AQA GCSE ECOLOGY PART 1

Ecosystem

Environment	The conditions surrounding an organism; abiotic and biotic.
Habitat	Place where organisms live e.g. woodland, lake.
Population	Individuals of a species living in a habitat.
Community	Populations of different species living in a habitat.

Organisms require a supply of materials from their surroundings and from the other living organisms.

Surviving and reproducing

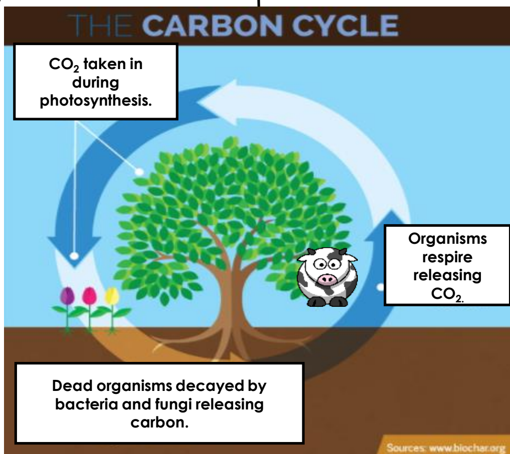
Competition	Plants in a community or habitat compete with each other for light, space, water and mineral ions.
	Animals compete with each other for food, mates and territory.
Interdependence	Species depend on each other for food, shelter, pollination, seed dispersal etc. Removing a species can affect the whole community

Decomposition and material cycling

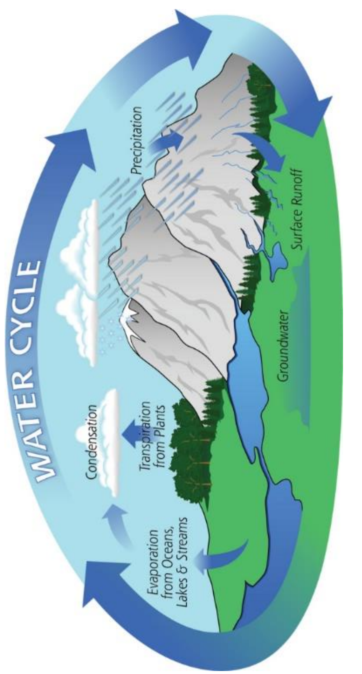
Farmers optimise conditions for making compost for use as a natural fertiliser.

Anaerobic decay in biogas generators produces methane gas, used as a fuel.

Bacteria respire when breaking down dead organisms releasing CO_2.



Materials are recycled to provide the building blocks for future organisms



Factors affecting rate of decay

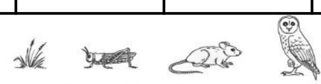
Factors affecting rate of decay
Temperature, water, oxygen
Increase the rate of decay. In enzyme controlled reactions raising the temperature too high will denature the enzymes.

Breakdown of dead organisms releases mineral ions into the soil.

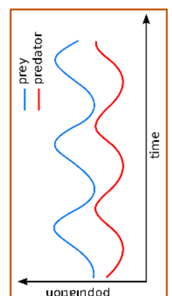
Levels of organisation

Photosynthetic organisms are the producers of biomass for life on Earth

Food chains			
Feeding relationships in a community			
Producer	Primary consumer	Secondary consumer	Tertiary consumer



All food chains begin with a producer e.g. grass that is usually a green plant or photosynthetic algae.	Consumers that kill and eat other animals are predators and those eaten are prey.



In a stable community the numbers of predators and prey rise and fall in cycles.

Interdependence and competition

EXAMPLE: climate change is leading to more dissolved CO_2 in oceans, lowering the pH of the water affecting organisms living there.

EXAMPLE: Introduction of grey squirrels to UK increased competition for food for red squirrels. The greys also carry a pathogen that kills reds.

Abiotic and biotic factors.

Abiotic	Biotic
Non-living factors that affect a community	***Living factors that affect a community***
Living intensity.	Availability of food.
Temperature.	
Moisture levels.	
Soil pH, mineral content.	New predators arriving.
Wind intensity and direction.	New pathogens.
Carbon dioxide levels for a plant.	One species outcompeting another so numbers are no longer sufficient to breed
Oxygen levels for aquatic organisms.	

Adaptations

"Organisms have features which enable them to survive in conditions where they normally live."

Adaptations may be structural, behavioural or functional.

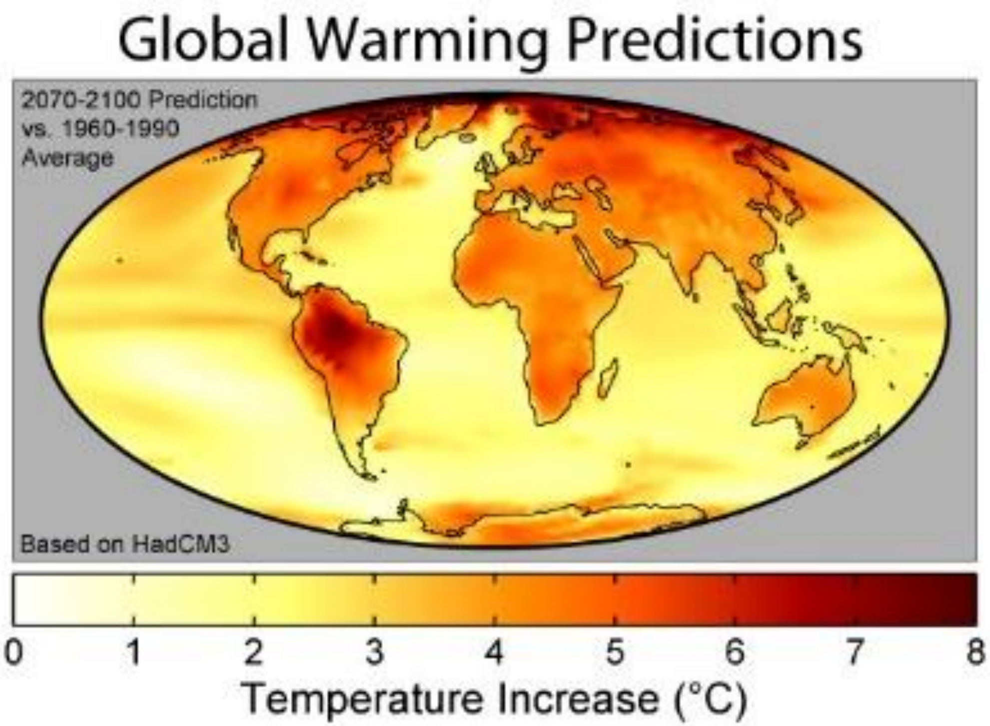
Adaptations		
Plants	***Animals***	***Extremophiles***
Cactus in dry, hot desert	Polar bear in extreme cold artic	Deep sea vent bacteria
		
No leaves to reduce water loss, wide deep roots for absorbing water.	Hollow hairs to trap layer of heat. Thick layer of fat for insulation.	Populations form in thick layers to protect outer layers from extreme heat of vent.

AQA GCSE ECOLOGY PART 2

Global warming

Global warming	***Levels of CO_2 and methane in the atmosphere are increasing.***	Decreased land availability from sea level rise, temperature rise damages delicate habitats, extreme weather events harm populations of plants and animals.

There is a global consensus about global warming and climate change based on systematic reviews of thousands of peer reviewed publications.



Maintaining biodiversity

Human activity can have a positive impact on biodiversity

Scientists and concerned citizens
Put in place programmes to reduce the negative impacts of humans on ecosystems and biodiversity
Breeding programmes for endangered species.
Protection and regeneration of rare habitats.
Reintroduction of field margins and hedgerows in agricultural areas where farmers grow only one type of crop.
Reduction of deforestation and CO_2 emissions by some governments.
Recycling resources rather than dumping waste in landfill.

Some of the programmes potentially conflict with human needs for land use, food production and high living standards.

AQA GCSE ECOLOGY PART 3

Biodiversity

Biodiversity is the variety of all different species of organisms on Earth, or within an ecosystem

Maintain a great biodiversity	***Ensures the stability of ecosystems***	By reducing the dependence on one species on another for food, shelter, or by maintenance of the physical environment.
	Future of human species	Many human activities cause reduction in biodiversity and only recently measures have been taken to stop it.

Experimental methods are used to determine the distribution and abundance of a species.

Sampling techniques	***Quadrats***	Organisms are counted within a randomly placed square
	Transects	Organisms are counted along a belt (transect) of the ecosystem. Transects sometimes use quadrats

Processing data	
Median	Middle value in a sample.
Mode	Most occurring value in a sample.
Mean	The sum of all the value in a sample divided by the sample number.

Biodiversity and the effect of human interaction on the ecosystem

Human activity can have a negative impact on biodiversity

Pollution kills plants and animals which can reduce biodiversity.

Waste management	***Rapid growth in human population and higher standard of living***	More resources used and more waste produced.
		Pollution in water; sewage, fertiliser or toxic chemicals.
		Pollution in air; smoke or acidic gases.
		Pollution on land; landfill and toxic chemicals.

Waste, land use and deforestation

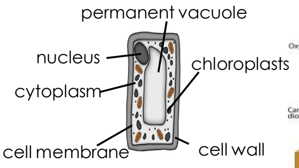
Land use
Humans reduce the amount of land and habitats available for other plants, animals and microorganisms.
Building and quarrying.
Farming for animals and food crops.
Dumping waste.
Destruction of peat bogs to produce cheap compost for gardeners/farmers to increase food production.

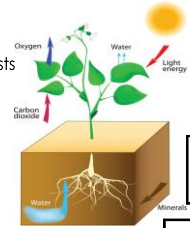
The decay or burning of peat release CO_2 into the atmosphere.

This conflicts with conserving peat bogs and peatlands as habitats for biodiversity and reduce CO_2 emissions.

Large scale deforestation
In tropical areas (e.g. rain forest) has occurred to:
Provide land for cattle and rice fields, grow crops for biofuels.

Deforestation reduces biodiversity and removes trees that could potentially reduce the amount of CO_2 in the atmosphere.





Used for Respiration, stored as insoluble starch, fats or oils for storage, cellulose for cell walls, combine with nitrates from the soil to form amino acids for protein synthesis

Plants use the glucose produced in photosynthesis in a variety of ways

Photosynthetic reaction

The plant manufactures glucose from carbon dioxide and water using energy transferred from the environment to the chloroplasts by light

Photosynthesis	***Plants make use of light energy from the environment (ENDOTHERMIC) to make food (glucose)***	Carbon dioxide + Water $\xrightarrow{\text{light}}$ Oxygen + Glucose
		$CO_2 + H_2O \xrightarrow{\text{light}} O_2 + C_6H_{12}O_6$

The rate of photosynthesis is affected by temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyll

Factors affecting the rate of photosynthesis	Factor	How the rate is affected	Limiting factors (why the rate stops going up)
	Temperature	***As the temperature of the environment the plant is in increases rate of photosynthesis increases (up to a point) as there is more energy for the chemical reaction.***	Photosynthesis is an enzyme controlled reaction. If the temperature increases too much, then the enzymes become denatured and the rate of reaction will decrease and stop
	Light intensity	***Light intensity increases as the distance between the plant and the light sources increases. As light intensity increases so does the rate of photosynthesis (up to a point) as more energy is available for the chemical reaction.***	At point X another factor is limiting the rate of photosynthesis. This could be carbon dioxide concentration, temperature or the amount of chlorophyll
	Carbon dioxide concentration	***Carbon dioxide is needed for plants to make glucose. The rate of photosynthesis will increase when a plant is given higher concentrations of carbon dioxide (up to a point).***	At point Y another factor is limiting the rate of photosynthesis. This could be light intensity, temperature or the amount of chlorophyll
	Amount of chlorophyll	***Chlorophyll is a photosynthetic pigment that absorbs light and allows the reaction between water and carbon dioxide to occur (photosynthesis)***	Another factor could limit the rate of photosynthesis. This could be light intensity, temperature or the carbon dioxide concentration

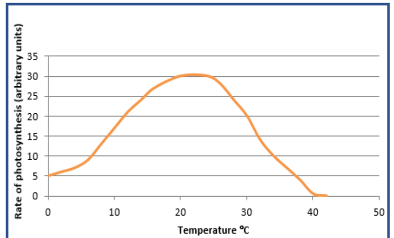
AQA GCSE BIOENERGETICS part 1

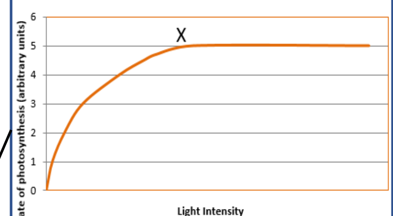
Control conditions in greenhouses to reduce limiting factors can improve crop yields	***Heating***	Used to provide optimum temperatures for maximum plant growth.
	Artificial lighting	Enhances the natural sunlight especially overnight and on cloudy days.
	Extra carbon dioxide	Gas can be pumped into the air inside the greenhouse.

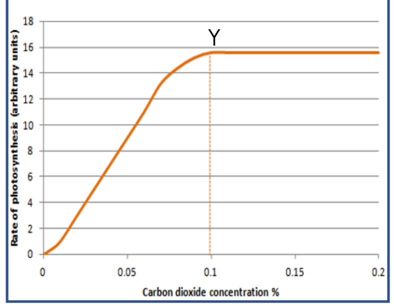
Growers must balance the economics of additional costs of controlling the conditions to maximise photosynthesis with making a profit.

Rate of photosynthesis HT Only

Rate of photosynthesis







Light intensity obeys the inverse square law. This means that if you <u>double</u> the distance between the plant and the light source you quarter the light intensity

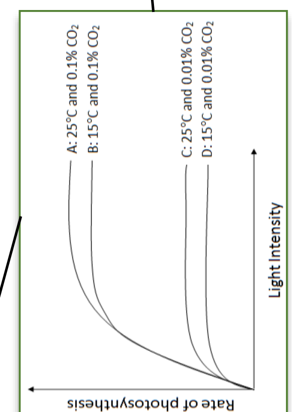
Graph lines C and D: If temperature is increased by 10°C then a slight increase in rate of photosynthesis occurs.

Graph lines A and D: If carbon dioxide concentration and temperature are increased the rate of photosynthesis increases significantly up to a point.

Graph line A: Rate could be limited by temperature and/or amount of chlorophyll. Plant tissue can be damaged when carbon dioxide concentrations exceed 0.1%

Explain graphs of two or three factors and decide which is the limiting factor

Graph Lines A and B: If carbon dioxide concentration is increased from 0.01% to 0.1% then a large increase in rate occurs up to a point.

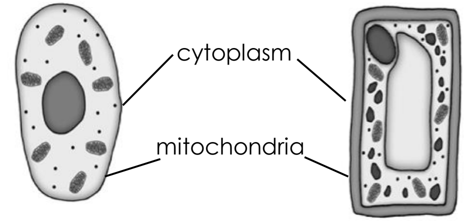


AQA GCSE BIOENERGETICS part 2

Respiration

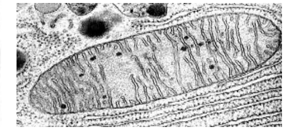
An organism will receive all the energy it needs for living processes as a result of the energy transferred from respiration	***For movement***		To enable muscles to contract in animals.
	For keeping warm		To keep a steady body temperature in a cold environment.
	For chemical reactions		To build larger molecules from smaller one.

Cellular respiration is an exothermic reaction which is continuously occurring in all living cells



animal cell

plant cell



Electron micrograph of a mitochondrion

Aerobic respiration

Respiration with oxygen. Occurs inside the mitochondria continuously

Glucose is oxidised by oxygen to transfer the energy the organism needs to perform its functions.

$C_6H_{12}O_6 + O_2 \longrightarrow CO_2 + H_2O$

glucose + oxygen ⟶ carbon dioxide + water

Aerobic respiration releases a large amount of energy from each glucose molecule

Anaerobic respiration

Respiration when oxygen is in short supply. Occurs during intensive exercise

During hard exercise, muscle cells are respiring so fast that blood cannot transport enough oxygen to meet their needs.

Glucose is partially oxidised to produce lactic acid which builds up in muscle tissue causing them to become painful and fatigued.

glucose ⟶ lactic acid

Anaerobic respiration releases a much smaller amount of energy than aerobic respiration.

The incomplete oxidation of glucose causes a build up of lactic acid and creates an oxygen debt

Anaerobic respiration in plant and yeast cells

The end products are ethanol and carbon dioxide. Anaerobic respiration in yeast cells is called fermentation

glucose ⟶ ethanol + carbon dioxide

This process is economically important in the manufacture of alcoholic drinks and bread.

Response to exercise

During long periods of vigorous activity muscles become fatigued and stop contracting efficiently

During exercise the human body reacts to increased demand for energy	***Heart rate increases***	To pump oxygenated blood **faster** to the muscle tissues and cells.
	Breathing rate and breath volume increase	This **increases** the amount of oxygen entering the blood stream.

Metabolism

Metabolism is the sum of all the reactions in a cell or the body

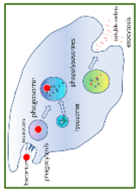
Metabolism	***The energy released in respiration in cells is used by the organism for the continual, enzyme controlled, processes of metabolism.***	Conversion of glucose to starch, glycogen and cellulose.
		The formation of lipid molecules from a molecule of glycerol and three molecules of fatty acid.
		The use of glucose and nitrate ions to form amino acids which in turn are used to synthesise proteins.
		Respiration
		Breakdown of excess proteins to form urea for excretion.

The extra amount of oxygen required to remove all lactic acids from cells is called the oxygen debt

Lactic acid builds up in the muscles cells during exercise ⟶ Blood flows through the muscle cells and transports the lactic acid to the liver ⟶ The liver oxidises the lactic acid and converts it back to glucose

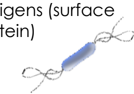
Response to exercise HT only

AQA GCSE INFECTION AND RESPONSE part 1



Phagocytes	***Phagocytosis***	Phagocytes engulf the pathogens and digest them.
Lymphocytes	***Antibody production***	Specific antibodies destroy the pathogen. This takes time so an infection can occur. If a person is infected again by the same pathogen, the lymphocytes make antibodies much faster.
	Antitoxin production	Antitoxin is a type of antibody produced to counteract the toxins produced by bacteria.

Antigens (surface protein)



Pathogens are identified by white blood cells by the different proteins on their surfaces **ANTIGENS.**

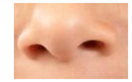
Human defence systems

Immune system

White blood cells are part of the immune system

Non-specific defence systems

The human body has several non specific ways of defending itself from pathogens getting in

	***Nose***	Nasal hairs, sticky mucus and cilia prevent pathogens entering through the nostrils.
	***Trachea and bronchus (respiratory system)***	Lined with mucus to trap dust and pathogens. Cilia move the mucus upwards to be swallowed.
	***Stomach acid***	Stomach acid (pH1) kills most ingested pathogens.
	***Skin***	Hard to penetrate waterproof barrier. Glands secrete oil which kill microbes

Pathogens may infect plants or animals and can be spread by direct contact, water or air

Pathogen	*Disease*	Symptoms	Method of transmission	Control of spread
Virus	***Measles***	Fever, red skin rash.	Droplet infection from sneezes and coughs.	Vaccination as a child.
Virus	***HIV***	Initially flu like systems, serious damage to immune system.	Sexual contact and exchange of body fluids.	Anti-retroviral drugs and use of condoms.
Virus	***Tobacco mosaic virus***	Mosaic pattern on leaves.	Enters via wounds in epidermis caused by pests.	Remove infected leaves and control pests that damage the leaves.
Bacteria	***Salmonella***	Fever, cramp, vomiting, diarrhoea.	Food prepared in unhygienic conditions or not cooked properly.	Improve food hygiene, wash hands, vaccinate poultry, cook food thoroughly.
Bacteria	***Gonorrhoea***	Green discharge from penis or vagina.	Direct sexual contact or exchange of body fluids.	Use condoms. Treatment using antibiotics.
Protists	***Malaria***	Recurrent fever.	By an animal vector (mosquitoes).	Prevent breeding of mosquitoes. Use of nets to prevent bites.
Fungus	***Rose black spot***	Purple black spots on leaves.	Spores carried via wind or water.	Remove infected leaves. Spray with fungicide.

Communicable diseases

Pathogens

Pathogens are microorganisms that cause infectious disease

Viruses live and reproduce inside cells causing damage

Viruses	Bacteria (prokaryotes)	Protists (eukaryotes)	Fungi (eukaryotes)
e.g. cold, influenza, measles, HIV, tobacco mosaic virus	***e.g. tuberculosis (TB), Salmonella, Gonorrhoea***	***e.g. dysentery, sleeping sickness, malaria***	***e.g. athlete's foot, thrush, rose black spot***
DNA or RNA surrounded by a protein coat	No membrane bound organelles (no chloroplasts, mitochondria or nucleus). Cell wall. Single celled organisms	Membrane bound organelles. Usually single celled.	Membrane bound organelles, cell wall made of chitin. Single celled or multi-cellular

Bacteria may produce toxins that damage tissues and make us fell ill

Plants have several ways of defending themselves from pathogens and animals

Physical	*Mechanical*
Thick waxy layers, cell walls stop pathogen entry	Thorns, curling up leaves to prevent being eaten
Chemical	
Antibacterial and toxins made by plant	

Detection and identification of plant diseases (bio only)

Detection	Identification
Stunted growth	Reference using gardening manual or website, laboratory test for pathogens, testing kit using monoclonal antibodies.
Spots on leaves	
Area of decay	
growths	
Malformed stem/leaves	
Discolouration	
Presence of pests	

Nitrate ions needed for protein synthesis – lack of nitrate = stunted growth.

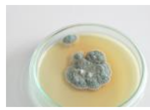
Magnesium ions needed to make chlorophyll – not enough leads to **chlorosis** – leaves turn yellow.

AQA INFECTION AND RESPONSE part 2

Discovery and drug development

Most new drugs are synthesised by chemists in the pharmaceutical industry.

Traditionally drugs were extracted from plants and microorganisms

Digitalis	***Aspirin***	***Penicillin***
Extracted from foxglove plants and used as a heart drug	A painkiller and anti-inflammatory that was first found in willow bark	Discovered by Alexander Fleming from the *Penicillium* mould and used as an antibiotic
		

Drugs have to be tested and trialled before to check they are safe and effective

New drugs are extensively tested for:

Efficacy	Make sure the drug works
Toxicity	Check that the drug is not poisonous
Dose	The most suitable amount to take

Preclinical trials - using cells, tissues and live animals - must be carried out before the drug can be tested on humans.

Clinical trials use healthy volunteers and patients

Stage 1	***Stage 2***	***Stage 3***	***Stage 4***
Healthy volunteers try small dose of the drug to check it is safe record any side effects	A small number of patients try the drug at a low dose to see if it works	A larger number of patients; different doses are trialled to find the optimum dose	A double blind trial will occur. The patients are divided into groups. Some will be given the drug and some a placebo.

Double blind trial: patients and scientists do not know who receives the new drug or placebo until the end of the trial. This avoids bias.

A placebo can look identical to the new drug but contain no active ingredients

Antibiotics and painkillers

Mutations can occur in bacteria

Sometimes this makes them resistant to antibiotic drugs.

Antibiotics have greatly reduced deaths from infectious bacterial disease

antibiotics	***e.g. penicillin***	Kill infective bacteria inside the body. Specific bacterial infections require specific antibiotics.
Painkillers and other medicines	***e.g. aspirin, paracetam ol, ibuprofen***	Drugs that are used to treat the symptoms of a disease. They do not kill pathogens

Antibiotics cannot be use to treat viral pathogens

It is difficult to develop drugs to kill viruses without harming body tissues because viruses live and reproduce inside cells

Vaccination

Used to immunise a large proportion of the population to prevent the spread of a pathogen

Vaccination			
	Small amount of dead or inactive form of the pathogen	***1st infection by pathogen***	White blood cells detect pathogens in the vaccine. Antibodies are released into the blood.
		Re-infection by the same pathogen	White blood cells detect pathogens. Antibodies are made much faster and in larger amounts.

A person is unlikely to suffer the symptoms of the harmful disease and it's spread in a population is prevented

Monoclonal antibodies (Biology only HT)

Specific to one binding site on the antigen. Can target specific chemicals or cells in the body

Monoclonal antibodies		
	Identical copies of one types of antibody produced in laboratory	1. A mouse is injected with pathogen
		2. Lymphocytes produce antibodies
		3. Lymphocytes are removed from the mouse and fused with rapidly dividing mouse tumour cells
		4. The new cells are called hybridomas
		5. The hybridomas divide rapidly and release lots of antibodies which are then collected

Monoclonal antibodies can be used in a variety of ways

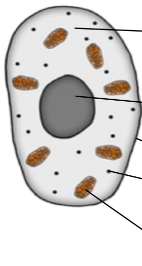
Diagnosis	***Detecting pathogens***	***Detecting molecules***	***Treatment***
e.g. pregnancy test – measure the level of hormones	Can detect very small quantities of chemicals in the blood	Fluorescent dye can be attached so it can be seen inside cells or tissues	Bound to radioactive substance, toxic drug or chemical Cancer cells are targeted to normal body cells are unharmed

Created more side effects than expected (fatal in some cases) and are not as widely used as everybody hoped when first developed.

AQA Cell Structure

Eukaryotes: complex organisms

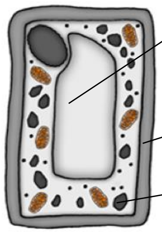
Animal cell



cytoplasm	*Site of chemical reactions in the cell*	Gel like substance containing **enzymes** to catalyse the reactions
nucleus	*Contains **genetic material/ DNA***	Controls the activities of the cell and codes for proteins
cell membrane	*Semi permeable*	Controls the movement of substances in and out of the cell
ribosome	*Site of protein synthesis*	mRNA is translated to an amino acid chain to make proteins
mitochondrion	*Site of respiration*	Where energy is released for the cell to function

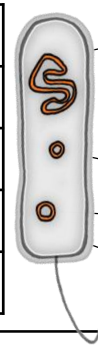
Plant cell

Contains all the parts of animal cells, plus extras



Permanent vacuole	*Contains cell sap*	Keeps cell turgid, contains sugars and salts in solution
Cell wall	*Made of cellulose*	Supports and strengthens the cell
Chloroplast	*Site of photosynthesis*	Contains chlorophyll, absorbs light energy

Prokaryotes: simpler organisms



cell membrane	*Semi-permeable*	Controls the movement of substances in and out of the cell
bacterial DNA	*Not in nucleus floats in the cytoplasm*	Controls the function of the cell
cell wall	***NOT** made of cellulose*	Supports and strengthens the cell
plasmid	*Small rings of DNA*	Contain additional genes
cytoplasm	*Site of chemical reactions in the cell*	Gel like substance containing enzymes to catalyse the reactions

Bacterial cells are much smaller than plant and animal cells

Cell differentiation

How a cell changes and becomes **specialised**
Undifferentiated call are called **STEM** cells

Animal cell differentiation

Early stages of development. Only for repair and replacement

Plant cell differentiation

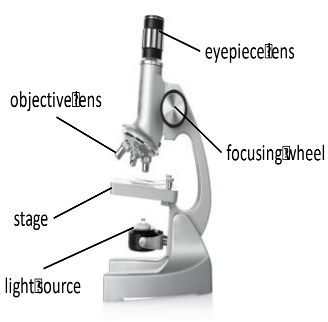
All stages of life cycle. The stem cells are grouped together in meristems

Microscopy

Magnification M = Size of image I / Real size of object A

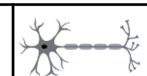
$$M = \frac{\text{Size of image } I}{\text{Real size of object } A}$$

Feature	Light (optical) microscope	Electron microscope
Radiation used	Light rays	Electron beams
Max magnification	~ 1500 times	~ 2 000 000 times
Resolution	200nm	0.2nm
Size of microscope	Small and portable	Very large and not portable
Cost	~£100 for a school one	Several £100,000 to £1 million plus

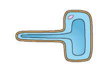


Specialised cells

Specialised animal cells

nerve		*Carry electrical signals*	Long branched connections and insulating sheath.
sperm		*Fertilise an egg*	Streamlined with a long tail. Acrosome containing enzymes. Large number of mitochondria.
muscle		*Contract to allow movement*	Contains a large number of mitochondria. Long.

Specialised plant cells

Root hair		*Absorb water and minerals from soil*	Hair like projections to increase the surface area.
Xylem		*Carry water and minerals*	TRANSPIRATION - dead cells. Cell walls toughened by lignin. Flows in one direction.
Phloem		*Carry glucose*	TRANSLOCATION - living cells. Cells have end plates with holes. Flows in both directions.

PREFIXES

Prefix	Multiple	Standard form
centi (cm)	1 cm = 0.01 m	x 10^{-2}
milli (mm)	1 mm = 0.001 m	x 10^{-3}
micro (μm)	1 μm **=** 0.000 001 m	x 10^{-6}
nano (nm)	1nm = 0.000 000 001 m	x 10^{-9}

AQA Cell Biology 2

largest

smallest

Cell	The smallest structural and functional unit of an organism.
Nucleus	A structure that contains genetic material/DNA and controls the activities of the cell.
Chromosome	A thread-like structure of coiled DNA found in the nucleus of eukaryotic cells.
DNA	A polymer made up of two strands forming a double helix.
Gene	A section of DNA that codes for a specific protein or characteristic.

ADAPTATIONS FOR DIFFUSION

Small intestines	*Villi – increase surface area; good blood supply to maintain concentration gradient. Thin membranes – short diffusion distance.*
Lungs	*Alveoli – increase surface area; good blood supply to maintain concentration gradient. Thin membranes – short diffusion distance.*
Gills in fish	*Gill filaments and lamella - increase surface area; good blood supply to maintain concentration gradient. Thin membranes – short diffusion distance.*
Roots	*Root hair cells - increase surface area.*
Leaves	*Large surface area, thin leaves for short diffusion path, stomata on the lower surface to let O_2 and CO_2 in and out.*

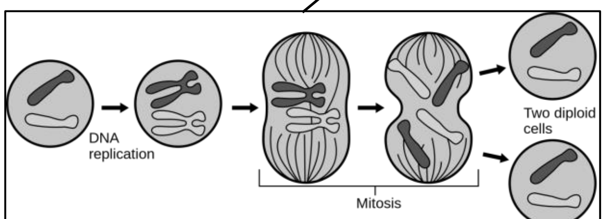
The greater the difference in concentrations, the faster the rate of diffusion.

Cell division

MITOSIS AND THE CELL CYCLE

Cells divide in a series of stages. The genetic material is doubled and then divided into two identical cells.

Stage 1	***Growth***	Increase the number of sub-cellular structures e.g. ribosomes and mitochondria.
Stage 2	***DNA Synthesis***	DNA replicates to form two copies of each chromosome.
Stage 3	***Mitosis***	One set of chromosomes is pulled to each end of the cell and the nucleus divides. Then the cytoplasm and cell membranes divide to form two cells that are identical to the parent cell.



Mitosis occurs during growth, repair, replacement of cells. Asexual reproduction occurs by mitosis in both plants and simple animals.

STEM CELLS

Undifferentiated cell of an organism

Divides to form more cells of the same type, and can differentiate to form many other cell types.

Human Embryonic stem cells	***Can be cloned and made to differentiate into most cell types***	Therapeutic cloning uses the same DNA as the patient so the body does not reject the tissue. Can be a risk of infection
Adult bone marrow stem cells	***Can form many types of human cells e.g. blood cells***	Tissue is matched to avoid rejection, risk of infection. Only a few types of cells can be formed.
Meristems (plants)	***Can differentiate into any plant cell type throughout the life of the pant.***	Used to produce clones quickly and economically, e.g. rare species, crop plants with pest /disease resisitance

Treatment with stem cells may be able to help conditions such as diabetes and paralysis. Some people object to the use of stem cells on ethical or religious grounds

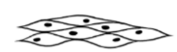
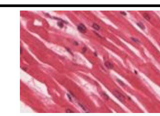
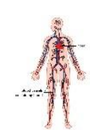
Transport in cells

Diffusion: *no energy required*	*Movement of particles in a solution or gas from a higher to a lower concentration.*	e.g.: O_2 and CO_2 in gas exchange, urea in kidneys. Factors that affect the rate are: concentration, temperature and surface area.
Osmosis: *no energy required*	*Movement of water from a dilute solution to a more concentrated solution.*	e.g.: plants absorb water from the soil by osmosis through their root hair cells. Plants use water for several vital processes, including photosynthesis and transporting minerals.
Active transport: *energy required*	*Movement of particles from a dilute solution to a more concentrated solution.*	e.g.: movement of mineral ions into roots of plants, and the movement of glucose into the small intestines.

AQA GCSE ORGANISATION Part 1

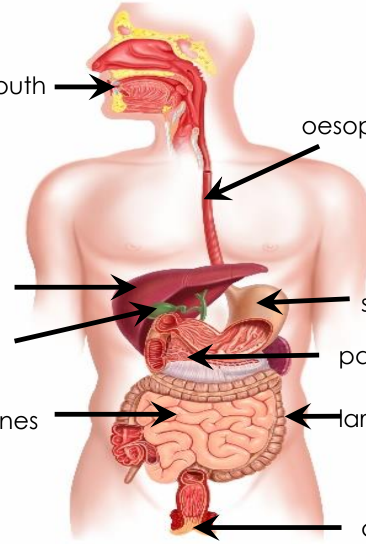
Principles of organisation

Cells, tissues, organs and systems

Cells		***e.g. muscle cells***	The basic building blocks of all living organisms.
Tissues		***e.g. muscle tissue***	A group of cells with a similar structure and function.
Organs		***e.g. the heart***	Aggregations (working together) of tissues performing a specific function.
Organ systems		***e.g. the circulatory system***	Organs working together to form organ systems, which work together to form an organism.

The human digestive system

An organ system in which organs work together to digest and absorb food.



Non-communicable diseases

More energy consumed in food and drink than used
obesity
Linked to increased rates of cardiovascular disease and development of diabetes type 2.

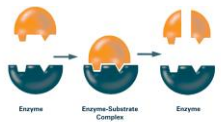
Food tests

Sugars (glucose)	***Benedicts' test + heat (above 60 °C)***	Blue to orange/brick red precipitate.
Starch	***Iodine solution test***	Turns brown to blue/black.
Biuret	***Biuret reagent***	Blue to Mauve or purple solution.

Enzymes in digestion

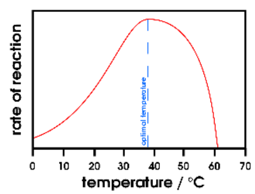
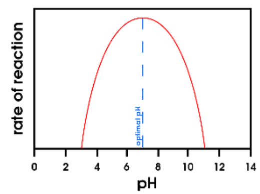
Enzymes catalyse (increase the rate of) specific reactions in living organisms

The 'lock and key theory' is a simplified model to explain enzyme action



Enzymes catalyse specific reactions in living organisms due to the shape of their active site

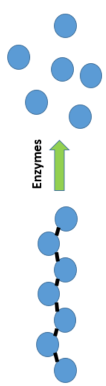
The activity of enzymes is affected by changes in temperature and pH

Enzymes activity has an optimum temperature	***Enzyme activity has an optimum pH***
	

Large changes in temperature or pH can stop the enzyme from working (denature)

Temperature too high	***pH too high or too low***
Enzyme changes shape (denatures) and the substrate no longer fits the active site.	

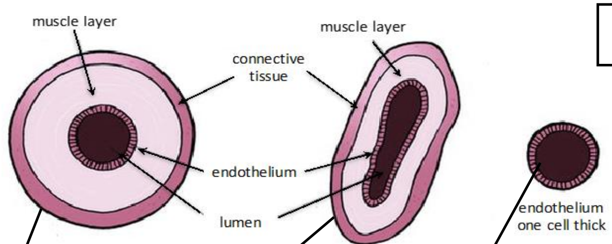
Digestive enzymes speed up the conversion of large insoluble molecules (food) into small soluble molecules that can be absorbed into the bloodstream

Carbohydrases (e.g. amylase)		***Made in salivary glands, pancreas, small intestine***	Break down carbohydrates to simple sugar (e.g. amylase breaks down starch to glucose).
Proteases		***Made in stomach, pancreas***	Break down protein to amino acids.
Lipases		***Made in pancreas (works in small intestine)***	Break down lipids (fats) to glycerol and fatty acids.
Bile (not an enzyme)		***Made in liver, stored in gall bladder.***	Emulsifies lipids to increase surface area to increase the rate of lipid break down by lipase. Changes pH to neutral for lipase to work

The products of digestion are used to build new carbohydrates, lipids and proteins. Some glucose is used for respiration.

AQA GCSE ORGANISATION part 2

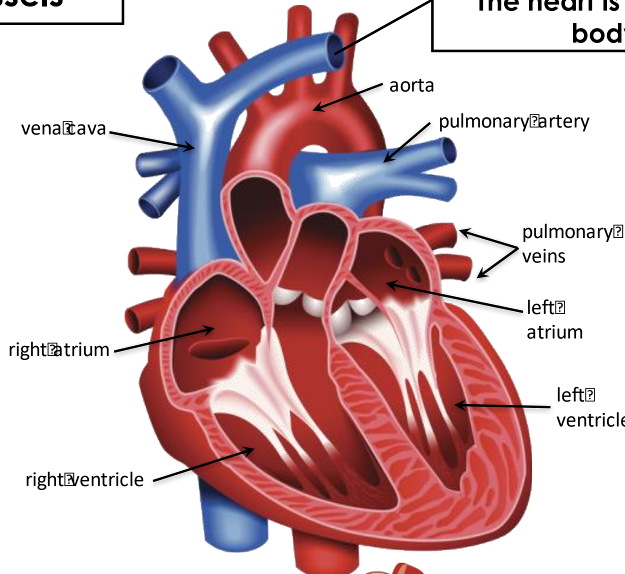
Blood vessels

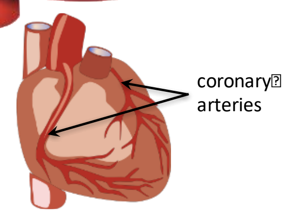


Artery	Vein	Capillary
Carry blood away from the heart	***Carry blood to the heart***	***Connects arteries and veins***
Thick muscular walls, small lumen, carry blood under high pressure, carry oxygenated blood (except for the pulmonary artery).	Thin walls, large lumen, carry blood under low pressure, have valves to stop flow in the wrong direction, carry deoxygenated blood (except for the pulmonary vein).	One cell thick to allow diffusion, Carry blood under very low pressure.

Heart

The heart is an organ that pumps blood around the body in a double circulatory system





Different structure in the heart have different functions

Right ventricle	Pumps blood to the lungs where gas exchange takes place.
Left ventricle	Pumps blood around the rest of the body.
Pacemaker (in the right atrium)	Controls the natural resting heart rate. Artificial electrical pacemakers can be fitted to correct irregularities.
Coronary arteries	Carry oxygenated blood to the cardiac muscle.
Heart valves	Prevent blood in the heart from flowing in the wrong direction.

Blood

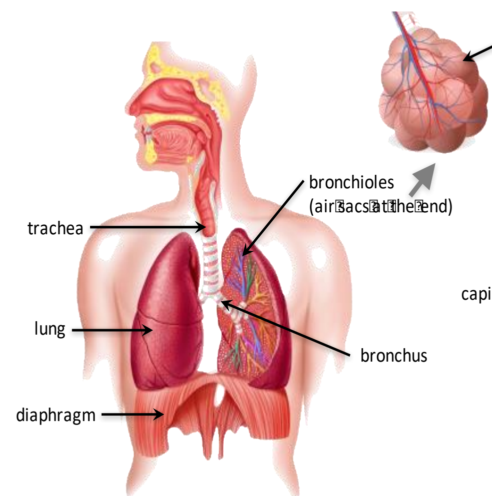
Blood is a tissue consisting of plasma, in which blood cells, white blood cells and platelets are suspended.

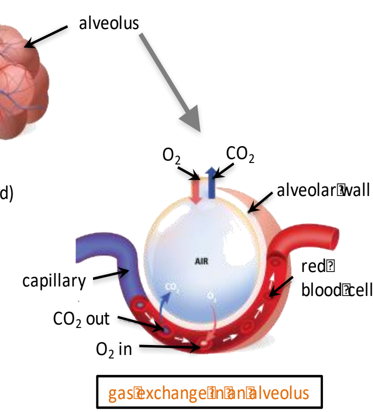
Plasma (55%)	***Pale yellow fluid***	Transports CO_2, hormones and waste.
Red blood cells (45%)	***Carries oxygen***	Large surface area, no nucleus, full of haemoglobin.
White blood cells (<1%)	***Part of the immune system***	Some produce antibodies, others surround and engulf pathogens.
Platelets (<1%)	***Fragments of cells***	Clump together to form blood clots.

Lungs and gas exchange

The heart pumps low oxygen/high carbon dioxide blood to the lungs

Trachea	***Carries air to/from the lungs***	Rings of cartilage protect the airway.
Bronchioles	***Carries air to/from the air sacs (alveoli)***	Splits into multiple pathways to reach all the air sacs.
Alveoli	***Site of gas exchange in the lungs***	Maximises surface area for efficient gas exchange.
Capillaries	***Allows gas exchange between into/out of blood***	Oxygen diffuses into the blood and carbon dioxide diffuses out.





gas exchange in an alveolus

AQA GCSE ORGANISATION part 3

Heart failure can be treated with a transplant or artificial heart

Disease	Cause	Effect	Treatment
Coronary heart disease (CHD)	***A build up or fatty substances in the coronary arteries (atherosclerosis)***	Oxygenated blood cannot get to the cardiac muscle leading to death of heart muscle cells	Stents: inserted into the blocked artery to open it up. Statins: lower levels of harmful cholesterol.
Faulty heart valves	***Valves don't open or close properly***	Blood can leak or flow in the wrong direction	Biological valve transplant or a mechanical valve can be inserted

Non-communicable diseases

Cancer

The result of changes in DNA that lead to uncontrolled cell growth and division

Benign tumour	Contained in one area of the body (usually by a membrane) – not cancer.
Malignant tumour	Invade tissues and spread to different parts of the body to form secondary tumours.

Some cancers have genetic risk factors.

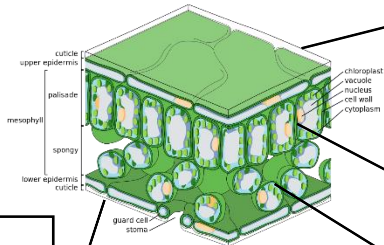
Carcinogens and ionising radiation increase the risk of cancer by changing/ damaging DNA

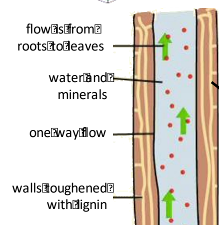
Risk factors for heart/lung disease and certain types of cancer include drinking alcohol, diet, obesity and smoking

These risk factors can also affect the brain, liver and the health of unborn babies

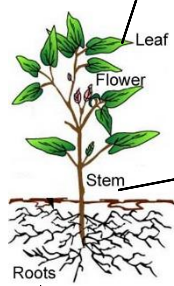
Plant organ systems

The roots, stem and leaves form a plant organ system for transport of substances around the plant

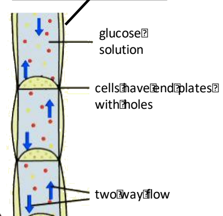


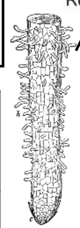


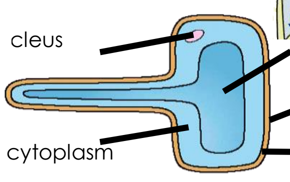
xylem



phloem



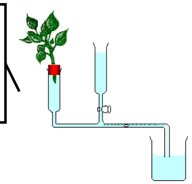


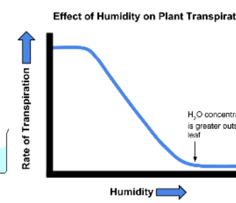


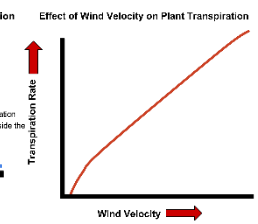
Plant tissues

Epidermal tissues	*Waxy cuticle (top layer of the leaf)*	Reduces water loss from the leaf
	Guard cells and stomata	Guard cells open and close the stomata to control water loss and allow for gas exchange (oxygen and carbon dioxide) which maximises photosynthesis
Palisade mesophyll	*Palisade cells*	Cells near the top surface of the leaf that are packed with chloroplasts that contain chlorophyll maximizes photosynthesis.
Spongy mesophyll	*Air spaces in the leaf between cells*	Increased surface area for gas exchange so that carbon dioxide can diffuse into photosynthesising cells.
xylem	*Hollow tubes strengthened by lignin adapted for the transportation of water in the transpiration stream*	Allows transport **of water** and **mineral ions** from the roots to the stem and the leaves.
phloem	*Cell sap moves from one phloem cell to the next through pores in the end walls*	**Translocation** - transports dissolved sugars from the leaves to the rest of the plant for immediate use or storage.
Meristem tissue	*New cells (roots and shoot tips) are made here including root hair cells*	Root hair cells have an increased surface area for the uptake of water by osmosis, and mineral ions by active transport.

A **potometer** is used to measure the amount of water lost over time (rate of transpiration)

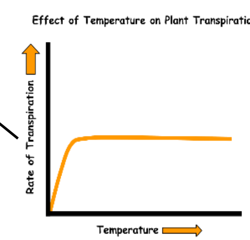






Transpiration

Transpiration	***The rate at which water is lost from the leaves of a plant. The transpiration stream is the column of water moving through the roots, stem and leaves***	Temperature, humidity, air movement and light intensity affect the rate of transpiration.



The shape of the graph for light intensity is the same for temperature (energy)

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/s²

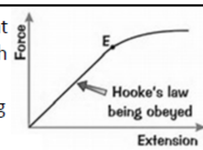
You need to remember the units for each quantity. They are in [ ] next to equations.

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

Key points to learn

1. 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 v² [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 e² [J] [N/m] [m] *(You are given this equation)*
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 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

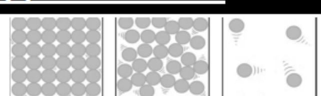
Not wasting heat energy in your home is important for the environment and for your finances. This topic will help you make more informed decisions so that you can save even more.

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. States of matter	
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 P3: Energy Resources

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

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.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: 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.)

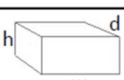
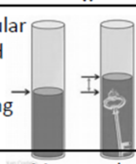
[kg/m³] $\rho = \frac{m}{V}$ $\frac{[kg]}{[m^3]}$

Latent heat: $Energy = mass \times specific\ latent\ heat$

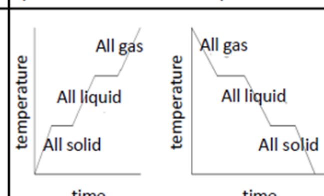
$E = m \times L$

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

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 m³
	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/m³
	$density = \frac{mass}{volume}$
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.)

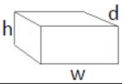
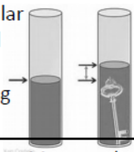
[kg/m³] $\rho = \frac{m}{V}$ $\frac{[kg]}{[m^3]}$

Latent heat: Energy = mass x specific latent heat

E = m x L (You are given this)

[J] [kg] [J/kg]

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
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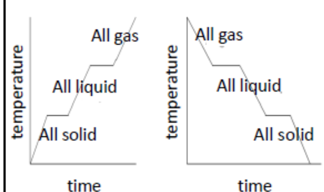
19. Heating and cooling curves	
20. Gas pressure	Caused by particles hitting surfaces. Increases when temperature increases

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)

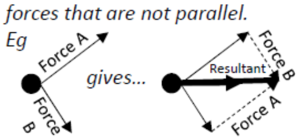
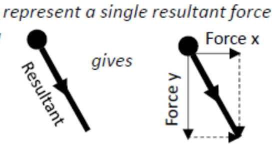
Additional information

Content in *italics* is Higher Tier only.

Key points to learn

1. 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 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

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

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

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	Temperature
	Resistance decreases as the temperature increases.
	Used in thermostats.
7. LDR	Light intensity
	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. Cell Battery
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 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

- $E = P \times t$
  Work done = Power x time
  [J] [W] [s]
  [kWh] [kW] [hr]
- $E = Q \times V$
  Work done = Charge flow x potential difference
  [J] [C] [V]

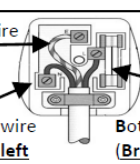
(You need to remember and be able to use all of the equations on this sheet.)

- $P = V \times I$
  power = potential difference × current
  [W] [V] [A]
- $P = I^2 \times R$
  power = current² × resistance
  [W] [A] [Ω]

Key points to learn

1. ac	Alternating current Found in mains
	Has an alternating potential difference (voltage) negative to positive. pd time
2. dc	Direct current Found in batteries pd time
	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 Bottom **left** (**Bl**ue) Live wire Bottom **r**ight (**Br**own) Through fuse

Trilogy P6: Radioactivity

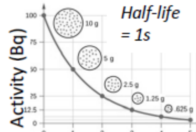
Collins rev guide: Atomic Structure

Knowledge Organiser

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

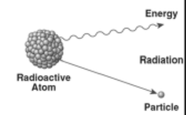
8. Activity	Rate of unstable nuclei decay. Measured in Becquerel (Bq)
9. Irradiated	Exposed to radiation but does not become radioactive.
10. Radioactive contamination	Unwanted presence of radioactive material.
11 Geiger counter	Nuclear radiation detector.
12. Half-life	Time it takes for the radioactive 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

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**

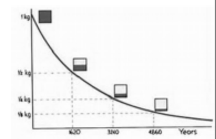
Background

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.
  $^{226}_{88}Ra \rightarrow ^4_2He + ^{222}_{86}Rn$
- *Finding Half-life using a graph*
  Find how long It takes until you have half what you started with



Trilogy P8: Motion

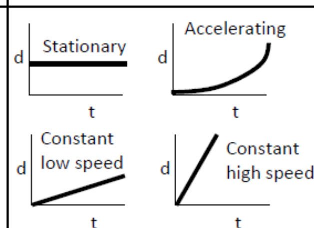
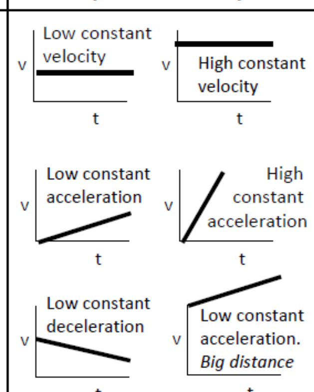
Collins rev guide: Forces

Knowledge Organiser

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/s²]	Any change in velocity. Can be either speed or direction
	Change in velocity per second. eg 10m/s² means velocity changes by 10m/s every second
	Acceleration = change in velocity / time taken for change a [m/s²] = Δv [m/s] / t [s]
7 Deceleration a [m/s²]	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/s²
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/s² s = distance travelled in m

Big picture (Physics Paper 2)

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

Background

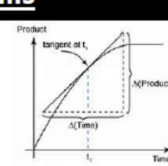
We all know about acceleration and speed, but how are they really related. The ideas on this page are essential in the use of vehicle design and tectonic movement. They can be used to describe any journey by any object.

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