from millions of years ago found in rocks.	
	Formed by: 1. Conditions needed for decay were not present 2. Parts of organism replaced by minerals as they decayed 3. Preserved traces eg footprints,	
4. Why so few fossils?	Many life forms had soft bodies. Geological activity destroyed some	
5. Extinct	No more surviving individuals of a species	
6. Evolutionary trees	Used to show how we think organisms are related 	

Key points to learn

7. Extinction	Permanent loss of all members of a species. Can be caused by: 1. Changes in environment eg climate 2. New predators 3. New diseases 4. New competition eg for food
8. Bacterial evolution	Can evolve quickly as the reproduce at such a fast rate
9. Resistant bacteria	Some bacteria have a mutation that makes them resistant to anti-biotics. This means we cannot kill them
	MRSA is resistant to antibiotics
10. Reducing development of resistant bacteria	1. Humans to not use antibiotics as often 2. Patients should always complete their courses of antibiotics so all bacteria are killed 3. Reduce use of antibiotics in agriculture
11 Developing new antibiotics	Is expensive and slow. It is unlikely to be done quick enough to cope with resistant bacteria
12 Classification	Putting living things into similar groups
13. Linnaean system	Carl Linnaeus's classification system **K**ingdom; **P**hylum; **C**lass; **O**rder; **F**amily; **G**enus; **S**pecies
	Keeping **P**recious **C**reatures **O**rganised **F**or **G**rumpy **S**cientists
14. Three Domain system	Classification developed by Carl Woese. • Archaea – primitive bacteria • Bacteria – true bacteria • Eukaryota – everything else living

Trilogy B14: Genetics and evolution

Collins Revision Guide: inheritance, variation and evolution

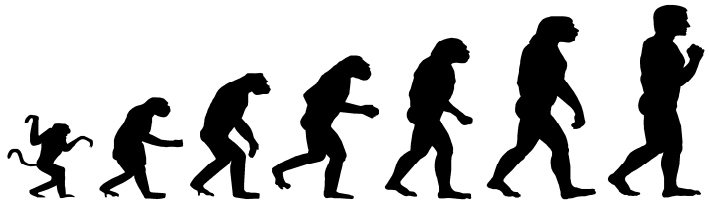
Knowledge Organiser

Big picture (Biology Paper 2)

- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - Variation and evolution
  - Genetics and evolution

Background

Understanding where we come from may be far more useful than satisfying our curiosity. It might help us fight the emergence of anti-biotic resistant bacteria - described as one of the greatest current threats to humanity.
So what is evolution all about?



Key points to learn

1 Communities	Group of interdependent plants or animals living together
2. Ecosystem	A system that includes all living organisms (biotic) in an area as well as non-living (abiotic) factors
3. Plants compete for	1. Light and space 2. Water 3. Mineral ions from soil
4. Animals compete for	1. Food 2. Mates – for reproduction 3. Territory
5. Interdepend-ence	Different species relying on each other for food, shelter, pollination, seed dispersal
	Changes to one species affect the whole community
6. Energy source for ecosystems	The sun is the source of energy in all food webs
	Plants use photosynthesis to convert light into chemical energy in glucose
7. Abiotic factors	Non-living factors that affect communities: 1. Light intensity 2. Temperature 3. Moisture levels 4. Soil pH and mineral content 5. Wind intensity and direction 6. Carbon dioxide levels – plants 7. Oxygen levels – aquatic animals
8. Aquatic	Lives in water
9. Food chain	A single path in a food web

Key points to learn

10. Biotic factors	Living factors that affect communities: 1. Availability of food 2. New predators 3. New pathogens (microorganisms that cause disease) 4. One species outcompeting leading to numbers too low to breed
11. Adaptations	Features which make an organism better suited to its environment
12. Structural adaptations	Physical features eg fur, beak shape, foot size, sharp claws, thick blubber, big leaves, long roots, camouflage
13 Behavioural adaptations	Changes in behaviour to help survive eg migration, tools, pack hunting
14. Functional adaptations	Biological processes such as reproduction or metabolism eg giving birth to lots of young; hibernation; a chameleons adaptive camouflage
15. Extremo-philes	Organisms that live in very extreme environments such as high pressure / temperature / salt concentrations
	Example: Bacteria in deep sea vents
16. Example plant adaptations	Long roots collect water; small leaves reduce water loss; big leaves increase light captured
17. Example animal adaptations	Camouflage to hide/hunt; big surface area increases heat loss; blubber reduces heat loss
18. Quadrat	Randomly chosen small area (often $1m^2$). Used to estimate total numbers
19. Line transect	A line along which you measure distribution of organisms

Trilogy B15: Adaptations, interdependence and competition

Collins Revision Guide: Ecology

Knowledge Organiser

Big picture (Biology Paper 2)

- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - Variation and evolution
  - Genetics and evolution

Background

A study recently estimated there to be 8.7 million different species of organism on our planet. They all compete for the limited resources available and nearly all rely on the Sun as their ultimate source of energy.

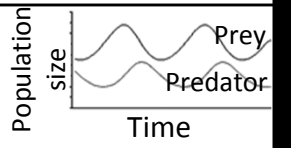
Maths skills

Find the mean, mode and median for a set of data

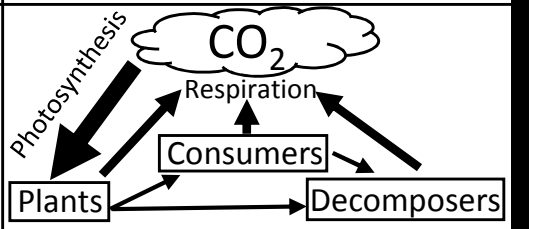
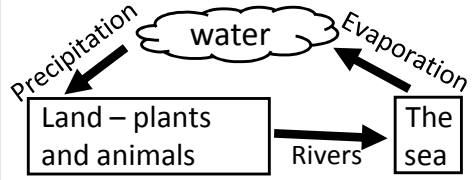
eg. 1, 2, 3, 4, 5, 5, 6

- Mean = (1+2+3+4+5+5+6) ÷ 7 = **3.7** (2sf)
- Median (middle number) = **4**
  Mode (most common number) = **5**

Key points to learn

1. Food chains	Producer → Primary consumer → Secondary consumer
2. Biomass	Amount of biological mass in an organism
3. Producers	Green plants or algae. Always first organism in a food chain. Produce most of the biomass for life on Earth eg phytoplankton
4. Primary consumers	Eat producers eg fish
5. Secondary consumers	Eat primary consumers eg seal
6. Tertiary consumers	Eat secondary consumers eg killer whale
7. Predators	Consumers that kill and eat other animals
8. Prey	Consumers that get eaten by predators
9. Predator-prey cycles	Numbers of both rise and fall in cycles 
	1. Lots of plants means prey numbers increase 2. Lots of prey means predator numbers increase 3. Lots of predators means prey numbers decrease 4. Less prey means predator numbers fall 5. Less predators means prey numbers increase

Key points to learn

10 Distribution	Where things are
11 Abundance	How many there are
12. Decomposers	Microorganisms that feed on dead organisms and waste
	Release carbon back into atmosphere and minerals ions into soil
13. Carbon cycle	
14. Photosynthe-sis	Chemical reaction in which chloroplasts make glucose and oxygen
	The reverse of respiration
	Carbon dioxide + Water → Glucose + Oxygen *Using light*
15. Respiration	Process by which all living things get energy from glucose and oxygen
	Glucose + Oxygen → Carbon dioxide + Water
16. Water cycle	
17 Material recycling	Many materials are recycled to provide building blocks for future
Combustion (burning)	Fuel + Oxygen → Carbon dioxide + Water

Trilogy B16: Organising and ecosystem

Collins Revision Guide: Ecology

Knowledge Organiser

Big picture (Biology Paper 2)

- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - **Organising an ecosystem**
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - Variation and evolution
  - Genetics and evolution

Background

All living and non-living things are made of atoms. These atoms have been around for millions of years and have been continuously cycled over that time. It is amazing to thing that the carbon in us could once been part of Einstein, a cloud, a grasshopper, Cleopatra, a tree or even a piece of tyrannosaurs rex dung. This process of cycling material (and energy) is essential to all life on Earth.

Key points to learn

1. Biodiversity	The variety of all different species in a particular ecosystem
2. Ecosystem	A system that includes all living organisms (biotic) in an area and non-living (abiotic) factors
3. High biodiversity	Ensures stability of ecosystems by reducing one species dependence on another
	Future of human species on Earth relies on high biodiversity
4. Negative human impact on biodiversity	Human actions are reducing biodiversity. Actions such as: • More waste • More land use • Population growth • Using resources
	Only recently have we tried to reduce impact of these actions
5. Pollution from waste	Pollution kills plants and animals which can reduce biodiversity
	• In water, from sewage, fertiliser or toxic chemicals • In air, from smoke and acidic gas • On land, from landfill and from toxic chemicals
6. Land use	Humans reduce land available for animals by: • Building • Quarrying • Farming • Dumping waste

Key points to learn

7. Destruction of peat bogs	Used for compost. Leads to reduction in size of this habitat.
	Decay or burning of peat releases carbon dioxide
8. Deforestation	Removal of forests to : • grow cattle and rice fields • grow crops for biofuels
9. Causes of global warming	Carbon dioxide and methane in the atmosphere contribute to global warming
10. Biological impact of global warming	• Loss of habitat through flooding • Changes in distribution of organisms as temperatures, rainfall and climate change • Changes in migration patterns as climates and seasons change • Reduced biodiversity as many organisms become extinct
11. Maintaining biodiversity	Actions humans are taking to reduce loss of biodiversity: • Breeding programmes for endangered species • Protection and regeneration of rare habitats • Reintroduction of field margins and hedgerows • Reduce deforestation • Reduce carbon dioxide emissions • Recycling rather than dumping in landfill

Trilogy B17: Biodiversity and ecosystems

Collins Revision Guide: Ecology

Knowledge Organiser

Big picture (Biology Paper 2)

- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - **Biodiversity and ecosystems**
- Genetics and reproduction
  - Reproduction
  - Variation and evolution
  - Genetics and evolution

Background

In order to ensure our future health, prosperity and well being we need to take some actions now. Humans need to survive in the environment in a sustainable way.
This topic explores the negative and positive impact we are having on biodiversity and the natural systems that support it.

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AQA Trilogy Science

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Paper 1 Chemistry topics

- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - Energy changes

Paper 2 Chemistry topics

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - Crude oil and fuels
- Analysis and the Earth's resources
  - Chemical analysis
  - The Earth's atmosphere
  - The Earth's resources

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Key points to learn

1. Chemical reaction	Reactants → Products *'turn into'*
2. Reactants	Ingredients in a chemical reaction
3. Products	The chemicals that are produced
Conservation of mass	In a chemical reaction the total mass of reactants = total mass of products
4	
5. Rate	How quickly something happens. Usually measured per second
6. Rate of reaction	How fast reactants turn into products
7. Measuring rate of reaction	1. Measure decrease in mass of a reaction if a gas is given off
	2. Increase in volume of gas given off. Catch gas given off
	3. Decrease in light passing through a solution
8. Calculating rate of reaction	The steepness of the line at any point on a reaction vs time graph.
	The steeper the line on the reaction vs time graph, the faster the reaction
9. Increasing temperature	Increases speed and energy of particles
10. Concentration	Amount of a substance per defined volume units of mol/dm^3
11. Pressure	Force applied per unit area [N/m^2]
12 Endothermic	Reaction that absorbs in energy
13 Exothermic	Reaction that releases heat energy
14 Equilibrium	Concentrations remain constant

Key points to learn

15. Collision theory	Reactions occur when particles collide with enough energy
16. Activation energy	Minimum energy needed in a collision for a reaction to occur
17. Increasing rate of reaction	1. Either need more particle collisions or more energetic collisions
	2. Increase surface area to volume ratio: greater rate of collisions
	3. Increase concentration: more particles, greater rate of collisions
	4. Increase pressure: particles closer, greater rate of collisions
	5. Increase temperature: greater rate of collisions each with more energy
	6. Use of a catalyst: reduce activation energy required for a reaction to happen
18. Catalyst	A substance that helps a reaction take place but is not used up itself
	In industry the increase rates of reaction and reduce energy cost
19. Reversible reactions	A reaction where the products will turn back into the products
	Reactants ⇌ Products
	eg hydrated copper sulfate ⇌ Anhydrous copper sulfate + water

Trilogy C8: Rates and equilibrium

Collins revision guide: The rate and extent of chemical change

Knowledge Organiser

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - Crude oil and fuels
- Analysis and the Earth's resources
  - Chemical analysis
  - The Earth's atmosphere
  - The Earth's resources

Background

In your body there are lots of reactions taking place all the time. Reactions are also important in industry to make products to sell for money. How do we measure or accelerate these reactions up? This topic finds out.

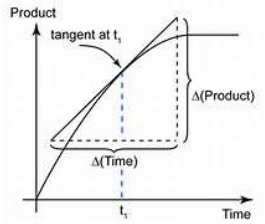
Additional

Look back at Trilogy C7: Energy Changes for more on endothermic, exothermic and activation energy.

Maths skills

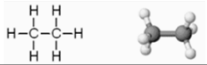
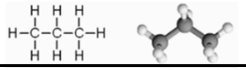
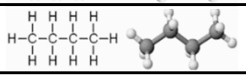
Finding the steepness (gradient) of a curved line at a point using a tangent.

Gradient = rise ÷ run

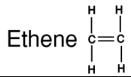
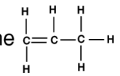


Rate of reaction = Δ(Product) ÷ Δ(time)

Key points to learn

1. Mixture	Not pure. Different compounds / elements not chemically bonded
2. Hydrocarbon	Compound containing only hydrogen and carbon eg CH_4
3. Crude oil	Fossil fuel mixture of hydrocarbons
4. Distillation	Separating liquid from a mixture by evaporation and condensation
5. Compound	Two or more different elements chemically bonded
6. Molecule	Two or more atoms chemically bonded
7. Fractions	Hydrocarbons with similar boiling points separated from crude oil
8. Alk**ane**s	Hydrocarbon with only single covalent bonds eg C–C
	Known as saturated hydrocarbons
	Methane (CH_4) 
	Ethane (C_2H_6) 
	Propane (C_3H_8) 
	Butane (C_4H_{10}) 
9. Boiling point	Temperature liquid turns to gas. (Long hydrocarbons have higher)
10. Volatility	How easily it evaporates (Long hydrocarbons have lower)
11. Flammability	How easily it lights and burns (Long hydrocarbons have lower)

Key points to learn

12. Viscosity	The resistance of a liquid to flowing or pouring. (Long hydrocarbons have higher)
13. Fractional distillation	Separating liquids from a mixture by boiling then condensing at different temperatures
14. Burning hydrocarbons	Hydrocarbon + Oxygen → Water + Carbon Dioxide
	eg $CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$
15. Oxidised	Oxygen added or electrons lost
16.Test for CO_2	Turns limewater cloudy
17. Incomplete combustion	When a fuel burns with insufficient oxygen. Produces toxic Carbon Monoxide (CO)
18. Cracking	Breaking large alkanes into smaller, more useful ones
19. Thermal decomposition	Breaking down a compound by heating it
20. Catalyst	Chemical which speeds up a reaction without being used itself
21. Alk**ene**s	Hydrocarbon with a double covalent bond eg C=C
	Known as unsaturated hydrocarbons
	Has twice as many H as C atoms
	eg Ethene  Propene 
22. Testing for alkenes	Unsaturated hydrocarbons turn bromine water colourless

Trilogy C9: Crude Oil and Fuels

Collins rev guide: Organic Chemistry

Knowledge Organiser

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - **Crude oil and fuels**
- Analysis and the Earth's resources
  - Chemical analysis
  - The Earth's atmosphere
  - The Earth's resources

Background

Fossil fuels are non-renewable which means they are running out. But why is oil so useful? This topic explores that very question.

Additional

Remember that non-metals bond by covalent bonding (sharing electrons) and that Carbon is in group 4 so needs 4 electrons to fill its outer shell.

Maths skills

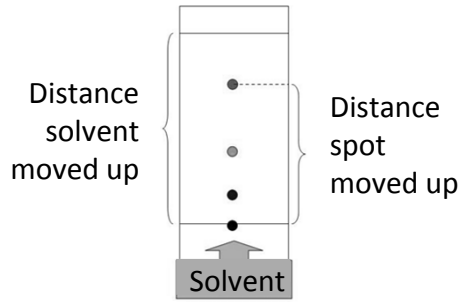
Balancing equations:

Number of atoms on reactant side = Number of atoms on product side

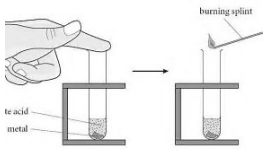
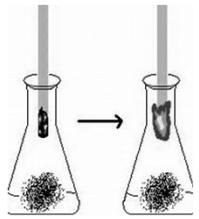
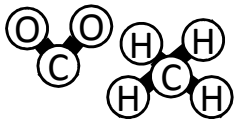
Alkane general formula: C_nH_{2n+2}

Alkene general formula: C_nH_{2n}

Key points to learn

1. Melting point	The temperature at which substances melt or freeze
2. Boiling point	The temperature at which substances boil or condense
3. Pure	Made of one substance. Can be an element or compound
4. Impure	Made of a mixture of substances
5. Fixed points	Melting and boiling pints of a pure substance Eg. Water 0°C and 100°C
6. Formulation	A mixture designed to produce a useful product
	Examples: paints, washing liquids, fuels, alloys, fertilisers, cosmetics
7. Paper Chroma-tography	A separation techniques where a solvent moves up a material and carries different substances up different heights with it
	
	Each substances has a unique Retention factor (R_f) at the same temperature in the same solvent
	$R_f = \frac{distance\ moved\ by\ substance}{distance\ moved\ by\ solvent}$

Key points to learn

8. Test for hydrogen	Hydrogen makes a squeaky 'pop' when lit with a splint 
9. Test for oxygen	Oxygen will relight a glowing splint. 
10. Test for carbon dioxide	If you bubble carbon dioxide through limewater it will turn milky (cloudy white)  *Clear → milky*
11. Test for chlorine gas	Chlorine gas will turn blue litmus paper white
	Need to be very careful as chlorine gas is toxic(poisonous)
12. Element	Only one type or atom present. Can be single atoms or molecules
	Both examples of the (N_2)  Nitrogen element (N)
13. Compound	Molecule containing more than one type of atom
	Carbon dioxide (CO_2)  Methane (CH_4)
14. Mixture	Two or more chemicals not chemically combined

Trilogy C10: Chemical analysis

Collins rev guide: Chemical analysis

Knowledge Organiser

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - Crude oil and fuels
- Analysis and the Earth's resources
  - **Chemical analysis**
  - The Earth's atmosphere
  - The Earth's resources

Background

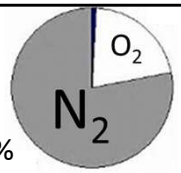
Somethings are useful, some are harmful. It's important that we can test to see what is in a substance or what is made in a reaction. Here are some of the methods we use in Science. You will have come across most of them earlier in school.

Maths skills

Rearrange and use the R_f chromatography equation

$$R_f = \frac{distance\ moved\ by\ substance}{distance\ moved\ by\ solvent}$$

Key points to learn

1 Atmosphere	Layer of gas around Earth
2. Earth's early atmosphere theory	Volcanos released carbon dioxide (CO_2), water vapour (H_2O) and nitrogen (N_2)
	Similar to Mars and Venus
3. Photosynthesis	We think it was responsible for changing early atmosphere
	Removes carbon dioxide and makes oxygen
	Carbon + Water → Oxygen + Glucose Dioxide
4. Fossil fuels	Coal, crude oil and natural gas. Formed from fossilised remains of plants and animals
5. Carbon 'locked into' rock	Carbon stored in shells and skeletons turned into limestone
	Carbon in living things was also locked away as fossil fuels
6. Ammonia and methane	Removed from atmosphere by reactions with oxygen
7. Earth's atmosphere today	Nitrogen: 78% Oxygen: 21% Argon: 0.9% Carbon dioxide: 0.04% Trace amounts of other gases 
8. Ozone layer	Nothing to do with Global warming or the Greenhouse Effect. A layer of O_3 protecting us from UV rays
9. Incomplete combustion	If not enough oxygen is available then poisonous carbon monoxide and soot are produced

Key points to learn

10. Greenhouse effect	Greenhouse gases stop heat escaping from the Earth into space. This results in Earth getting hotter
11. Greenhouse gases	1. Carbon dioxide: released from burning fossil fuels 2. Methane: released from swamps, rice fields 3. Water vapour (eg steam and clouds)
12. Risks of global climate change	1. Rising sea levels as a result of melting ice caps 2. Extreme weather eg storms 3. Changes to temperature and rainfall patterns 4. Ecosystems under threat
13 Issues with reducing greenhouse gas emission	1. It will cost money 2. There is still disagreement that it is a problem 3. It is difficult to implement
14. Carbon footprint	The CO_2 released as a result of a persons activities over a year
15. Ideas for reducing our carbon footprint	1. Burn less fossil fuels 2. Carbon capture 3. Reduce demand for beef 4. Planting more trees
16. Carbon capture	Pumping and storing CO_2 underground in rocks
17. Nitrogen oxide	Released by burning fossil fuels. Causes acid rain and breathing issues
18 . Sulfur dioxide	Released by burning fossil fuels. Causes acid rain

Trilogy C11: The Earth's atmosphere

Collins revision guide: Chemistry of the atmosphere

Knowledge Organiser

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - Crude oil and fuels
- Analysis and the Earth's resources
  - Chemical analysis
  - **The Earth's atmosphere**
  - The Earth's resources

Background

The bubble of gas around our planet that we call Earth's atmosphere does far more than provide the oxygen we need for respiration. In Europe, winters are almost two weeks shorter than they were 40 years ago. Extreme weather seems more common than ever. Cases of asthma and respiratory difficulties increase year-on-year and we are always looking at ways of making our air cleaner .

Key points to learn

1. Natural resources	Can be found in their natural form. Some are finite and will run out.
2. Fossil fuels	Coal, crude oil and natural gas. Formed from fossilised remains of plants and animals
3. Non-renewable	Finite. Are used quicker than they are made. So will run out
4. Renewable	Made quicker than they are used. Will not run out
5. Sustainable development	Meets current demands without affecting future generations.
6. Potable water	Water that is safe to drink. Not pure as it contains dissolved substances
7. Pure water	No dissolved substances. Only H_2O
8. Normal way of making potable water	1. Choose source of water 2. Filter the water in filter beds 3. Sterilise the water with chlorine, ozone or ultraviolet light
9. Desalination	Method for treating salty water. Two methods both energy intensive 1. Distillation – evaporate water then condense steam 2. Reverse osmosis. Uses membranes
10. Life cycle assessments (LCAs)	Product environmental impact in: 1. Extracting raw materials 2. Manufacturing and packing 3. Use during life 4. Disposal at end of life
11. Recycling	Saves energy and finite resources. Less pollution from making new

Key points to learn

12. Aerobic	With oxygen (exposed to air)
13. Anaerobic	Without oxygen
14. Treating waste water	1. Remove lumps – screening 2. Let sludge sink – sedimentation 3. Bacteria added to clean - Aerobic treatment
15. Treating sludge	Anaerobic digestion by bacteria Can be used as fertiliser or as biofuel
16. Ore	*Rock containing enough metal compounds to be worth extracting*
17. Copper Ores	*Contain copper compounds. Becoming scarce so much harder to find large quantities. Main ways of extracting copper:* *1. Mining – dig up rocks* *2. Phytomining* *3. Bioleaching* *4. Electrolysis* *5. Displacement with iron*
18. Phytomining	*Plants absorb coppers compounds. Plants then burned and copper obtained from ash*
19. Bioleaching	*Bacteria pumped underground absorb copper. Produce leachate solutions containing copper compounds*
20. Electrolysis	*Breaking down a substance in a liquid using electricity*
21. Displacement	*A more reactive metal will displace a less reactive metal*
22. Economic issues	The cost of doing something

Trilogy C12: The Earth's resources

Collins rev guide: Using resources

Knowledge Organiser

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - Crude oil and fuels
- Analysis and the Earth's resources
  - Chemical analysis
  - The Earth's atmosphere
  - **The Earth's resources**

Background

Up to 60% of the rubbish in the average dustbin could be recycled. This wasteful approach has big environmental and economic impact for us all.

What are natural resources and why are they important? This topic looks at some of the issues that affect all of humankind.

Additional information

Content in *italics* is Higher Tier only.

Look back at Topic C5 and C6 for more on displacement reactions and electrolysis.

AQA Trilogy Science

SAMUEL WARD ACADEMY TRUST

Paper 1 Physics topics

- Energy and energy resources
  - Conservation and dissipation of energy
  - Energy transfer by heating
  - Energy resources
- Particles at work
  - Electric circuits
  - Electricity in the home
  - Molecules and matter
  - Radioactivity

Paper 2 Physics topics

- Forces in action
  - Forces in balance
  - Motion
  - Forces and motion
- Waves and electromagnetism
  - Wave properties
  - Electromagnetic waves
  - Electromagnetism

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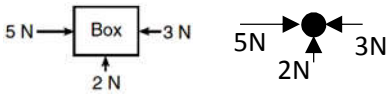
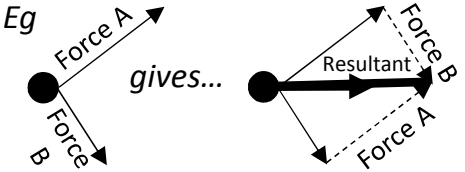
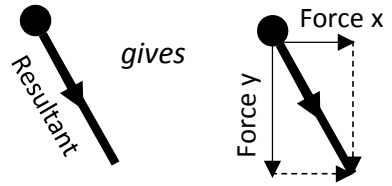
Key points to learn

1. Scalar	Magnitude only eg speed
2. Vector	Magnitude and direction eg velocity, force
	Can be drawn as an arrow →
3. Displacement	Distance away from start point in a straight line
4 Magnitude	Size of a quantity
5 Force, F [N]	Push or a pull acting on an object
6. Contact force	Forces that act though touch eg friction, air resistance, tension
7. Non-contact force	Forces that act without need for touch eg magnetic force, gravity, electrostatic force
8. Newton's Third Law	When two objects interact they exert an equal and opposite force on each other
9. Driving force	A force that makes a vehicle move
10. Friction	A force that tries to stop an object moving. Generates heat
11. Resultant force	The force you have if you replaced all the forces on an object with one single force
	If it is zero, forces are balanced
12. Newton's First Law	If the forces on an object are balanced the object will either: 1. Remain still 2. Keep moving same velocity

Key points to learn

13. Free body force diagram	*Shows the forces as arrows acting on an object. Object represented as a dot on centre of mass*
	Eg 
14. Centre of mass	Point at which mass of an object appears to be concentrated
	All objects will hang with their centre of mass below the pivot
	The centre of mass of a regular shape is at the centre
15. The parallelogram of forces	*Used to find the resultant of two forces that are not parallel.* *Eg* 
16. Resolving forces	*Drawing two forces at right angles to represent a single resultant force* *Eg* 
17. Weight, W [N]	Force acting on a mass due to gravity (Weight = mass x gravity)
18 Mass, m [kg]	The amount of matter in an object
19. Normal contact force	Push between solids. Acts at right angle to the surface at the point of contact

Trilogy P7: Forces in balance

Collins rev guide: Forces

Knowledge Organiser

Big picture (Physics Paper 2)

- Forces in action
  - Forces in balance
  - Motion
  - Forces and motion
- Waves and electromagnetism
  - Wave properties
  - Electromagnetic waves
  - Electromagnetism

Background

Anything that changes direction, speed or shape does so because of unbalanced forces. They are the reason we go to bed up to 2cm shorter than we are when we wake up. Weird? That's forces.

Maths skills

Drawing scale diagrams to find the diagonal of a parallelogram (see Fact 15) or drawing a scale parallelograms around a diagonal (see Fact 16)

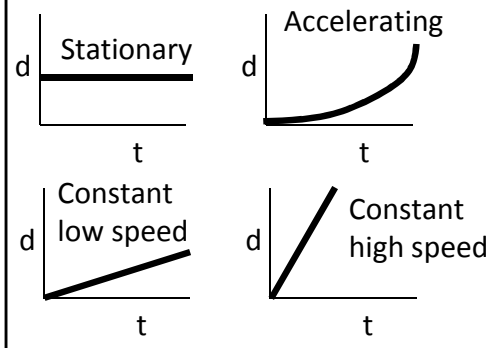
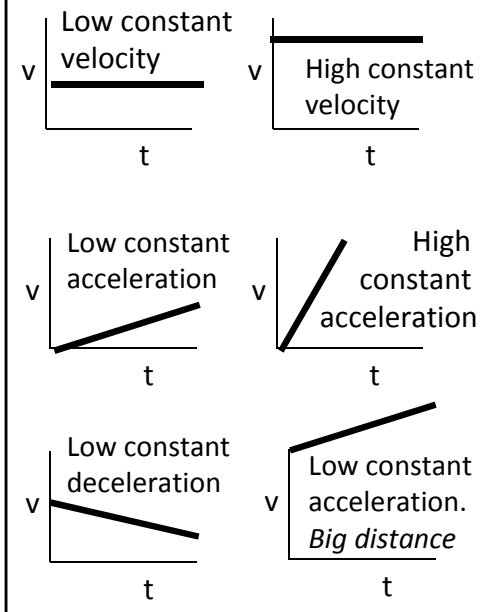
Additional information

Content in *italics* is Higher Tier only.

Key points to learn

1. Distance-time (d-t) graph	A graph showing how distance changes with time
	Gradient represents speed
2. Speed, *v* [m/s]	Scalar. Distance travelled in one second Speed = distance travelled, s [m] / time taken, t [s]
3. Average speed [m/s]	Considers the total distance travelled and the total time taken
4. Velocity, v [m/s]	Vector. Speed in a given direction. Uses the same formula as speed
5. Displacement	Vector. Distance travelled in a certain direction
6. Acceleration, a [m/s^2]	Any change in velocity. Can be either speed or direction
	Change in velocity per second. eg 10m/s^2 means velocity changes by 10m/s every second
	Acceleration = change in velocity / time taken for change a [m/s^2] = $\frac{\Delta v}{t}$ [m/s] / [s]
7 Deceleration a [m/s^2]	When acceleration is negative. Object slows down
10. Scalar	Magnitude only eg speed
11. Vector	Magnitude and direction eg velocity
12. Velocity-time (v-t) graph	A graph showing how velocity changes with time
	Gradient represents acceleration
	Area under a v-t graph line represents distance travelled

Key points to learn

13. Typical speeds	Walking ~1.5m/s Running ~1.5m/s Cycling ~6m/s Sound ~330m/s
14. Slopes of d-t graphs	
15. Slopes of v-t graphs	
16 Gravitational acceleration	Acceleration due to gravity on Earth is ~9.8m/s^2
17. Equation of motion	You need to be able to use this equation. It is given in the exam. $v^2 \quad u^2 = 2as$ *v* = final velocity in m/s *u* = start velocity in m/s *a* = acceleration in m/s^2 *s* = distance travelled in m

Trilogy P8: Motion

Collins rev guide: Forces

Knowledge Organiser

Big picture (Physics Paper 2)

- Forces in action
  - Forces in balance
  - Motion
  - Forces and motion
- Waves and electromagnetism
  - Wave properties
  - Electromagnetic waves
  - Electromagnetism

Background

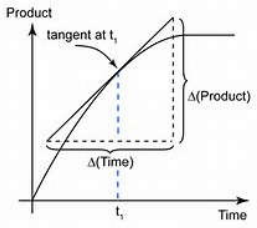
We all know about acceleration and speed, but how are they really related. The ideas on this page are essential in the use of vehicle design and tectonic movement. They can be used to describe any journey by any object.

Maths skills

Graph skills:

- Finding the steepness (gradient) of a curved line at a point using a tangent.

  Gradient = rise ÷ run



- Find the area under a straight line graph. Using areas of triangles and rectangle

Rearrange the speed equation v = s ÷ t

Key points to learn

1. Newton's Second Law	Acceleration is directly proportional to force and indirectly proportional to mass
	Resultant = mass x acceleration Force F = m x a [N] [kg] [m/s^2]
	Greater resultant force leads to greater acceleration
2. Inertial mass	*How difficult it is to change the velocity of an object.*
	Ratio of Force ÷ acceleration
3. Inertia	*Tendency of objects to maintain same motion*
4 Force, F [N]	Push or a pull acting on an object
5. Acceleration, a [m/s^2]	Any change in velocity. Can be either speed or direction
	Change in velocity per second. eg 10m/s^2 means velocity changes by 10m/s every second
	Acceleration = change in velocity / time taken for change a = $\frac{\Delta v}{t}$ [m/s] / [s] [m/s^2]
6. Resultant force, F [N]	The force you have if you replaced all the forces on an object with one single force
	If it is zero forces are balanced
7 Mass, m [kg]	Amount of matter in something
8 Gravitational field strength	Constant on each planet. Symbol of g. On Earth it is ~9.8 N/kg

Key points to learn

9. Weight, W [N]	The force on a mass due to gravity
	Weight = mass x gravitational field strength W = m x g [N] [kg] [N/kg]
10. Terminal velocity [m/s]	Maximum velocity of a falling object. When fluid drag increases until it balances weight
11. Stopping distance [m]	Shortest distance a vehicle can safely stop
	Split into two parts: 1. Thinking distance – travelled during reaction time 2. Braking distance – travelled once brakes applied Stopping = Thinking + Braking distance distance distance
12. Reaction time [s]	Time it takes a person to react. Differs for everyone from 0.2 - 0.9s
	Affected by: tiredness, drugs, alcohol and distractions
13. Factors affecting braking distance	1. Road and weather conditions 2. Condition of vehicle brakes or tyres
14. Momentum, p [kg m/s]	Momentum = mass x velocity p = m x v [kg m/s] [kg] [m/s]
15 Conservation of momentum	In a closed system, total momentum before an event is the same as the total momentum after
16. Elastic	Will return to original shape
17. Inelastic	Will not return to original shape

Trilogy P9: Force and motion

Collins rev guide: Forces

Knowledge Organiser

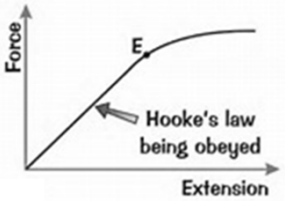
Big picture (Physics Paper 2)

- Forces in action
  - Forces in balance
  - Motion
  - **Forces and motion**
- Waves and electromagnetism
  - Wave properties
  - Electromagnetic waves
  - Electromagnetism

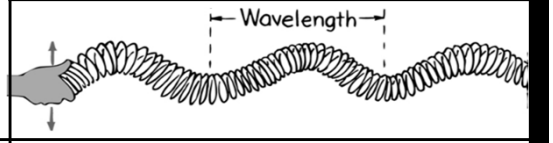
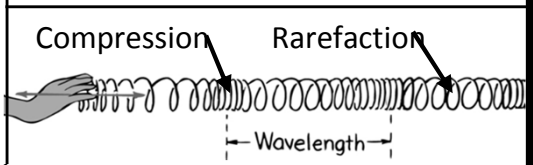
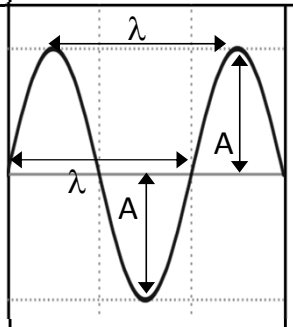
Background

Forces can make things change how they move or make them change shape. Every time one of these things happens it is down to a resultant force.

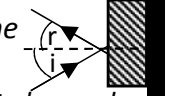
Key points to learn

18. Hooke's Law	A springs extension/compression is proportional to the force on it
	The gradient of this graph is known as k, the spring constant. 
	Force = spring constant x extension F = k x e [N] [N/m] [m]

Key points to learn

1 Oscillations	Vibrations of a wave
2. Waves	Carry energy using oscillations
	Can reflect - bounce off a boundary
	Can refract - change direction at a boundary as they change speed
	Two types: transverse and longitudinal
3. Transverse waves	Oscillate at right angles to direction that the wave transfers energy
	Eg Electromagnetic waves, such as light, radio, ripples on water
	
4. Longitudinal waves	Oscillate in same direction as the wave transfers energy eg sound
	
5. Drawing waves	 Wavelength, λ Amplitude, A Both measured in metres (m)
6 Mechanical waves	Need particles to move eg sound, water, Mexican
7. Vacuum	No particles. Space is a vacuum

Key points to learn

8. Electromagnetic waves	Family of transverse waves.
	Travel through vacuum at speed of light (300 000 km/s)
	The waves in the EM family are: Radio, **I**nfra Red, **V**isible light, **U**ltra **V**iolet, **X**-ray and **G**amma
	Rich Men **I**n **V**egas **U**se **X**-ray **G**lasses
9. Amplitude, A [cm]	Height/depth of the wave above/below the rest point
10. Wavelength, λ [m]	Length of one wave. Distance on a wave from one point to the next identical point
11. Frequency, f [Hz]	Number of waves in one second. Measure in Hertz *(You are given this in the exam)*
	Frequency [Hz] = 1 ÷ Period [s] $f = \frac{1}{T}$
12. Period, T [s]	Time for one wave to pass
13. Wave equation	Speed of a wave = frequency x wavelength *(You need to learn this)* $v = f \times \lambda$ [m/s] [Hz] [m]
15. Sound waves	Longitudinal. Cannot travel through a vacuum. Reflections are called echoes
16. Observing waves	We can use these devices: 1. A ripple tank 2. A slinky spring 3. A signal generator
17. Law of reflection	*Angle of reflection is same as angle of incidence.* *Speed and wavelength not changed* 

Trilogy P10: Wave properties

Collins rev guide: Waves

Knowledge Organiser

Big picture (Physics Paper 2)

- Forces in action
  - Forces in balance
  - Motion
  - Forces and motion
- Waves and electromagnetism
  - **Wave properties**
  - Electromagnetic waves
  - Electromagnetism

Background

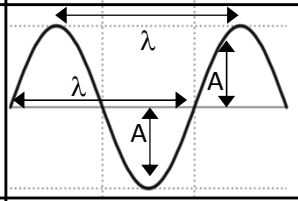
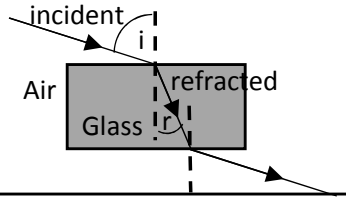
We are continuously hit with waves in many forms from sound to radio. They are so much more than just ripples on water we can surf on.

Maths skills

You need to be able to use the equation relating f and T (statement number 11). In it you have to divide 1 by a number.
Units of quantities are shown in square brackets [ ].
The wavelength and frequencies of waves varies hugely. You will be expected to use standard form.

Prefix	Meaning	Standard form
Mega (M)	x 1000000	x 10^6
kilo (k)	x 1 000	x 10^3

Key points to learn

1. Electro-magnetic waves	Family of transverse waves. Travel through vacuum at speed of light.
	Long (1000 m) ↑ Wavelength, λ ↓ Very short ($^1/_{1000000}$)m **R**adio **M**icrowave **I**nfrared (IR) **V**isible **U**ltraviolet (UV) **X**-ray **G**amma ray Low ↓ Frequency (Hz) ↑ High
	Rich **M**en **I**n **V**egas **U**se **X**-ray **G**lasses
2. Drawing waves	 Wavelength, λ Amplitude, A Both measured in metres (m)
3 Transverse wave	Oscillate at right angles to direction that the wave transfers energy
4. Wave equation	Speed of a wave = frequency x wavelength v = f x λ [m/s] [Hz] [m] *(You need to learn this)*
5. Energy of waves	Increases as frequency increases. Gamma have most, radio least
6. Refraction	*Light changing direction as it changes speed at a boundary*
	
7. Ionising	Knocking electrons off atoms
Absorbing waves	Waves carry energy so absorbing any wave generates some heat

Key points to learn

9. Radio waves	No known dangers
	Can be made and absorbed by electrical circuits
	Used for television and radio
10. Microwaves	Some can cause burning
	Used for satellite communications, and cooking food
11. Infrared radiation	Can cause burning
	Emitted by hot objects.
	Matt black surfaces are best absorbers and emitters
	Smooth shiny surfaces reflect IR waves so are worst absorbers and emitters
	Used for electric heaters, cooking, infrared cameras
12. Visible light	Very bright light can cause blindness
	We see. Used in fibre optics
13. Ultraviolet	Ionising: can cause skin cancer
	Used in energy efficient lamps, sun tanning and sterilising
14. X-rays and gamma rays	Ionising: can cause cancer
	Used in medical imaging and in radiotherapy treatment and sterilising
15. Carrier waves	*Used in communication. Different amplitudes mean different things*
16 Frequency, f [Hz]	Number of waves in one second. Measure in Hertz

Trilogy P11: Electromagnetic waves

Collins rev guide: Waves

Knowledge Organiser

Big picture (Physics Paper 2)

- Forces in action
  - Forces in balance
  - Motion
  - Forces and motion
- Waves and electromagnetism
  - Wave properties
  - **Electromagnetic waves**
  - Electromagnetism

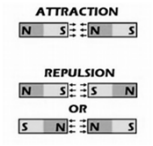
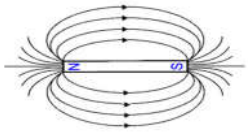
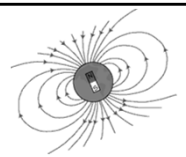
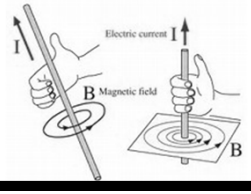
Background

This family of waves is all around us, all the time. They travels at 300million metres a second through space and are some of the building blocks of the Universe. So what are they and how do we use them?

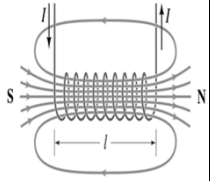
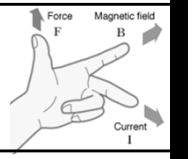
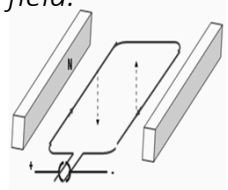
Maths skills

You need to remember and be able to rearrange the Wave Equation. A nice way to check is by finding the frequency of your microwave oven ~2450MHz (usually written on back of oven). Speed of light is $3x10^8$m/s. You should be able to calculate that a microwave in your oven is 0.12m long exactly.

Key points to learn

1. Magnetic poles	North and South Like poles attract Unlike poles repel 
Permanent 2. magnet	Has its own magnetic field
3. Induced magnet	Becomes a magnet when put in a magnetic field. Loses it when removed
4. Magnetic field, B	Region around a magnet which attracts magnetic material.
	Caused by magnetic field lines
	Strongest at poles of a magnet
	Known as magnetic flux density, B measured in Tesla, T
5. Magnetic field lines	Closer the lines, the stronger the magnetic field 
6. Earth's magnetic field	 Acts like a giant bar magnet
7. Magnetic material	Are attracted by magnetic fields: iron, steel, cobalt and nickel
8. Solenoid	A coil of wire, looks like a spring
9. Magnetic field around a wire	If a wire carries a current it becomes an electromagnet 

Key points to learn

10. Magnetic field around a solenoid	If a wire is coiled and carries a current it becomes an electromagnet 
	Magnetic field inside is strong and uniform
	Outside looks similar to a bar magnet
11.Increasing strength of electromagnet	1. Add an iron core 2. Increase current 3. More coils
12. Motor effect	A wire carrying a current <u>at a right angle</u> through a magnetic field feels a force
13. Size of motor effect force	Force = magnetic x current x length flux density $F = B \times I \times l$ [N] [T] [A] [m] *(You are given this)*
14. Direction of motor force	Is given by Flemings Left Hand rule 
15. Increasing force of a motor	*1. More current* *2. Stronger magnetic field* *3. More coils*
16. Electric motor	*Coil of wire carrying a current inside a magnetic field. Each side moves in different direction causing it to rotate.* 
17 *Commutator*	*Stops motor wires twisting*

Trilogy P12: Electromagnetism

Collins rev guide: Magnetism and electromagnetism

Knowledge Organiser

Big picture (Physics Paper 2)

- Forces in action
  - Forces in balance
  - Motion
  - Forces and motion
- Waves and electromagnetism
  - Wave properties
  - Electromagnetic waves
  - **Electromagnetism**

Background

Electromagnetic effects are used in motors to make things move, generators to provide electricity and automatic locks on security doors. Magnetism is far more useful to us than just helping pigeons to navigate.

Additional information

Higher Tier only content is shown in

Maths skills

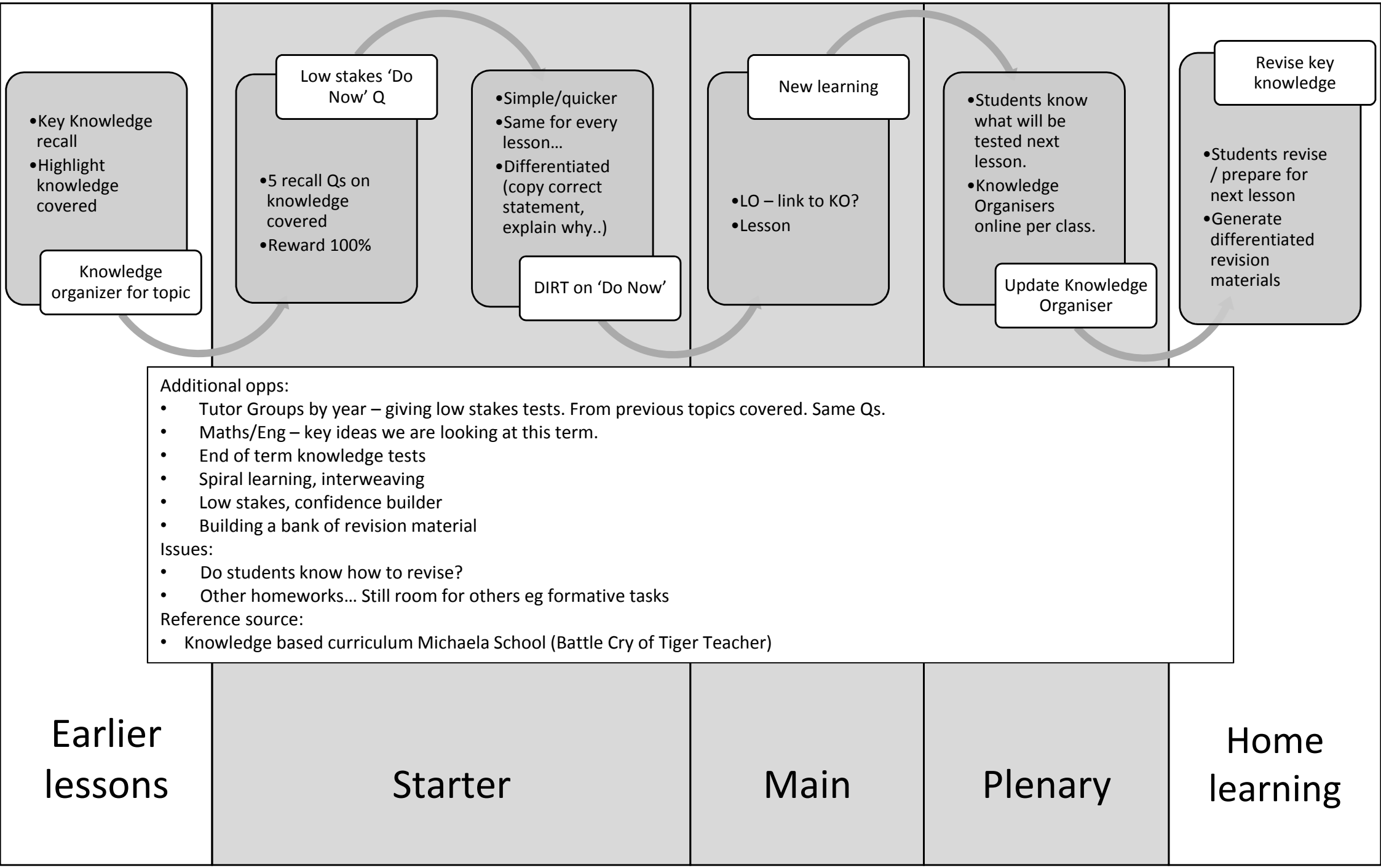
There is only one formula in this topic and it is only for Higher Tier. It is given to you in the equation sheet but you need to be able to use it.

Blank page

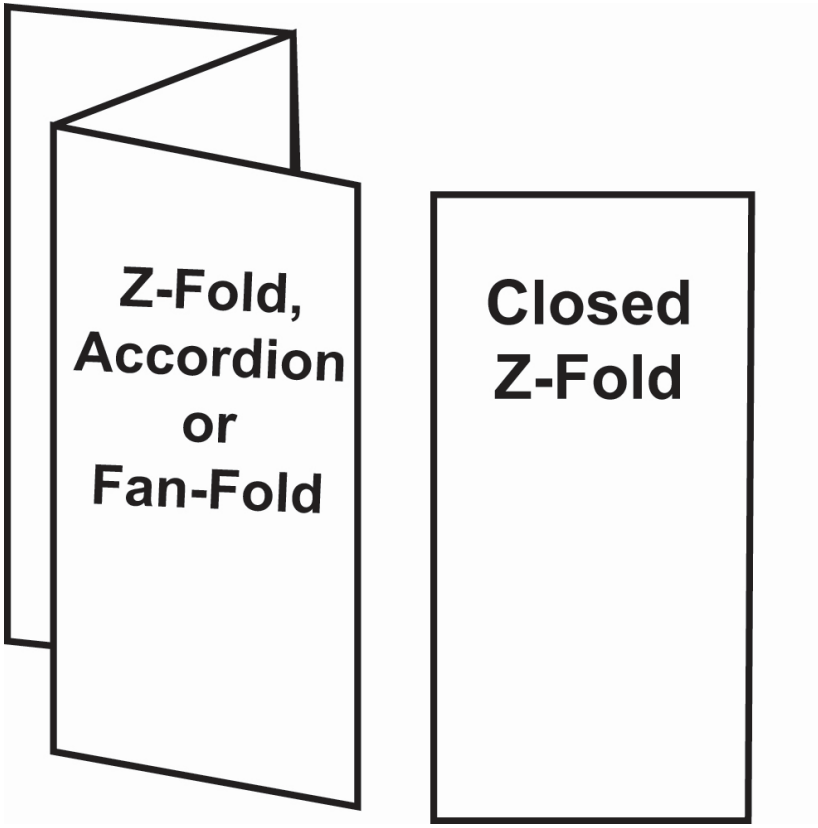
Concept behind…. Knowledge Organisers

- AQA GCSE 9-1
- Single side summary of key recall facts taken from specification
- Will form basis of frequent key knowledge tests in class and at end of term/topic
- Foldable to allow them to be stuck in exercise books
- Black and white for cheaper photocopying
- Based on OUP/AQA Topics (44 Topics in all across 3 years and 2 GCSEs)

NAS: Using Knowledge Organisers to build core knowledge




Z
FOLD
BROCHURE


Z-Fold,
Accordion
or
Fan-Fold
Closed
Z-Fold

Take Away Task Selector!

Choose your task from the menu below:

The Peri-ometer suggests the difficulty or challenge the task may offer.

Every term you should attempt **<u>at least one</u>** **'EXTRA HOT'** task!

Write a poem or song which summarises the topic. *Make it informative but catchy and remember to include key terms…*	Make a revision board game for the topic. *To be played by at least two people. Include questions, answers and rules.*	Summarise the entire topic in five words and one picture. *Explain each key term or idea in a drawing. Then combine each into one large picture that you can interpret.*
Create a leaflet which summarises the topic we have studied recently. *Use key terms, make it informative and eye catching…*	Create a factsheet summarising the topic, but also add additional research and facts. *Use correct terminology and find extra relevant facts (no copy/paste)*	Create a comic strip to explain to summarise the topic. *Use pictures and key words to explain the topic in a clear way…*
Create a poster summarising the topic. Use key terms, make it informative and eye catching…	Create revision flashcards for the topic. Make at least 15. Key term on one side and information on the back.	Create 10-15 quiz questions about the topic. Write the questions with correct answers separate to test a peer…
Create a mind map summarising the topic. Use key terms, make it informative and eye catching…	Identify and list the key terms we've used in the topic. Write a glossary to help you to learn spellings…	Make a FaceBook profile page on paper summarising the topic. No more than two A4 pages; use #'s for key words.

Take Away Task Selector!

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