Half Term 1&2

EDEXCEL KEY CONCEPTS OF PHYSICS

SI Units for physical quantities

SI units are used all round the World.

Common names

Physical quantity	Unit
Mass	Kilogram (Kg)
Length	Metre (m)
Volume	Metre cubed (m^3)
Time	Second (s)
Current	Ampere (A)
Temperature	Kelvin (K)

Derived units with special names

Physical quantity	Unit and abbreviation
Energy	Joule (J)
Frequency	Hertz (Hz)
Force	Newton (N)
Power	Watt (W)
Pressure	Pascal (Pa)
Electric charge	Coulomb (C)
Electric potential difference	Volt (v)
Electric resistance	Ohm (Ω)
Magnetic flux density	Tesla (T)

Multiples and sub-multiples of units

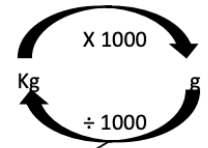
SI base units with prefixes in front of them. | Prefix tells you how much bigger or smaller a unit is than the base unit | e.g. kilogram is one thousand grams.

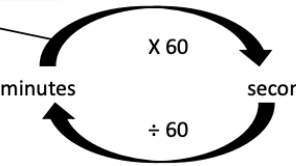
Scaling prefixes | Used for large or small quantities | Makes the size of the number more manageable.

Prefix	Symbol	Multiple of Unit	Standard form
terra	T	1,000,000,000,000	10^{12}
giga	G	1,000,000,000	10^{9}
mega	M	1,000,000	10^{6}
kilo	k	1000	10^{3}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	μ	0.000001	10^{-6}
nano	n	0.000000001	10^{-9}

Conversion between units

From a smaller unit to a bigger unit	Divide by the conversion factor
From a bigger unit to a smaller unit	Multiply by the conversion factor





Standard form

Number	Standard form
1000	1 X 10^{3}
1,000,000	1 X 10^{6}
0.00001	1 X 10^{-5}

Standard form | An easy way to write very large or very small numbers

Significant figures

Significant figures (s.f.) | Sometimes we do not need to give detailed answers to problems - we just want a rough idea. A long number, could be rounded off to the nearest thousand, or nearest million.

Another method of giving an approximated answer is to round off using significant figures.

The first significant figure of a number is the first digit that is not a zero.

The second and third significant figures come straight after the first, even if they are zeros.

e.g. 0.33566 to 2 s.f. = 0.34 (2 s.f.)

Remember in any calculation you should round down to the lowest number of significant figures given.

Remember to write down how many significant figures you have rounded your answer to.

Half Term 1&2

EDEXCEL TOPIC 2 - MOTION AND FORCES (part 1)

Describing Motion

Scalar and vector quantities

Speed	*How fast an object moves*	The speed of a car is 30m/s. A car moves forward with a velocity of 30m/s.
Velocity	*Speed + direction*	
Distance	*How far*	The table is 1m long.
Displacement	*Distance + direction*	The beach is 1km due east of the town.

Scalar	*A quantity that only has magnitude (size)*	e.g. mass, time, speed, temperature, energy, distance.
Vector	*A quantity that only has magnitude and direction*	e.g. force, velocity, momentum, displacement, acceleration, weight.

Car in town	*13m/s*
Car on motorway	*31m/s*
Train	*55m/s*
Sound in air	*340m/s*

Wind	*5 – 20 m/s*

Walking	*1.4m/s*
Running	*3m/s*
Cycling	*5.5m/s*

Speed is rarely constant.

Measuring Motion

Equations

Average speed = distance ÷ time

s = d ÷ t

Acceleration = (final velocity – initial velocity) ÷ time taken

a = (v – u) ÷ t

Acceleration is positive, object is accelerating

Acceleration is negative, object is decelerating

Acceleration	*How quickly an object speeds up*
	The change in velocity in a certain amount of time

(final velocity squared – initial velocity squared) = 2 X acceleration X distance ÷ time taken

$v^2 - u^2 = 2 \times a \times x$

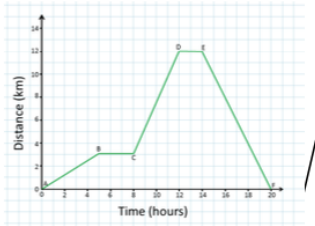
Uniform acceleration	*Acceleration due to gravity is constant for objects in free fall*
	Constant acceleration
Estimating Acceleration	*Estimate how long it takes the object to stop and then use the acceleration equation*

Acceleration in free fall = 10m/s^2

Core Practical
Determine the speed of objects
Using light gates

Speed	*Metre/second (m/s)*
Distance	*Metre (m)*
Time	*Second (s)*
Current	*Ampere (A)*
Temperature	*Kelvin (K)*
Acceleration	*Metres/second squared (m/s^2)*
Velocity	*Metre/second (m/s)*

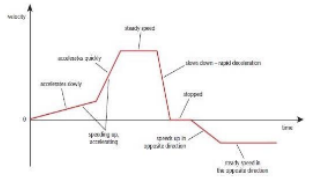
Motion Graphs



Distance-time graphs

Distance-time graph	*Shows how far an object moves along a straight line*
Speed of object	*Use the gradient of graph*
Object stopped	*Graph line flat*
Object going faster	*Graph line steeper*
Object accelerating	*Graph line curves*

Calculating speed from d-t graph	*If the graph is a straight line, the speed along the line is equal to the gradient of the line*	Gradient = vertical ÷ horizontal
	If the graph is a curve, the speed is found by drawing a tangent to the curve and then the gradient of the tangent	



Velocity-time graphs

Velocity-time graph	*Shows how fast an object moves*
Gradient of graph	*Object accelerating*
Graph line flat	*Object has constant / steady speed*
Graph line steeper	*Object has greater acceleration*
Positive diagonal line	*Object is accelerating at a constant rate*
Negative diagonal line	*Object is decelerating at a constant rate*
Graph line curves	*Object is changing acceleration*

Calculate acceleration	*Use the gradient gradient = vertical ÷ horizontal*	
Calculating distance travelled from v-t graph	*The area under a section of the graph is equal to the distance travelled in that time*	Distance = Speed X time
	If the acceleration is constant, the area can be split into a rectangle or a triangle	Area of rectangle = base X height Area of triangle = ½ base X height

Half Term 1&2

EDEXCEL TOPIC 2 - MOTION AND FORCES (part 2)

Forces

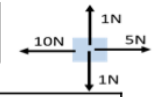
Contact and Resultant forces

Force	*Push or pull*	Stretch, squash, turn.
Contact force	*Exerted between two objects when they touch*	Friction, air resistance, tension.
Non-contact force	*Exerted between two objects without touching*	Gravity, electrostatic forces, magnetic forces.

Resultant force	*The overall effect of all of the forces acting upon an object*	Two forces acting in the same direction are added.
		Two forces acting in the opposite direction are taken away.

An arrow can be used to show vectors
- *Length of arrow = magnitude of vector*
- *Direction of arrow = direction of vector*

Object moves left with a force of 5N.



Free body diagram: *Show magnitude and direction of all forces upon an object*

Weight	*Newton (N)*
Mass	*Kilograms (kg)*
Gravitational field strength	*Newton per kilogram (N/kg)*
Force	*Newton (N)*
Acceleration	*Kilogram metre per second (Kg m/s)*
Momentum	*Joules (J)*
Velocity	*Metre per second (m/s)*
Time	*Second (s)*

Reactions and stopping

Measuring reaction times	*How fast someone reacts*
Dropping the ruler test or computer based test.	
Typical reaction time = 0.2 – 0.6s.	

Frictional forces decelerate a moving object and bring it to rest.

. An alert driver has a reaction time of 1s.

Thinking distance	*Distance travelled whilst the driver reacts*
Braking distance	*Distance travelled whilst the car is stopped by the brakes*
Stopping distance	*Total thinking and braking distances*

Speed affects both thinking and braking distances.

Car's mass ~1000Kg, single decker bus ~10,000Kg, loaded lorry ~30,000Kg

PHYSICS ONLY

Speed increases so does stopping distance.

Speed increases thinking distance also increases at the same rate.

If speed doubles, braking distance increases by a factor of four (2^2).

Work done to bring a vehicle to rest = its initial kinetic energy

Factors affecting stopping distances	Drivers reaction times	Drinking alcohol, taking drugs, tired.
	Braking distances	Weather conditions, worn brakes or tyres, road surface, size of braking force.

Braking and kinetic energy	*Work done by braking force, reduces kinetic energy*	Kinetic energy decreases, temperature of brakes increases due to frictional forces.

Newton's Laws and Momentum

Newton's first Law	*Balanced forces*	When the resultant force on an still object = 0, the object is stationary.
		When the resultant force on a moving object = 0, the object is at a constant speed.
Newton's second Law	*Unbalanced forces*	When the resultant force is greater than 0, the object accelerates. It could speed up, slow down or change direction.
Newton's third Law	*Equal and opposite forces*	When two objects interact the forces exerted are equal and in an opposite direction.

HIGHER ONLY

Inertial mass	*How difficult it is to change the velocity of an object*	If the mass is large, to change velocity a big force is needed.
Inertial mass = force ÷ acceleration.		

F = (mv – mu) ÷ t

Is a vector.

Force = change in momentum ÷ time.

Momentum = mass X velocity

p = m X v

Changes in momentum	*Force is applied to stop momentum*	**If momentum changes slowly, the force applied is small so less damage.**

Crumple zones

Conservation of momentum	*When two objects collide, the momentum they have before the collision = the momentum they have after the collision*	
	Closed system = no external forces acting on it.	

Force = mass X acceleration.

F = m X a

HIGHER ONLY

When objects continue in the same state of motion	Speed or direction only changes if a resultant force acts on the object	
Inertia		

HIGHER ONLY

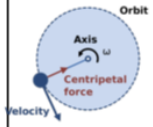
Changing velocity	*Objects in a circular motion, change direction but keep a constant speed*	

Centripetal force	*This force acts towards the centre of the circle*	

There must be a resultant force acting upon the object.

An object travelling in a circle at a constant speed, is constantly changing direction so it is constantly changing velocity which means it is accelerating.

Car travelling around a bend	Constant speed, direction changes.
Satellite orbiting the Earth	Constant speed, direction changes.



Gravitational field strength	Gravity exerted around an object.	Earth's gfs = 9.8N/kg.

Each Kg has a gravitational pull of 9.8N.

W = m X g

Weight = mass X gravitational field strength

Weight	*Force acting upon an object due to gravity*	Newton (N)
Mass	*How much matter*	Kilograms (Kg)

Core Practical

Investigate force, mass and acceleration

Vary mass added to trolley.

- Acceleration is proportional to resultant force.
- Acceleration is inversely proportional to mass.

Frictional forces decelerate a moving object and bring it to rest.

Momentum

Half Term 1&2

EDEXCEL TOPIC SC1-2: STATES OF MATTER

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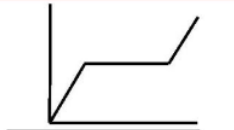


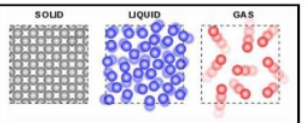
Melting point of a pure substance

Melting point of an impure substance

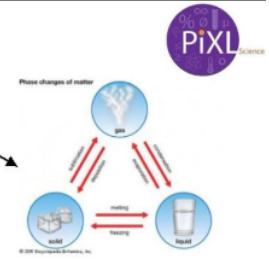
Pure substances	*A pure substances is a single element or compound, not mixed with any other substance.*	Pure substances melt and boil at specific temperatures. Heating graphs can be used to distinguish pure substances from impure.

Pure substances

States of matter

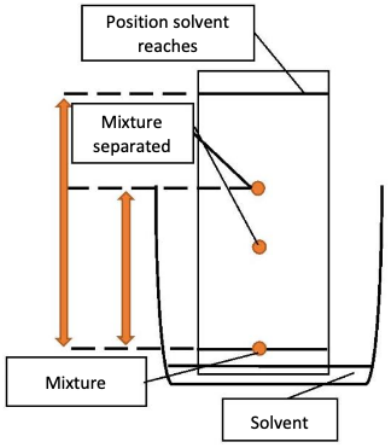
Solid, liquid, gas	*Melting and freezing happen at melting point, boiling and condensing happen at boiling point.*	 The amount of energy needed for a state change depends on the strength of forces between particles in the substance.

s	solid
l	liquid
g	gas



Energy and movement	*Gas particles have higher levels of energy than liquids and solids*	**Gas particles move more than the other states of matter, with solids moving the least due to their tightly packed arrangement. Solid particles can only vibrate around their fixed positions.**

Method of separating substances



Chromatography

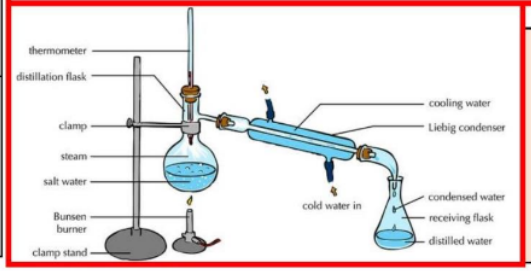
Chromatography	*Can be used to separate mixtures and help identify substances.*	Involves a mobile phase (e.g. water or ethanol) and a stationary phase (e.g. chromatography paper).
R_f values	*The ratio of the distance moved by a compound to the distance moved by solvent.*	R_f = distance moved by substance / distance moved by solvent
Pure substances	*The compounds in a mixture separate into different spots.*	This depends on the solvent used. A pure substance will produce a single spot in all solvents whereas an impure substance will produce multiple spots.

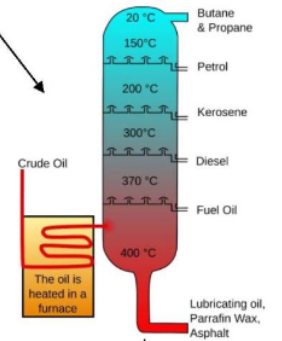
Fractional distillation

Fractions	*The hydrocarbons in crude oil can be split into fractions*	Each fraction contains molecules with a similar number of carbon atoms in them. The process used to do this is called fractional distillation.
Fractional distillation	*Crude oil is heated and hydrocarbons boil and condense at certain temperatures*	This is due to the different lengths of hydrocarbon chains.

Simple distillation

Distillation	*Used to separate a mixture of liquids*	**During distillation, the mixture gets heated causing one liquid at a time to evaporate and then condense in the Liebig condenser.**
Boiling points	*Each of the liquids in the mixture will have a different boiling point*	**This enables the liquids to be separated. Distillation can also be used to analyse purity of a substance as pure substances have a sharp boiling point.**





Using fractions	*Fractions can be processed to produce fuels and feedstock for petrochemical industry*	We depend on many of these fuels; petrol, diesel and kerosene. Many useful materials are made by the petrochemical industry; solvents, lubricants and polymers.

Half Term 1&2

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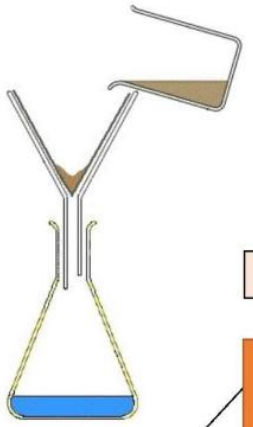
EDEXCEL TOPIC SC1-2: STATES OF MATTER

Methods of separating substances

Filtration

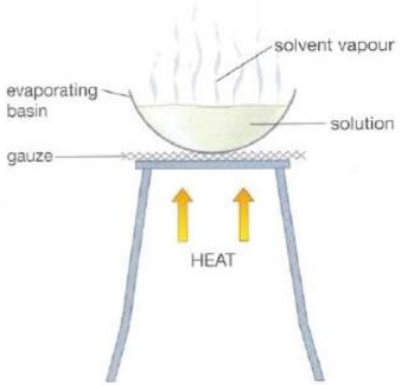


Filtration	*This technique separates substances that are insoluble in a solvent from those that are soluble*	An example is sand in water; the sand will collect in the filter paper and the water will move through the it.

The filtrate is the liquid that moves through the filter paper and collects underneath	The residue is the insoluble solid that collects in the filter paper.

Crystallisation

Crystallisation	*This technique separates a soluble substance from a solvent by evaporation*	An example is the crystallisation of sodium chloride from a salt solution.



Purifying substances

Potable water

Potable water	*Water of an appropriate quality is essential for life*	Human drinking water should have low levels of dissolved salts and microbes. This is called potable water.
UK water	*Rain provides water with low levels of dissolved substances*	This water collects in the ground/lakes/rivers. To make potable water an appropriate source is chosen, which is then passed through filter beds and then sterilised.
Desalination	*Needs to occur is fresh water is limited and salty/sea water is needed for drinking*	This can be achieved by distillation or by using large membranes e.g. reverse osmosis. These processes require large amounts of energy.

Sterilising agents include chlorine, ozone and UV light.

Using water	*Water used for chemical analysis must not contain any dissolved salts*	Water used for this purpose must be treated in order to be suitable.
Producing potable water	*There are 4 main steps to producing potable water*	1. Choosing appropriate source of fresh water 2. Sedimentation 3. Passing the water through filter beds 4. Chlorination

Waste water treatment

Waste water	*Produced from urban lifestyles and industrial processes*	These require treatment before used in the environment. Sewage needs the organic matter and harmful microbes removed.
Sewage treatment	*Includes many stages*	- Screening and grit removal - Sedimentation to produce sludge and effluent (liquid waste or sewage). - Anaerobic digestion of sludge - Aerobic biological treatment of effluent.

Half Term 3&4

EDEXCEL TOPIC 3 - CONSERVATION OF ENERGY (PART 1)

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System	An object or group of objects that interact together

Closed system	No change in total energy in system
Open system	Energy can dissipate (can enter or leave)

Dissipate – To scatter in all directions or to use wastefully: When energy is 'wasted', it dissipates into the surroundings as thermal energy and the temperature rises.

Useful energy	Energy transferred and used
Wasted energy	Dissipated energy, stored less usefully

Conduction transfers thermal energy through solid objects.

Thermal conductivity

How well a material conducts energy

Metals have high thermal conductivity.

Energy transfers

Kinetic	Anything moving has energy in its kinetic energy store.
Thermal	Any object – the hotter it is the more energy is in its thermal energy store
Chemical	Anything that can release energy by a chemical reaction e.g. food, fuels
GPE	Anything that can fall / in a gravitational field
EPE	Anything stretched e.g. springs, rubber bands
Electrostatic	Two charges that attract or repel each other
Magnetic	Two magnets that attract or repel each other
Nuclear	Atomic nuclei release energy from this store in nuclear reactions

Conservation of energy

Total energy input = useful energy output + wasted energy

Principle of conservation of energy – The amount of energy always stays the same.: Energy cannot be created or destroyed, only changed from one store to another.

Energy is only useful when it is transferred from one store to another useful store

Cavity walls	An air gap reduces the amount of energy transfer by conduction
Thick walls	Thick walls have a slow rate of energy transfer

In buildings the lower the thermal conductivity the slower the rate of energy transfer

Energy (KE, EPE, GPE, thermal)	Joules (J)
Velocity	Metres per second (m/s)
Mass	Kilogram (Kg)
Gravitational field strength	Newton per kilogram (N/Kg)
Height	Metres (m)

Efficiency

Efficiency	How much energy is usefully transferred

Efficiency = Useful output energy transfer / Total input energy transfer

Efficiency = Useful power output / Total power input

HIGHER ONLY

Efficiency can be increased by reducing the thermal energy transferred due to friction by lubricating and the energy transferred by heating by insulation.

Gravitational Potential energy (GPE)	Energy gained by an object raised above the ground
Kinetic energy (KE)	Energy stored by a moving object

Change in GPE = Mass X gravitational field strength X change in vertical height
$\Delta GPE = m \times g \times \Delta h$

$KE = \frac{1}{2} \times mass \times (speed)^2$
$KE = \frac{1}{2} \times m \times v^2$

Transfers between stores

Mechanical	A force acts on an object (doing work e.g. push, squash, stretch
Electrically	A charge doing work against resistance e.g. charges moving round a circuit
By heating	Energy transfers from a hot object to a cooler object e.g. hot drink
By radiation	Energy transfers by waves e.g. sunlight reaching the Earth

Important energy Transfers between stores

An object projected upwards or up a slope	The object does work against gravity so energy is transferred mechanically from the object's KE store to the GPE store.
A moving object hitting an obstacle	The moving object has energy in it's KE store. Some of this is mechanically transferred to the obstacle's KE store. Some energy is mechanically transferred to the thermal energy store of the object and obstacle, to the thermal energy store of the surroundings by heat and the rest of the energy is 'carried' away by sound
An object being accelerated by a constant force	Assuming there is no air resistance, gravity does work on the object. The object accelerates constantly towards the ground. Energy is transferred mechanically from the GPE store to the object's KE store.
A vehicle slowing down	Energy in the vehicle's KE store is transferred mechanically due to friction between the road and tyres, and then by heating to the thermal energy store of the vehicle and road.
Boiling water in an electric kettle	Energy is transferred electrically from the mains to the element in the kettle. The energy is then transferred by heating to the thermal energy store of the water.

Energy transfer diagrams

An easy way to show what happens to the energy

Boxes = energy stores and arrows = energy transfers

Unit
Joules (J)

Thermal energy store of hot drink

By heating Thermal energy transfers from hot liquid to cooler air and cup

Thermal energy store of cup and surrounding s

Half Term 3&4

EDEXCEL TOPIC 3 - CONSERVATION OF ENERGY (PART 2)

Energy resources

Non-renewable energy resource	*These will run out. It is a finite reserve. It cannot be replenished.*	e.g. Fossil fuels (coal, oil and gas) and nuclear fuels.
Renewable energy resource	*These will never run out. It is an infinite reserve. It can be replenished.*	e.g. Solar, Tides, Waves, Wind, Geothermal, Biomass, Hydroelectric

Most do cause some damage to the environment but less than non-renewables

Do not provide a lot of energy and some are unreliable

Negatives for using fossil fuels and nuclear fuel

Create environmental problems	Fossil fuels release carbon dioxide when burnt.
Non-renewable	Will run out.
Nuclear power stations are expensive	To build and to decommission safely.

Burning coal and oil release sulphur dioxide which causes acid rain.

Oil spillages cause serious marine environmental problems

Nuclear waste is dangerous and difficult to dispose of and there is always a risk of catastrophes.

CO_2 is a greenhouse gas and contributes to global warming

Positives for using fossil fuels and nuclear fuel

Reliable	Provides lots of energy.
Plenty of fuel to meet current demand	Respond quickly to electrical needs from National Grid.
Cost to extract is low	Fossil fuel power plants relatively cheap to build and run.

Biofuels

Made from plants and animal waste dung

Positives.	Negatives.
Renewable.	Cost to refine biofuels is very high.
Can be solid, liquid or gas and can be burnt to produce electricity.	Growing biofuels takes space away from growing food.
Reliable and take a short time to grow.	Natural habitats are destroyed to make room to grow biofuels.
'Carbon neutral' theoretically plants take in the same amount of CO_2 as they release when burnt	Decay or burning of the cleared vegetation increases methane and CO_2 emissions.

Trends in Energy resource use

Fossil fuels

Produce most of our electricity	The need for electricity increased greatly in the 20th century
Devices are becoming more efficient	Designers are trying to reduce the amount of wasted energy

Other uses of fossil fuels

Oil (diesel and petrol) used to fuel cars	
Gas is used to heat homes and to cook food	

Energy resources are chosen for their effect upon the environment.

Fossil fuels have a negative effect upon the environment.

Targets have been introduced to reduce the use of fossil fuels.

Car companies are designing electric and hybrid cars.

Renewable fuels

Limited by reliability	Energy resources cannot quickly respond to demand like fossil fuels
Limited by cost	Building new renewable power stations is expensive

Hybrid cars and solar panels for houses are still very expensive

Research into improving the reliability of renewable energy resources is expensive and takes time.

People object to wind farms (visual pollution).

Solar cells

Made from materials that use energy transferred by light to create an electric current

Positives.	Negatives.
No damage to the environment	Expensive
Used in remote places.	Weather dependant – cannot be used in cloudy countries.

Tidal barrages

Big dams built across river estuaries with turbines in them. As the tide comes in, water fills up the estuary, then water is let out through the turbines to generate electricity

Positives.	Negatives.
No polluting gases	Visual pollution
Reliable as tides occur twice a day	Prevent boat access
	Alter habitats for wading birds
No fuel costs, minimal running costs	Initial costs high

Wind

Each wind turbine has a generator inside it. As the wind rotates the blades, the generator turns and produces electricity

Positives.	Negatives.
No polluting gases.	Initial costs quite high
	Need lots to make enough electricity.
Running costs minimal.	Visual and noise pollution.
	Weather dependant – only work when windy

Hydro-electric power

Rainwater collects behind the dam and is allowed out through turbines.

Positives.	Negatives.
Can respond immediately to demand.	Building dams and flooding valleys
	Big impact upon environment. Loss of habitats. .
No polluting gases.	Initial costs high but minimal running costs.

Half Term 3&4

Edexcel GCSE Biology Key Concepts Part 1

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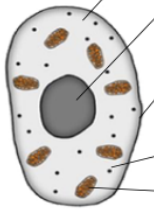


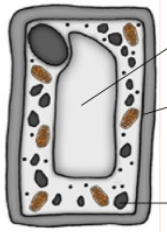
cytoplasm	*site of chemical reactions in the cell*	gel like substance containing enzymes to catalyse the reactions
nucleus	*contains **genetic material***	controls the activities of the cell and codes fro proteins
cell membrane	*semi permeable*	controls the movement of substances in and out of the cell
ribosome	*site of protein synthesis*	mRNA is translated to an amino acid chain
mitochondrion	*site of respiration*	where energy is released for the cell to function

animal cell

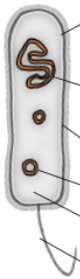
plant cell

Eukaryotes complex organisms

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



cell membrane	*site of chemical reactions in the cell*	gel like substance containing enzymes to catalyse the reactions
bacterial DNA	*not in nucleus floats in the cytoplasm*	controls the function of the cell. Can be found as chromosomal DNA and plasmid DNA (small rings).
cell wall	***NOT** made of cellulose*	supports and strengthens the cell
cytoplasm	*semi permeable*	controls the movement of substances in and out of the cell
flagella	*whip like tail*	allows the bacterial cell to move
ribosome	*site of protein synthesis*	mRNA is translated to an amino acid chain

Bacterial cells are much smaller than plant and animal cells

Prokaryotes simpler organisms

Specialised cells

egg		*fertilised by a sperm*	nutrients in the cytoplasm, haploid nucleus and changes in the cell membrane after fertilisation
sperm		*fertilise an egg*	streamlined with a long tail acrosome containing enzymes large number of mitochondria, haploid nucleus
Ciliated epithelial cell		*push and move mucus*	Thin layer of moving hairs on the surface of the cells called cilia.

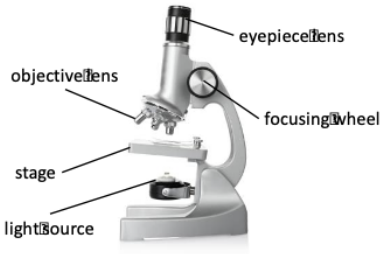
Microscopy

magnification = size of image / real size of the object

PREFIXES

decreasing size and scale

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}
pico (pm)	1pm = 0.000 000 000 001m	x 10^{-12}



Estimates can be useful when you only have a sample of what you are counting e.g. the number of red blood cells in a blood sample

Many of the structures found in cells were not able to be seen before the development of electron microscopes e.g. ribosomes

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

Half Term 3&4

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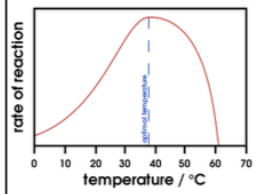
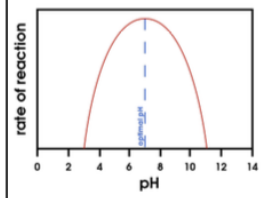
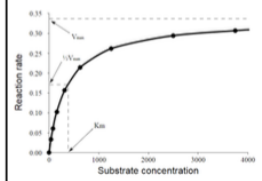
Edexcel GCSE Biology Key Concepts Part 2

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

The rate of a reaction can be measured by how fast reactants are used up or by how fast products are formed.

Enzymes

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

Enzymes activity has an optimum temperature	*Enzyme activity has an optimum pH*	*Increasing substrate concentration increases rate (limited by number of active sites)*
		

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

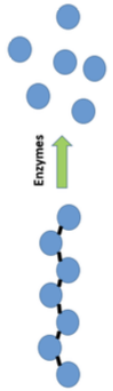
Enzymes catalyse specific reactions in living organisms due to the shape of their active site.

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

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

Temperature too high	*pH too high or too low*

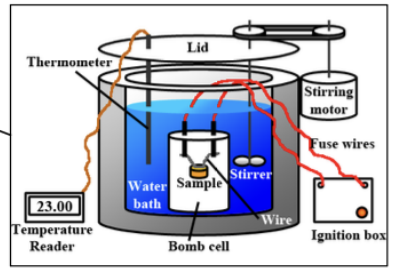
Enzyme changes shape (denatures) the substrate no longer fits the active site.

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).

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

Calorimetry

The energy in food can be calculated by how much it heats up water when it burns in a calorimeter.



Osmosis

Calculate percentage gain/loss of mass in osmosis.

$$\%\ change\ in\ mass = \frac{(final\ mass\ -\ initial\ mass)}{initial\ mass} \times 100$$

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

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.

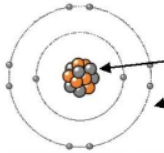
Half Term 5&6

1	2											3	4	5	6	7	0
				1 **H** hydrogen 1													4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	[285] **Cn** copernicium 112	[286] **Nh** nihonium 113	[289] **Fl** flerovium 114	[289] **Mc** moscovium 115	[293] **Lv** livermorium 116	[294] **Ts** tennessine 117	[294] **Og** oganesson 118

Half Term 5&6

Edexcel Topic SC3-4 Atomic Structure

Atom	*The smallest part of an element that can exist*	Have a radius of around 0.1 nanometres and have no charge (0). The nucleus is very small compared to the overall size of the atom.
Element	*Contains only one type of atom*	Around 100 different elements each one is represented by a symbol e.g. O, Na, Br.
Compound	*Two or more elements chemically combined*	Compounds can only be separated into elements by chemical reactions.



Central nucleus	Contains protons and neutrons
Electron shells	Contains electrons

Name of Particle	Relative Charge	Relative Mass
Proton	+1	1
Neutron	0	1
Electron	-1	Very small

Atoms contain equal numbers of protons and electrons in order to have an overall neutral charge.

Electronic shell	Max number of electrons
1	2
2	8
3	8
4	2

Atomic structure

Subatomic particles; masses, charges and numbers

7
Li
3

Mass number	*The sum of the protons and neutrons in the nucleus*	
Atomic number	*The number of protons in the atom*	Number of electrons = number of protons
Elements	*All atoms of a certain element had the same number of protons*	This number of protons is unique to that element.

Isotopes	*Atoms of the same element with the same number of protons and different numbers of neutrons*	^{35}Cl (75%) and ^{37}Cl (25%) Relative abundance = (% isotope 1 x mass isotope 1) + (% isotope 2 x mass isotope 2) ÷ 100 **e.g. (25 x 37) + (75x 35) ÷ 100 = 35.5**

The model of the atom

Pre 1900	*Tiny solid spheres that could not be divided*	Before the discovery of the electron, John Dalton said the solid sphere made up the different elements.
1897 'plum pudding'	*A ball of positive charge with negative electrons embedded in it*	JJ Thompson 's experiments showed that showed that an atom must contain small negative charges (discovery of electrons).
1909 nuclear model	*Positively charge nucleus at the centre surrounded negative electrons*	Ernest Rutherford's alpha particle scattering experiment showed that the mass was concentrated at the centre of the atom.
1913 Bohr model	*Electrons orbit the nucleus at specific distances*	Niels Bohr proposed that electrons orbited in fixed shells; this was supported by experimental observations.

James Chadwick	*Provided the evidence to show the existence of neutrons within the nucleus*

The periodic table

Elements arranged in order of atomic number	*Elements with similar properties are in columns called groups*	Elements in the same group have the same number of outer shell electrons and elements in the same period (row) have the same number of electron shells.

Metals	*To the left of the Periodic table*	Form positive ions. Conductors, high melting and boiling points, ductile, malleable.
Non metals	*To the right of the Periodic table*	Form negative ions. Insulators, low melting and boiling points.

Before discovery of protons, neutrons and electrons	*Elements arranged in order of atomic weight*	Early periodic tables were incomplete, some elements were placed in inappropriate groups if the strict order atomic weights was followed.

Mendeleev	*Left gaps for elements that hadn't been discovered yet*	Elements with properties predicted by Mendeleev were discovered and filled in the gaps. Knowledge of isotopes explained why order based on atomic weights was not always correct.

1	2											3	4	5	6	7	0
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	?	?	?						

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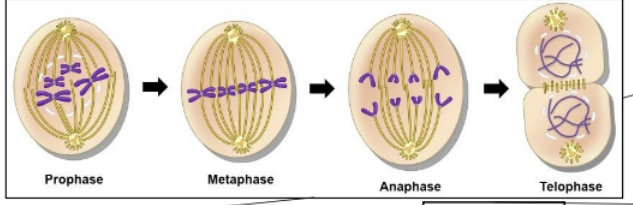
Half Term 5&6



Mitosis occurs during growth, repair, replacement of cells. Asexual reproduction occurs by mitosis in both plants & simple animals producing genetically identical clones.

MITOSIS produces two genetically identical DIPLOID CELLS

Stage 1	***Interphase (not part of mitosis)***	Before mitosis: Increase the number of sub-cellular structures e.g. ribosomes, mitochondria. DNA replication makes copies of chromosomes.
Stage 2	***Prophase***	Nucleus breaks down and spindle fibres appear.
Stage 3	***Metaphase***	Chromosomes are lined up on spindle fibres on the equator (middle) of the cell.
Stage 4	***Anaphase***	Chromosome copies are separated and pulled to opposite ends of the cell.
Stage 5	***Telophase***	A new nuclear membrane forms around each set of chromosomes.
Stage 6	***Cytokinesis***	Cell surface membrane forms to separate the cells (+new cell wall in plants).

Cells divide in a series of stages to produce two daughter cells, each with identical set of chromosomes to the parent cell (in the nucleus).

Cancer — **The result of changes in DNA that lead to uncontrolled growth and division**

MITOSIS is part of THE CELL CYCLE

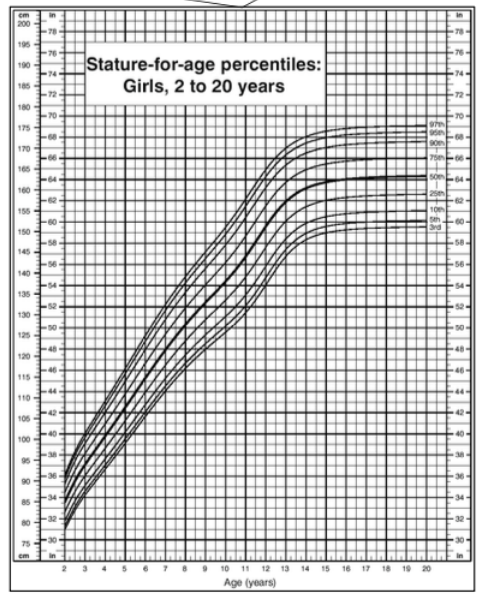
Cell division and growth

Growth in organisms	***Growth in plants***	Cell division and differentiation, elongation (cells increase in length)
	Growth in animals	Cell division and differentiation.

Edexcel GCSE Biology Cells and Control Part 1

Percentile charts can be used to monitor growth

The 50th percentile (bold line) is the median (average) growth of the population at that age. Half will be below and half above.



how a cell changes and becomes **specialised** so that different cells can carry out different functions.

Cell differentiation

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

Undifferentiated cell of an organism

STEM CELLS

Human Embryonic stem cells	***Can be cloned and made to differentiate into any cell type***	Therapeutic cloning of stem cells to produce new tissue uses same genes so the body does not reject the tissue. Can be a risk of infection
Adult stem cells	***Can form into surrounding human cells e.g. blood cells***	Tissue made from adult stem cells 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

Half Term 5&6

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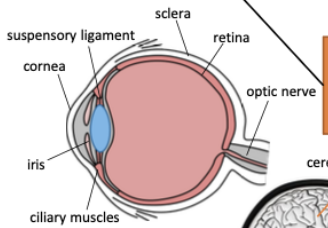
Sense organ containing receptors sensitive to light intensity and colour

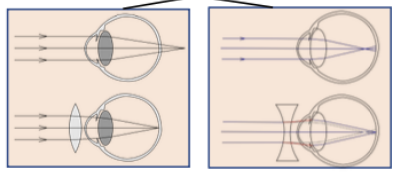
Edexcel GCSE Biology Cells and Control Part 2

The Eye

Structures of the eye	
Retina	Light sensitive cell layer made of rod (light intensity) and cone (red, green, blue colour perception) cells.
Optic nerve	Carries impulse to brain.
Cornea	Transparent layer that covers the pupil and iris.
Iris	Controls size of pupil and the amount of light let in the eyes
Lens	Changes thickness to refract and focus light onto the retina.



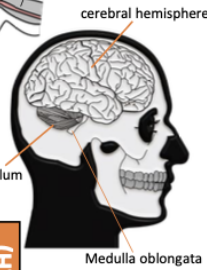
Hyperopia (long sightedness)	*Myopia (short sightedness)*
Lens can not be made thick enough. Treated using a convex lens so the light is focused on the retina.	Lens too thick. Treated using a concave lens so light is focused on the retina.



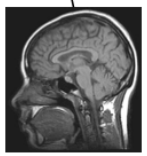
Cataracts are caused by protein build up in the lens blocking light entering the eye. They can be removed with surgery and an artificial lens inserted.

Colour blindness is when cones in the retina do not work properly and some colours cannot be detected.

The Brain



Neuro-scientists have been able overcome difficulties of accessing brain tissue in the skull using CT and PET scanning

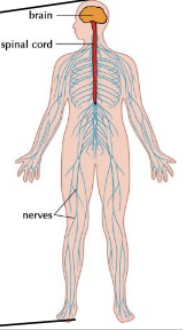


(HT) The complexity and delicacy of the brain makes treating brain tumours/spinal injuries very difficult

The brain controls complex behaviour. It is made of billions of interconnected neurones.

The brain has different regions that carry out different functions.	
Cerebral hemispheres	Largest part of the human brain. Higher thinking skills e.g. speech, decision making.
Cerebellum	Balance and voluntary muscle function e.g. walking, lifting.
Medulla oblongata	Involuntary (automatic) body functions e.g. breathing, heart rate.

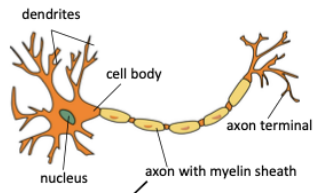
The human nervous system



Structure and functions	
Sensory receptor	Detect stimuli e.g. Pressure cells in skin
Sensory neurone	Long axon carries impulse from receptor to spinal cord.
Synapse	Gap where neurones meet. Chemical message using neurotransmitter.
Relay neurone in CNS	Allows impulses to travel between sensory and motor neurones in the spinal cord.
Motor neurone	Long axon carries impulse from receptor to effector.
Effector	Muscle or gland that carries out response.

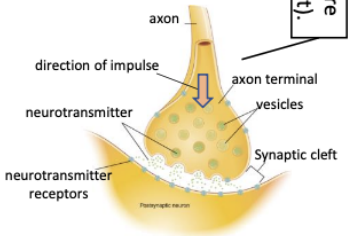
(HT) Adult stem cells cannot be differentiated to form neurones in the spinal cord and brain to repair damage/disease

Neurone structure	
Axon	Carries electrical impulse to axon terminals.
Dendron	Carries electrical impulse from receptor cells in sensory neurones.
Myelin sheath	Insulates the electrical impulse in the neurone.



Typical motor neurone

Synapse (gap where two neurones meet).



Information from receptors passes along cells (neurones) as electrical impulses to the central nervous system (CNS)

The CNS is the brain and the spinal cord.

Reflex actions are automatic and rapid; they do not involve the conscious part of the brain and can protect humans from harm.

Stimulus	Touch hot object
⇩	⇩
Sensory receptor	Cells in skin
⇩	⇩
Relay neurone in CNS	CNS
⇩	⇩
motor neurones	Muscles connected to arm
⇩	⇩
Response	Hand moves away