Biology Paper 2 Revision

<u>Paper 2 topics:</u>

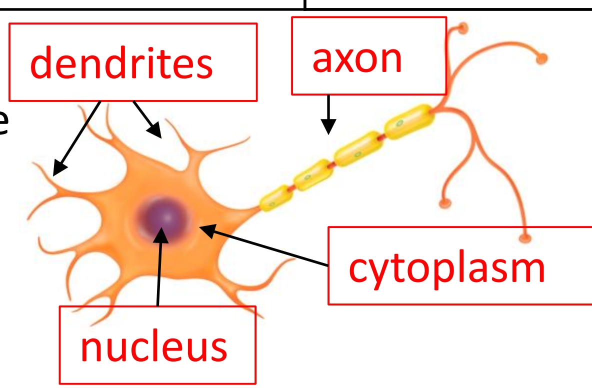
- Homeostasis
- Inheritance
- Variation & Evolution
- Ecology
- Human Impact
- Food Production

Homeostasis

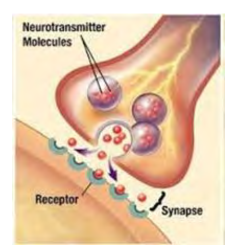
- Regulation of the internal conditions (in a cell or organism) to maintain optimum conditions for function in response to internal and external changes.
- Nervous or Chemical – all systems have:
- Receptors? Detect stimuli
- Coordination centres? e.g. Brain, spinal cord and pancreas
- Effectors? Muscles or glands

Part of the nervous system	Function	Examples:
Receptor	Groups of specialised cells that can detect stimuli from the environment.	Pain - skin Temperature - skin Pressure - skin Chemicals – tongue and nose Light – eye Sound - ear
Neurone	Transmits electrical impulse	Sensory Relay Motor
Coordinator	Receive and process information from receptors.	Brain Spinal cord
Effector	Carries out a response	Muscle (contracts) Gland (secretes hormone)

Label the neurone



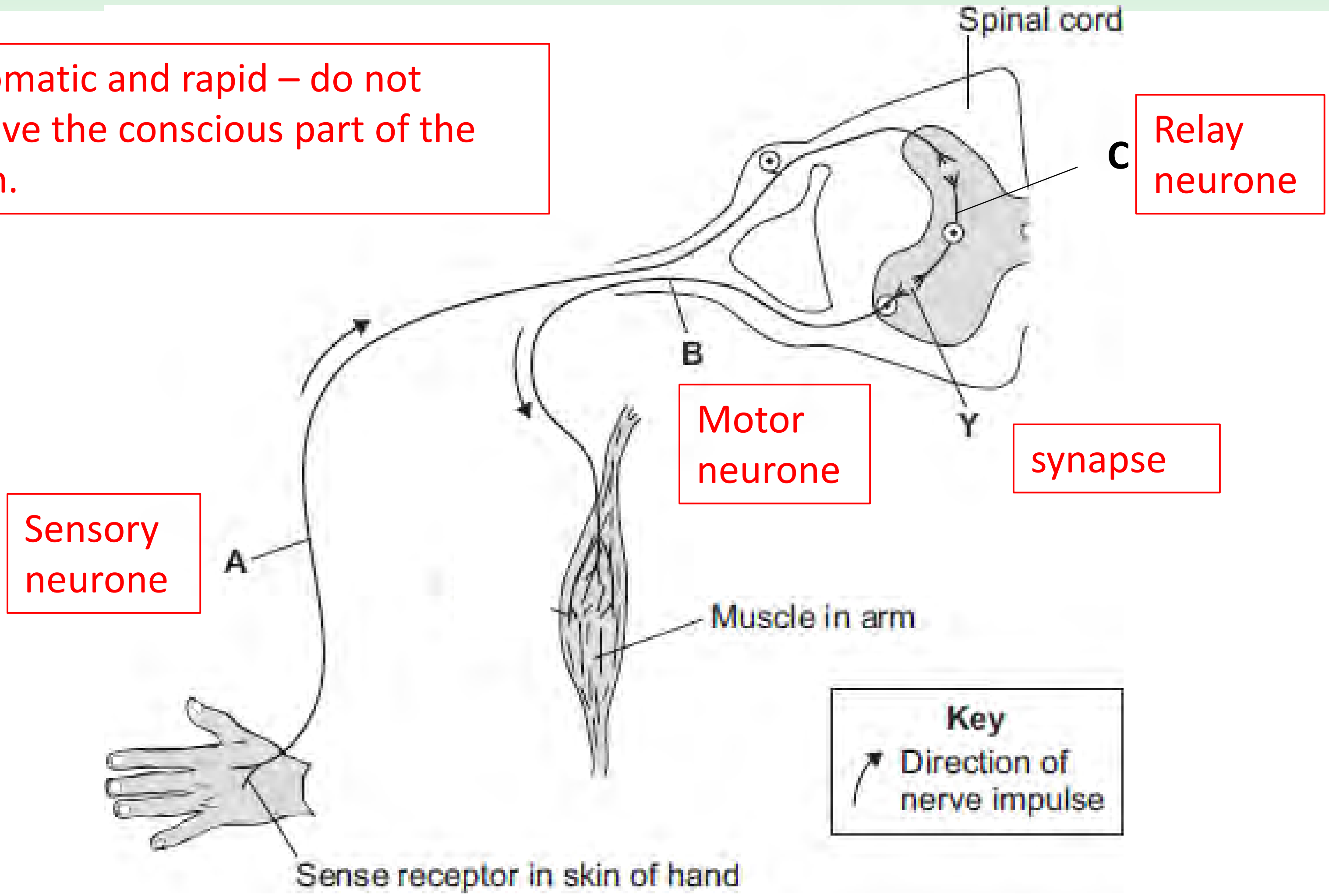
What is a synapse?



Gap between neurones. Chemicals diffuse across the gap

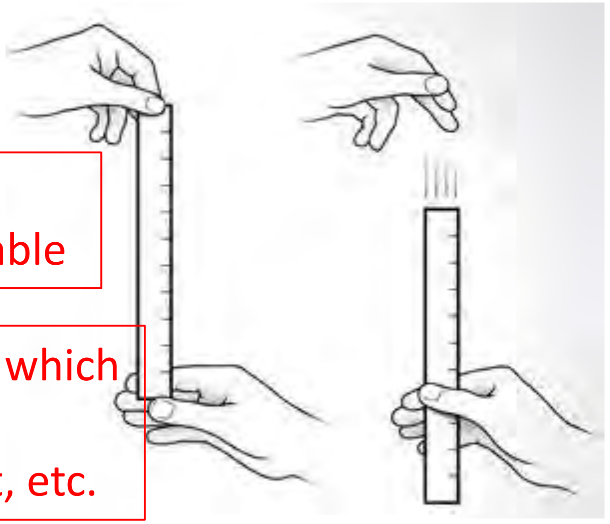
Reflex actions

Automatic and rapid – do not involve the conscious part of the brain.



Required Practical: Reaction Time

Independent variable – could investigate e.g. age of participant, dominant/weaker hand, effect of caffeine etc.



Dependent variable? Distance ruler falls in cm. Can convert to reaction time in ms using a conversion table

Control variables? Distance between finger and thumb. Way in which the ruler is dropped.
Posture of participant, position of their wrist, etc.

What were the problems with this method?

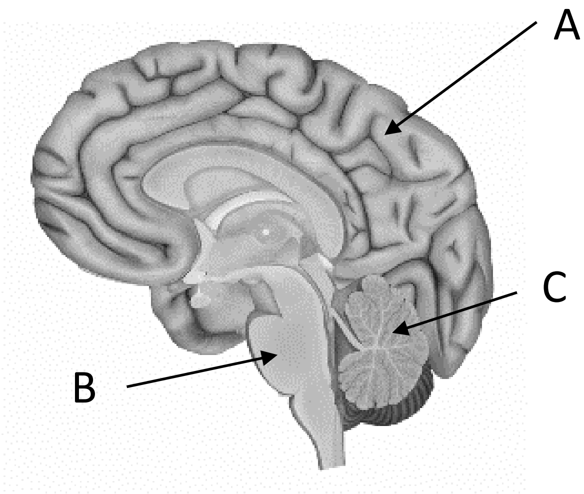
- Not very accurate – human error – e.g. don’t always drop in exactly the same way, difficult to keep finger and thumb exactly the same distance apart
- Can guess when your partner is about to drop, so can cheat

Why would be a computer program be better? (e.g. pushing a button when you see a word appear)

- More accurate – removes human error
- More repeatable

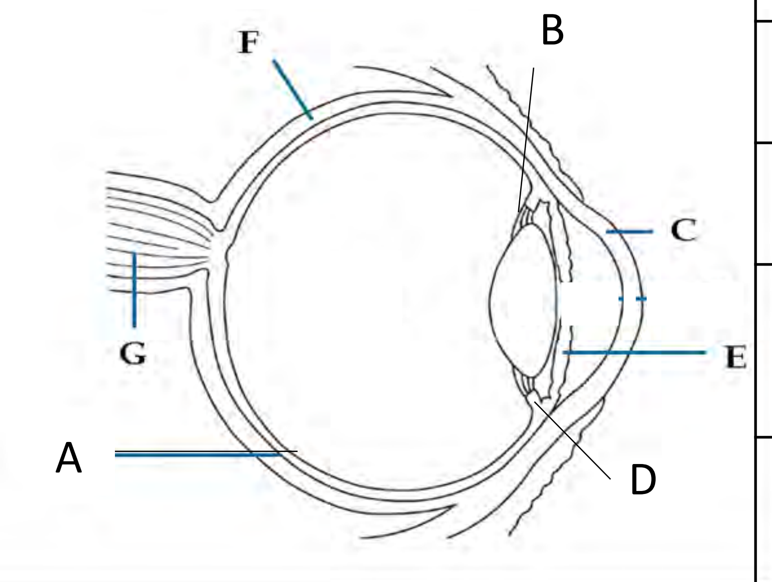
The brain

Name parts A, B and C. What are their functions?



Part	Name	Function
A	Cerebral cortex	• Memories • Consciousness • Intelligence • Language
B	Medulla	Controls unconscious (automatic/involuntary) activities, e.g. heart/ breathing rate, vomiting
C	Cerebellum	Controls and co-ordinates the movement of muscles

The eye

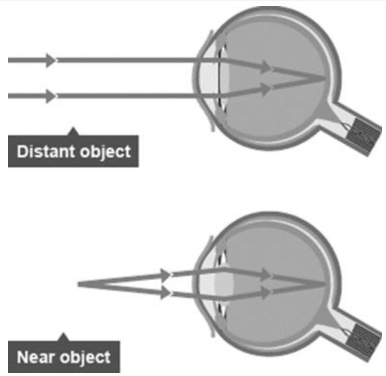


Part	**Name**	How does its structure relate to its function?
A	Retina	Contains many rod and cone cells to detect light
B	Suspensory ligaments	Strong in order to pull lens thin
C	Cornea	Transparent to allow light through. Refracts the light.
D	Ciliary muscles	Contains muscle fibres to contract and relax to change shape of lens
E	Iris	Contains muscle fibres to contract and relax to change size of pupil to control amount of light entering the eye
F	Sclera	Tough outer coating to protect the eye
G	Optic nerve	Contains neurones to carry electrical impulses to the CNS

Accommodation and eye defects

What is accommodation?

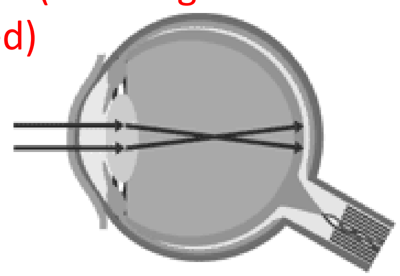
Changing the shape of the lens to focus on near or distant objects



What happens to the…..	Focussing on a near object	Focussing on a distant object
Ciliary muscles	Contract	Relax
Suspensory ligaments	Loosen	Pulled tight
Thickness of the lens	Gets thicker	Pulled thin
Amount the light rays are refracted	Refracts strongly	Only slightly refracts

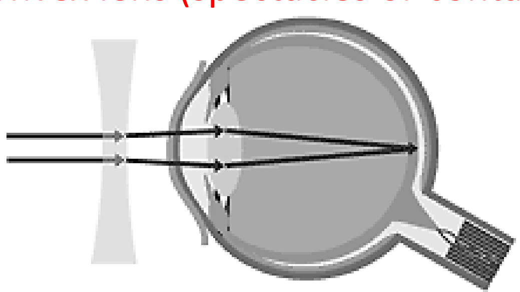
What eye defect is this?

Myopia (short sightedness – distant objects appear blurred)



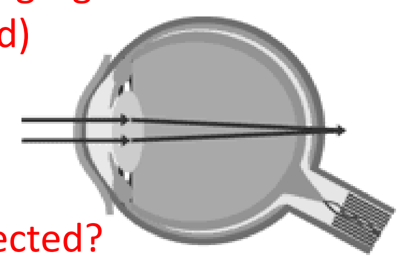
How is it corrected?

Convex lens (spectacles or contact lens)



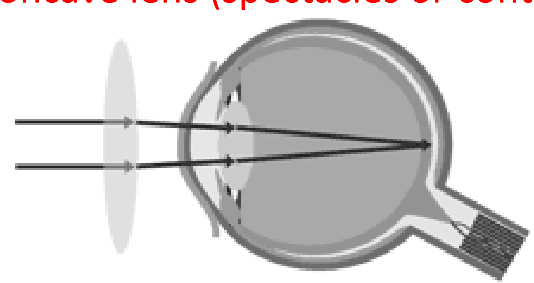
What eye defect is this?

Hyperopia (long sightedness - Close objects appear blurred)



How is it corrected?

Concave lens (spectacles or contact lens)



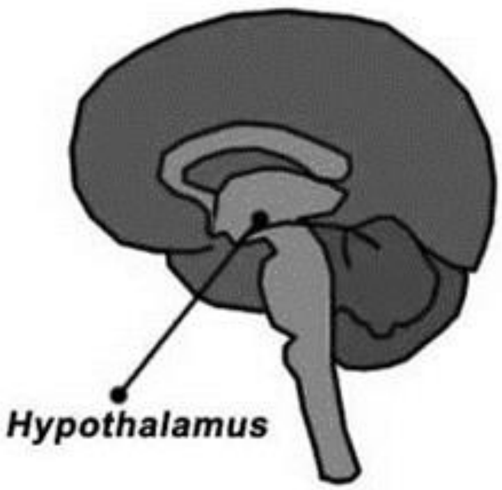
Regulating body temperature

Coordinator?

- **thermoregulatory centre** (TRC) in the brain.

Receptors?

- In TRC - detect **temperature of blood** flowing through the brain
- skin - send information to the TRC about **skin temperature**.



Too hot?

- Blood vessels supplying the skin capillaries dilate (**vasodilation**):

→more blood flows through the capillaries

→ more heat is lost from skin (by radiation)

- Sweat glands release more sweat:

→ cools the body (by evaporation of water)

Too cold?

- Blood vessels supplying the skin capillaries constrict (**vasoconstriction**):

→ less blood flows through the capillaries

→ less heat lost from skin by radiation

- Muscles “shiver” (contract rapidly):

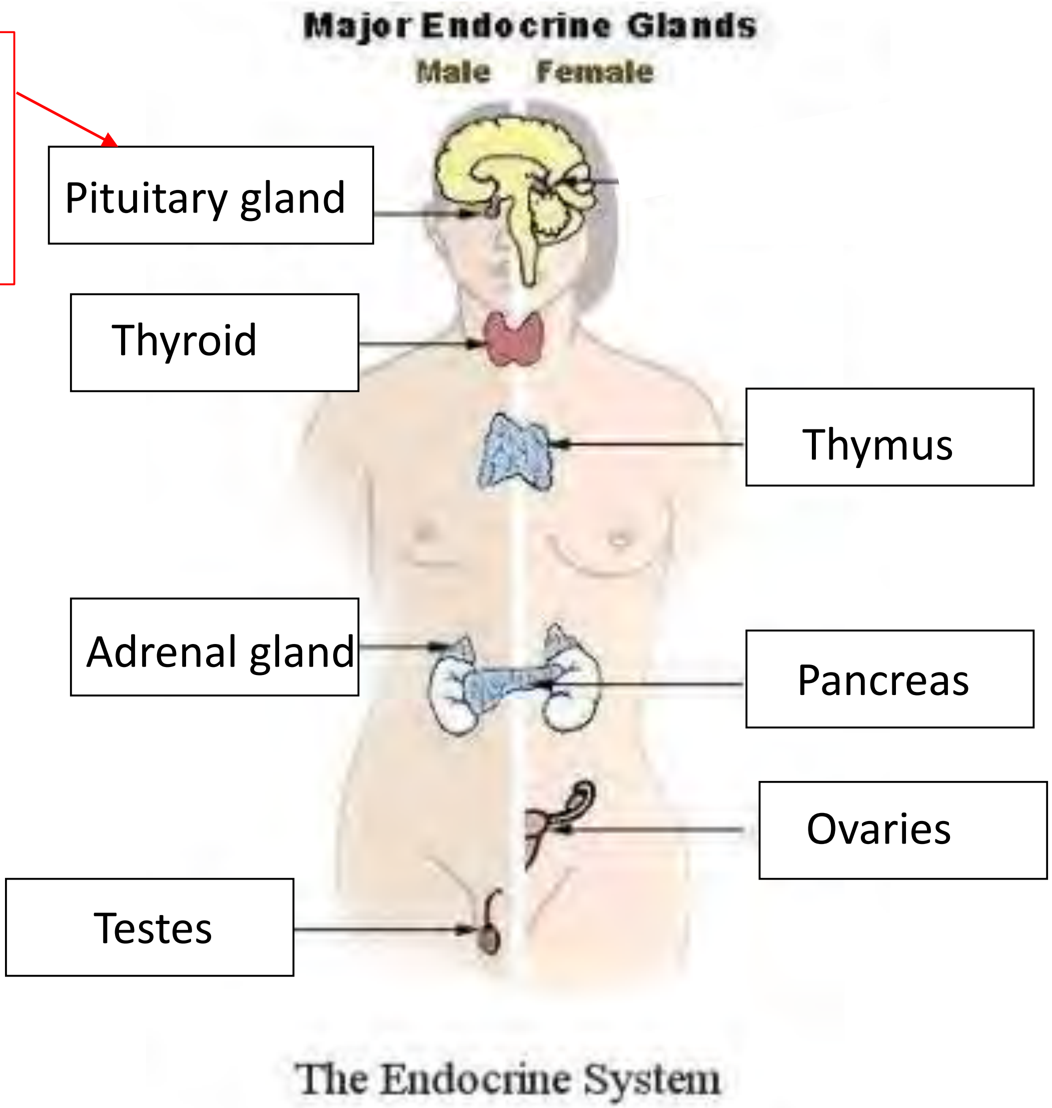
→ muscle contraction needs respiration

→ energy released as heat

What is a hormone?

- Chemical messenger (often a protein)
- Made by a gland
- Travels through the blood stream
- Acts on a target organ to cause a response to happen.

Master gland!
Secretes several
hormones which act
on other glands



Non-hormonal contraceptive? Barrier methods e.g. condom – stops sperm reaching the egg

Hormone	Gland that produces it	Effect
Insulin	Pancreas	Causes liver cells to take up glucose and store as glycogen
Glucagon	Pancreas	Causes liver cells to break down glycogen into glucose and release glucose into the blood.
Adrenaline	Adrenal	Increases heart rate
Thyroxine	Thyroid	Increases metabolism
FSH	...tuitary	Causes egg to mature
LH	...tuitary	Causes egg to be released
Oestrogen	Ovaries	Thickens uterus lining. Stops FSH production
Pr...	...varies	Maintains uterus lining Stops LH production
Testosterone	Testes	Stimulates sperm production

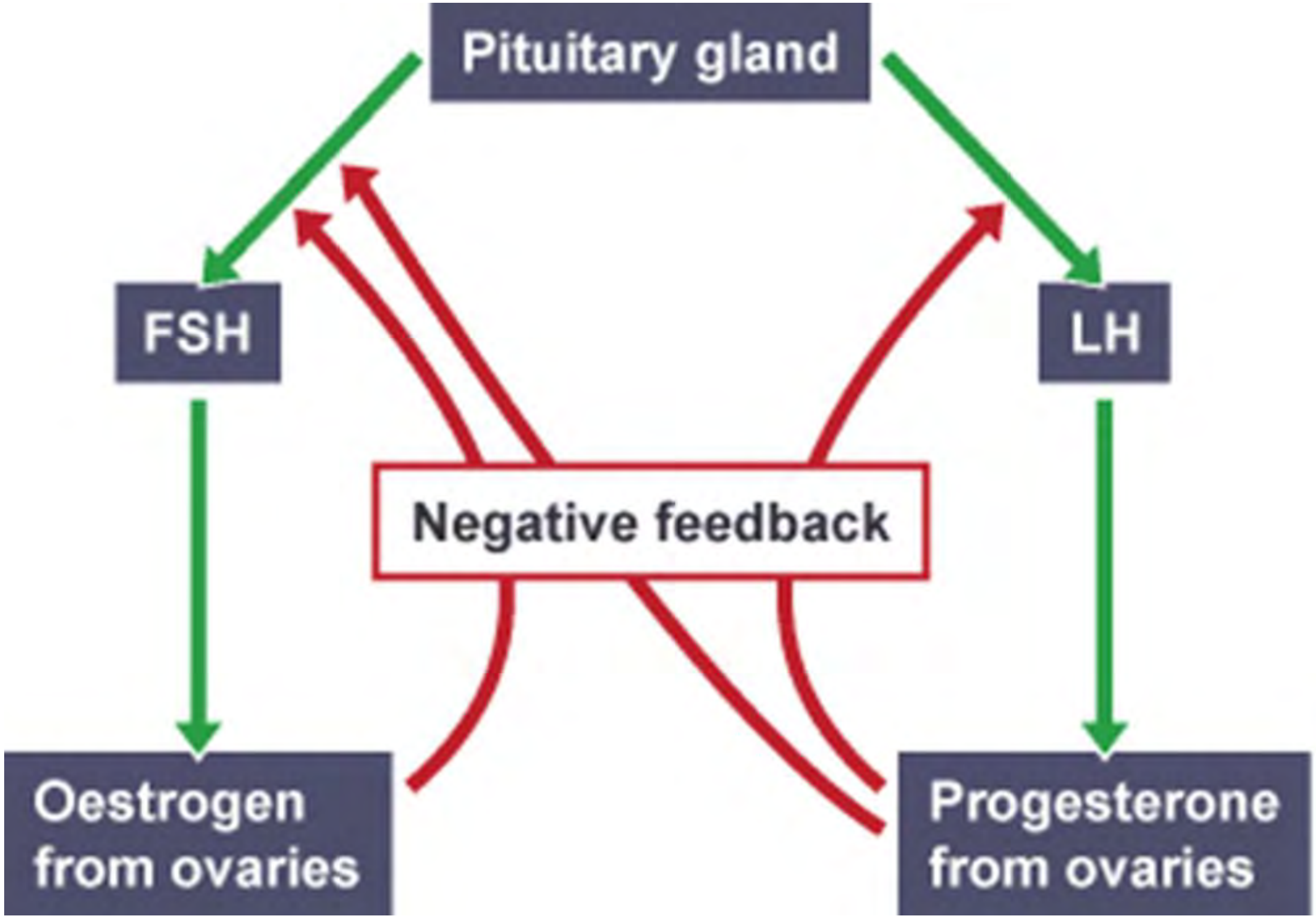
Used in IVF – why?

Causes eggs to mature and be released

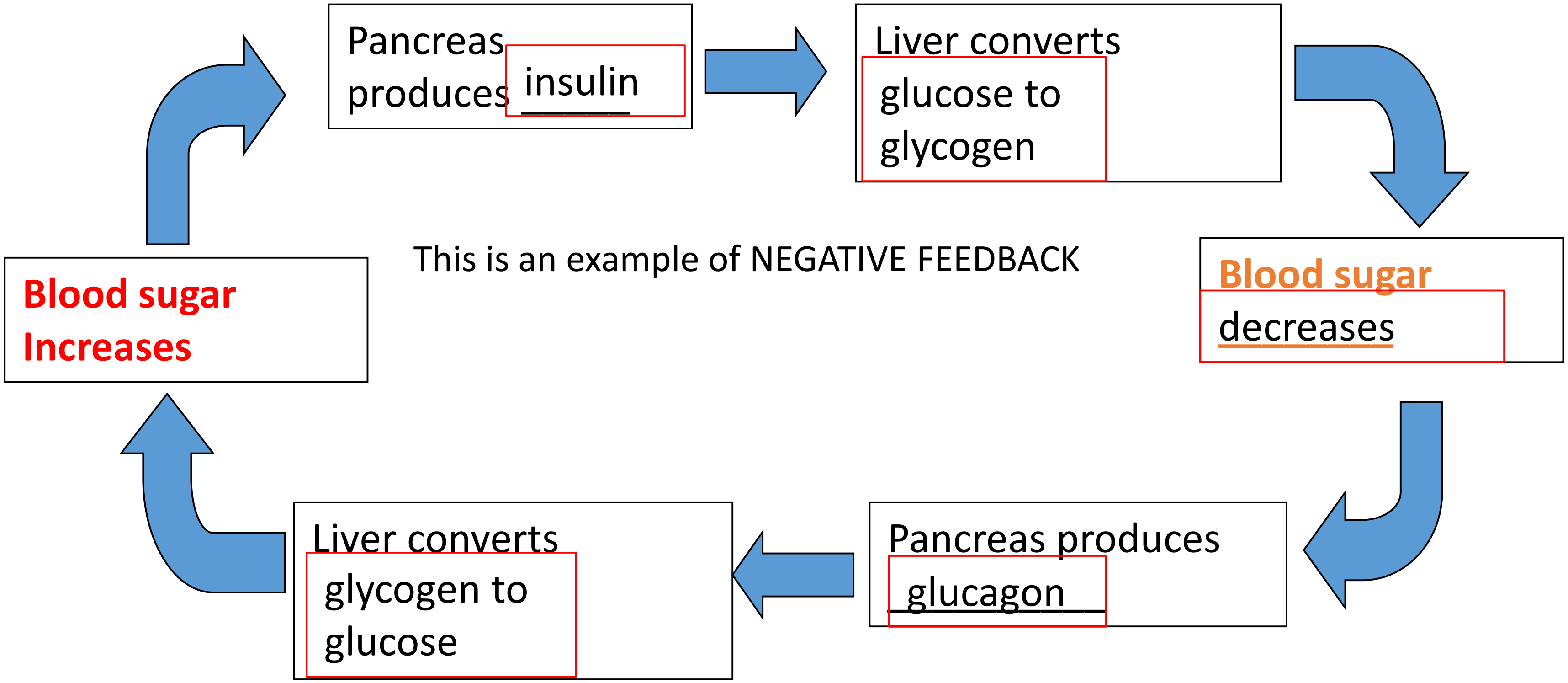
Used in contraceptive pills and implants– why?

Stops eggs maturing and being released

Negative feedback



Controlling blood sugar levels



Type 1 diabetes – what is it? How is it treated?

- Pancreas produces NO or VERY LITTLE insulin.
- Treated with insulin injections

Type 2 diabetes – what is it? How is it treated?

- Body cells don't respond to insulin (risk factor is obesity)
- Treated by a carbohydrate controlled diet and exercise.

Negative Feedback

Body detects a change and makes an adjustment to return it back to normal.

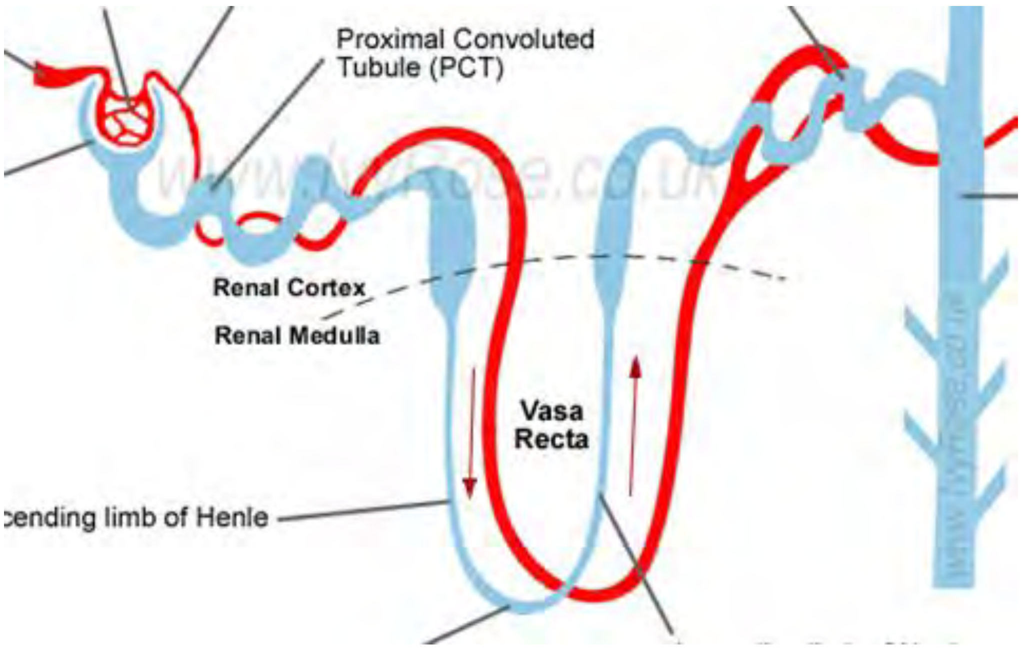
- Body has detected a change (high or low glucose concentration in the blood) and made an adjustment to return it back to normal.

What happens in the kidney

1. Blood plasma is filtered in kidney tubules (High pressure = ultrafiltration)

All small molecules are filtered out - such as?

Glucose, urea, water, mineral ions, amino acids



2. Essential materials selectively reabsorbed back into blood (all glucose, some ions, some water)

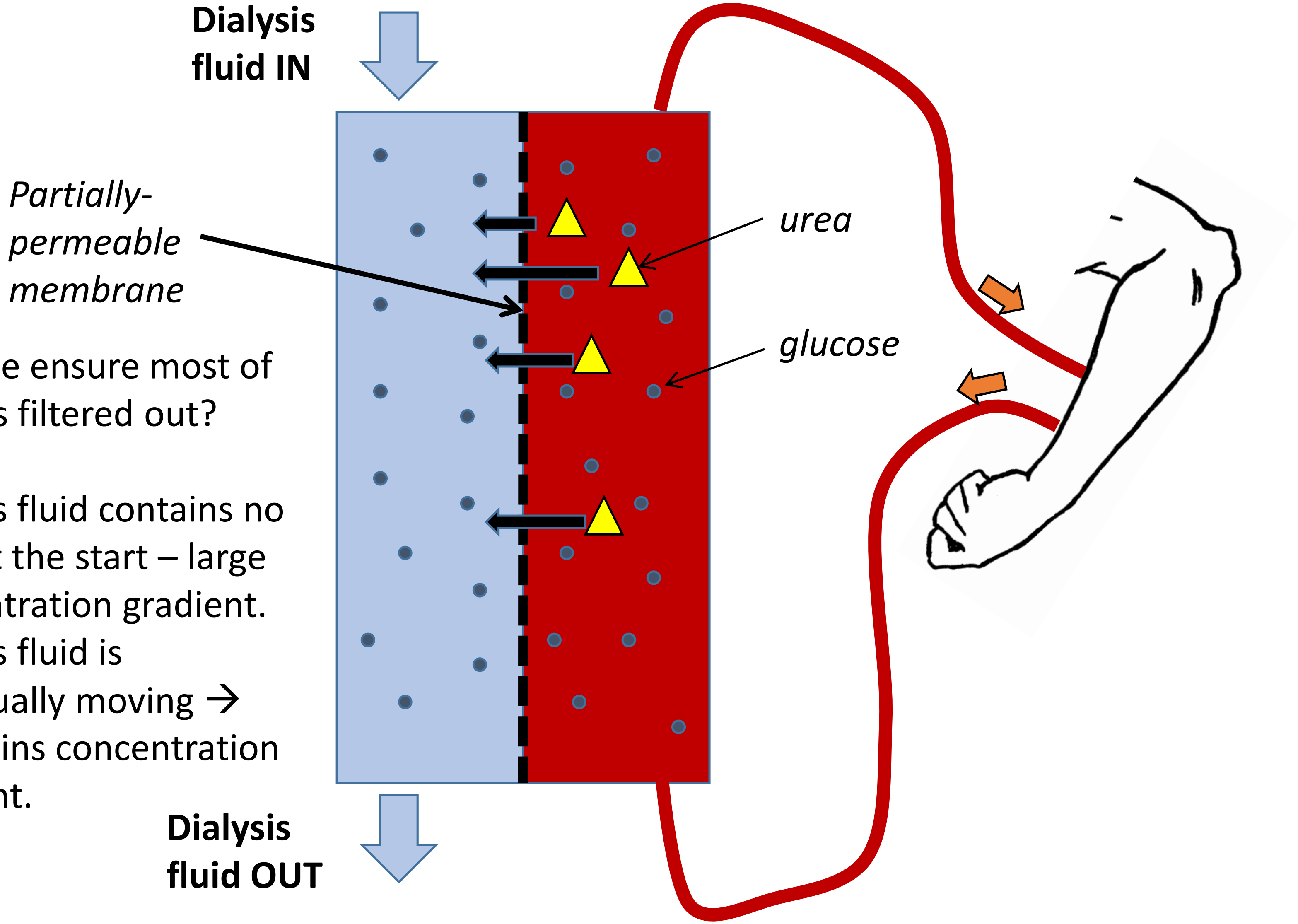
3. Waste Products excreted into urine (urea, excess ions and water)

Where and how is urea produced?

In the liver

Excess amino acids are deaminated → ammonia → urea

Dialysis



How do we ensure most of the urea is filtered out?

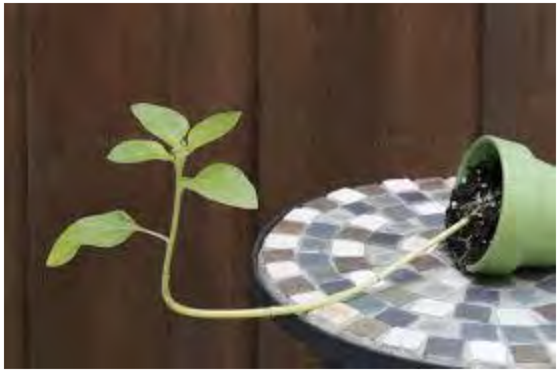
- Dialysis fluid contains no urea at the start – large concentration gradient.
- Dialysis fluid is continually moving → maintains concentration gradient.

Transplant vs Dialysis

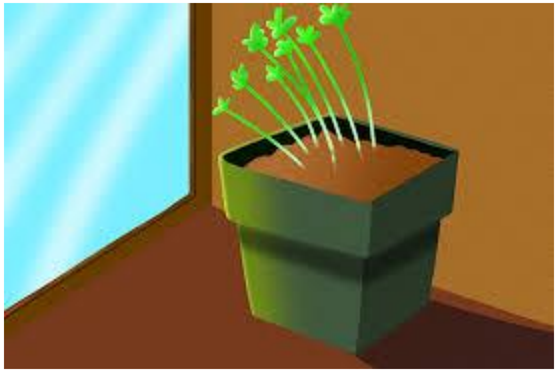
Transplant	Dialysis
transplant is (usually) permanent (although may need to be replaced)	dialysis only short term – repetitive treatment
kidney works all the time	dialysis intermittent
Concentrations in blood kept more or less constant	Substances build up in blood between dialysis sessions – can cause poisoning/ damage to body
can eat or drink without constraint with transplant	social point – inconvenience of dialysis
Hazards of operation for transplant May be rejected - need to use immunosuppressant drugs	Risk of blood clots with dialysis
susceptible to other infections	Danger of infection / damage to blood vessels by needles
high <u>initial</u> cost	long term expense of dialysis / excessive use of health service resources
shortage of donors	

Plant hormones

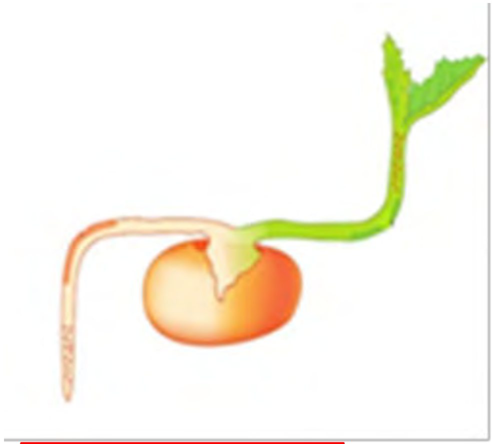
- Which tropism is demonstrated in each picture?



gravitropism



phototropism



gravitropism

- Which hormone is responsible? How does it carry out this response?
- Auxin. Unequal distributions of auxin cause unequal growth rates in plant roots and shoots.

	Meiosis
Where?	
Chromosome number of daughter cells	
DNA replication?	
Number of Divisions	
Genetic Variation	
Purpose?	

Reproduction

	Sexual reproduction	Asexual reproduction
Type of cell division	Meiosis –makes gametes (egg & sperm, egg & pollen).	Mitosis
Variation?	Yes – mixing of genetic info from 2 parents.	No – clones are produced.
Advantages	• variation in the offspring • If the environment changes, variation gives a survival advantage by **natural selection.** • Humans can speed up natural selection using **selective breeding.**	• No need to find a mate (only one parent needed) – energy and time-efficient. • Rapid (e.g. plant can spread quickly to out compete other plants) • Can produce lots of identical offspring when conditions are favourable.

Reproduction



Organisms that reproduce by both methods?

Fungi

- asexually - spores
- sexually - to maintain variation

Many plants

- asexually -runner (strawberries) or bulb division (daffodils)
- sexually – seeds

Malarial parasites:

- Asexually – in liver and blood stream of human host.
- Sexually - in the digestive tract of mosquitos.

Mendel

What experiments did he carry out?

- Crossed pure breeding pea plants together, observed characteristics of first and second generation offspring.

What did he conclude?

- Inheritance of each characteristic is determined by ‘units’ that are passed on to descendants unchanged.
- Some characteristics are **dominant** over others.

Why were his ideas not accepted at first?

- Most scientists believed in “blended inheritance” – all characteristics passed on.
- No one knew about chromosomes or genes yet.

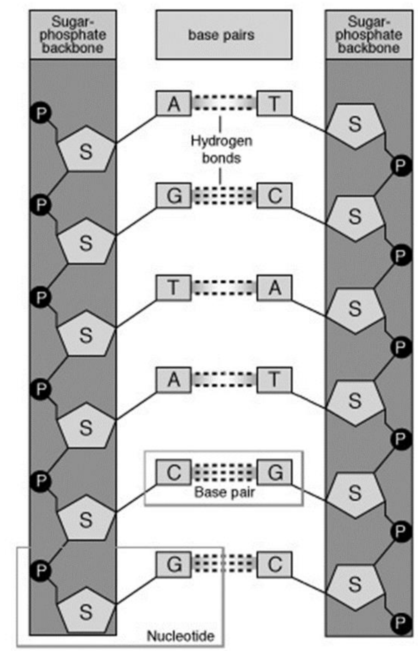
How did later scientists discover inheritance of genetic material?

- Better microscopes were developed → observed behaviour of chromosomes during cell division.

DNA structure

- What is each unit of DNA called?
- What is the structure of DNA described as?
- How many types of base are there? What are they called?
- What structure is the DNA molecule folded into?
- How many bases on DNA code for one amino acid?

- Nucleotide
- polymer of 2 strands bonded together and twisted into a double helix
- 4 – A, T, C and G
- Chromosome
- 3

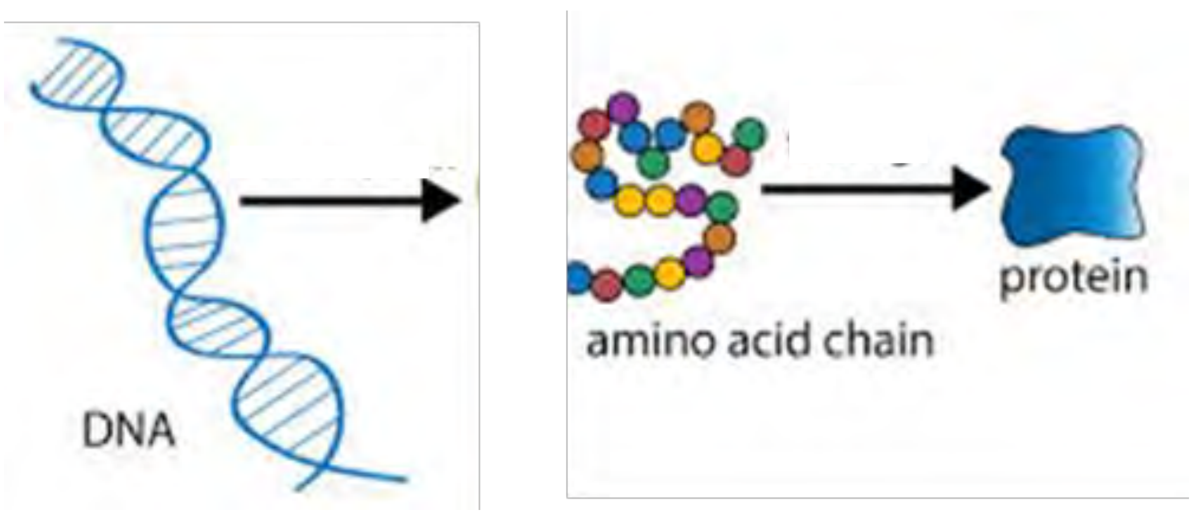


What’s the keyword?

Genome	The entire genetic material of an organism.
Chromosome	A complete length of DNA coiled together that contains several hundred genes. Often in the shape of an X.
Gene	A small section of DNA on a chromosome which codes for a particular sequence of amino acids, to make a specific protein.
Mutation	a permanent change to DNA.
Allele	Different forms of the same gene.
Genotype	What alleles are present.
Phenotype	Expression of genotype. Physical appearance.
Dominant	Allele will always be expressed, even if only one copy is present
Recessive	Allele is only expressed if two copies are present
Heterozygous	Two different alleles for a trait.
Homozygous	Two identical alleles for a trait.

Genotype to Phenotype

- Each gene codes for a particular sequence of amino acids, to make a specific protein.
- Different alleles will code for slightly different proteins.



The Human Genome Project

1. What is the Human Genome Project?
   - Scientists from around the world worked together to identify the entire sequence of DNA in a human. The sequence is stored in a database.
2. What do scientists hope to be able to do as a result of the HGP?
   - Genetic tests to show the likelihood of certain diseases developing.
   - understand and treat genetic disorders
   - trace human migration patterns from the past.

Genetics

- How many chromosomes are there in human body cells?
- How many chromosomes are there in human gametes?
- Is XY male or female?
- What is the likelihood of having a male child?
- Give 2 examples of characteristics that are controlled by a single gene.
- Is the allele for cystic fibrosis recessive or dominant?
- Is the allele for polydactyly recessive or dominant?
- What is embryo screening?

- 46
- 23
- Male
- 1 in 2 or 50%
- colour-blindness in humans (recessive) and fur colour in mice
- Recessive
- Dominant
- Embryo DNA is tested.
- Tests will detect genes for disorders if present.

Cystic fibrosis

- Both parents must have the faulty allele for a child to get the disease
- A parent who has only one faulty allele (heterozygous) is a “carrier”

	C	c
C	**CC**	**Cc**
c	**Cc**	**cc**

What proportion have cystic fibrosis?

25%

Selective breeding

- Briefly describe the process.
  - Choose parents with the desired characteristic, breed together.
  - Breed offspring with the desired characteristic together.
  - Continues over many generations.
- Why do we use selective breeding?
  - Disease resistance in food crops.
  - Animals which produce more meat or milk.
  - Domestic dogs with a gentle nature.
  - Large or unusual flowers.
- Advantages?
  - Increase food production and efficiency.
  - Farmers make more money
  - Used in zoos to prevent species becoming extinct.
- Disadvantages?
  - Reduces the gene pool → species could become extinct if they are not able to fight a particular disease.
  - inbreeding → breed is more likely to get disease or inherited defects.

Genetic Engineering

• What is used to cut out the desired gene from the genome?	• Enzymes
• What is the gene inserted into?	• a vector – e.g. a bacterial plasmid or a virus
• Where does the vector insert the gene into?	• cells of animals, plants or microorganisms at an early stage (e.g. embryo) so they develop with desired characteristics.
• Why might the vector have a marker, e.g. a fluorescent tag?	• Shows which cells have taken up the new gene.
• Advantages	• make drugs and medicines, e.g. human insulin. • GM crops - insert gene to make crop resistant to diseases/insect attack/herbicides, produce bigger better fruits → increased yields → could solve food production problems, e.g. make drought resistant crops, increase nutrient content to prevent deficiency diseases • Insert genes in animals that make them produce less fat • If you have a genetic disorder, add a healthy gene so that you don't get ill
• Disadvantages	• Possible effect on populations of wild flowers and insects. • Concerns that eating GM crops might be harmful.

Cloning

- Give two ways of cloning plants. Advantages/disadvantages of each?

- Give two ways of cloning animals. Advantages/disadvantages of each?

- Taking cuttings – very quick and easy to do.
- Tissue culture – can create thousands of clones, but more specialist equipment needed.
- Embryo cloning – similar principles to selective breeding, but then split the embryo. Doesn't guarantee genetics of offspring (sexual reproduction still involved).
- Adult cell cloning – take DNA from adult body cell, insert into empty egg cell → exact clone of desired animal.

Who’s the scientist?

Darwin	Came up with the theory of evolution by natural selection
Lamarck	Came up with the theory of evolution by acquired characteristics
Alfred Russel Wallace	developed ideas of speciation and that warning colours of animals were advantageous
Linnaeus	Came up with the 5 kingdom method of classification
Woese	Came up with the 3 kingdom method of classification

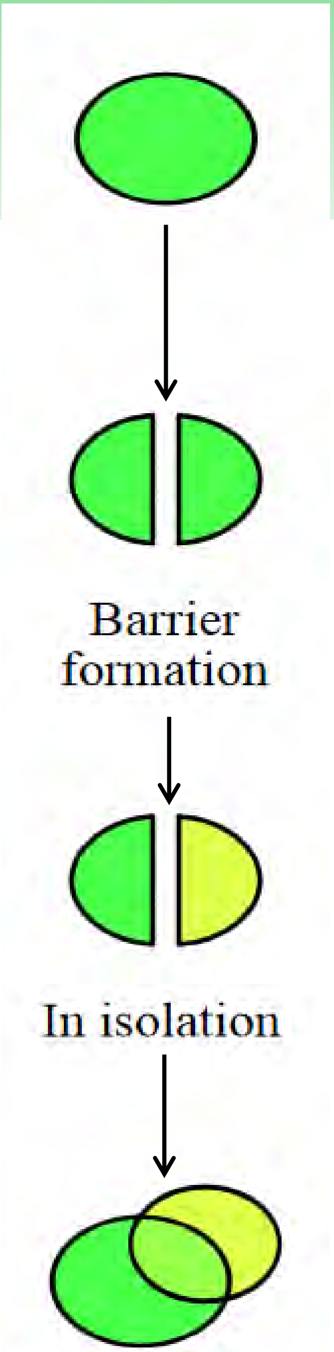
Variation and natural selection

- What are the two sources of variation in phenotype? Give examples of each.
- What does the theory of evolution by natural selection state?
- What are the stages in natural selection?
- What evidence did Darwin have for his ideas?
- What new evidence do we have?

- Alleles (genetic variation) e.g. flower colour
- Environmental variation e.g. seedling height
- All species of living things have evolved from simple life forms that first developed more than three billion years ago.
- Mutation
- Variation
- Competition
- Survival
- Reproduction
- Inheritance of advantageous characteristics.
- Observation of finches on Galapagos Islands
- Discussions with Alfred Russel Wallace who developed similar ideas - speciation
- Fossils show gradual changes in species
- Genetic similarities – DNA sequencing
- Resistant bacteria

Speciation

- A species becomes _isolated______e.g. due to volcanic activity.
- A barrier is formed between the two populations so they cannot meet to breed.
- There is _genetic_ variation between the species.
- Over time in each population natural selection will cause the most _adapted_ individuals to _survive___(_alleles_ that give an advantage are passed on).
- Eventually the differences between the species will become so great that when they meet again they cannot successfully _reproduce_ (cannot breed to produce _fertile_ offspring).



Extinction

- Why aren't scientists certain how life began on Earth?
- Early forms of life were **soft-bodied** → no fossils.
- Define extinction.
- when there are no remaining individuals of a species still alive.
- List 6 causes of extinction
- New diseases
- New predators
- New, more successful competitors
- Global change in climate
- A single catastrophic event – e.g. volcanic eruption, asteroid collision
- Speciation

Fossils

- What are fossils?

The 'remains' of organisms from many years ago, which are found in rocks.

- Why do we study fossils?

To learn how organisms have changed as life developed on Earth.

- How are fossils formed?

<u>Mummification</u>

Conditions mean no decomposition e.g. in peat bogs or glaciers.

<u>Mineral replacement</u>

Sediment layers cover organism. Minerals replace parts as they decay, and turn to stone.

<u>Trace fossils</u>

Moulds and casts made from footprints, burrows, root shapes, droppings.

Classification

Carl Linnaeus

Kingdom **K__________**

Phylum **P__________**

Class **C__________**

Order **O__________**

Family **F__________**

Genus **G__________**

Species **S__________**

Carl Woese

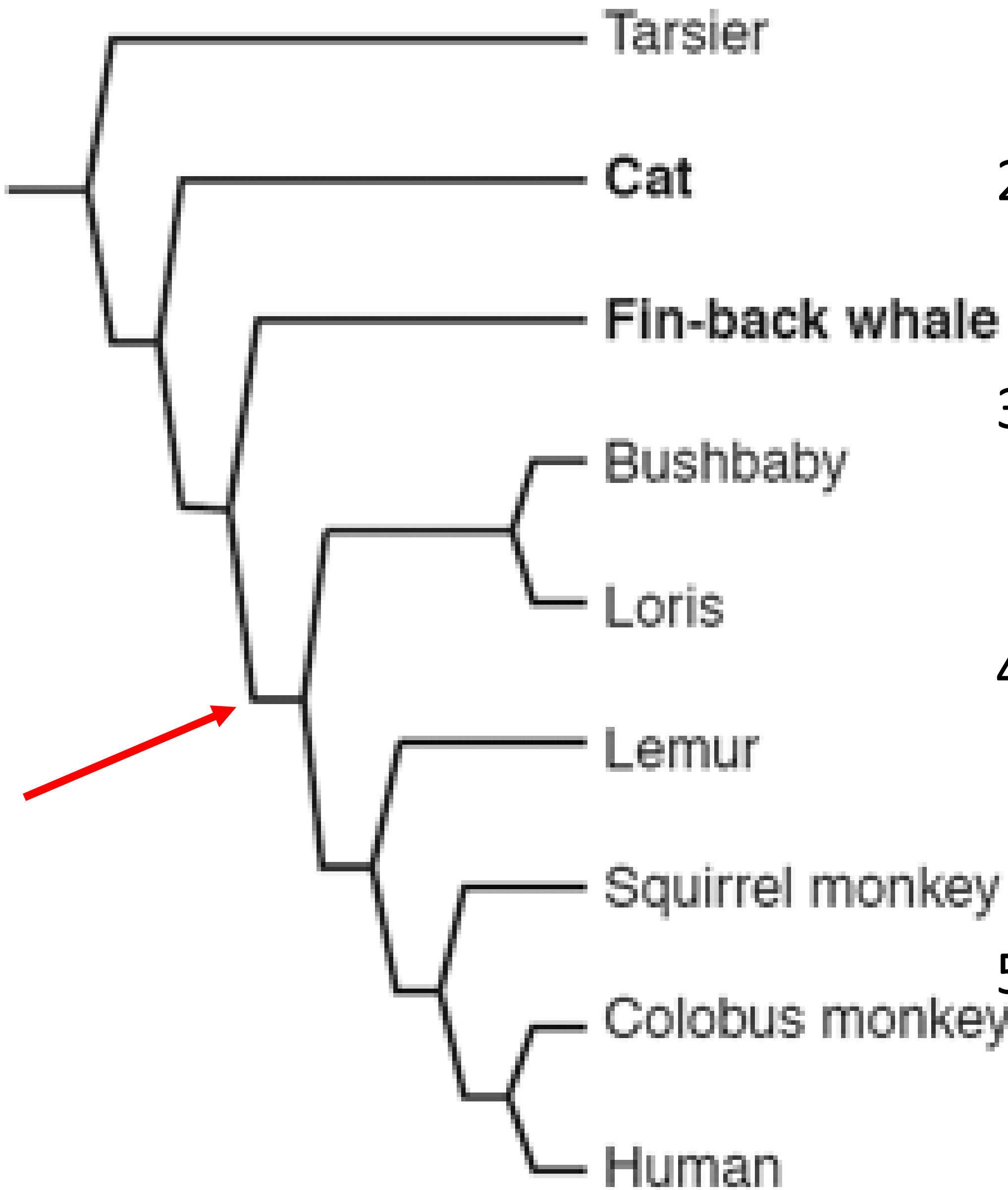
E___________ Eukarya

A___________ Archaea

B___________ Bacteria

What genus is the grizzy bear (scientific name is *Ursus horribilis*)?

ursus



1. What is the closest relative of the human? Colobus monkey
2. What is our most distant relative on this tree? Tarsier
3. What is the Loris most closely related to?

   Bush baby
4. What is the arrow showing?

   Common ancestor
5. What has happened where each branch splits? Speciation

Adaptations?

- Camouflage – colour of fur
- Animals in cold regions have a small surface area:volume ratio to conserve heat
- Fat layer for insulation in arctic fox
- Fur is shorter in desert fox
- Eyes on the front of the head to see prey
- Sharp teeth for ripping flesh

Type of adaptation	Meaning	Example(s)
Behavioural	Responses made by an organism that help it to survive/reproduce	huddling, moving in herds
Structural	A feature of an organism's body that helps it to survive/reproduce	Sharp teeth in a predator, small surface area: volume ratio in arctic animals
Functional	A body process that helps an organism to survive/reproduce	a drop in body temperature during hibernation, camels produce urine with a low water content and don't sweat much.

Abiotic and Biotic factors

- What is an abiotic factor?
- Give some examples.

- non living factors

- Light intensity
- Carbon dioxide levels (plants)
- Oxygen levels (aquatic animals)
- Moisture levels
- Soil pH and mineral content
- Wind intensity and direction

- What is a biotic factor?
- Give some examples.

- living factors

- availability of food
- new predator arriving
- new pathogen
- one species out-competing another

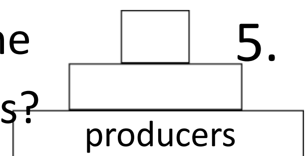
What's the keyword?

Keyword	Definition
Habitat	A place where a community of organisms lives
Community	All the populations of different organisms living and interacting in a place at the same time.
Ecosystem	The interaction of a community of living organisms with the non-living parts of their environment.
Interdependence	Within a community each species depends on other species for food, shelter, pollination, seed dispersal. If one species is removed it can affect the whole community.
Stable community	All the species and environmental factors are in balance so that population sizes remain fairly constant.

Food chains and biomass

Algae → water beetle → frog → kingfisher

1. Which organism is the producer in this food chain?
2. Which organism is the secondary consumer?
3. What do the arrows represent?
4. What is biomass?
5. Why must the producers be on the bottom of the pyramid of biomass?



6. Why is the efficiency of biomass transfer from producers to primary consumers only around 1%?
7. Why is the efficiency of biomass transfer from primary consumers to secondary consumers only around 10%?

1. algae
2. frog
3. Transfer of biomass
4. A quantity of living material
5. Producer is a photosynthetic organism, so makes the organic substances for consumers.
6. Light is reflected, passes through leaf, wrong wavelength, heat loss through respiration
7. Heat loss through respiration, energy losses through movement, faeces, urine

Sampling

What type of sampling would you use to sample the distribution of dandelions in a large field?

random

How would you make sure that your results are:

- Not biased

- Use a random number generator and coordinates on a grid to place quadrats

- Representative

Do enough repeats so that the mean represents the whole area

What type of sampling would you use to sample the distribution of bluebells as you moved from a shaded wood into a sunny field?

transect

What equipment would you need for this investigation?

Tape measure, quadrat, light meter

Decomposition

Which types of organisms carry out decomposition?

Bacteria, fungi

Briefly describe the process of decomposition.

Bacteria excrete enzymes (amylase, protease, lipase) which break down large molecules (starch, proteins, fats). Bacteria absorb the products of digestion by diffusion.

Which factors affect the speed of decomposition?

Temperature, moisture, oxygen

Why is decay important?

Cycles nutrients through an ecosystem

Water cycle

What process, involving plants, releases water vapour into the atmosphere?

transpiration

List ways in which living organisms rely on processes in the water cycle.

Transpiration in plants

Cell hydration in all organisms

as a solvent

in chemical reactions

Carbon cycle

What process in the carbon cycle takes in a carbon compound from the atmosphere and converts it into an organic compound that can be used to build biomass?

photosynthesis

What process releases carbon back into the atmosphere? List the types of organism that carry out this process.

Respiration.

Plants, animals, decomposers

How are carbon compounds moved between trophic levels?

Feeding by consumers

Food production

- What is food security?
- Give 3 biological factors that affect food security.
- What is fusarium?
- What product can we get from it?
- What conditions is it grown in?
- How can the efficiency of food production using animals be improved?
- Why is it important to maintain fish stocks?
- How can we maintain food stocks?

- Having enough food to feed a population.

- Population growth (increasing birth rate)
- New pests and pathogens
- Effects of climate change e.g. widespread famine if rains fail, flooding destroying growing crops.

- A fungus
- Mycoprotein – useful for vegetarians.
- Glucose syrup, Aerobic conditions, Biomass is harvested and purified.

- Limit movement of animals → reduces energy transfer to the environment.
- Controlling temperature of their surroundings → reduces heat loss to the environment.
- Fed high protein foods → increase growth.

- Fish stocks are declining , need to be kept at a level where breeding continues.

- Control net size
- Introduce fishing quotas

Energy losses in free range animals

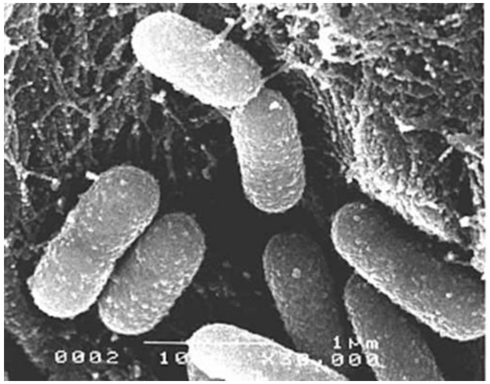
Limit animal's movement → Less energy needed for movement and finding food

Keep animals in warm building → Less energy needed to maintain body temperature

Less energy lost means more food is converted into animal meat (or eggs, milk etc). This makes intensive animal farming more EFFICIENT (although not nice for the animals!!)

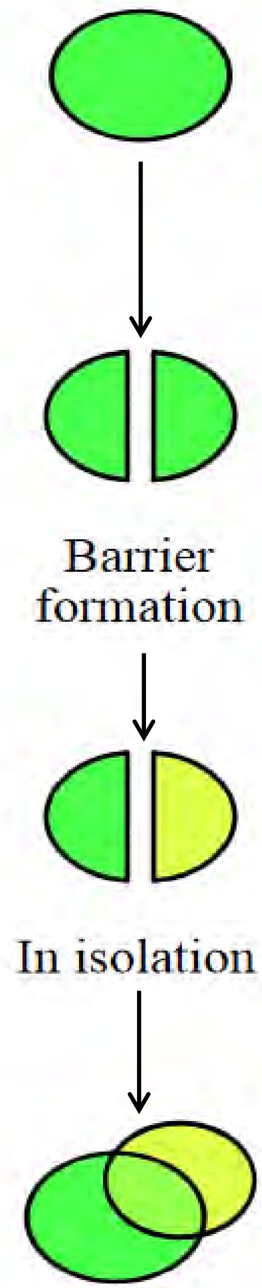
Decomposition by microbes:

- Enzymes released (such as?)
- Material (such as?) broken into smaller molecules (such as?)
- Smaller molecules absorbed (how?)
- What process will microbes be carrying out to allow e.g. active transport to happen?



Speciation

- A species becomes ____________e.g. due to volcanic activity.
- A barrier is formed between the two populations so they cannot meet to breed.
- There is _________ variation between the species.
- Over time in each population natural selection will cause the most ________ individuals to _________(_________ that give an advantage are passed on).
- Eventually the differences between the species will become so great that when they meet again they cannot successfully ____________.



Random sampling

- Why do we need to place the quadrat at several different random sites in the field?

So it is representative of the whole field

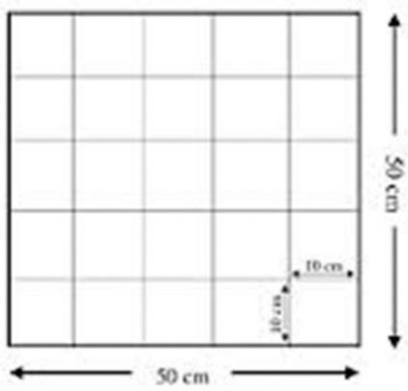
Mean number of daisies per quadrat = 14

- The quadrats were 0.5m by 0.5m. How many of these quadrats could we fit into $1m^2$?

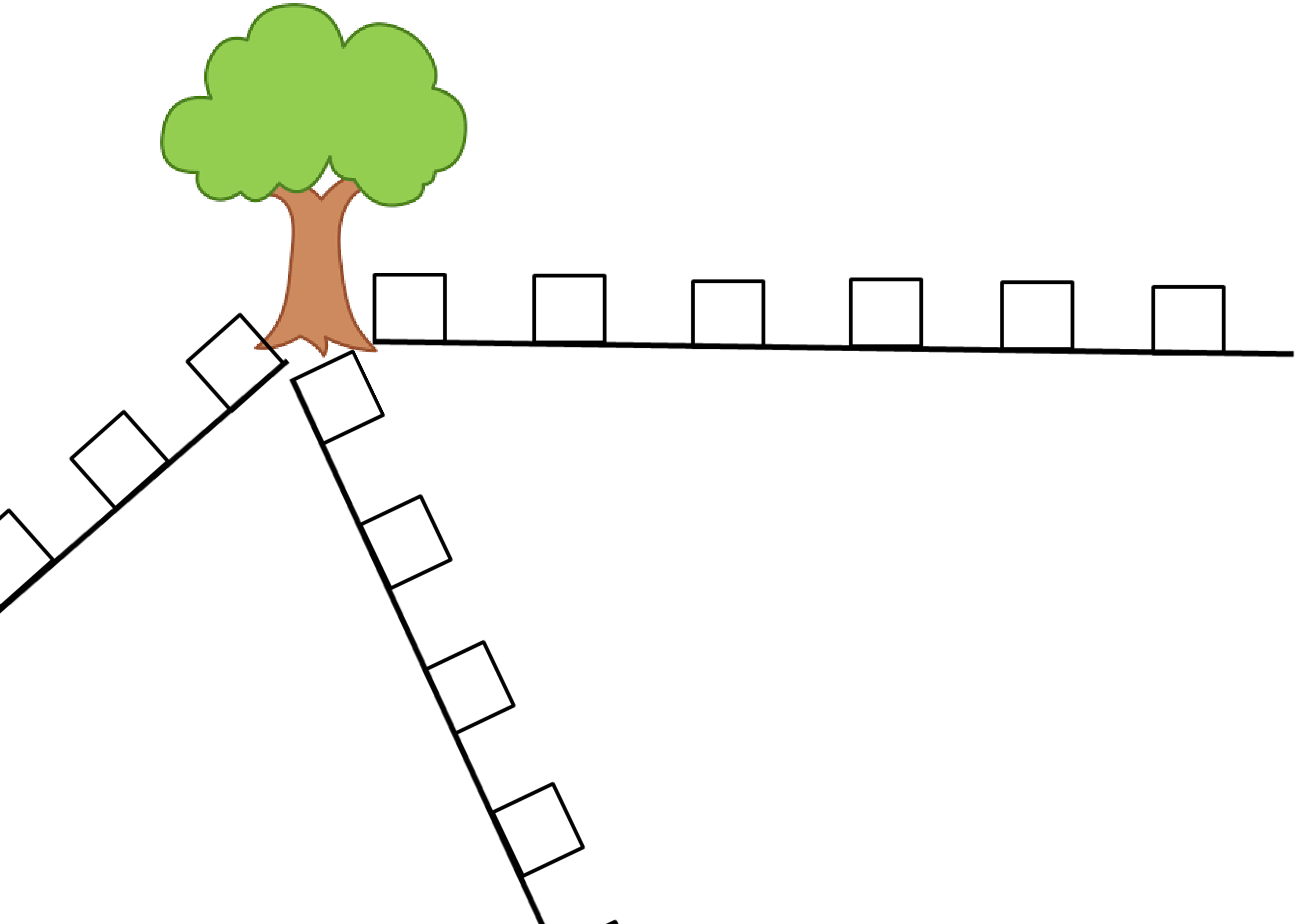
4

- If the field is $334m^2$, use the mean to estimate the abundance of daisies. Give your answer to 3sf.

18,700



Transect sampling



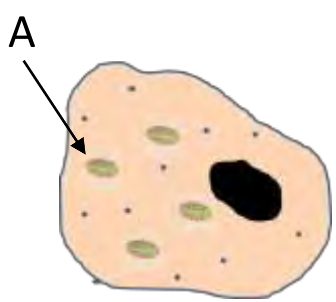
Biology 1 Revision

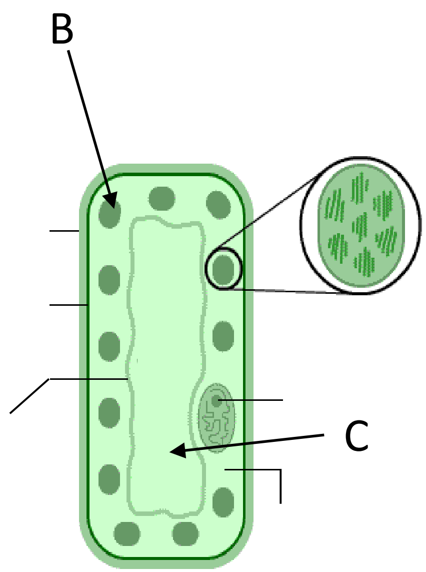
Paper 1 topics:

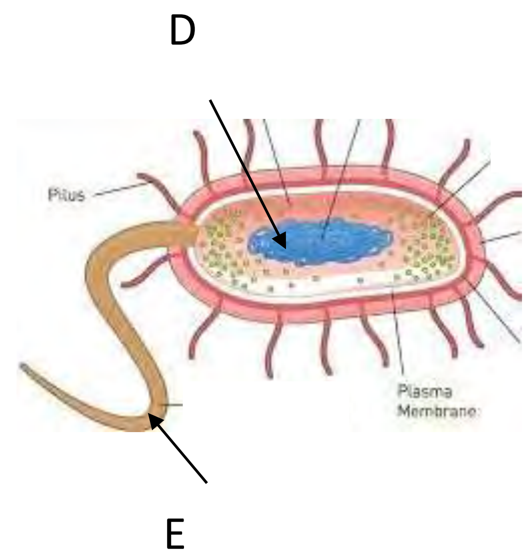
- Cells
- Systems
- Plants
- Disease

Cell structure

- Plant, animal or bacterial? Prokaryote or Eukaryote?
- What are the names of structures A-E?



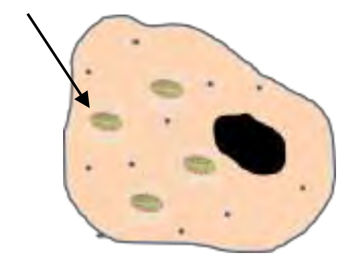




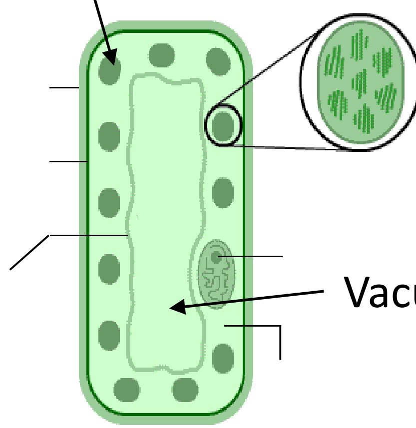
Cell structure

- Plant, animal or bacterial?
- What are the names of structures A-E?

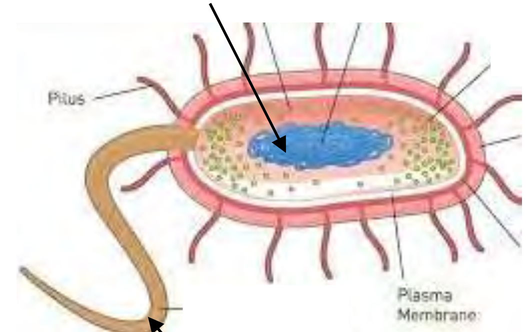
Animal - eukaryote



Plant - eukaryote

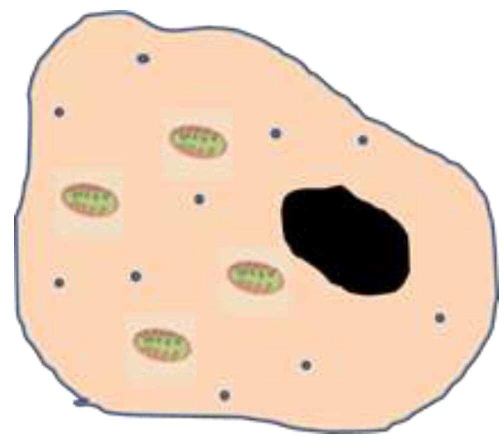


Bacteria - Prokaryote

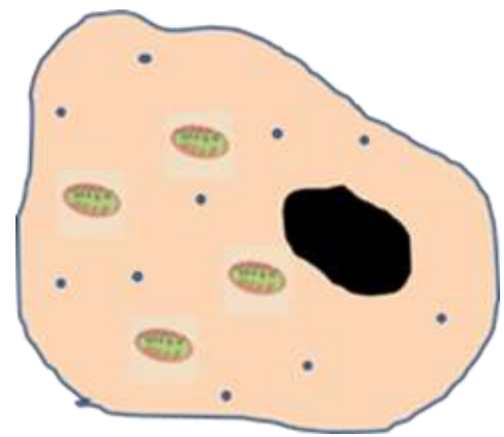


Part	Function	Animal	Plant
Nucleus		✓	✓
	most of the chemical reactions take place here.		
Mitochondria			
	where protein synthesis occurs		
	controls the passage of substances into and out of the cell		
	made of cellulose, which strengthens the cell		
Chloroplasts			
	filled with cell sap.		

What should the blank spaces say?



Part	Function	Animal	Plant
Nucleus	Contains DNA, controls the activities of the cell	✓	✓
Cytoplasm	most of the chemical reactions take place here.	✓	✓
Mitochondria	Site of respiration	✓	✓
Ribosome	where protein synthesis occurs	✓	✓
Cell Membrane	controls the passage of substances into and out of the cell	✓	✓
Cell Wall	made of cellulose, which strengthens the cell	X	✓
Chloroplasts	absorb light energy to make food	X	✓
Vacuole	filled with cell sap.	X	✓



Specialised cells

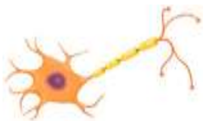
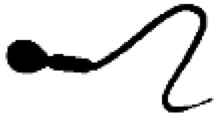
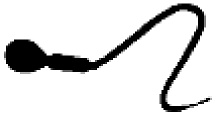
Diagram	Name	Function	Adaptation
		Transmit electrical impulse	
		Transport oxygen	
		Sweep mucus & pathogens away from the lungs	
		Fertilise an egg cell	

Diagram	Name	Function	Adaptation
	Nerve cell	Transmit electrical impulse	Long axon to carry impulse over long distances Many dendrites to make many connections with other cells
	Red blood cell	Transport oxygen	Biconcave shape → large surface area No nucleus so it can contain more haemoglobin
	Ciliated epithelial cell	Sweep mucus & pathogens away from the lungs	Sticky mucus traps dust. Hairs move dirt away from lungs.
	Sperm cell	Fertilise an egg cell	Streamlined shape & tail – can swim to the egg Chemicals in the tip to enter the egg cell.

Microscopes

Which microscope allows us to see mitochondria?

electron

How many micrometres are there in a millimetre?

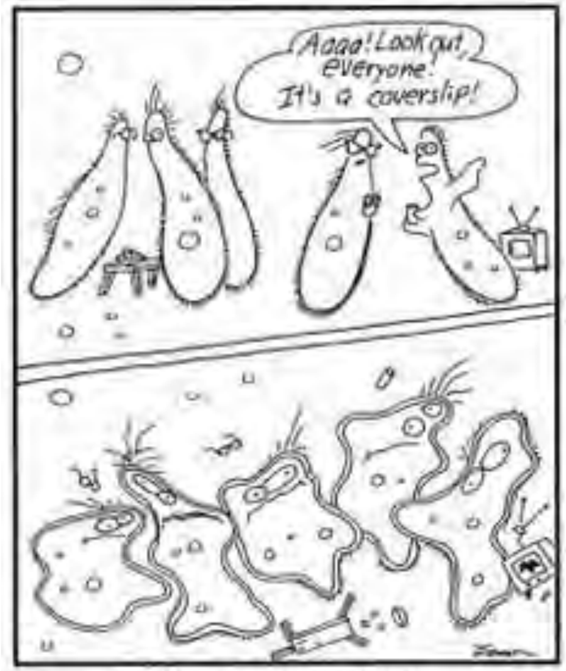
1000

A scientist viewed a picture of a cell, that had been magnified 100,000 times.

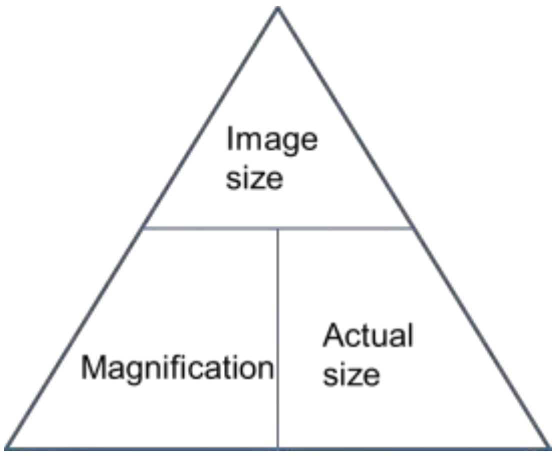
The size of the cell in the image was 25mm.

How large was the actual cell?

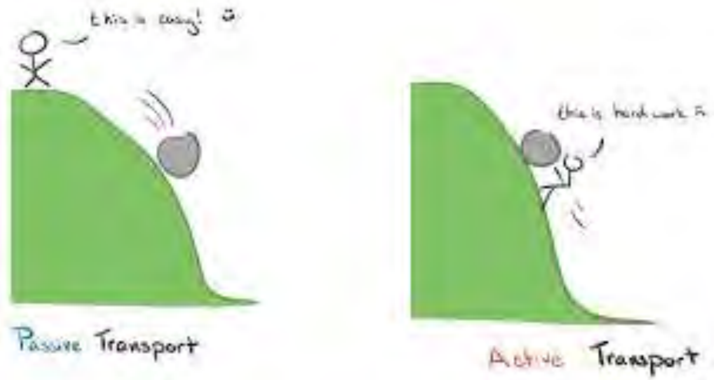
0.25µm



Life on a microscope slide



Exchange of substances



Diffusion, osmosis or active transport?

- Uptake of mineral ions in the soil into root hair cells, against the concentration gradient.

ACTIVE TRANSPORT – requires energy from respiration

- Uptake of water in root hair cells.

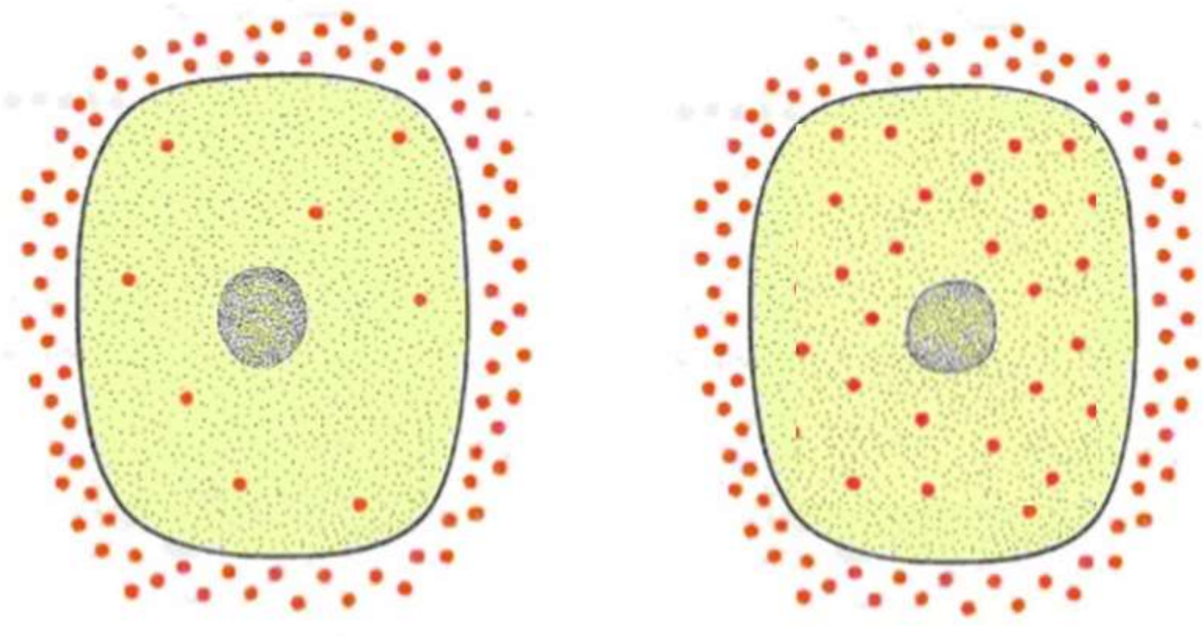
OSMOSIS

- Movement of oxygen and carbon dioxide between alveoli and capillaries.

DIFFUSION – passive, no energy required as it is moving from an area of high concentration to an area of low concentration.

Exchange of substances

- How can we speed up diffusion?
- How is this achieved in the lungs and small intestine?

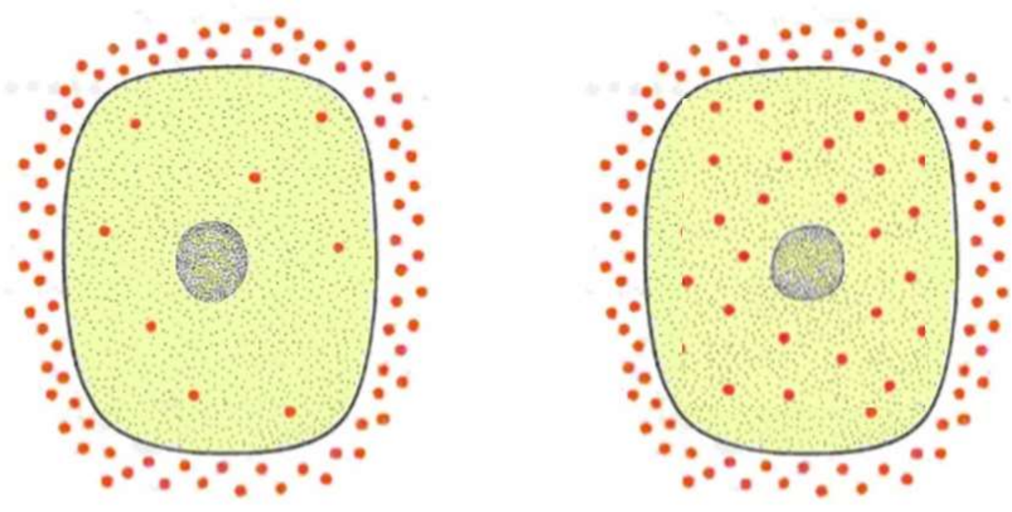


Which cell will have more rapid diffusion of oxygen?

Why?

Exchange of substances

- Many alveoli and villi → Large surface area
- Many capillaries so an excellent blood supply → Steep concentration gradient
- Alveoli and villi both have thin walls → Short diffusion distance

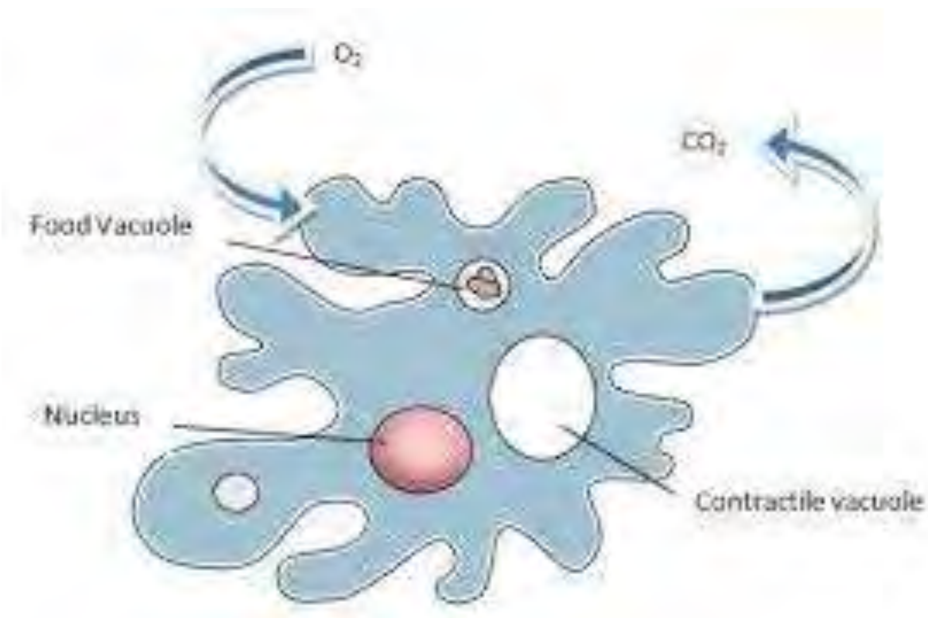


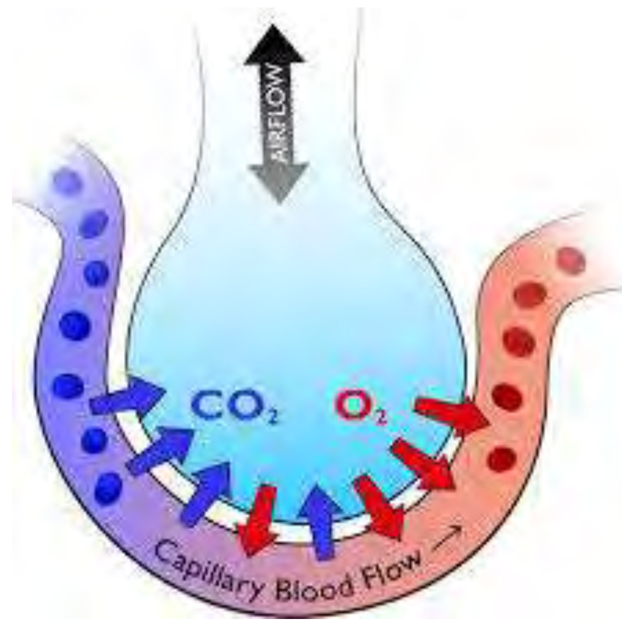
The cell on the left:

There is a steeper concentration gradient so diffusion is faster. This cell is respiring rapidly, so the oxygen concentration inside the cell remains low.

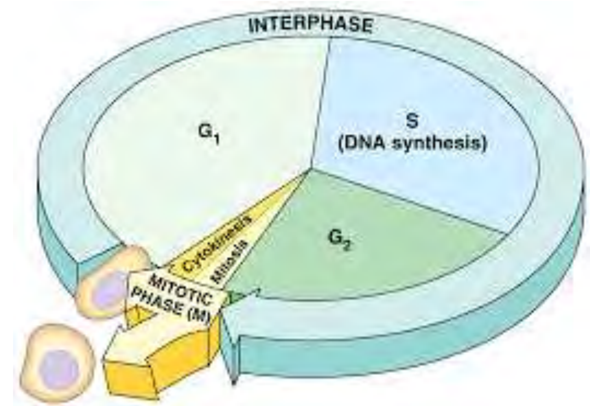
Why do we have lungs?

Multicellular organisms need specialised exchange surfaces – diffusion across the surface would not be sufficient to supply the organism's needs.





Cell cycle

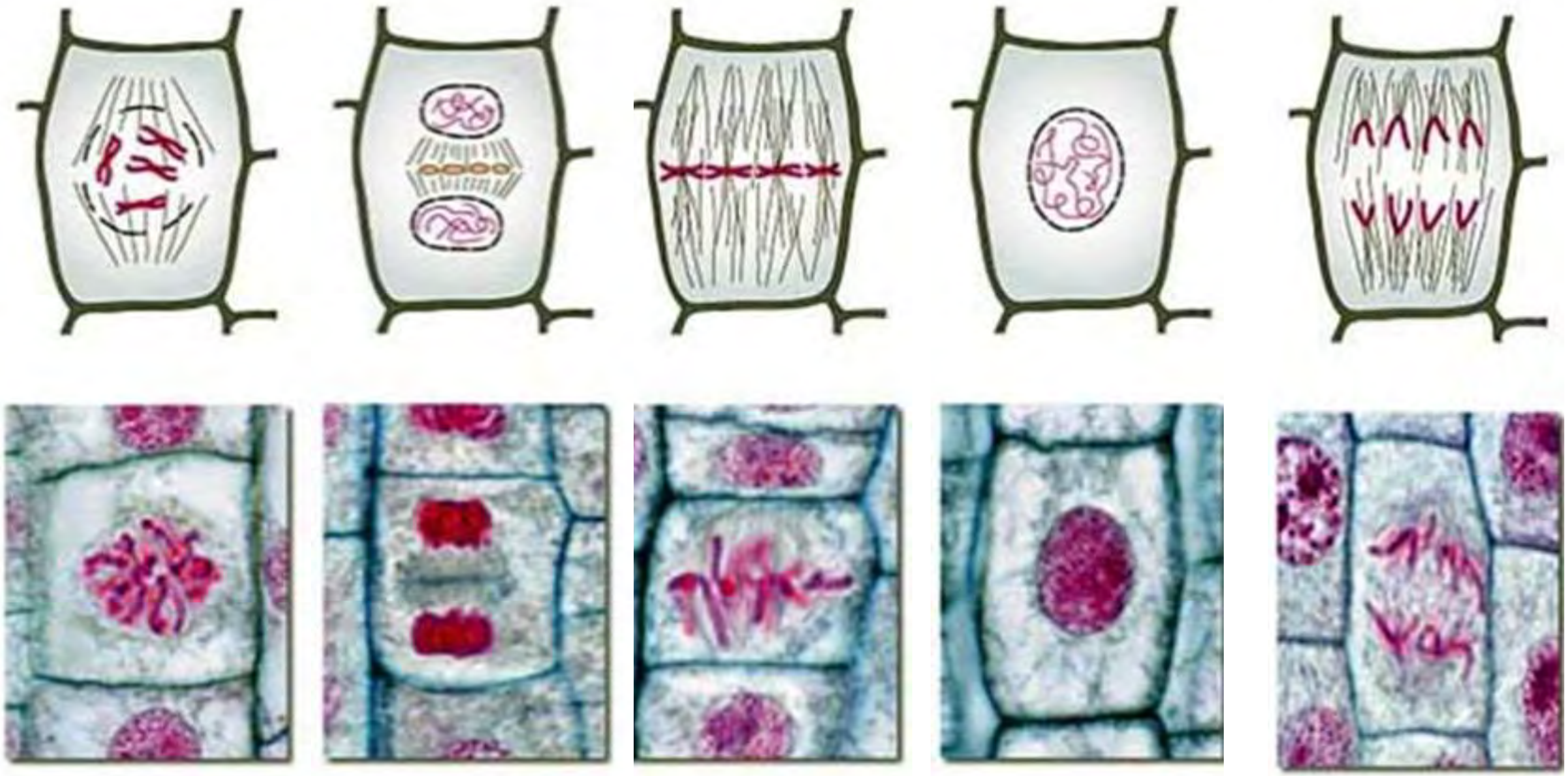


- Main stages
- G1 – growth – new ribosomes, mitochondria
- S – DNA replication
- G2 – more growth, checking for errors
- M – Mitosis – nucleus divides

- What happens at each stage?

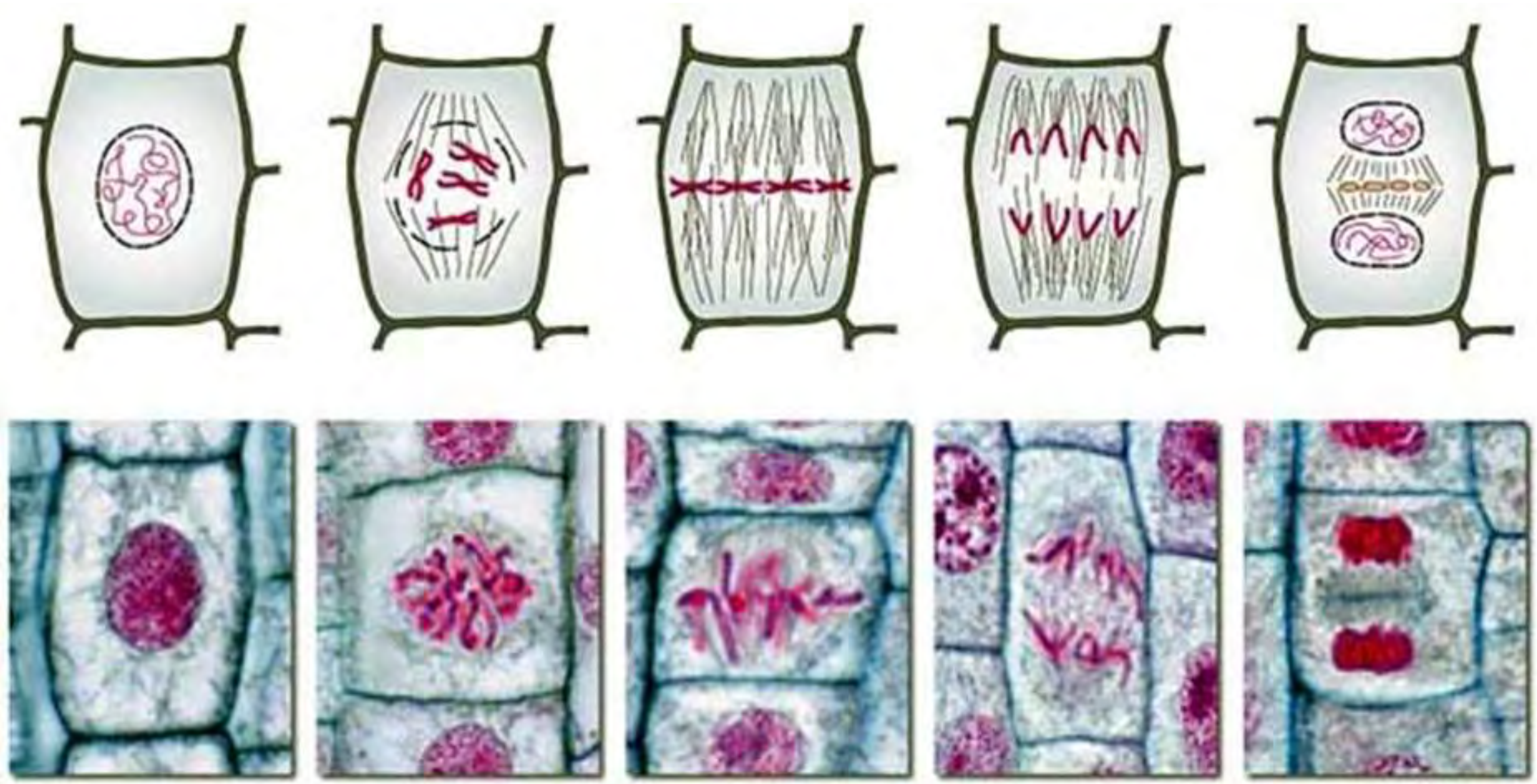
Mitosis – put the stages in order

A **B** **C** **D** **E**

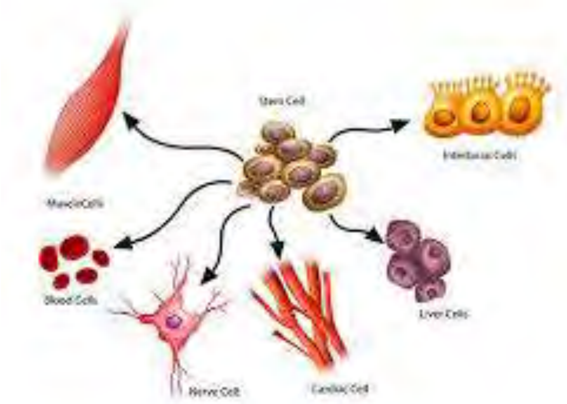


Mitosis

D **A** **C** **E** **B**



Stem cells



- What are they?

Undifferentiated cells, capable of dividing many times and developing into different types of specialised cells

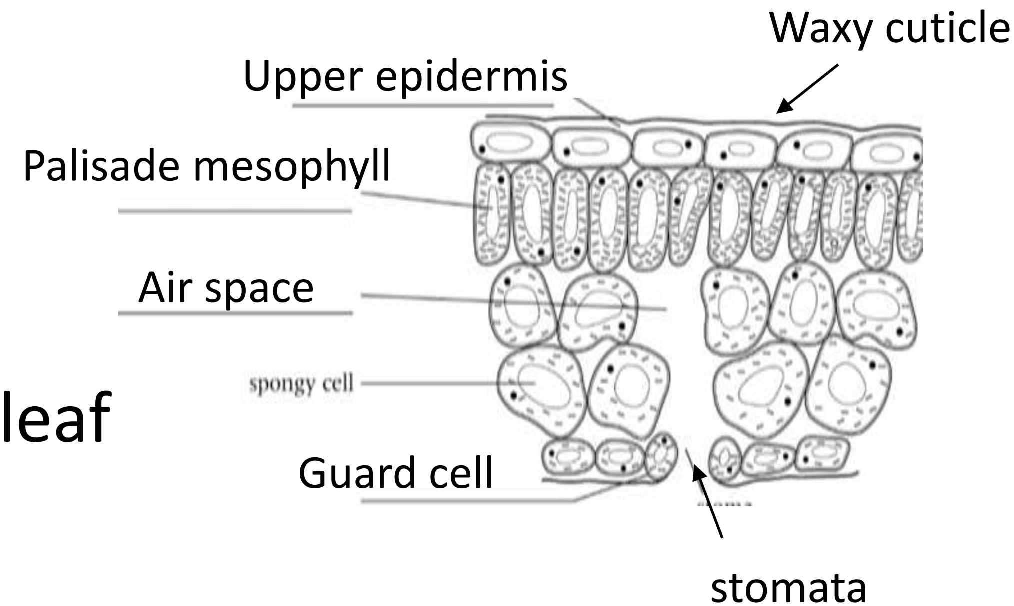
- Adult vs Embryo
  - Range of cell types –

  embryo can develop into many more cell types, so can treat more diseases
  - Rejection

  if the stem cell is taken from a patient's own bone marrow there will not be issues with rejection
  - Ethical issues

  some people object to using embryonic stem cells as it involves destroying embryos.

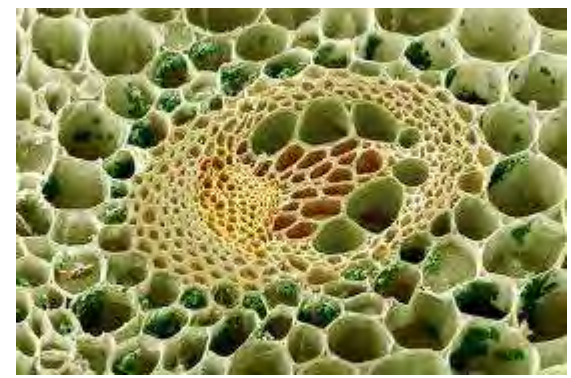
Plant tissues



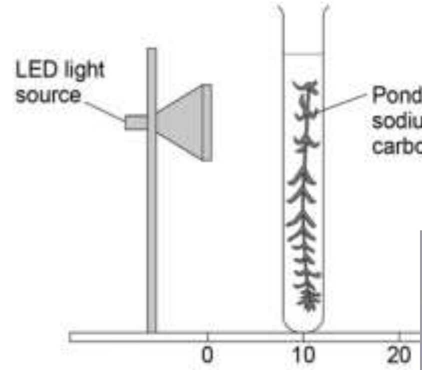
- Label the parts of the leaf

- Which plant tissue is it?

Plant tissue	Role
Mesophyll	Carry out photosynthesis
Epidermis	Cover the plant
Xylem and Phloem	Transport substances
Meristem	Growing tips of shoots and roots



Photosynthesis



- Equation:

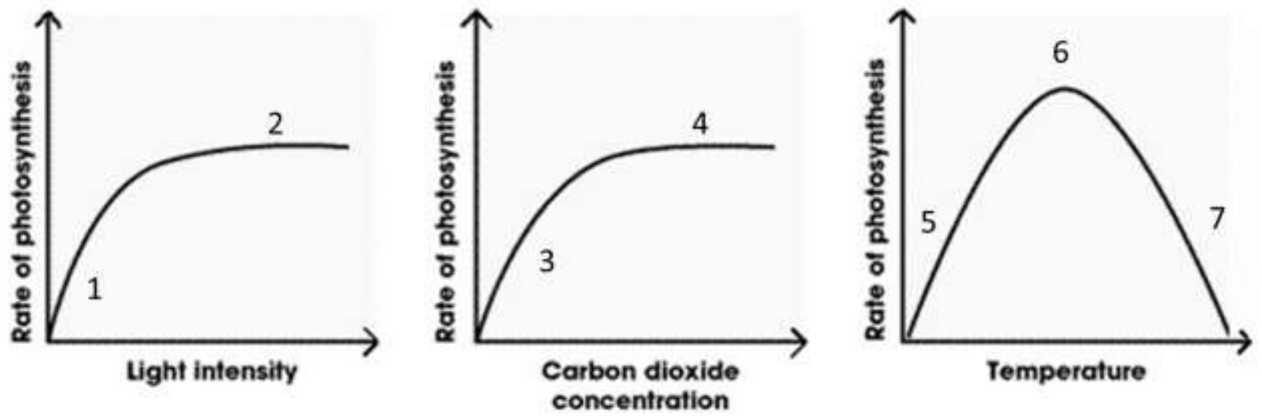
Carbon dioxide + water → glucose + oxygen

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

- Why do plants do photosynthesis?
- To produce glucose – stored as starch, stored as fats and oils, used to make amino acids, used to make cellulose for cell walls, used in respiration
- Measuring photosynthesis?
- Counting bubbles under water in a minute, measuring volume of oxygen produced per minute, testing leaves for the presence of starch

Limiting factors

- What are the limiting factors for photosynthesis?
- Light intensity, temperature, carbon dioxide levels (chloroplasts)



What is the limiting factor(s) at:

1 light intensity

2 carbon dioxide levels/temperature

3 carbon dioxide levels

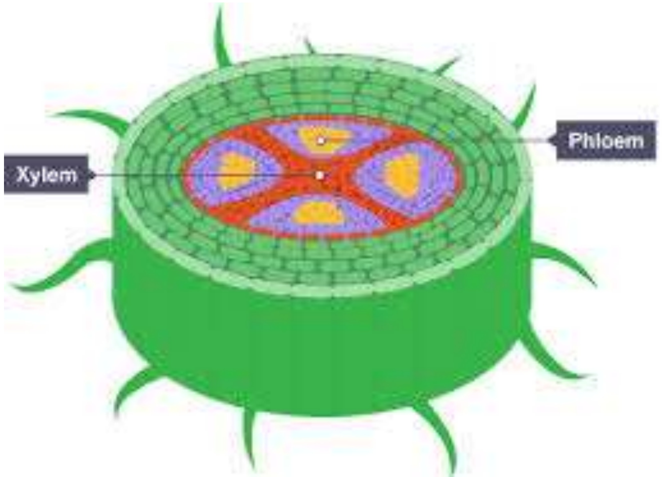
4 light intensity/temperature

5 temperature

6 light intensity/carbon dioxide levels

7 temperature

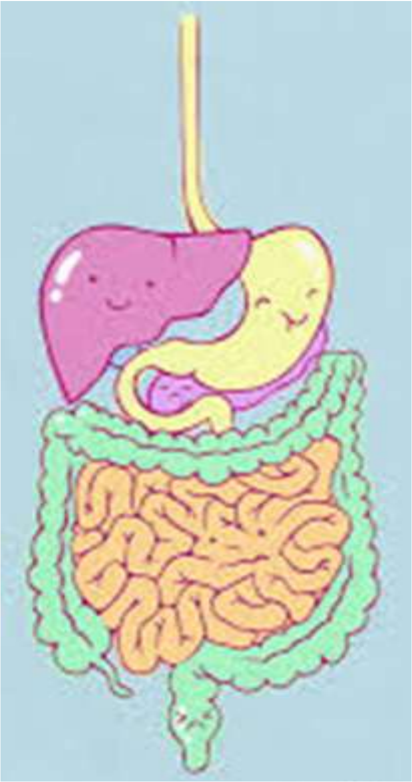
Transport in plants



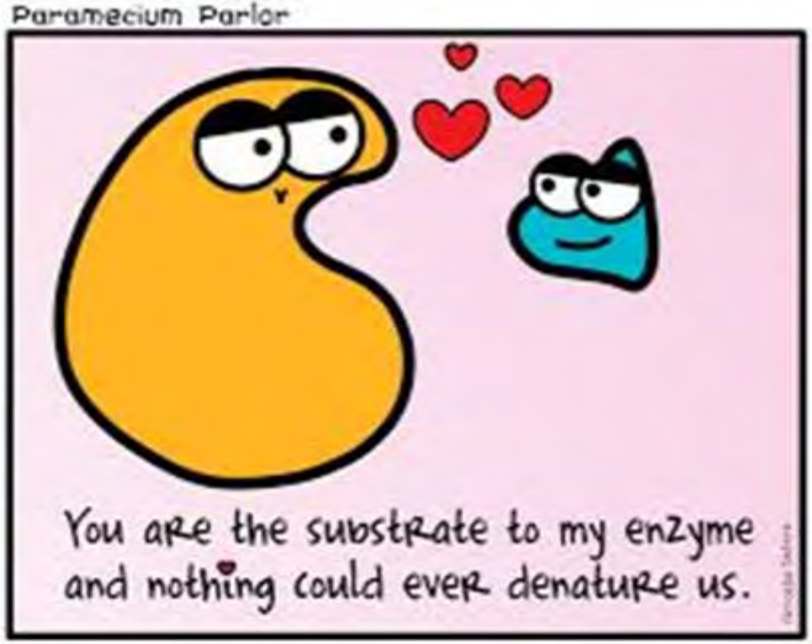
- What does the xylem transport?
- Water and mineral ions
- What does the phloem transport?
- sugar
- What is transpiration?
- Evaporation of water from stomata in the leaves
- What factors speed up transpiration?
- High temperature, low humidity, wind, high light intensity (opens stomata)

Systems – digestive system

- What do amylase, protease and lipase break down? What is the product in each case?
    - Amylase: Starch → sugar
    - Protease: Protein → amino acids
    - Lipase: Fat → fatty acids and glycerol
- What is the food test for:
- Starch
- Iodine – turns blue black
- Protein
- Biuret – turns purple
- Fat
- Sudan III – top layer is red
- Glucose
- Heat with benedict's – turns orange



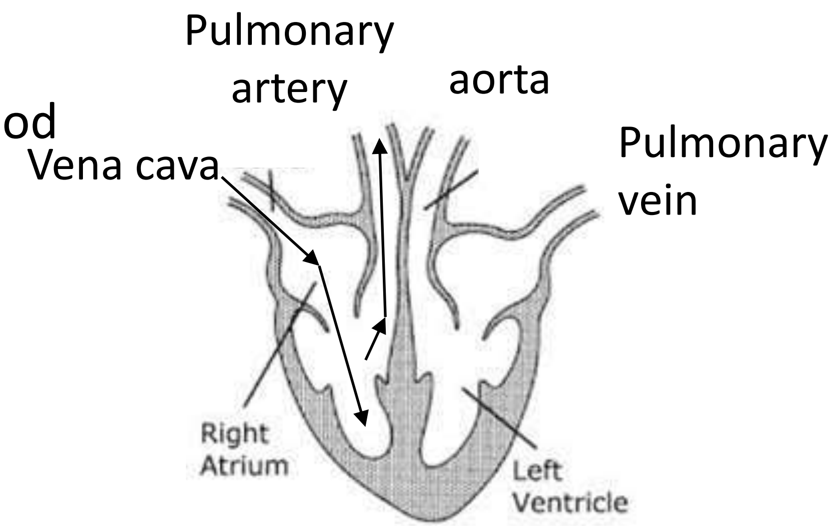
Digestive system

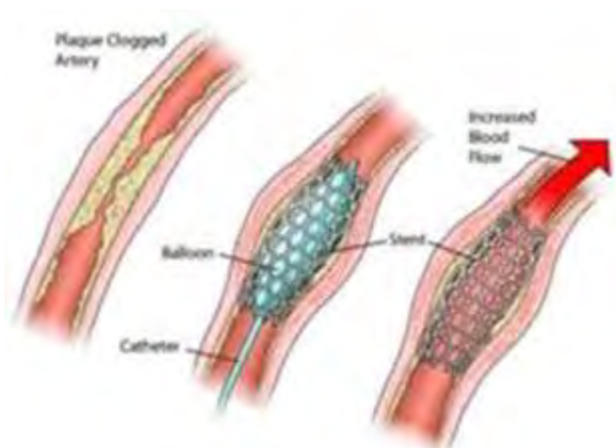


- Which organ makes bile?
- Liver (stored in the gall bladder)
- What does bile do?
- Emulsifies fat droplets to increase the surface area, neutralises stomach acid, so the small intestine is the correct pH.
- Where are villi found?
- Small intestine
- What happens to enzymes at high temperatures or the wrong pH?
- Enzymes denature (active site changes shape so substrate cannot fit)

Systems – Circulatory system

- Label the blood vessels
- Add arrows to show the direction of blood flow.
- How is heart rate controlled?
- Pacemaker on the right atrium.
- How can an irregular heart beat be treated?
- Artificial pacemaker





What is this? What is it used for?

Stent

Widens coronary arteries if there is a fatty deposit

Advantages – increases blood flow to heart muscle

Disadvantages – surgery/ anaesthetic risk, blood clotting, damage to blood vessels

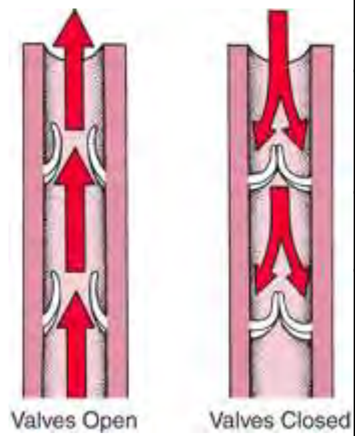
Systems – Circulatory system

Why do arteries have a thick muscle layer?

To cope with high blood pressure.

Why do veins have valves?

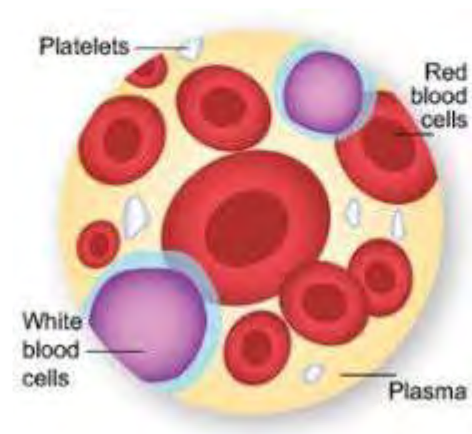
To prevent backflow



Why do capillaries have thin walls?

To allow rapid exchange of substances by diffusion.

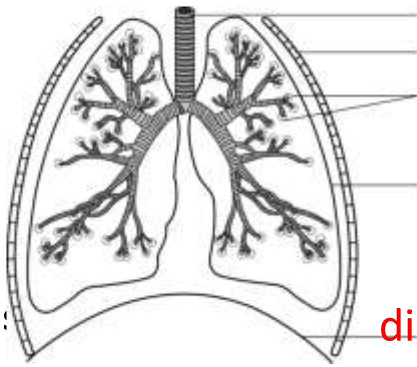
Component	Function
Red blood cells	Transports oxygen
White blood cells	Destroys pathogens
Platelets	Clots blood
Plasma	Transports dissolved substances, e.g. urea, water, glucose, amino acids, mineral ions, hormones



Systems – Respiratory system

- **What is the equation for aerobic respiration?**
- Glucose + oxygen → carbon dioxide + water
- $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
- **What is the equation for anaerobic respiration in animals?**
- Glucose → lactic acid
- **What is the equation for anaerobic respiration in plants and yeas**
- Glucose → ethanol + carbon dioxide
- **Why is lactic acid produced when we exercise?**
- We don’t have enough oxygen reaching our muscles, so they do anaerobic respiration instead of aerobic respiration.
- **Why does our heart rate increase when we exercise?**
- More oxygen and glucose are delivered to our cells.
- Our cells do more respiration. This releases more energy.

Label the diagram

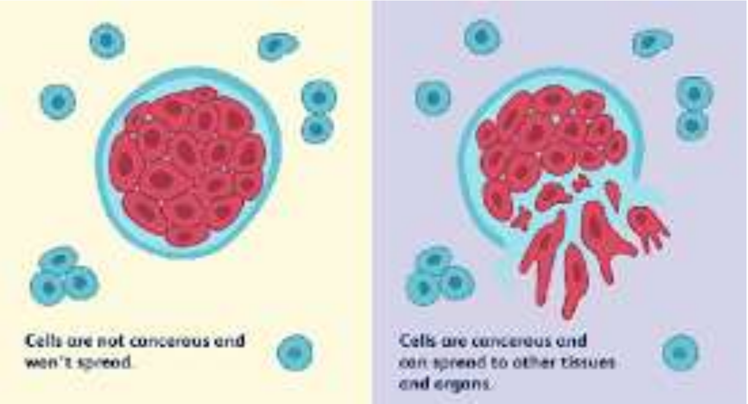


Non-communicable diseases

- Match the risk factors to the disease:

Disease	Risk Factor
Lung disease and lung cancer	Diet, smoking and lack of exercise
Cancer	Obesity
Cardiovascular disease	Alcohol
Liver and brain function	Smoking
Type 2 Diabetes	Smoking and alcohol
Unborn babies	Carcinogens and ionising radiation

Cancer



- What is cancer?
- Changes in cells that lead to uncontrolled growth and division.
- What are benign tumours?
- Abnormal growths of cells contained in one area.
- What are malignant tumours?
- Cancers that spread to other tissues through the blood where they form secondary tumours.

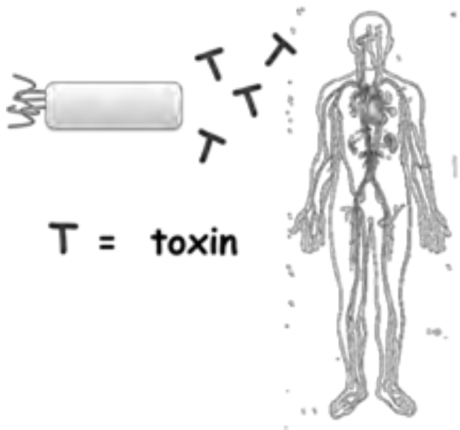
Disease

Type of pathogen	Name of disease	How it is spread	Reducing the spread	Symptoms	Treatment
Virus	Measles	droplets from sneezes, coughs	vaccination	Rash, fever	
	HIV	Sexual contact, dirty needles	condoms	More likely to get other infections (white blood cells are affected)	antiretroviral drugs
	Tobacco mosaic virus			Mosaic pattern on leaves → less photosynthesis	
Fungus	Rose black spot	Wind, water	Remove and destroy affected leaves	Black spots on leaves → less photosynthesis	fungicide
Bacteria	Salmonella	Poor food hygiene	Wash hands before handling food, vaccinate chickens		
	Gonorrhoea	sexual contact	condoms	Yellow/green discharge, pain when urinating	antibiotics
Protist	Malaria	mosquitos	Mosquito nets, destroy breeding sites	Fever, can be fatal	

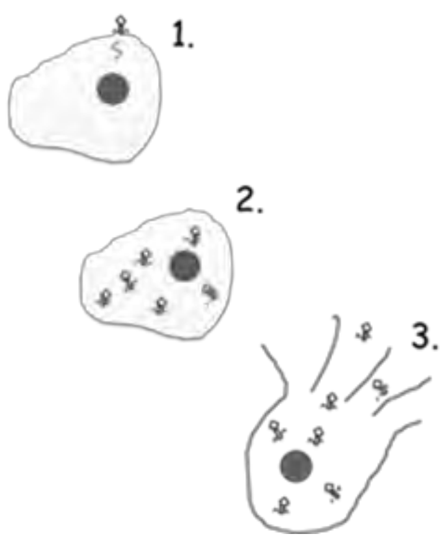
What do plants need minerals for?

- Nitrates – TO MAKE PROTEIN
- Not enough nitrates → stunted growth
- Magnesium – TO MAKE CHLOROPHYLL
- Not enough magnesium → yellow leaves

For each picture, name the type of pathogen it represents and say why it makes us feel ill.



Bacteria
Reproduces rapidly and makes toxins



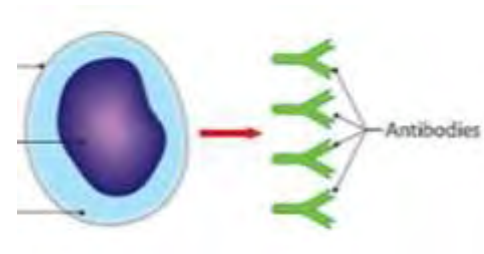
Virus

Damages tissues

Body's defences

- What do they do?
- Mucus
- Traps pathogens and dirt in the airways
- Cilia
- Sweeps mucus, pathogens and dirt away from the lungs
- Skin
- Forms a barrier
- Platelets
- Clots the blood at the site of a wound
- Stomach acid
- Destroys pathogens in food and drink

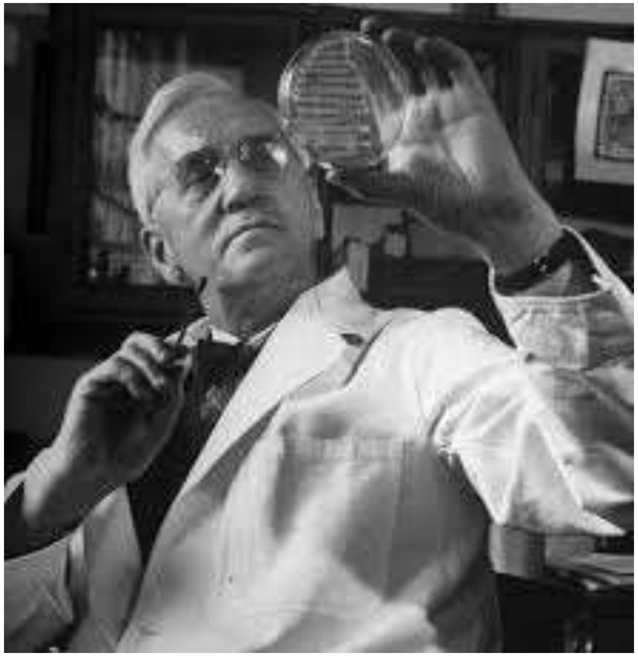
Which type of white blood cell does each picture show? How do they each protect us?



Phagocyte - Engulfs and ingests pathogens (phagocytosis)

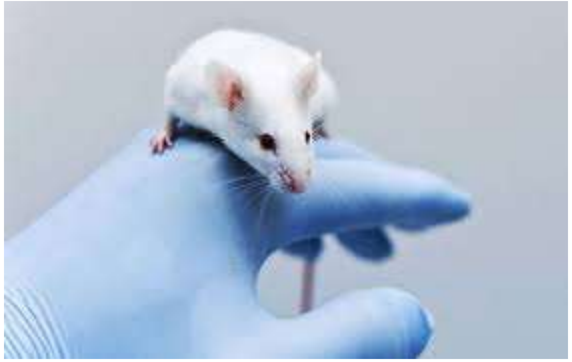
Lymphocyte - Produces antibodies and antitoxins

Drugs



- What is an antibiotic?
- Drug that kills bacteria.
- What is a painkiller?
- Drug that relieves symptoms only.
- Why can't antibiotics cure a common cold?
- Antibiotics only kill bacteria not viruses.
- Why should doctors only give out specific antibiotics for specific infections?
- Reduces risk of getting resistant strains of bacteria
- Where do aspirin, digitalis and penicillin originate from?
- Willow tree, foxglove and a mould.

Drug testing



- Why do drugs need to be tested
- For toxicity, efficacy, dosage and side effects.
- What steps are involved in pre-clinical testing?
- Cells and tissue testing, testing live animals.
- What steps are involved in clinical testing?
- Testing healthy volunteers, testing patients with the disease.
- What is a placebo?
- Fake drug
- What is a double blind trial?
- Neither the doctors nor the patients know who has been given the real drug and who has been given the placebo.

Biology Paper 2 Revision

<u>Paper 2 topics:</u>

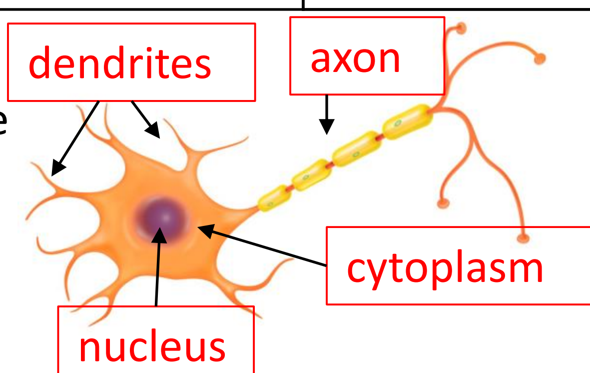
- Homeostasis
- Inheritance
- Variation & Evolution
- Ecology
- Human Impact
- Food Production

Homeostasis

- Regulation of the ___internal___ conditions (in a cell or organism) to maintain ___optimum___ conditions for function in response to internal and external ___changes___.
- Nervous or Chemical – all systems have:
- Receptors? Detect stimuli
- Coordination centres? e.g. Brain, spinal cord and pancreas
- Effectors? Muscles or glands

Part of the nervous system	Function	Examples:
Receptor	Groups of specialised cells that can detect stimuli from the environment.	Pain - skin Temperature - skin Pressure - skin Chemicals – tongue and nose Light – eye Sound - ear
Neurone	Transmits electrical impulse	Sensory Relay Motor
Coordinator	Receive and process information from receptors.	Brain Spinal cord
Effector	Carries out a response	Muscle (contracts) Gland (secretes hormone)

Label the neurone

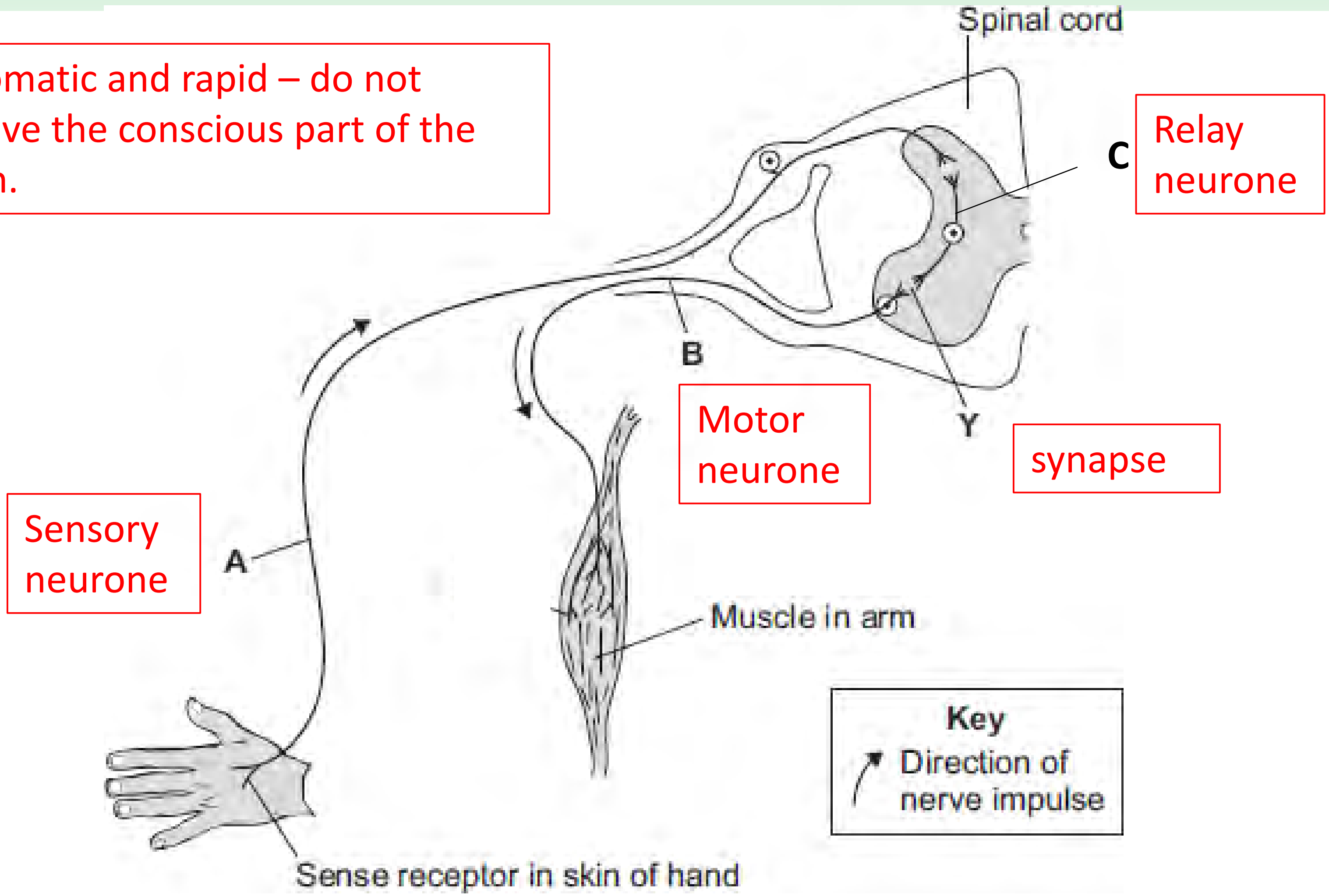


What is a synapse?

Gap between neurones. Chemicals diffuse across the gap

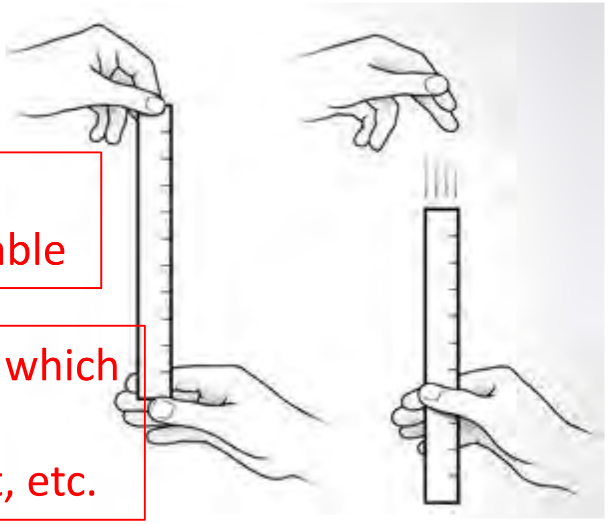
Reflex actions

Automatic and rapid – do not involve the conscious part of the brain.



Required Practical: Reaction Time

Independent variable – could investigate e.g. age of participant, dominant/weaker hand, effect of caffeine etc.



Dependent variable? Distance ruler falls in cm. Can convert to reaction time in ms using a conversion table

Control variables? Distance between finger and thumb. Way in which the ruler is dropped.
Posture of participant, position of their wrist, etc.

What were the problems with this method?

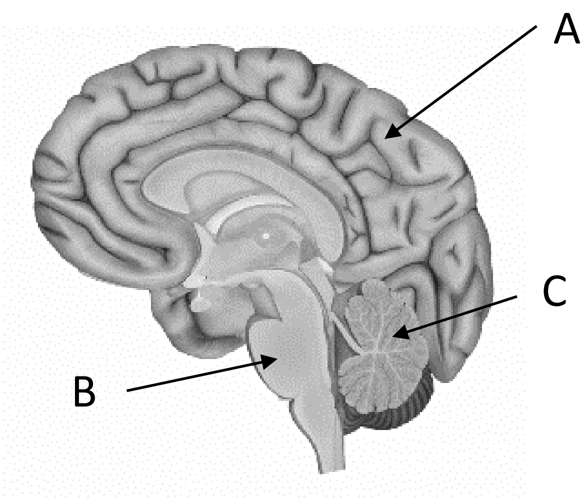
- Not very accurate – human error – e.g. don't always drop in exactly the same way, difficult to keep finger and thumb exactly the same distance apart
- Can guess when your partner is about to drop, so can cheat

Why would be a computer program be better? (e.g. pushing a button when you see a word appear)

- More accurate – removes human error
- More repeatable

The brain

Name parts A, B and C. What are their functions?



Part	Name	Function
A	Cerebral cortex	• Memories • Consciousness • Intelligence • Language
B	Medulla	Controls unconscious (automatic/involuntary) activities, e.g. heart/ breathing rate, vomiting
C	Cerebellum	Controls and co-ordinates the movement of muscles

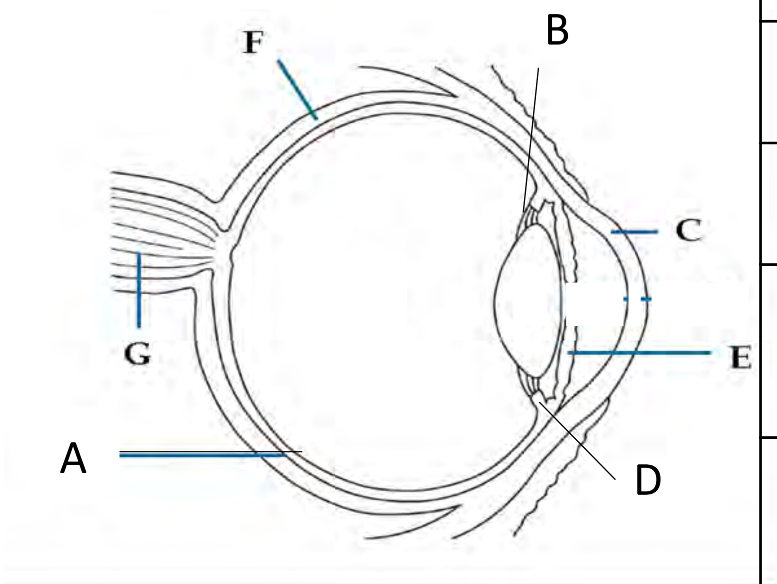
How do scientists study the brain?

- MRI scans
- Studying patients with brain damage
- Electrically stimulating different parts of the brain

Why is it difficult to investigate brain function?

- Brain is very delicate and complex.
- Investigative procedures could harm patients

The eye

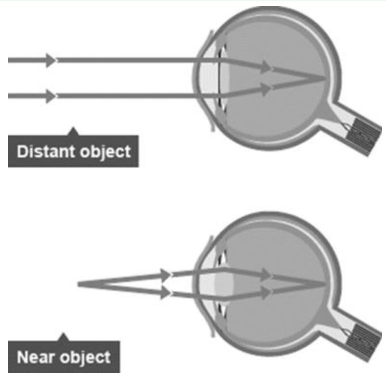


Part	**Name**	How does its structure relate to its function?
A	Retina	Contains many rod and cone cells to detect light
B	Suspensory ligaments	Strong in order to pull lens thin
C	Cornea	Transparent to allow light through. Refracts the light.
D	Ciliary muscles	Contains muscle fibres to contract and relax to change shape of lens
E	Iris	Contains muscle fibres to contract and relax to change size of pupil to control amount of light entering the eye
F	Sclera	Tough outer coating to protect the eye
G	Optic nerve	Contains neurones to carry electrical impulses to the CNS

Accommodation and eye defects

What is accommodation?

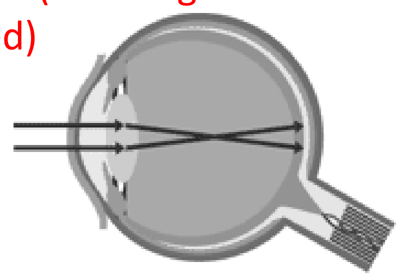
Changing the shape of the lens to focus on near or distant objects



What happens to the…..	Focussing on a near object	Focussing on a distant object
Ciliary muscles	Contract	Relax
Suspensory ligaments	Loosen	Pulled tight
Thickness of the lens	Gets thicker	Pulled thin
Amount the light rays are refracted	Refracts strongly	Only slightly refracts

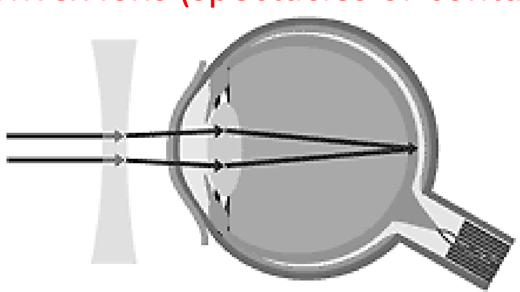
What eye defect is this?

Myopia (short sightedness – distant objects appear blurred)



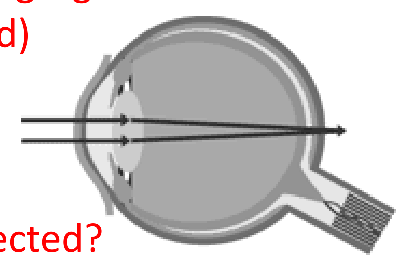
How is it corrected?

Convex lens (spectacles or contact lens)



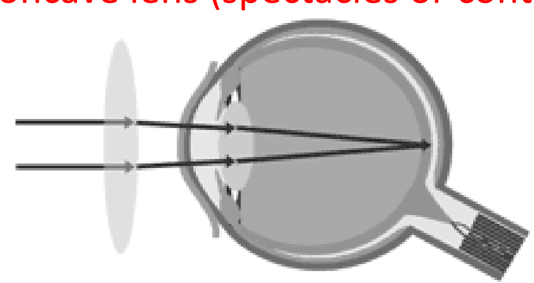
What eye defect is this?

Hyperopia (long sightedness - Close objects appear blurred)



How is it corrected?

Concave lens (spectacles or contact lens)



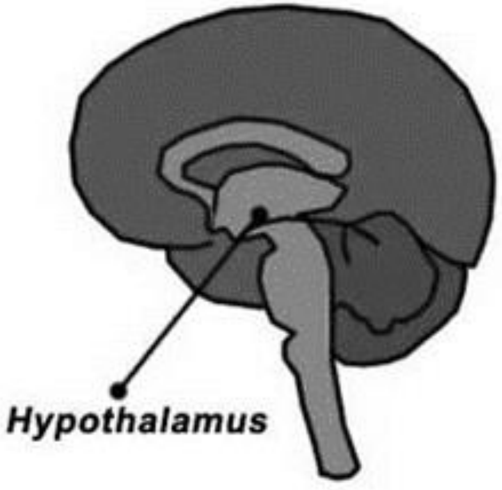
Regulating body temperature

Coordinator?

- **thermoregulatory centre** (TRC) in the brain.

Receptors?

- In TRC - detect **temperature of blood** flowing through the brain
- skin - send information to the TRC about **skin temperature**.



Too hot?

- Blood vessels supplying the skin capillaries dilate (**vasodilation**):

→ more blood flows through the capillaries

→ more heat is lost from skin (by radiation)

- Sweat glands release more sweat:

→ cools the body (by evaporation of water)

Too cold?

- Blood vessels supplying the skin capillaries constrict (**vasoconstriction**):

→ less blood flows through the capillaries

→ less heat lost from skin by radiation

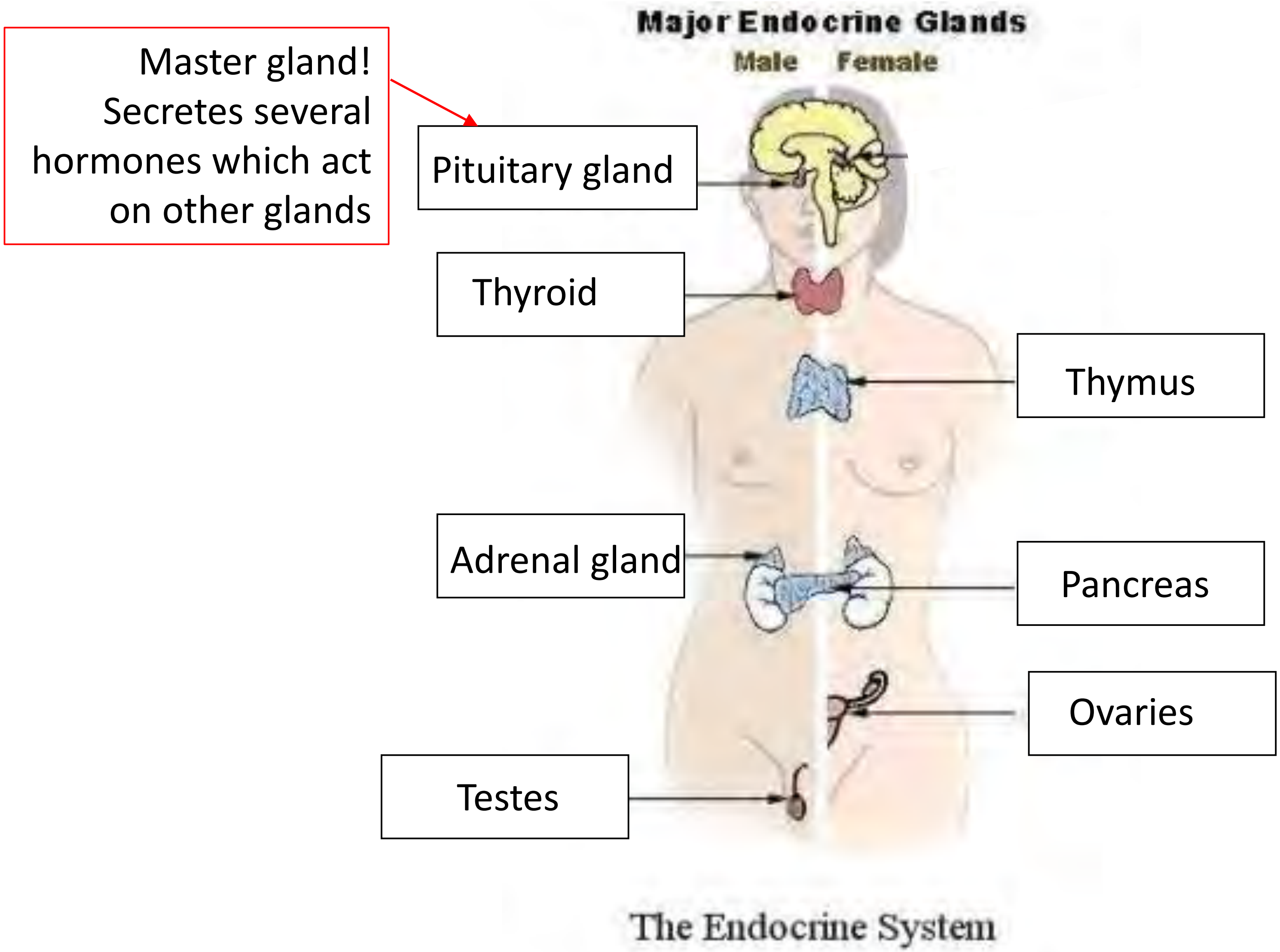
- Muscles "shiver" (contract rapidly):

→ muscle contraction needs respiration

→ energy released as heat

What is a hormone?

- Chemical messenger (often a protein)
- Made by a gland
- Travels through the blood stream
- Acts on a target organ to cause a response to happen.


Master gland! Secretes several hormones which act on other glands
Major Endocrine Glands
Male
Female
Pituitary gland
Thyroid
Thymus
Adrenal gland
Pancreas
Ovaries
Testes
The Endocrine System

Non-hormonal contraceptive? Barrier methods e.g. condom – stops sperm reaching the egg

Hormone	Gland that produces it	Effect
Insulin	Pancreas	Causes liver cells to take up glucose and store as glycogen
Glucagon	Pancreas	Causes liver cells to break down glycogen into glucose and release glucose into the blood.
Adrenaline	Adrenal	Increases heart rate
Thyroxine	Thyroid	Increases metabolism
FSH	tuitary	Causes egg to mature
LH	tuitary	Causes egg to be released
Oestrogen	Ovaries	Thickens uterus lining. Stops FSH production
Pr	varies	Maintains uterus lining Stops LH production
Testosterone	Testes	Stimulates sperm production

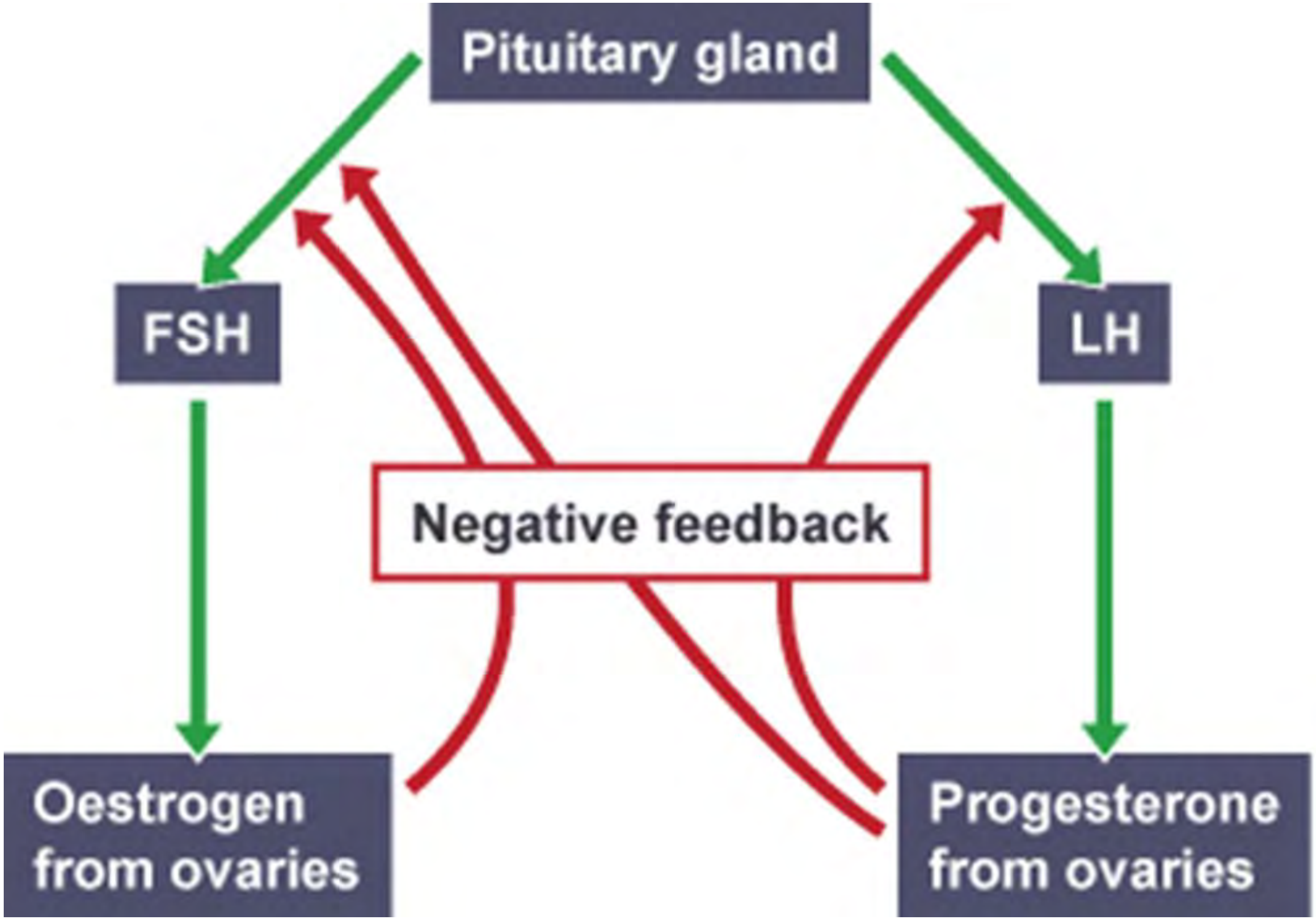
Used in IVF – why?

Causes eggs to mature and be released

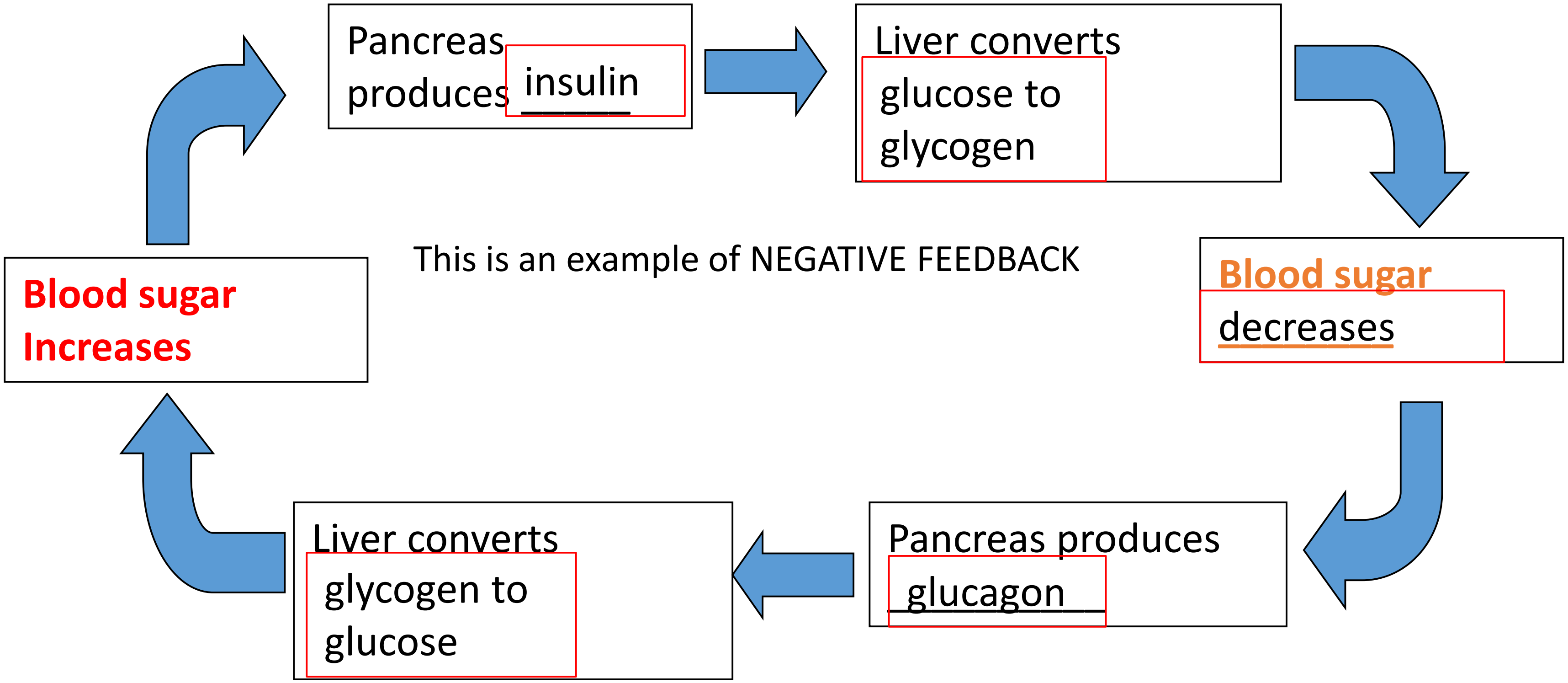
Used in contraceptive pills and implants– why?

Stops eggs maturing and being released

Negative feedback



Controlling blood sugar levels



Type 1 diabetes – what is it? How is it treated?

- Pancreas produces NO or VERY LITTLE insulin.
- Treated with insulin injections

Type 2 diabetes – what is it? How is it treated?

- Body cells don't respond to insulin (risk factor is obesity)
- Treated by a carbohydrate controlled diet and exercise.

Negative Feedback

Body detects a change and makes an adjustment to return it back to normal.

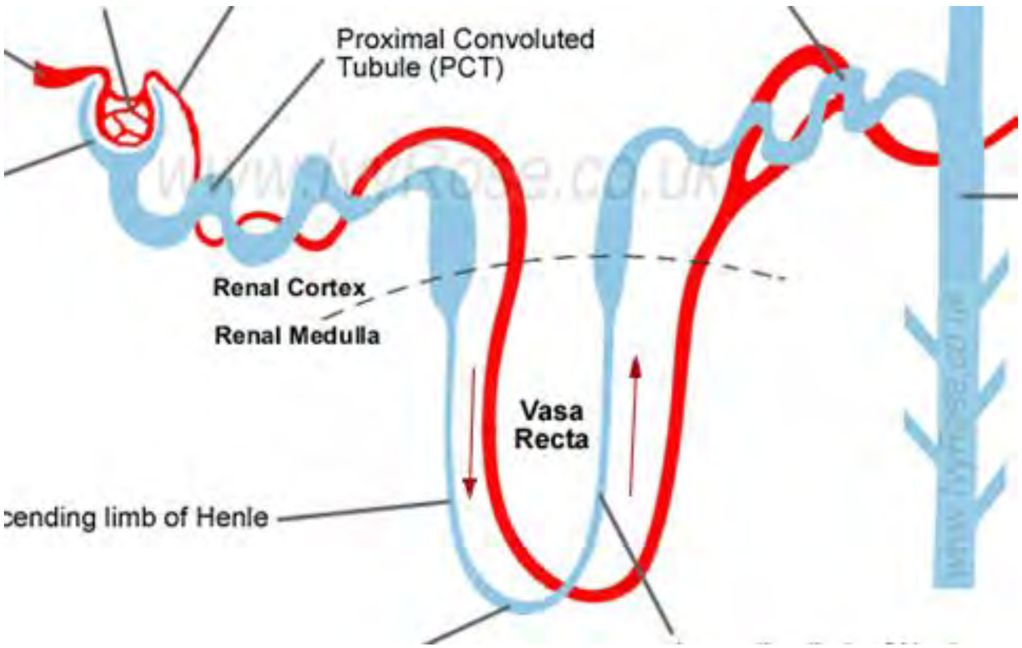
- Body has detected a change (high or low glucose concentration in the blood) and made an adjustment to return it back to normal.

What happens in the kidney

1. Blood plasma is filtered in kidney tubules (High pressure = ultrafiltration)

All small molecules are filtered out - such as?

Glucose, urea, water, mineral ions, amino acids



2. Essential materials selectively reabsorbed back into blood (all _glucose_, some _ions_, some _water_)

3. Waste Products excreted into urine (_urea_, excess _ions_ and _water_)

Where and how is urea produced?

In the liver

Excess amino acids are deaminated → ammonia → urea

Osmoregulation

Where is the osmoregulatory centre found?

- In the brain, near the pituitary gland.

What type of receptor monitors the concentration of the blood?

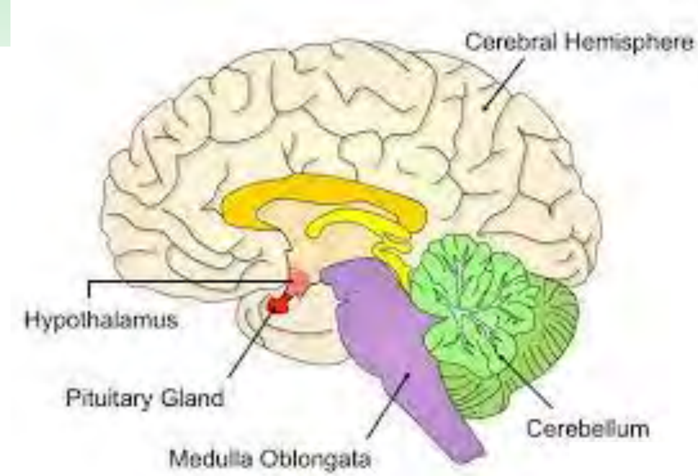
- osmoreceptor

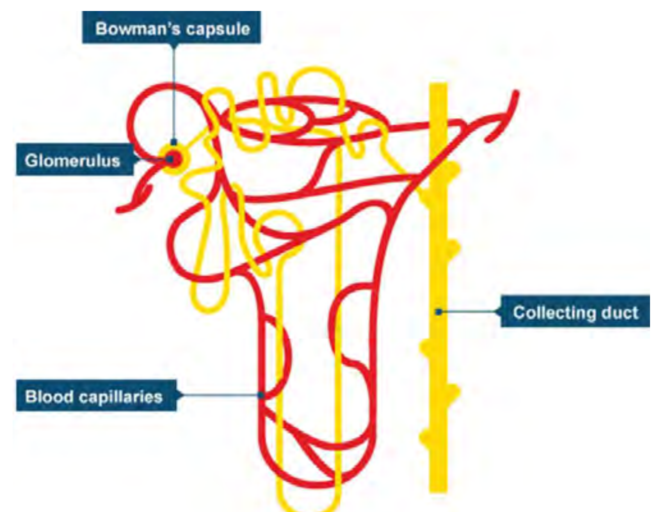
Which hormone does the pituitary gland release?

- ADH (the “no pee” hormone)

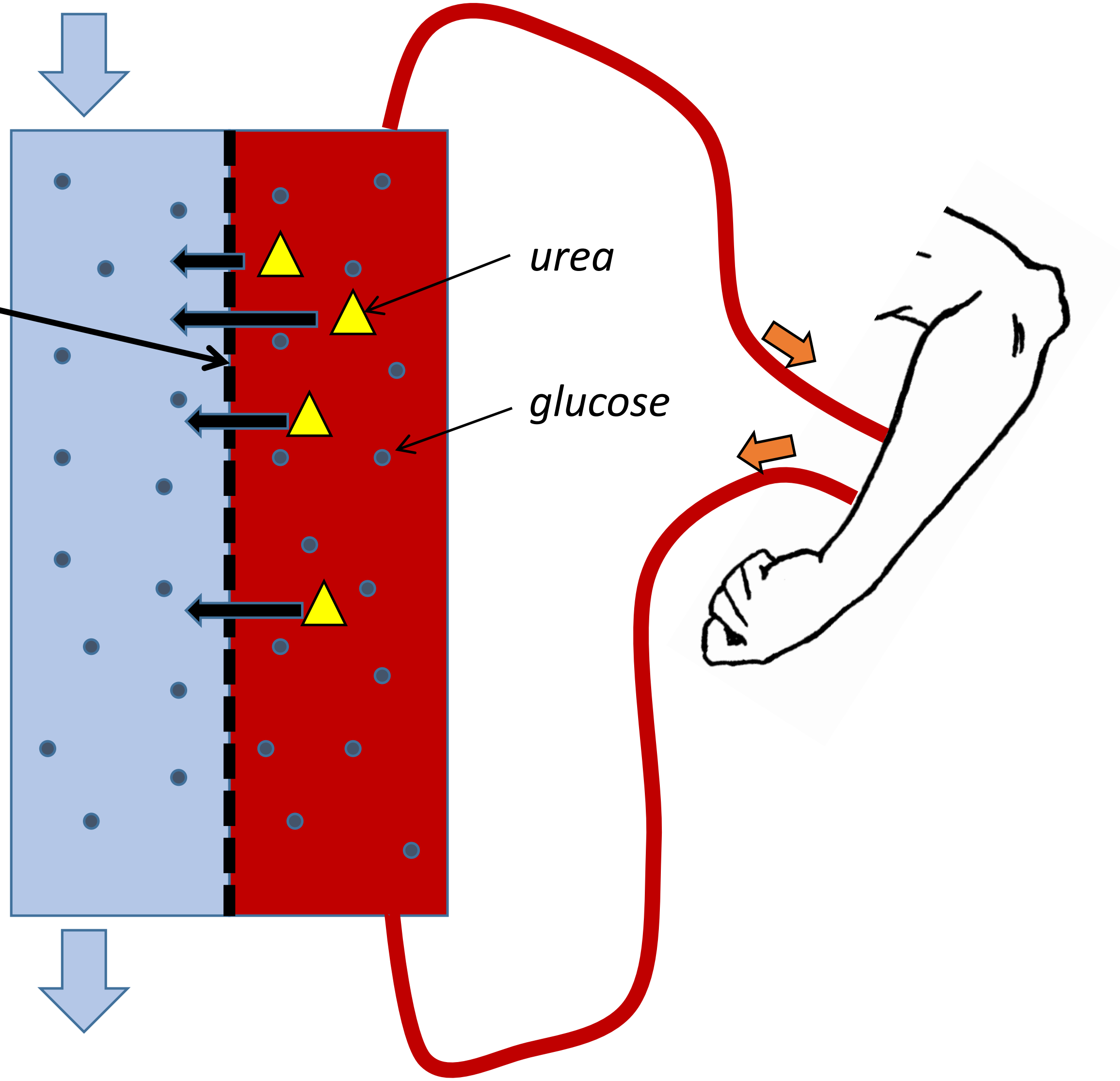
What does this hormone do to the kidney tubules?

- Makes them more permeable to water → more water is reabsorbed into the blood → urine is more concentrated (no or less pee)





Dialysis



How do we ensure most of the urea is filtered out?

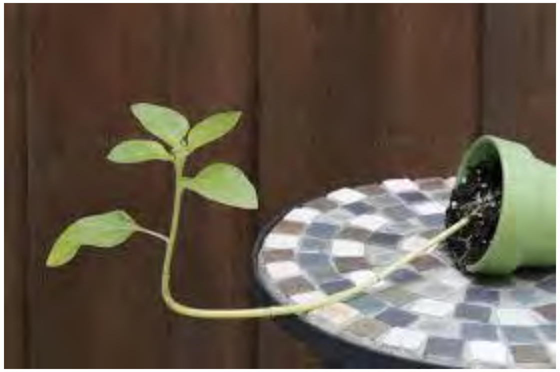
- Dialysis fluid contains no urea at the start – large concentration gradient.
- Dialysis fluid is continually moving → maintains concentration gradient.

Transplant vs Dialysis

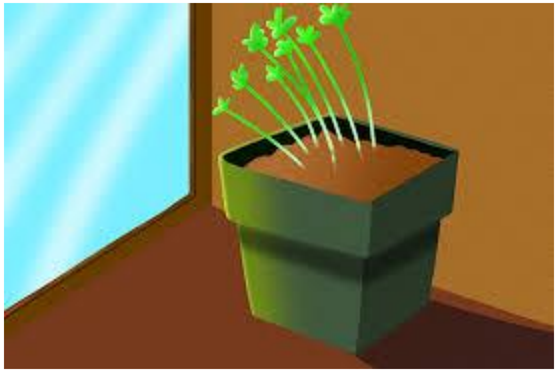
Transplant	Dialysis
transplant is (usually) permanent (although may need to be replaced)	dialysis only short term – repetitive treatment
kidney works all the time	dialysis intermittent
Concentrations in blood kept more or less constant	Substances build up in blood between dialysis sessions – can cause poisoning/ damage to body
can eat or drink without constraint with transplant	social point – inconvenience of dialysis
Hazards of operation for transplant May be rejected - need to use immunosuppressant drugs	Risk of blood clots with dialysis
susceptible to other infections	Danger of infection / damage to blood vessels by needles
high <u>initial</u> cost	long term expense of dialysis / excessive use of health service resources
shortage of donors	

Plant hormones

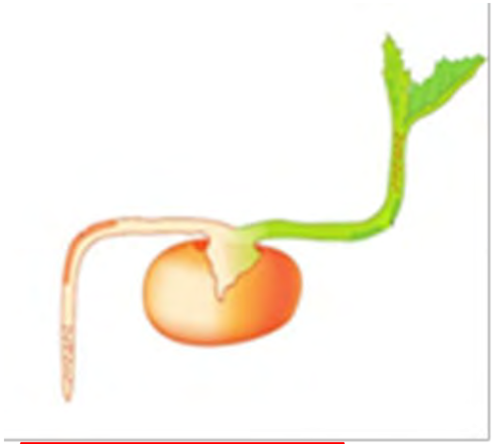
- Which tropism is demonstrated in each picture?



gravitropism



phototropism



gravitropism

- Which hormone is responsible? How does it carry out this response?
- Auxin. Unequal distributions of auxin cause unequal growth rates in plant roots and shoots.

Identify the plant hormone for each use/function (they each appear more than once!)

Hormone	Use/function
Gibberellins	Promote flowering
Auxins	Promoting growth in tissue culture
Gibberellins	initiate seed germination
Ethene	Control ripening of fruits
Auxins	Control growth rates in roots and shoots
Gibberellins	Increase fruit size
Auxins	Weed killers
Ethene	Control cell division
Gibberellins	End seed dormancy
Auxins	Rooting powders

	Meiosis
Where?	
Chromosome number of daughter cells	
DNA replication?	
Number of Divisions	
Genetic Variation	
Purpose?	

Reproduction

	Sexual reproduction	**Asexual reproduction**
Type of cell division	Meiosis –makes gametes (egg & sperm, egg & pollen).	Mitosis
Variation?	Yes – mixing of genetic info from 2 parents.	No – clones are produced.
Advantages	• variation in the offspring • If the environment changes, variation gives a survival advantage by **natural selection.** • Humans can speed up natural selection using **selective breeding.**	• No need to find a mate (only one parent needed) – energy and time-efficient. • Rapid (e.g. plant can spread quickly to out compete other plants) • Can produce lots of identical offspring when conditions are favourable.

Reproduction

Organisms that reproduce by both methods?

Fungi

- asexually - spores
- sexually - to maintain variation

Many plants

- asexually -runner (strawberries) or bulb division (daffodils)
- sexually – seeds

Malarial parasites:

- Asexually – in liver and blood stream of human host.
- Sexually - in the digestive tract of mosquitos.

Mendel

What experiments did he carry out?

- Crossed pure breeding pea plants together, observed characteristics of first and second generation offspring.

What did he conclude?

- Inheritance of each characteristic is determined by 'units' that are passed on to descendants unchanged.
- Some characteristics are **dominant** over others.

Why were his ideas not accepted at first?

- Most scientists believed in "blended inheritance" – all characteristics passed on.
- No one knew about chromosomes or genes yet.

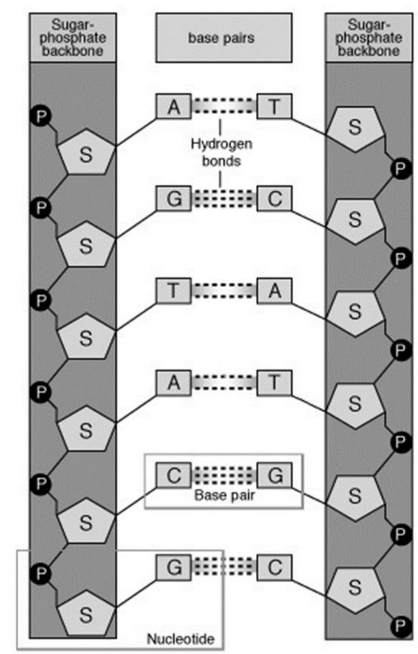
How did later scientists discover inheritance of genetic material?

- Better microscopes were developed → observed behaviour of chromosomes during cell division.

DNA structure

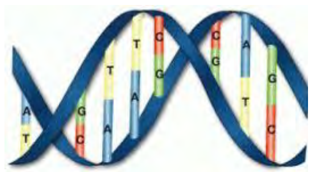
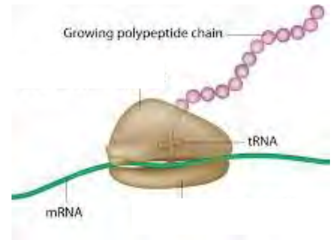
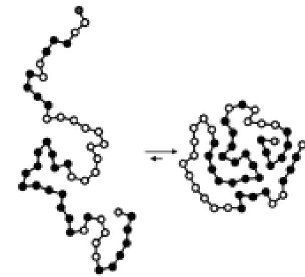
- What is each unit of DNA called?
- What is the structure of DNA described as?
- How many types of base are there? What are they called?
- What structure is the DNA molecule folded into?
- How many bases on DNA code for one amino acid?

- Nucleotide
- polymer of 2 strands bonded together and twisted into a double helix
- 4 – A, T, C and G
- Chromosome
- 3

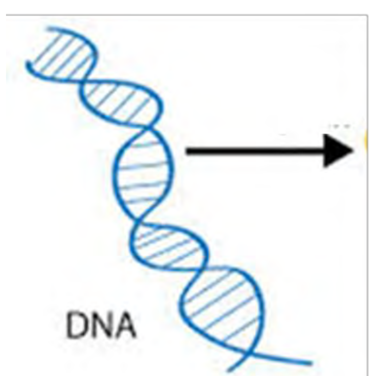


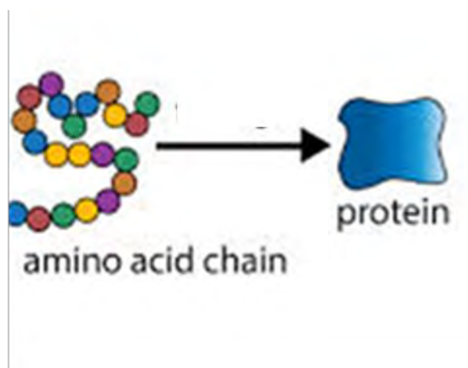
What’s the keyword?

Genome	The entire genetic material of an organism.
Chromosome	A complete length of DNA coiled together that contains several hundred genes. Often in the shape of an X.
Gene	A small section of DNA on a chromosome which codes for a particular sequence of amino acids, to make a specific protein.
Mutation	a permanent change to DNA.
Allele	Different forms of the same gene.
Genotype	What alleles are present.
Phenotype	Expression of genotype. Physical appearance.
Dominant	Allele will always be expressed, even if only one copy is present
Recessive	Allele is only expressed if two copies are present
Heterozygous	Two different alleles for a trait.
Homozygous	Two identical alleles for a trait.

				
The gene has a particular sequence of bases.	A template of the gene is taken out of the nucleus (mRNA).	Ribosomes use this template to make an amino acid chain.	Carrier molecules (tRNA) bring specific amino acids to add to the growing polypeptide chain in the correct order.	When the protein chain is complete, it folds up to form a unique shape.

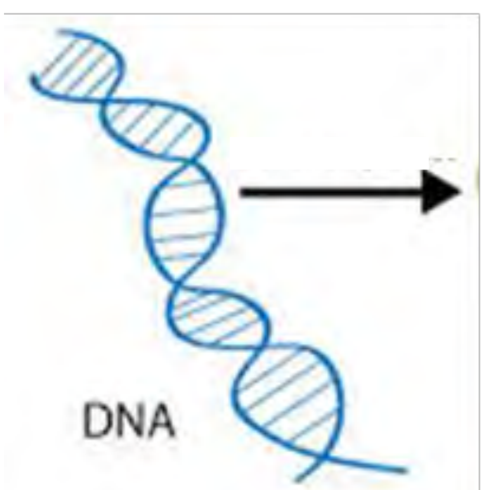
Each gene codes for a particular sequence of amino acids, to make a specific protein. Different alleles will code for slightly different proteins.

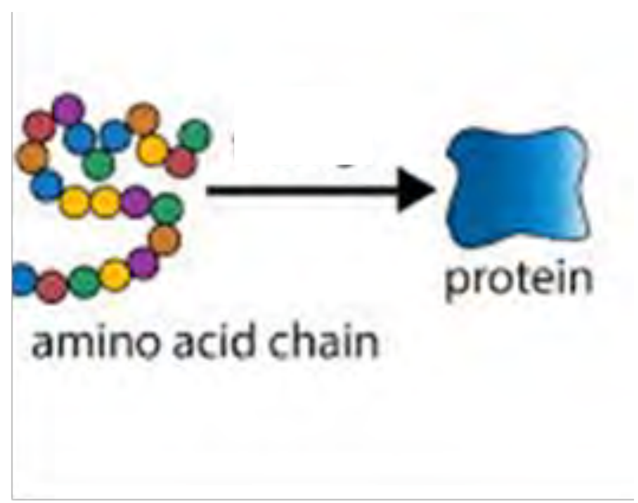




Genotype to Phenotype

- Each gene codes for a particular sequence of amino acids, to make a specific protein.
- Different alleles will code for slightly different proteins.





The Human Genome Project

1. What is the Human Genome Project?
   - Scientists from around the world worked together to identify the entire sequence of DNA in a human. The sequence is stored in a database.
2. What do scientists hope to be able to do as a result of the HGP?
   - Genetic tests to show the likelihood of certain diseases developing.
   - understand and treat genetic disorders
   - trace human migration patterns from the past.

Genetics

- How many chromosomes are there in human body cells?
- How many chromosomes are there in human gametes?
- Is XY male or female?
- What is the likelihood of having a male child?
- Give 2 examples of characteristics that are controlled by a single gene.
- Is the allele for cystic fibrosis recessive or dominant?
- Is the allele for polydactyly recessive or dominant?
- What is embryo screening?

- 46
- 23
- Male
- 1 in 2 or 50%
- colour-blindness in humans (recessive) and fur colour in mice
- Recessive
- Dominant
- Embryo DNA is tested.
- Tests will detect genes for disorders if present.

Cystic fibrosis

- Both parents must have the faulty allele for a child to get the disease
- A parent who has only one faulty allele (heterozygous) is a "carrier"

	C	c
C	CC	Cc
c	Cc	cc

What proportion have cystic fibrosis?

25%

Selective breeding

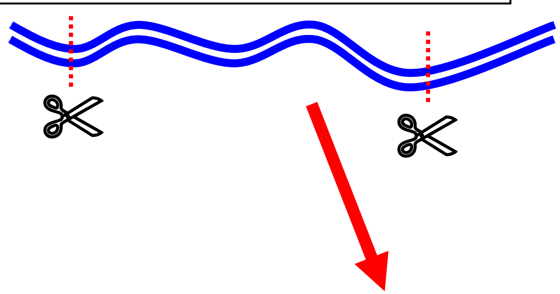
- Briefly describe the process.
  - Choose parents with the desired characteristic, breed together.
  - Breed offspring with the desired characteristic together.
  - Continues over many generations.
- Why do we use selective breeding?
  - Disease resistance in food crops.
  - Animals which produce more meat or milk.
  - Domestic dogs with a gentle nature.
  - Large or unusual flowers.
- Advantages?
  - Increase food production and efficiency.
  - Farmers make more money
  - Used in zoos to prevent species becoming extinct.
- Disadvantages?
  - Reduces the gene pool → species could become extinct if they are not able to fight a particular disease.
  - inbreeding → breed is more likely to get disease or inherited defects.

Genetic Engineering

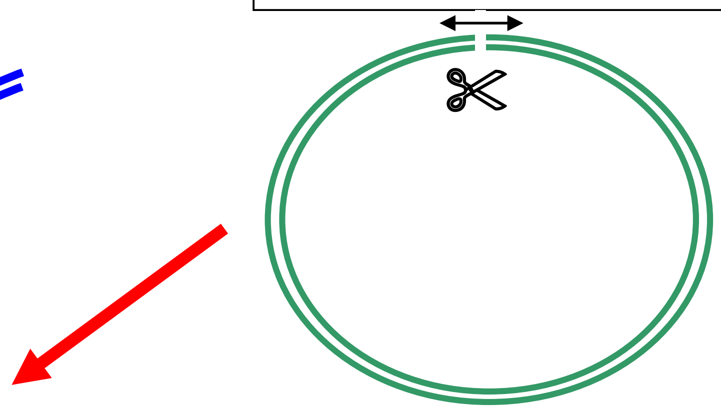
• What is used to cut out the desired gene from the genome?	• Enzymes
• What is the gene inserted into?	• a vector – e.g. a bacterial plasmid or a virus
• Where does the vector insert the gene into?	• cells of animals, plants or microorganisms at an early stage (e.g. embryo) so they develop with desired characteristics.
• Why might the vector have a marker, e.g. a fluorescent tag?	• Shows which cells have taken up the new gene.
• Advantages	• make drugs and medicines, e.g. human insulin. • GM crops - insert gene to make crop resistant to diseases/insect attack/herbicides, produce bigger better fruits → increased yields → could solve food production problems, e.g. make drought resistant crops, increase nutrient content to prevent deficiency diseases • Insert genes in animals that make them produce less fat • If you have a genetic disorder, add a healthy gene so that you don't get ill
• Disadvantages	• Possible effect on populations of wild flowers and insects. • Concerns that eating GM crops might be harmful.

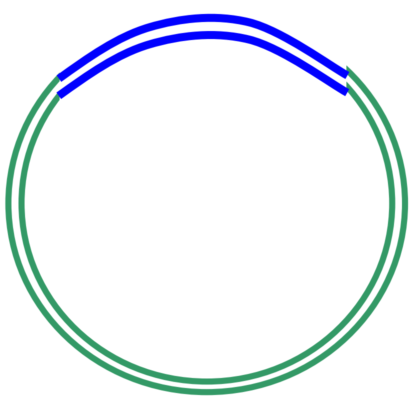
Producing Insulin 1

1. Identify and isolate insulin _____ in human ____________ using an _________.



2. Cut open bacterial DNA (_________) using an ___________

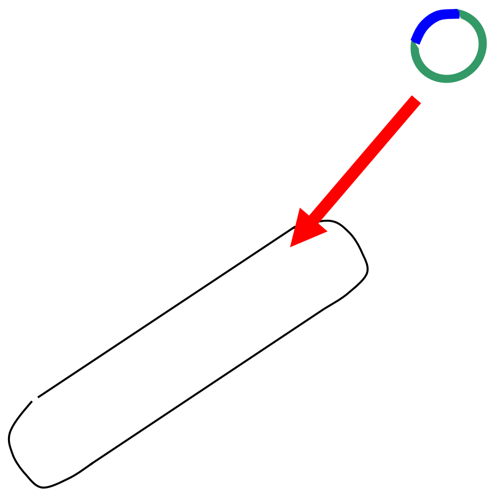




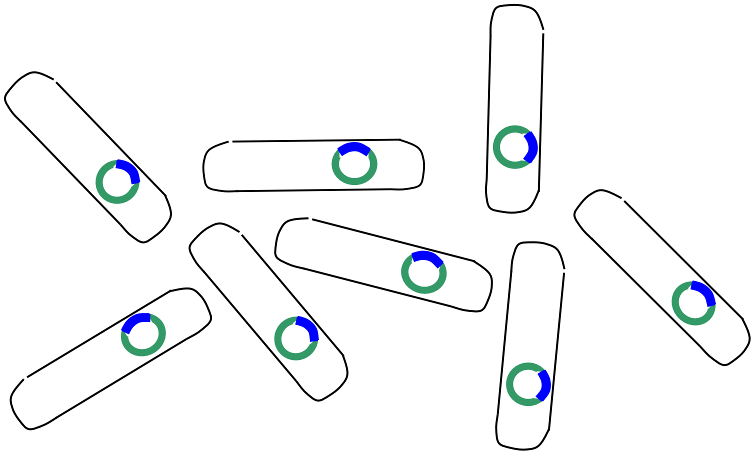
3. Insert the _____ into the _________

Producing Insulin 2

4. Re-insert the modified p_____ into the _________ cell



5. Culture the modified ________ in large fermentation vessels – they will now produce _______



Cloning

- Give two ways of cloning plants. Advantages/disadvantages of each?
- Give two ways of cloning animals. Advantages/disadvantages of each?

- Taking cuttings – very quick and easy to do.
- Tissue culture – can create thousands of clones, but more specialist equipment needed.
- Embryo cloning – similar principles to selective breeding, but then split the embryo. Doesn't guarantee genetics of offspring (sexual reproduction still involved).
- Adult cell cloning – take DNA from adult body cell, insert into empty egg cell → exact clone of desired animal.

Who’s the scientist?

Darwin	Came up with the theory of evolution by natural selection
Lamarck	Came up with the theory of evolution by acquired characteristics
Alfred Russel Wallace	developed ideas of speciation and that warning colours of animals were advantageous
Linnaeus	Came up with the 5 kingdom method of classification
Woese	Came up with the 3 kingdom method of classification

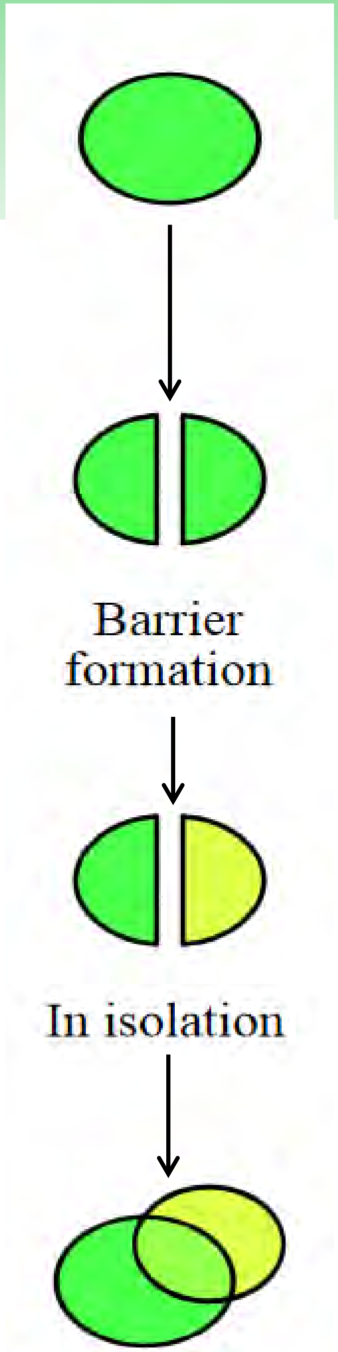
Variation and natural selection

- What are the two sources of variation in phenotype? Give examples of each.
- What does the theory of evolution by natural selection state?
- What are the stages in natural selection?
- What evidence did Darwin have for his ideas?
- What new evidence do we have?

- Alleles (genetic variation) e.g. flower colour
- Environmental variation e.g. seedling height
- All species of living things have evolved from simple life forms that first developed more than three billion years ago.
- Mutation
- Variation
- Competition
- Survival
- Reproduction
- Inheritance of advantageous characteristics.
- Observation of finches on Galapagos Islands
- Discussions with Alfred Russel Wallace who developed similar ideas - speciation
- Fossils show gradual changes in species
- Genetic similarities – DNA sequencing
- Resistant bacteria

Speciation

- A species becomes _isolated______e.g. due to volcanic activity.
- A barrier is formed between the two populations so they cannot meet to breed.
- There is _genetic_ variation between the species.
- Over time in each population natural selection will cause the most _adapted_ individuals to survive___(_alleles_ that give an advantage are passed on).
- Eventually the differences between the species will become so great that when they meet again they cannot successfully _reproduce_ (cannot breed to produce _fertile_ offspring).



Extinction

- Why aren't scientists certain how life began on Earth?
- Early forms of life were **soft-bodied** → no fossils.

- Define extinction.
- when there are no remaining individuals of a species still alive.

- List 6 causes of extinction
- New diseases
- New predators
- New, more successful competitors
- Global change in climate
- A single catastrophic event – e.g. volcanic eruption, asteroid collision
- Speciation

Fossils

- What are fossils?

The ‘remains’ of organisms from many years ago, which are found in rocks.

- Why do we study fossils?

To learn how organisms have changed as life developed on Earth.

- How are fossils formed?

Mummification

Conditions mean no decomposition e.g. in peat bogs or glaciers.

Mineral replacement

Sediment layers cover organism. Minerals replace parts as they decay, and turn to stone.

Trace fossils

Moulds and casts made from footprints, burrows, root shapes, droppings.

Classification

Carl Linnaeus

Kingdom **K**__________

Phylum **P**__________

Class **C**__________

Order **O**__________

Family **F**__________

Genus **G**__________

Species **S**__________

Carl Woese

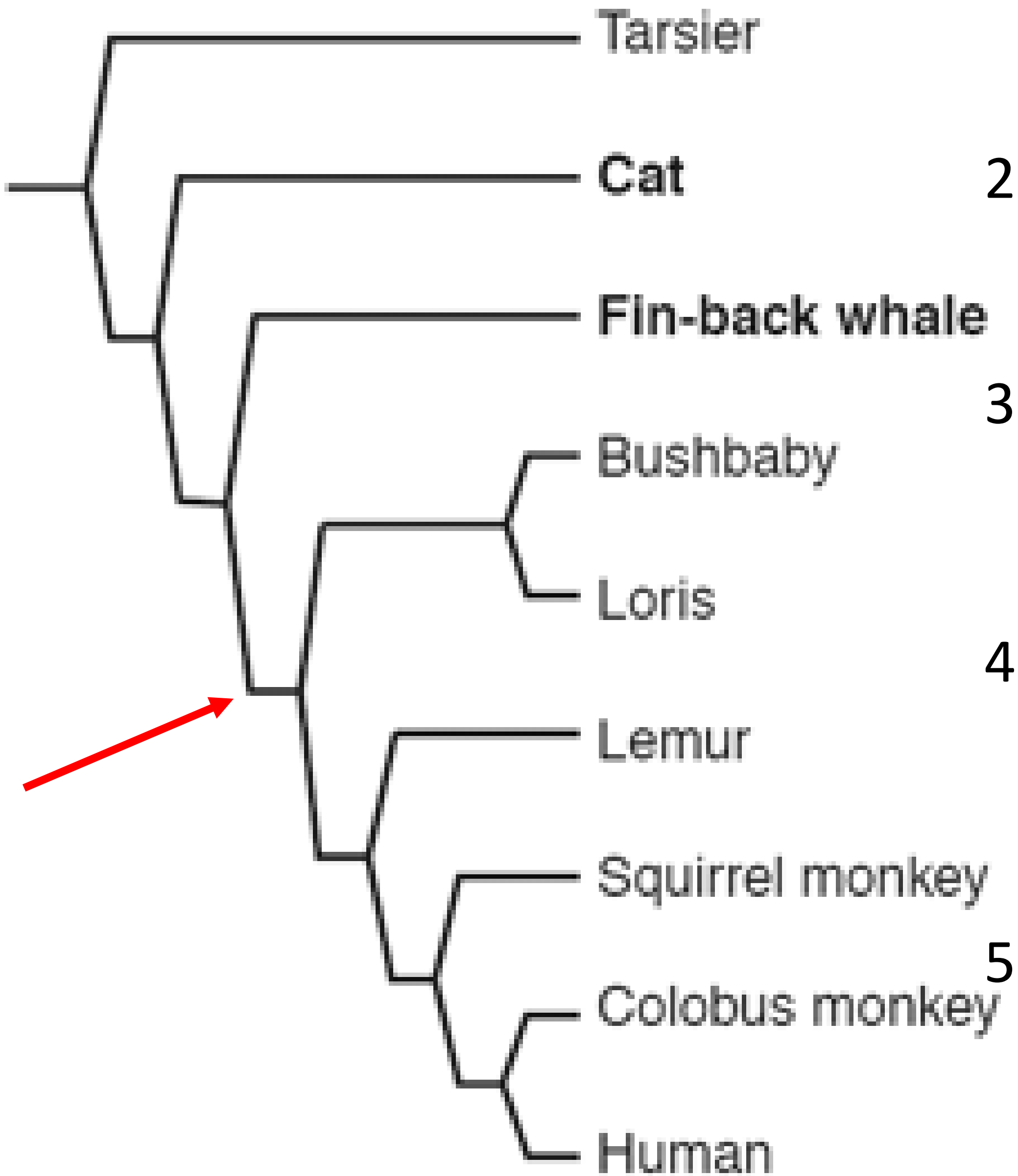
E___________ Eukarya

A___________ Archaea

B___________ Bacteria

What genus is the grizzy bear (scientific name is *Ursus horribilis*)?

ursus



1. What is the closest relative of the human? Colobus monkey
2. What is our most distant relative on this tree? Tarsier
3. What is the Loris most closely related to?

   Bush baby
4. What is the arrow showing?

   Common ancestor
5. What has happened where each branch splits? Speciation

Adaptations?

- Camouflage – colour of fur
- Animals in cold regions have a small surface area:volume ratio to conserve heat
- Fat layer for insulation in arctic fox
- Fur is shorter in desert fox
- Eyes on the front of the head to see prey
- Sharp teeth for ripping flesh

Type of adaptation	Meaning	Example(s)
Behavioural	Responses made by an organism that help it to survive/reproduce	huddling, moving in herds
Structural	A feature of an organism's body that helps it to survive/reproduce	Sharp teeth in a predator, small surface area: volume ratio in arctic animals
Functional	A body process that helps an organism to survive/reproduce	a drop in body temperature during hibernation, camels produce urine with a low water content and don't sweat much.

Abiotic and Biotic factors

- What is an abiotic factor?
- Give some examples.

- non living factors

- Light intensity
- Carbon dioxide levels (plants)
- Oxygen levels (aquatic animals)
- Moisture levels
- Soil pH and mineral content
- Wind intensity and direction

- What is a biotic factor?
- Give some examples.

- living factors

- availability of food
- new predator arriving
- new pathogen
- one species out-competing another

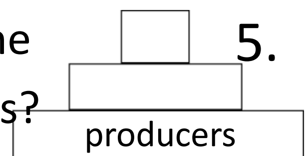
What's the keyword?

Keyword	Definition
Habitat	A place where a community of organisms lives
Community	All the populations of different organisms living and interacting in a place at the same time.
Ecosystem	The interaction of a community of living organisms with the non-living parts of their environment.
Interdependence	Within a community each species depends on other species for food, shelter, pollination, seed dispersal. If one species is removed it can affect the whole community.
Stable community	All the species and environmental factors are in balance so that population sizes remain fairly constant.

Food chains and biomass

Algae → water beetle → frog → kingfisher

1. Which organism is the producer in this food chain?
2. Which organism is the secondary consumer?
3. What do the arrows represent?
4. What is biomass?
5. Why must the producers be on the bottom of the pyramid of biomass?



6. Why is the efficiency of biomass transfer from producers to primary consumers only around 1%?
7. Why is the efficiency of biomass transfer from primary consumers to secondary consumers only around 10%?

1. algae
2. frog
3. Transfer of biomass
4. A quantity of living material
5. Producer is a photosynthetic organism, so makes the organic substances for consumers.
6. Light is reflected, passes through leaf, wrong wavelength, heat loss through respiration
7. Heat loss through respiration, energy losses through movement, faeces, urine

Sampling

What type of sampling would you use to sample the distribution of dandelions in a large field?

random

How would you make sure that your results are:

- Not biased

- Use a random number generator and coordinates on a grid to place quadrats

- Representative

Do enough repeats so that the mean represents the whole area

What type of sampling would you use to sample the distribution of bluebells as you moved from a shaded wood into a sunny field?

transect

What equipment would you need for this investigation?

Tape measure, quadrat, light meter

Decomposition

Which types of organisms carry out decomposition?

Bacteria, fungi

Briefly describe the process of decomposition.

Bacteria excrete enzymes (amylase, protease, lipase) which break down large molecules (starch, proteins, fats). Bacteria absorb the products of digestion by diffusion.

Which factors affect the speed of decomposition?

Temperature, moisture, oxygen

Why is decay important?

Cycles nutrients through an ecosystem

Water cycle

What process, involving plants, releases water vapour into the atmosphere?

transpiration

List ways in which living organisms rely on processes in the water cycle.

Transpiration in plants

Cell hydration in all organisms

as a solvent

in chemical reactions

Carbon cycle

What process in the carbon cycle takes in a carbon compound from the atmosphere and converts it into an organic compound that can be used to build biomass?

photosynthesis

What process releases carbon back into the atmosphere? List the types of organism that carry out this process.

Respiration.

Plants, animals, decomposers

How are carbon compounds moved between trophic levels?

Feeding by consumers

Human Impact

1. The release of which gases cause acid rain? Which human activity produces them?
2. What are the 2 greenhouse gases? Which human activities release them?
3. Give some possible consequences of global warming.
4. What is biodiversity?
5. Give at least 3 ways in which humans have tried to reduce the negative effects of humans on ecosystems and biodiversity:

1. Sulfur dioxide and nitrogen oxides. Burning fossil fuels.
2. (a) Carbon dioxide & methane.
2. (b) Burning fossil fuels, deforestation, destroying peat bogs, landfill, cattle farming.
3. Change in species distribution, change in migration patterns of birds, loss of habitat due to ice melting, flooding.
4. The variety of all the different species of organisms on earth, or within an ecosystem.
5. breeding programmes for endangered animals

- protecting rare habitats e.g. by creating national parks.
- reintroducing hedgerows on farming land.
- reducing deforestation and carbon dioxide emissions.
- recycling resources rather than dumping waste in landfill.

Food production

- What is food security?
- Give 3 biological factors that affect food security.
- What is fusarium?
- What product can we get from it?
- What conditions is it grown in?
- How can the efficiency of food production using animals be improved?
- Why is it important to maintain fish stocks?
- How can we maintain food stocks?

- Having enough food to feed a population.

- Population growth (increasing birth rate)
- New pests and pathogens
- Effects of climate change e.g. widespread famine if rains fail, flooding destroying growing crops.

- A fungus
- Mycoprotein – useful for vegetarians.
- Glucose syrup, Aerobic conditions, Biomass is harvested and purified.

- Limit movement of animals → reduces energy transfer to the environment.
- Controlling temperature of their surroundings → reduces heat loss to the environment.
- Fed high protein foods → increase growth.

- Fish stocks are declining , need to be kept at a level where breeding continues.

- Control net size
- Introduce fishing quotas

Which group of cows will lose more energy to the surroundings?

Maximum increase in biomass from animals without feeding them extra food.

Factory Farming

Keep animals inside:

- Restricted space to move.
- Constant ideal temperature.

Can be sold for meat very quickly.

Keep fish in cages.

Energy losses in free range animals

Limit animal's movement → Less energy needed for movement and finding food

Keep animals in warm building → Less energy needed to maintain body temperature

Less energy lost means more food is converted into animal meat (or eggs, milk etc). This makes intensive animal farming more EFFICIENT (although not nice for the animals!!)

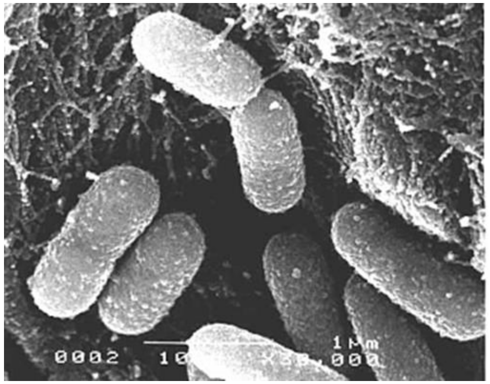
Decomposition by microbes:

- Enzymes released (such as?)

- Material (such as?) broken into smaller molecules (such as?)

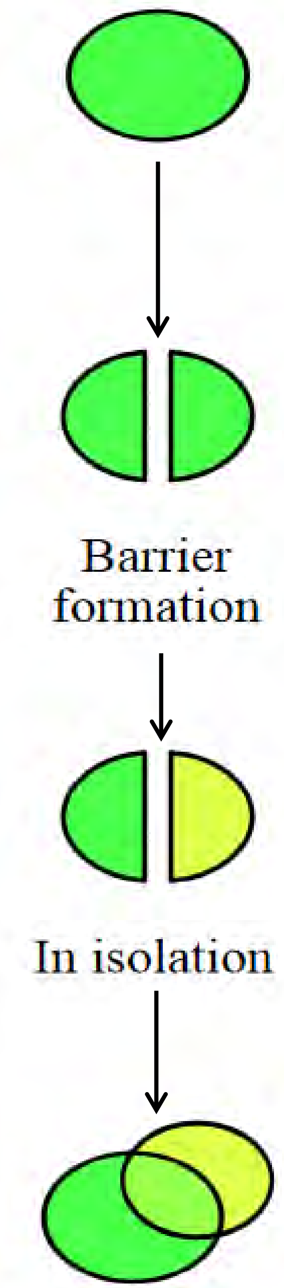
- Smaller molecules absorbed (how?)

- What process will microbes be carrying out to allow e.g. active transport to happen?



Speciation

- A species becomes ____________e.g. due to volcanic activity.
- A barrier is formed between the two populations so they cannot meet to breed.
- There is _________ variation between the species.
- Over time in each population natural selection will cause the most ________ individuals to _________(_________ that give an advantage are passed on).
- Eventually the differences between the species will become so great that when they meet again they cannot successfully ____________.



Random sampling

- Why do we need to place the quadrat at several different random sites in the field?

So it is representative of the whole field

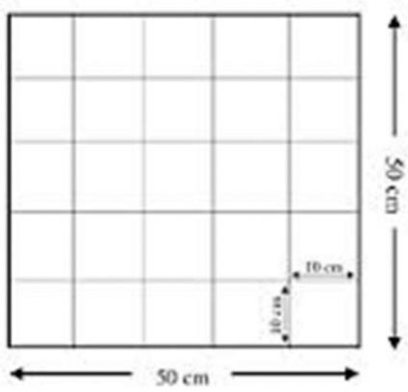
Mean number of daisies per quadrat = 14

- The quadrats were 0.5m by 0.5m. How many of these quadrats could we fit into $1m^2$?

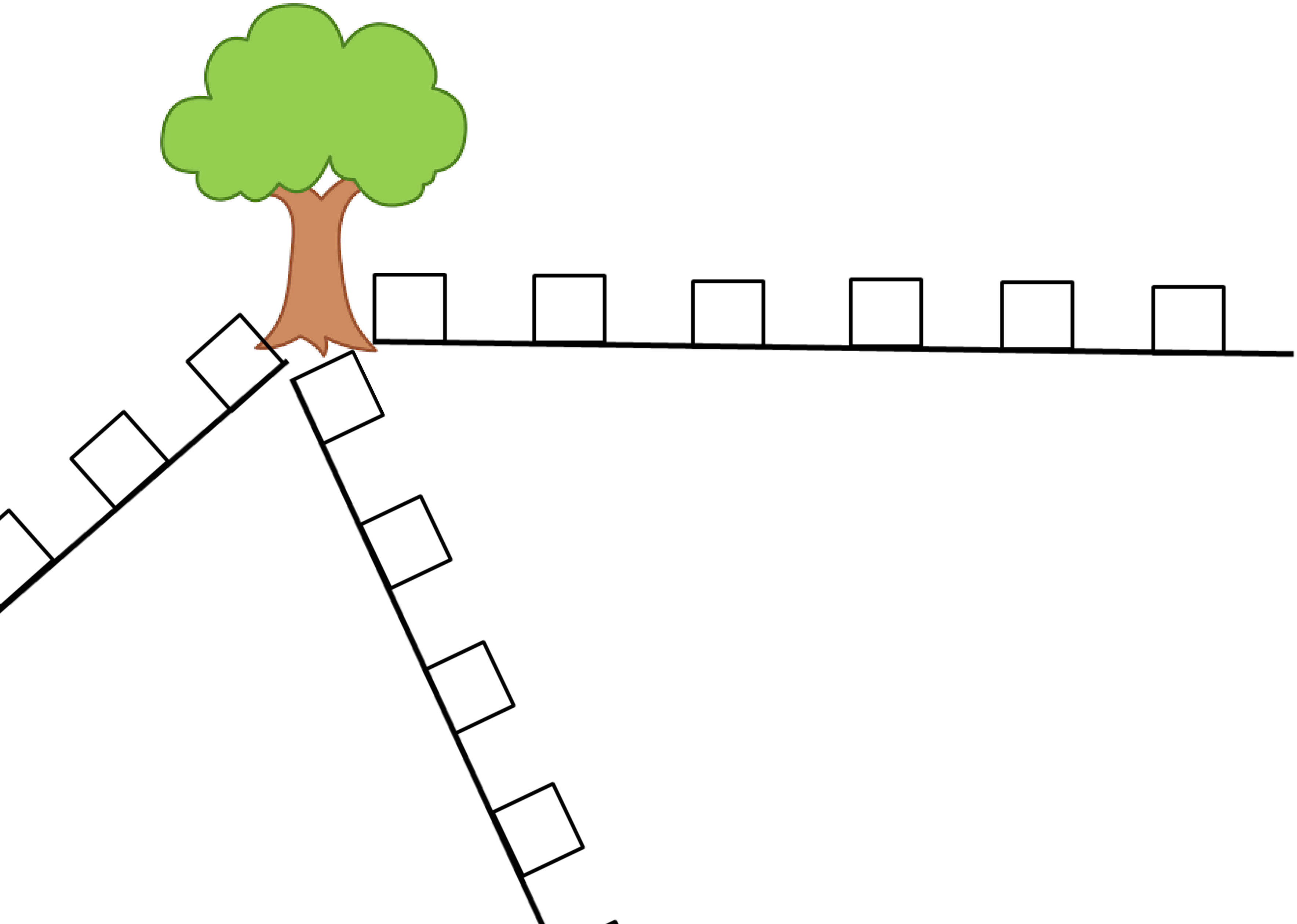
4

- If the field is $334m^2$, use the mean to estimate the abundance of daisies. Give your answer to 3sf.

18,700



Transect sampling



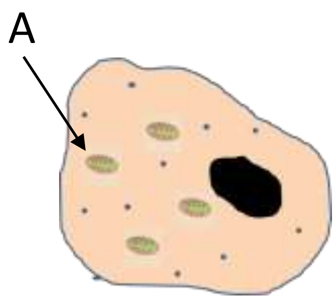
Biology 1 Revision

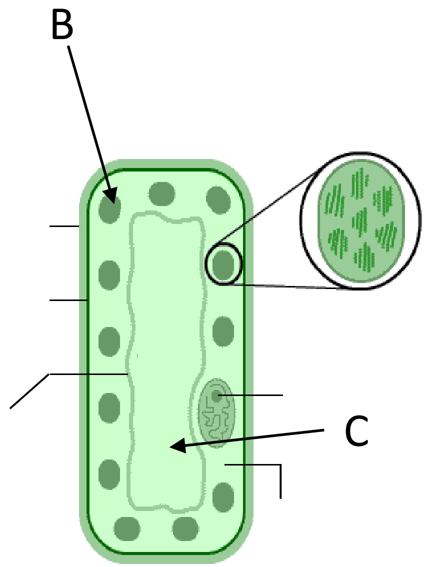
<u>Paper 1 topics:</u>

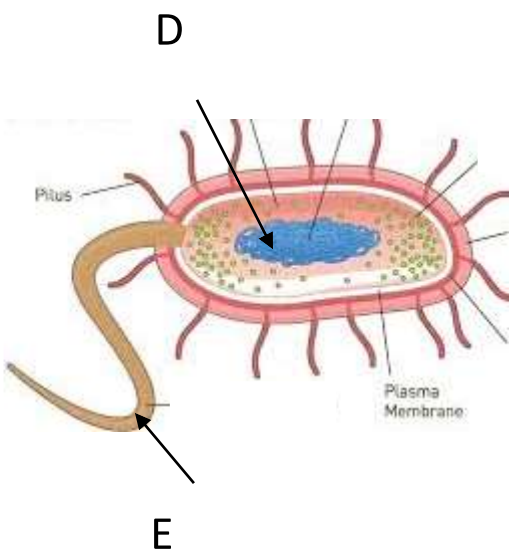
- Cells
- Systems
- Plants
- Disease

Cell structure

- Plant, animal or bacterial? Prokaryote or Eukaryote?
- What are the names of structures A-E?



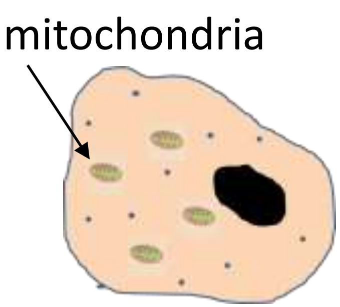




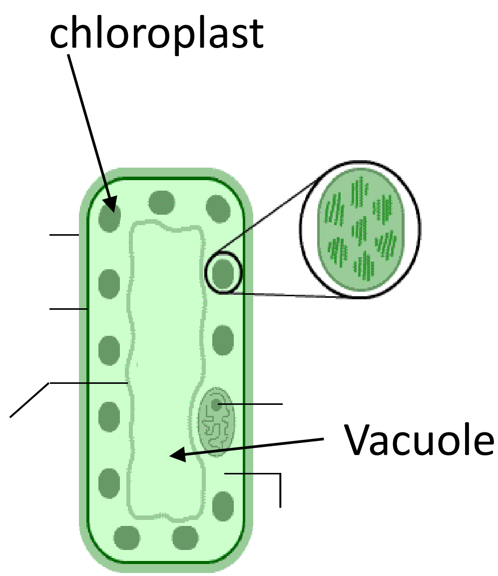
Cell structure

- Plant, animal or bacterial?
- What are the names of structures A-E?

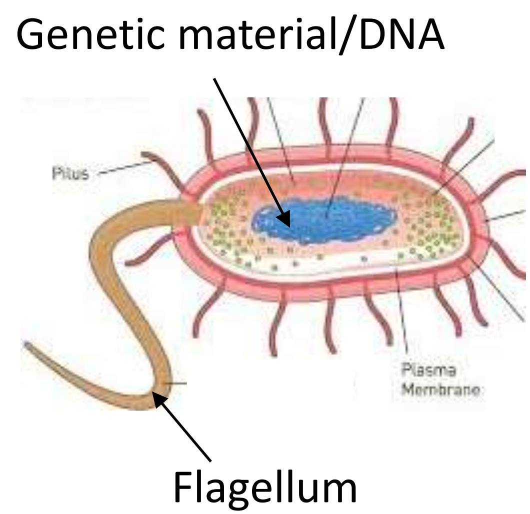
__Animal - eukaryote__



__Plant - eukaryote__

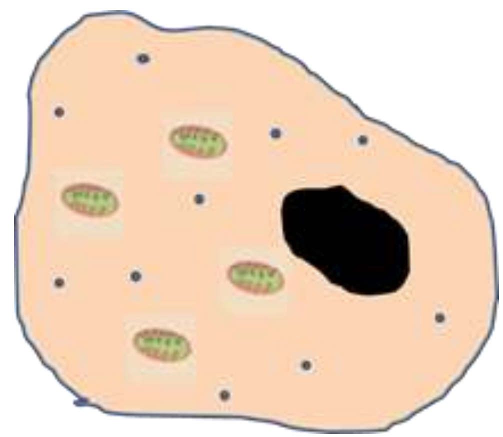


__Bacteria - Prokaryote__

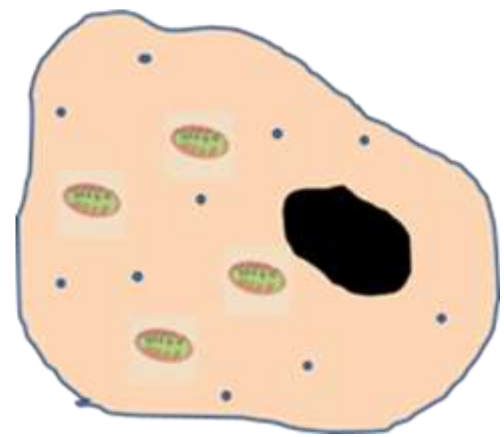


Part	Function	Animal	Plant
Nucleus		✓	✓
	most of the chemical reactions take place here.		
Mitochondria			
	where protein synthesis occurs		
	controls the passage of substances into and out of the cell		
	made of cellulose, which strengthens the cell		
Chloroplasts			
	filled with cell sap.		

What should the blank spaces say?



Part	Function	Animal	Plant
Nucleus	Contains DNA, controls the activities of the cell	✓	✓
Cytoplasm	most of the chemical reactions take place here.	✓	✓
Mitochondria	Site of respiration	✓	✓
Ribosome	where protein synthesis occurs	✓	✓
Cell Membrane	controls the passage of substances into and out of the cell	✓	✓
Cell Wall	made of cellulose, which strengthens the cell	X	✓
Chloroplasts	absorb light energy to make food	X	✓
Vacuole	filled with cell sap.	X	✓



Specialised cells

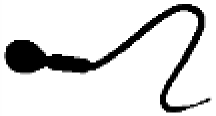
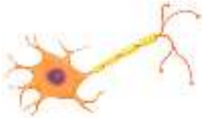
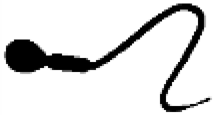
Diagram	Name	Function	Adaptation
		Transmit electrical impulse	
		Transport oxygen	
		Sweep mucus & pathogens away from the lungs	
		Fertilise an egg cell	

Diagram	Name	Function	Adaptation
	Nerve cell	Transmit electrical impulse	Long axon to carry impulse over long distances Many dendrites to make many connections with other cells
	Red blood cell	Transport oxygen	Biconcave shape → large surface area No nucleus so it can contain more haemoglobin
	Ciliated epithelial cell	Sweep mucus & pathogens away from the lungs	Sticky mucus traps dust. Hairs move dirt away from lungs.
	Sperm cell	Fertilise an egg cell	Streamlined shape & tail – can swim to the egg Chemicals in the tip to enter the egg cell.

Microscopes

Which microscope allows us to see mitochondria?

electron

How many micrometres are there in a millimetre?

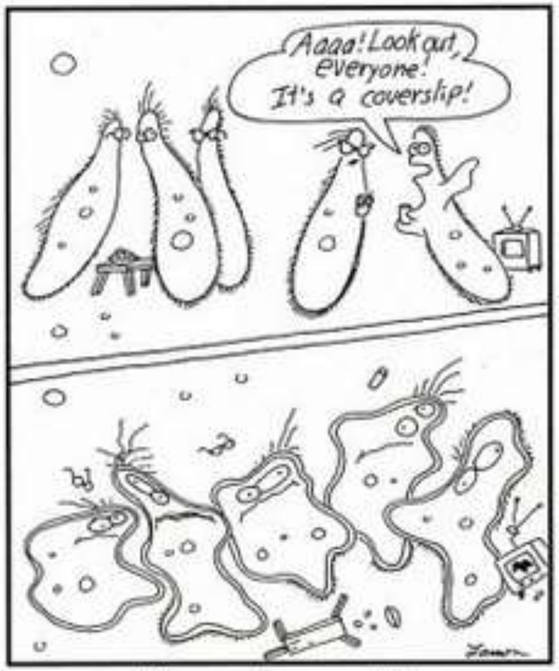
1000

A scientist viewed a picture of a cell, that had been magnified 100,000 times.

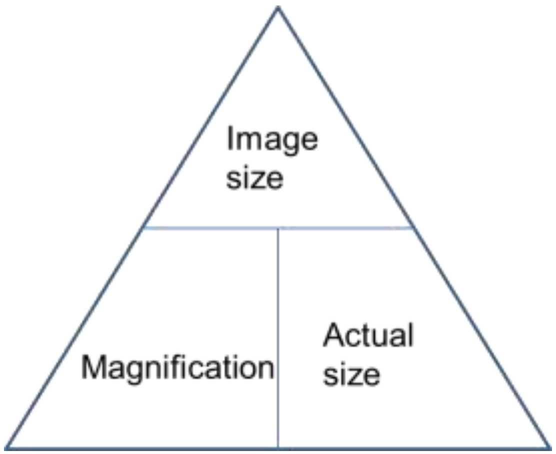
The size of the cell in the image was 25mm.

How large was the actual cell?

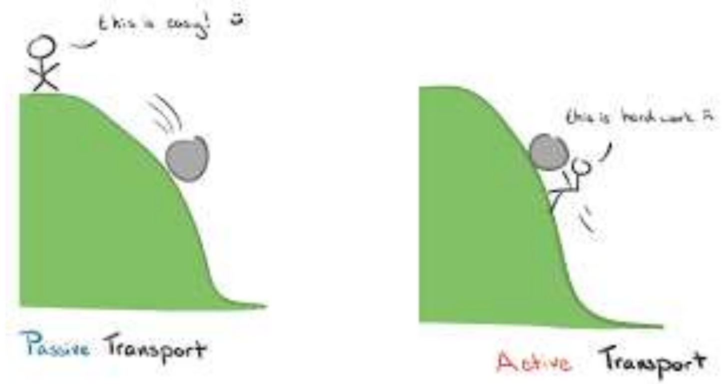
0.25µm



Life on a microscope slide



Exchange of substances



Diffusion, osmosis or active transport?

- Uptake of mineral ions in the soil into root hair cells, against the concentration gradient.

ACTIVE TRANSPORT – requires energy from respiration

- Uptake of water in root hair cells.

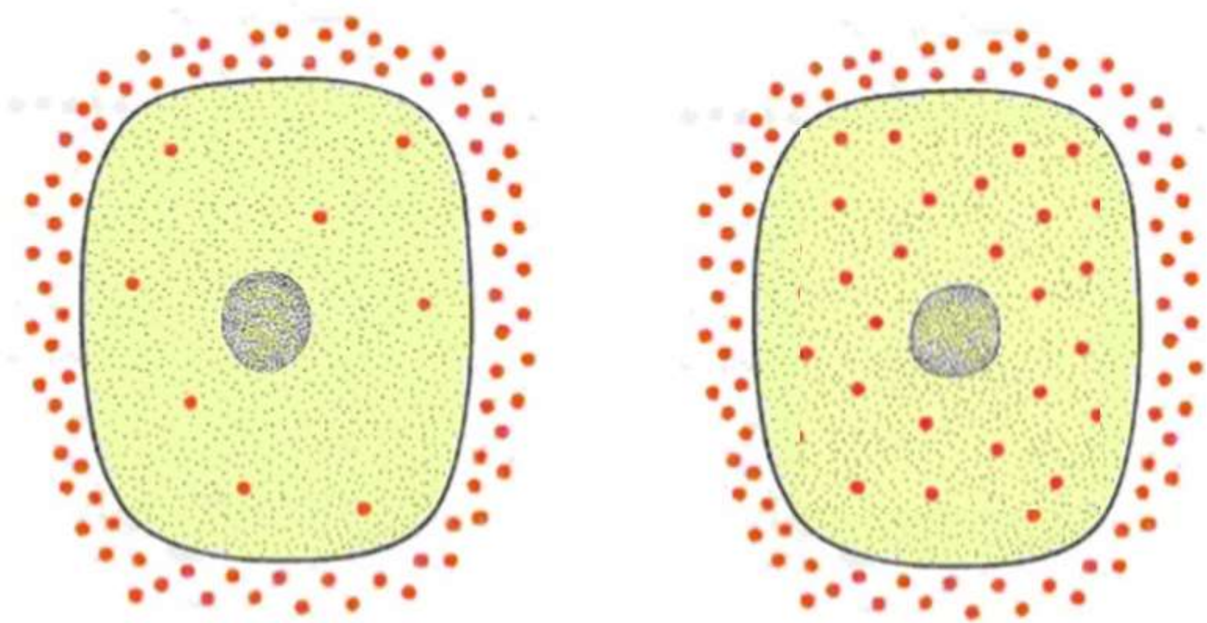
OSMOSIS

- Movement of oxygen and carbon dioxide between alveoli and capillaries.

DIFFUSION – passive, no energy required as it is moving from an area of high concentration to an area of low concentration.

Exchange of substances

- How can we speed up diffusion?
- How is this achieved in the lungs and small intestine?

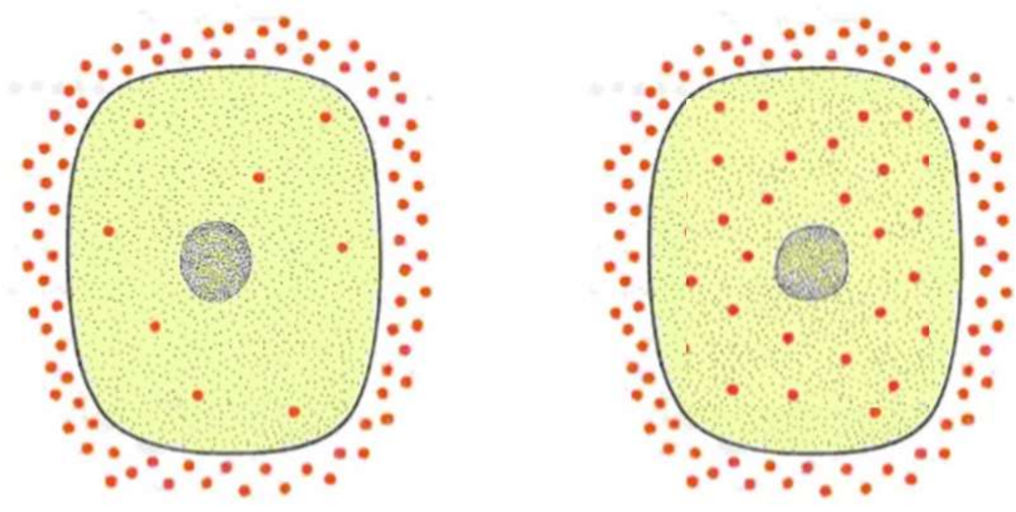


Which cell will have more rapid diffusion of oxygen?

Why?

Exchange of substances

- Many alveoli and villi → Large surface area
- Many capillaries so an excellent blood supply → Steep concentration gradient
- Alveoli and villi both have thin walls → Short diffusion distance

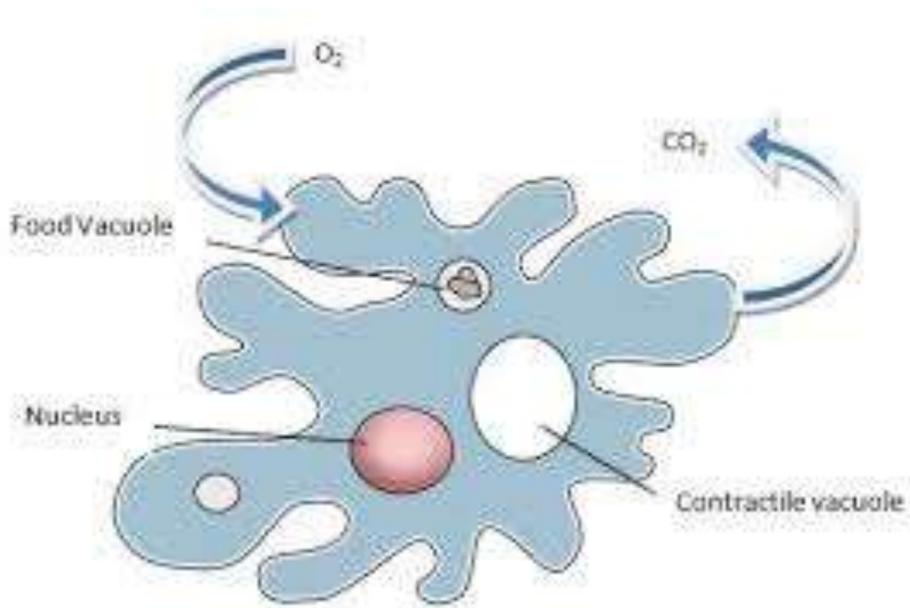


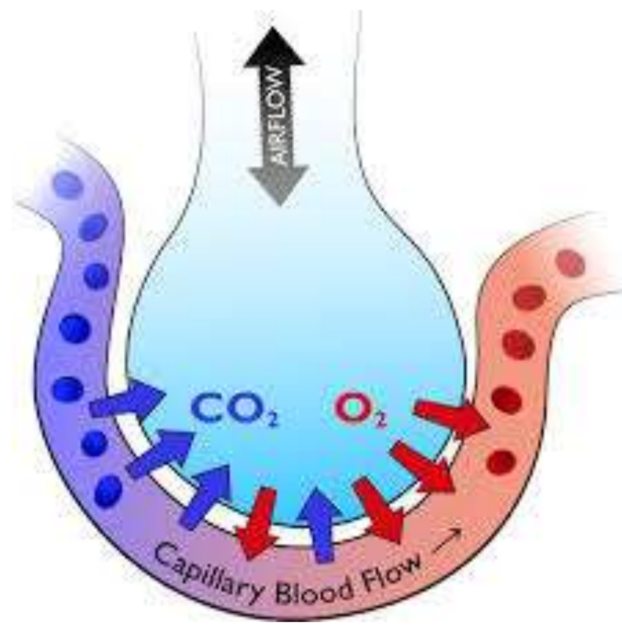
The cell on the left:

There is a steeper concentration gradient so diffusion is faster. This cell is respiring rapidly, so the oxygen concentration inside the cell remains low.

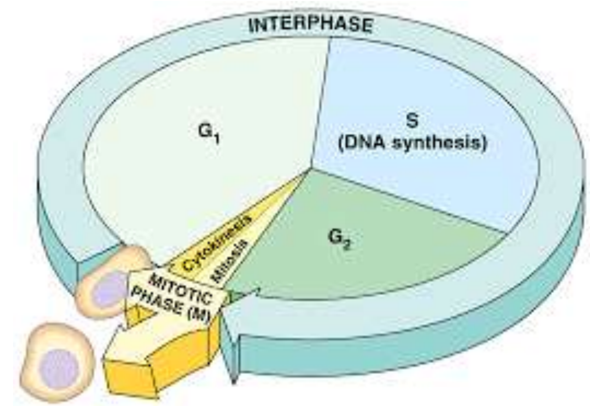
Why do we have lungs?

Multicellular organisms need specialised exchange surfaces – diffusion across the surface would not be sufficient to supply the organism's needs.





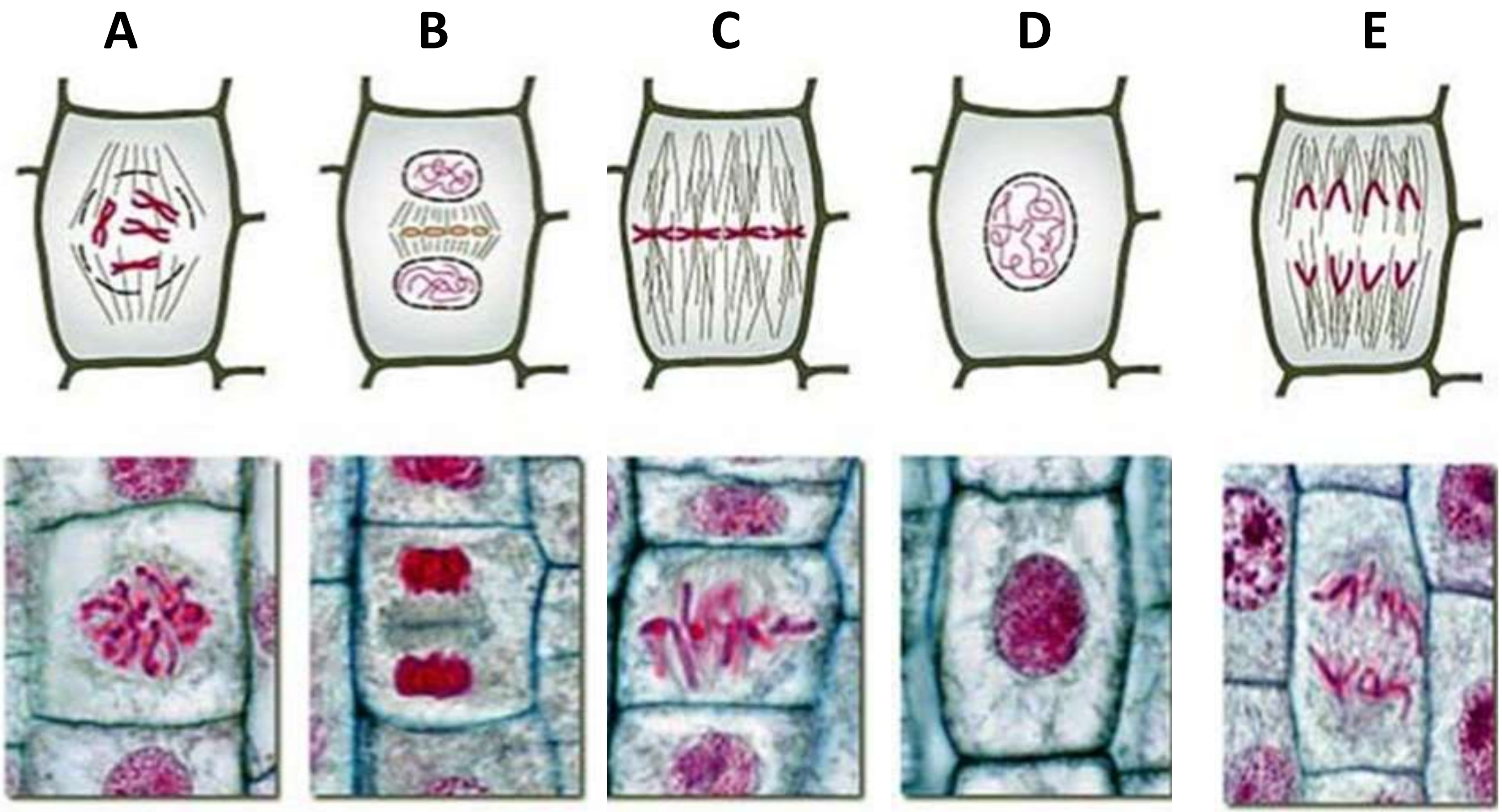
Cell cycle



- Main stages
- G1 – growth – new ribosomes, mitochondria
- S – DNA replication
- G2 – more growth, checking for errors
- M – Mitosis – nucleus divides

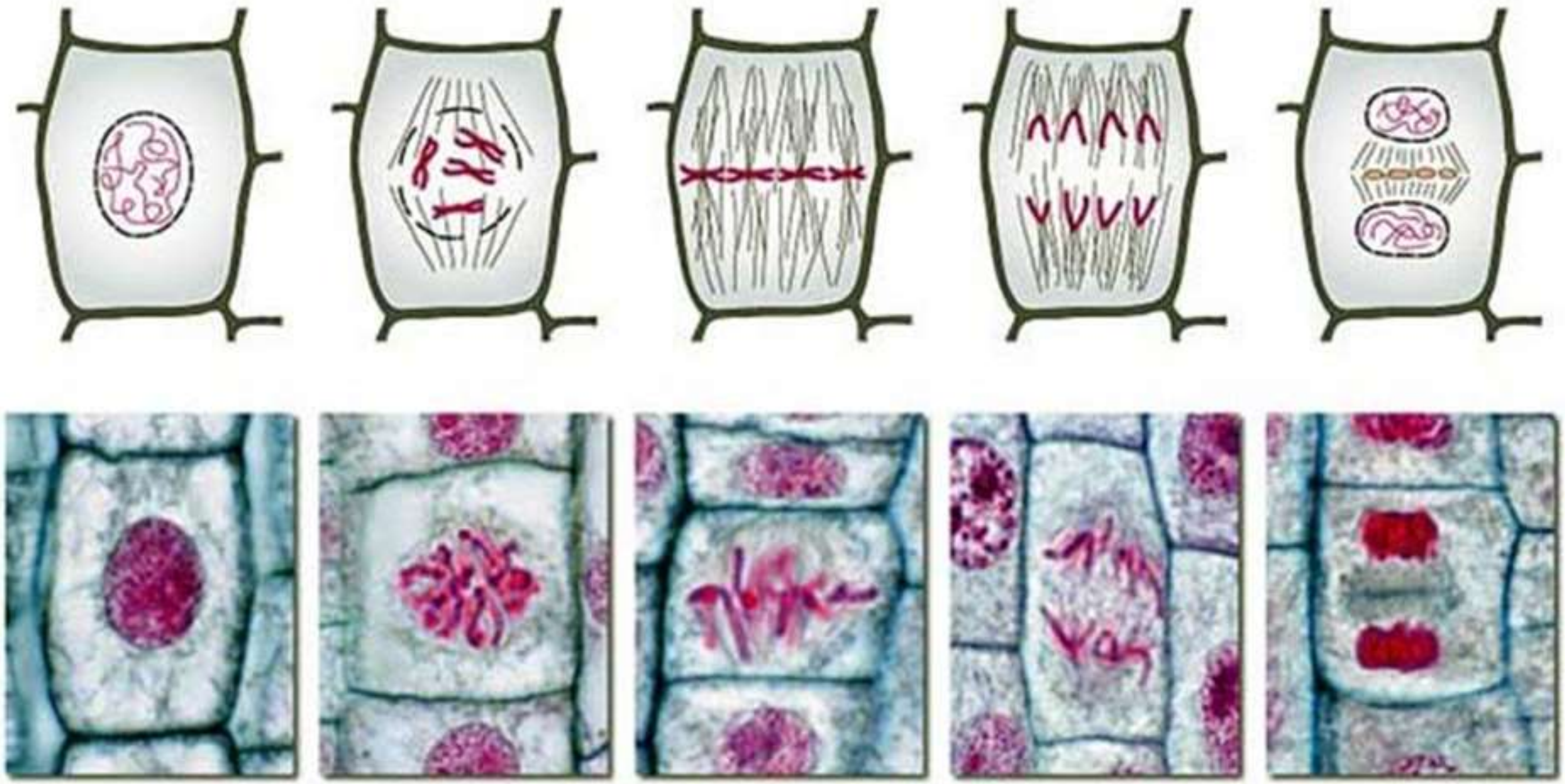
- What happens at each stage?

Mitosis – put the stages in order

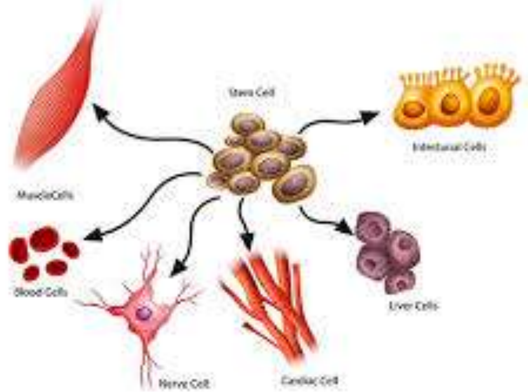


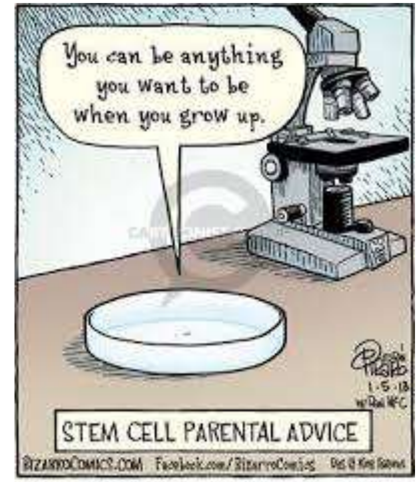
Mitosis

D **A** **C** **E** **B**



Stem cells





©Dan Piraro

- What are they?

Undifferentiated cells, capable of dividing many times and developing into different types of specialised cells

- Adult vs Embryo
    - Range of cell types –

    embryo can develop into many more cell types, so can treat more diseases

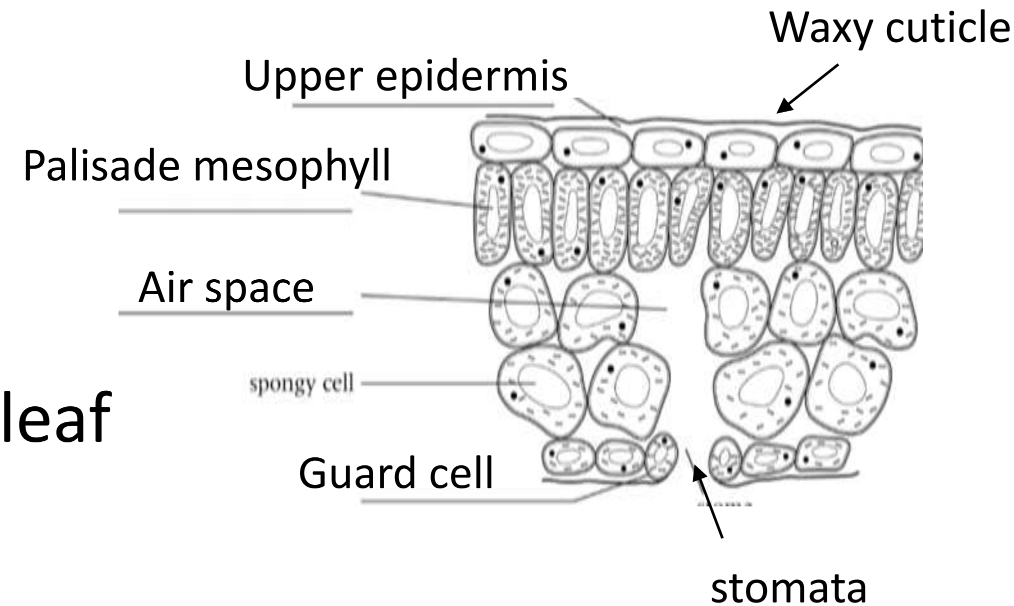
    - Rejection

    if the stem cell is taken from a patient's own bone marrow there will not be issues with rejection

    - Ethical issues

    some people object to using embryonic stem cells as it involves destroying embryos.

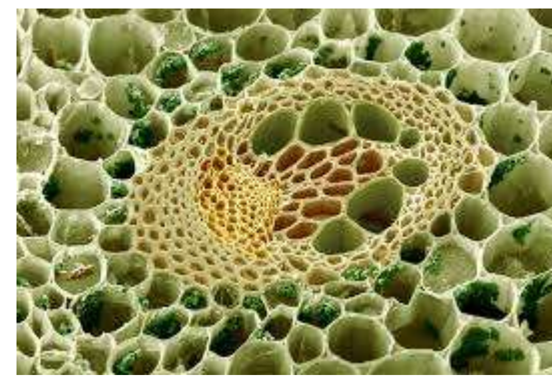
Plant tissues



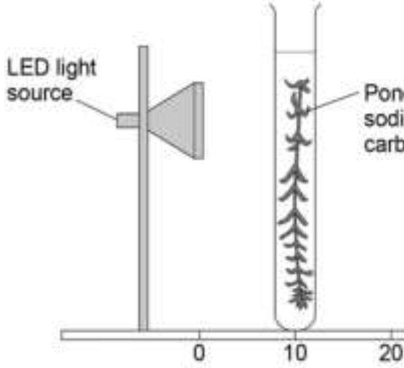
- Label the parts of the leaf

- Which plant tissue is it?

Plant tissue	Role
Mesophyll	Carry out photosynthesis
Epidermis	Cover the plant
Xylem and Phloem	Transport substances
Meristem	Growing tips of shoots and roots



Photosynthesis



- Equation:

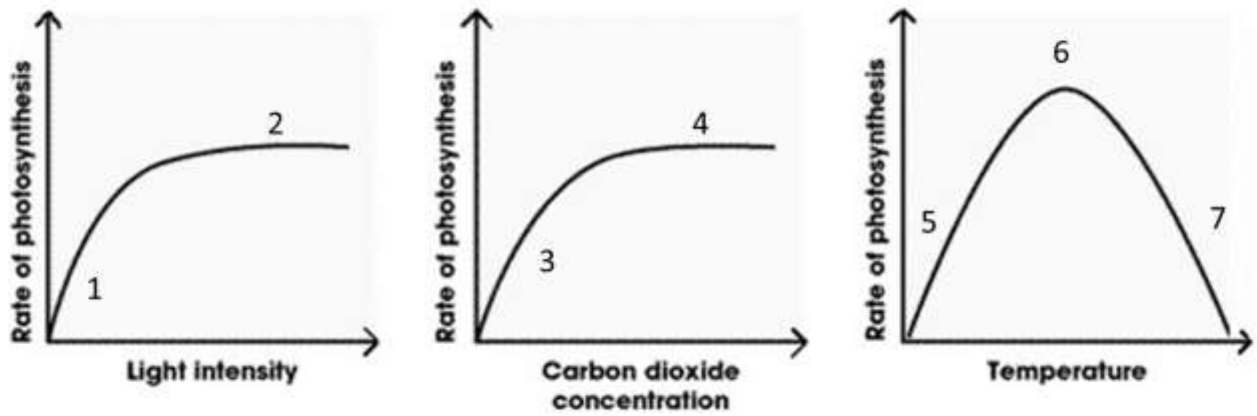
Carbon dioxide + water → glucose + oxygen

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

- Why do plants do photosynthesis?
- To produce glucose – stored as starch, stored as fats and oils, used to make amino acids, used to make cellulose for cell walls, used in respiration
- Measuring photosynthesis?
- Counting bubbles under water in a minute, measuring volume of oxygen produced per minute, testing leaves for the presence of starch

Limiting factors

- What are the limiting factors for photosynthesis?
- Light intensity, temperature, carbon dioxide levels (chloroplasts)



What is the limiting factor(s) at:

1 light intensity

2 carbon dioxide levels/temperature

3 carbon dioxide levels

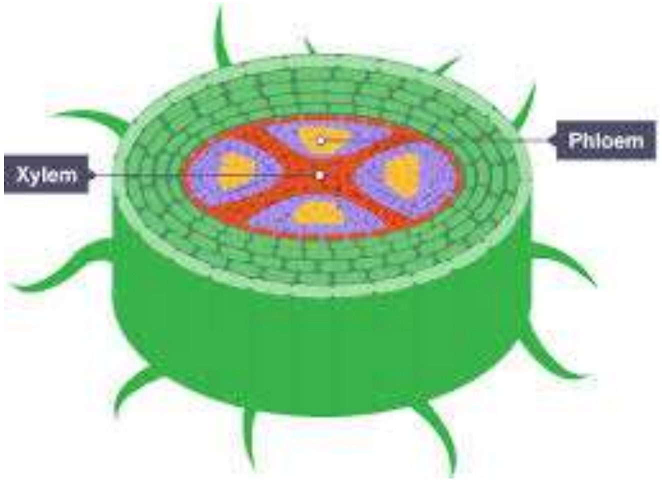
4 light intensity/temperature

5 temperature

6 light intensity/carbon dioxide levels

7 temperature

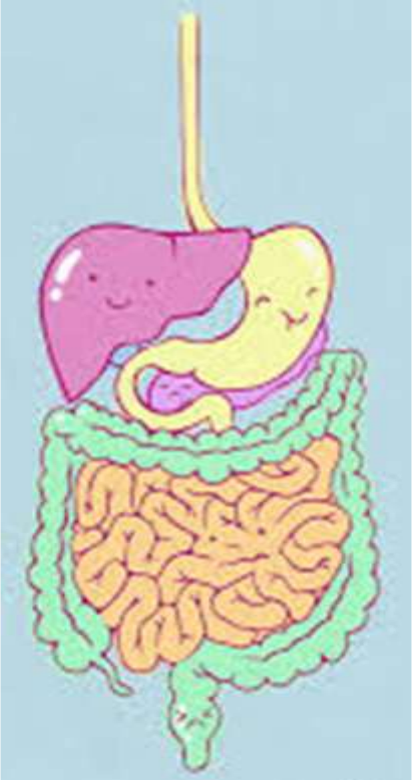
Transport in plants



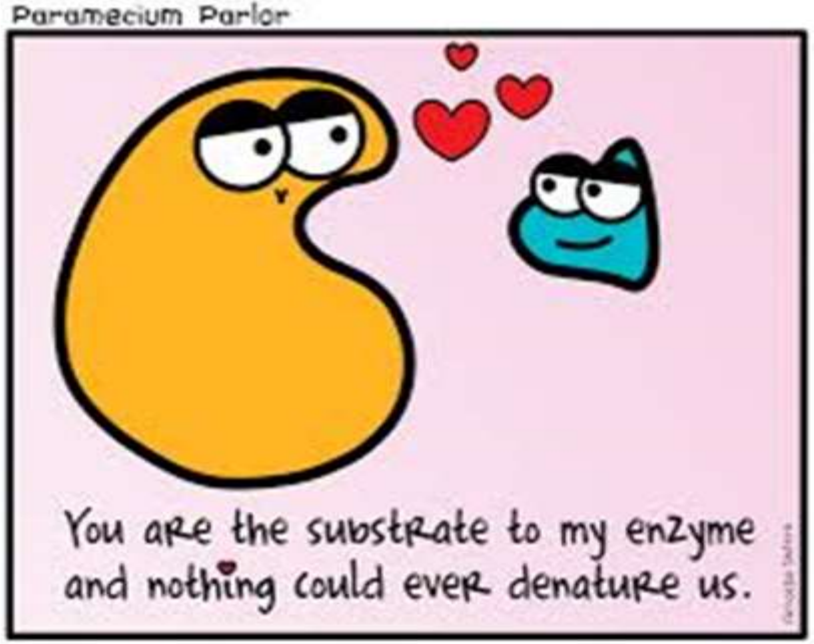
- What does the xylem transport?
- Water and mineral ions
- What does the phloem transport?
- sugar
- What is transpiration?
- Evaporation of water from stomata in the leaves
- What factors speed up transpiration?
- High temperature, low humidity, wind, high light intensity (opens stomata)

Systems – digestive system

- What do amylase, protease and lipase break down? What is the product in each case?
  - Amylase: Starch → sugar
  - Protease: Protein → amino acids
  - Lipase: Fat → fatty acids and glycerol
- What is the food test for:
- Starch
- Iodine – turns blue black
- Protein
- Biuret – turns purple
- Fat
- Sudan III – top layer is red
- Glucose
- Heat with benedict's – turns orange



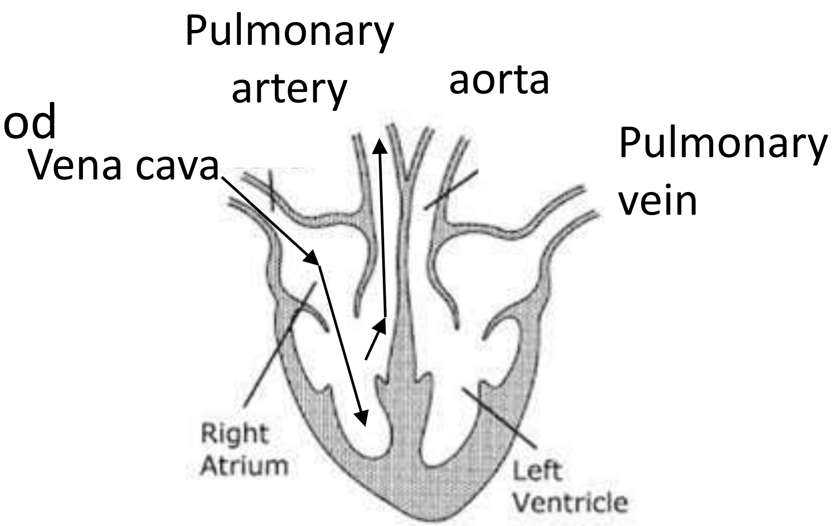
Digestive system

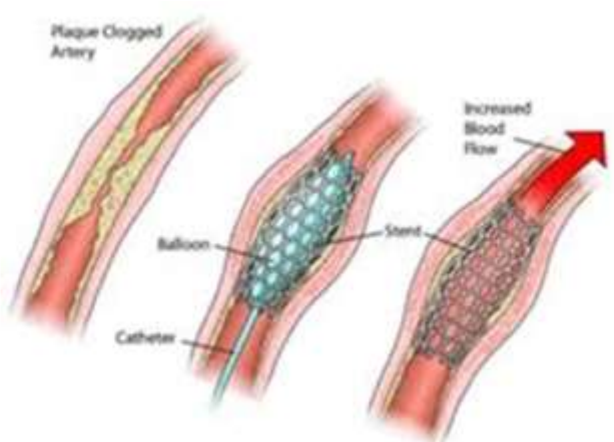


- Which organ makes bile?
- Liver (stored in the gall bladder)
- What does bile do?
- Emulsifies fat droplets to increase the surface area, neutralises stomach acid, so the small intestine is the correct pH.
- Where are villi found?
- Small intestine
- What happens to enzymes at high temperatures or the wrong pH?
- Enzymes denature (active site changes shape so substrate cannot fit)

Systems – Circulatory system

- Label the blood vessels
- Add arrows to show the direction of blood flow.
- How is heart rate controlled?
- Pacemaker on the right atrium.
- How can an irregular heart beat be treated?
- Artificial pacemaker





What is this? What is it used for?
Stent
Widens coronary arteries if there is a fatty deposit
Advantages – increases blood flow to heart muscle
Disadvantages – surgery/ anaesthetic risk, blood clotting, damage to blood vessels

Systems – Circulatory system

Why do arteries have a thick muscle layer?

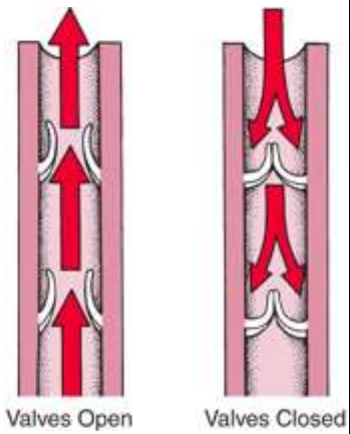
To cope with high blood pressure.

Why do veins have valves?

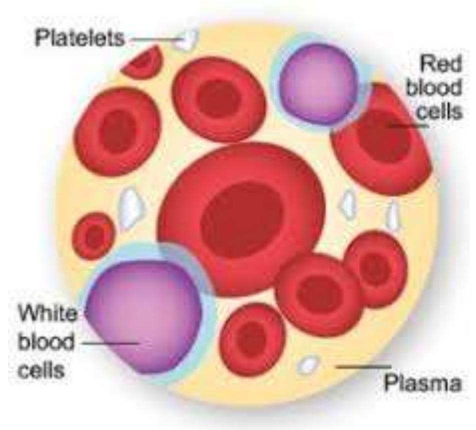
To prevent backflow

Why do capillaries have thin walls?

To allow rapid exchange of substances by diffusion.



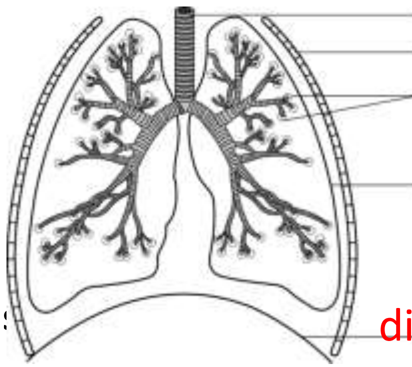
Component	Function
Red blood cells	Transports oxygen
White blood cells	Destroys pathogens
Platelets	Clots blood
Plasma	Transports dissolved substances, e.g. urea, water, glucose, amino acids, mineral ions, hormones



Systems – Respiratory system

- **What is the equation for aerobic respiration?**
- Glucose + oxygen → carbon dioxide + water
- $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
- **What is the equation for anaerobic respiration in animals?**
- Glucose → lactic acid
- **What is the equation for anaerobic respiration in plants and yea**
- Glucose → ethanol + carbon dioxide
- **Why is lactic acid produced when we exercise?**
- We don’t have enough oxygen reaching our muscles, so they do anaerobic respiration instead of aerobic respiration.
- **Why does our heart rate increase when we exercise?**
- More oxygen and glucose are delivered to our cells.
- Our cells do more respiration. This releases more energy.

Label the diagram

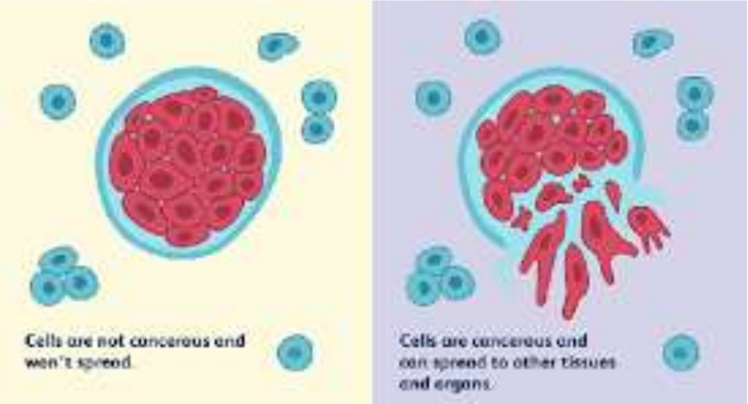


Non-communicable diseases

- Match the risk factors to the disease:

Disease	Risk Factor
Lung disease and lung cancer	Diet, smoking and lack of exercise
Cancer	Obesity
Cardiovascular disease	Alcohol
Liver and brain function	Smoking
Type 2 Diabetes	Smoking and alcohol
Unborn babies	Carcinogens and ionising radiation

Cancer



- What is cancer?
- Changes in cells that lead to uncontrolled growth and division.
- What are benign tumours?
- Abnormal growths of cells contained in one area.
- What are malignant tumours?
- Cancers that spread to other tissues through the blood where they form secondary tumours.

Disease

Type of pathogen	Name of disease	How it is spread	Reducing the spread	Symptoms	Treatment
Virus	Measles	droplets from sneezes, coughs	vaccination	Rash, fever	
	HIV	Sexual contact, dirty needles	condoms	More likely to get other infections (white blood cells are affected)	antiretroviral drugs
	Tobacco mosaic virus			Mosaic pattern on leaves → less photosynthesis	
Fungus	Rose black spot	Wind, water	Remove and destroy affected leaves	Black spots on leaves → less photosynthesis	fungicide
Bacteria	Salmonella	Poor food hygiene	Wash hands before handling food, vaccinate chickens		
	Gonorrhoea	sexual contact	condoms	Yellow/green discharge, pain when urinating	antibiotics
Protist	Malaria	mosquitos	Mosquito nets, destroy breeding sites	Fever, can be fatal	

Plant Disease – Detection

- Stunted growth
- Spots on leaves
- Areas of decay (rot)
- Growths
- Malformed stems or leaves
- Discolouration
- Presence of pests e.g. aphids

What do plants need minerals for?

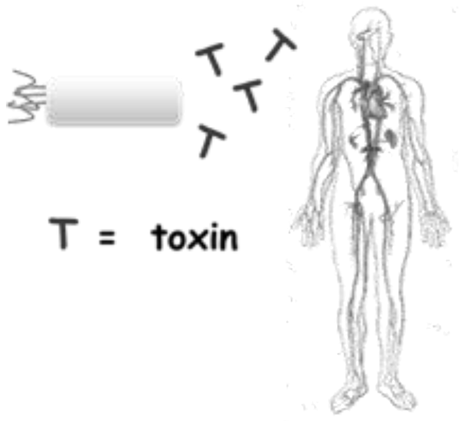
- Nitrates – TO MAKE PROTEIN
- Not enough nitrates → stunted growth
- Magnesium – TO MAKE CHLOROPHYLL
- Not enough magnesium → yellow leaves

Plant Disease –Identification

How could you check exactly what the problem was?

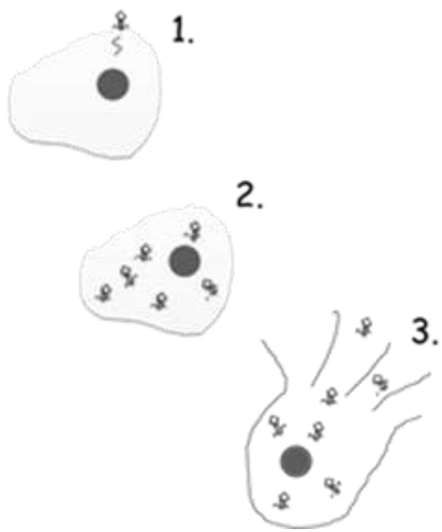
1. Use a gardening guide / manual
2. Take infected plants to a laboratory to identify the pathogen
3. Use testing kits that contain monoclonal antibodies

For each picture, name the type of pathogen it represents and say why it makes us feel ill.



Bacteria

Reproduces rapidly and makes toxins



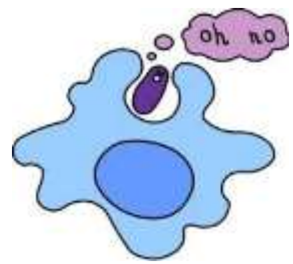
Virus

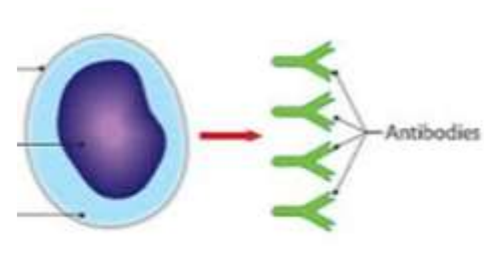
Damages tissues

Body's defences

- What do they do?
- Mucus
- Traps pathogens and dirt in the airways
- Cilia
- Sweeps mucus, pathogens and dirt away from the lungs
- Skin
- Forms a barrier
- Platelets
- Clots the blood at the site of a wound
- Stomach acid
- Destroys pathogens in food and drink

Which type of white blood cell does each picture show? How do they each protect us?

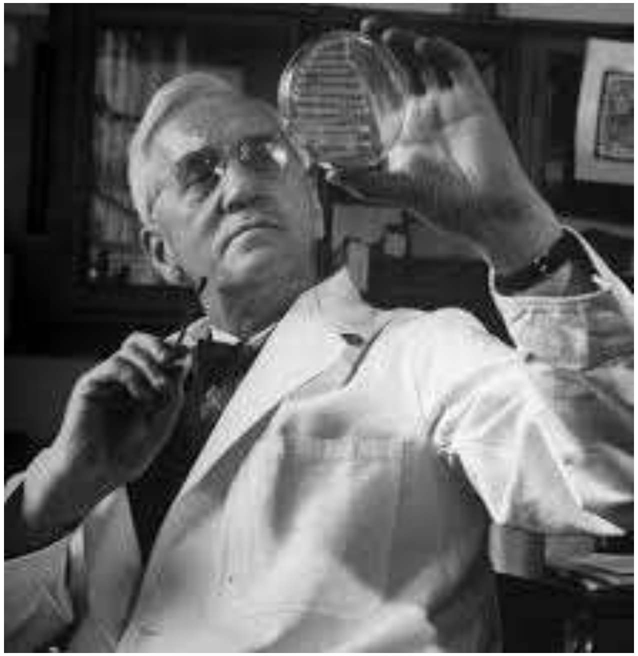




Phagocyte - Engulfs and ingests pathogens (phagocytosis)

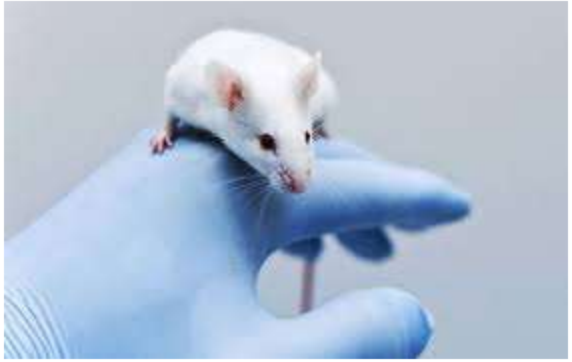
Lymphocyte - Produces antibodies and antitoxins

Drugs

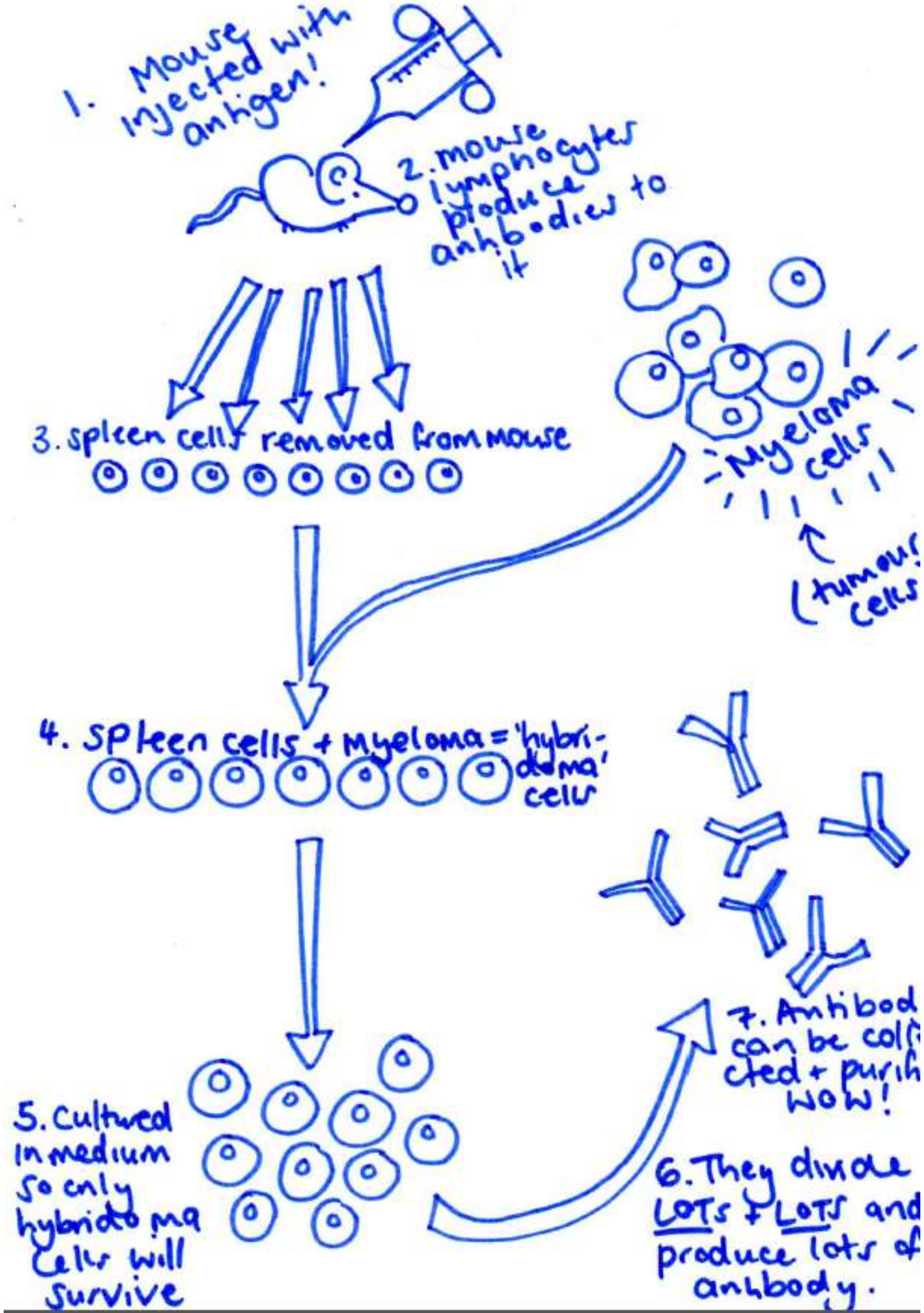


- What is an antibiotic?
- Drug that kills bacteria.
- What is a painkiller?
- Drug that relieves symptoms only.
- Why can’t antibiotics cure a common cold?
- Antibiotics only kill bacteria not viruses.
- Why should doctors only give out specific antibiotics for specific infections?
- Reduces risk of getting resistant strains of bacteria
- Where do aspirin, digitalis and penicillin originate from?
- Willow tree, foxglove and a mould.

Drug testing



- Why do drugs need to be tested
- For toxicity, efficacy, dosage and side effects.
- What steps are involved in pre-clinical testing?
- Cells and tissue testing, testing live animals.
- What steps are involved in clinical testing?
- Testing healthy volunteers, testing patients with the disease.
- What is a placebo?
- Fake drug
- What is a double blind trial?
- Neither the doctors nor the patients know who has been given the real drug and who has been given the placebo.


1. Mouse injected with antigen!
2. mouse lymphocytes produce antibodies to it
3. spleen cells removed from mouse
Myeloma cells
(tumour cells
4. Spleen cells + Myeloma = 'hybri-doma' cells
5. Cultured in medium so only hybridoma cells will survive
6. They divide LOTS + LOTS and produce lots of antibody.
7. Antibod can be coll cted + purif WOW!

Uses of Monoclonal Antibodies

- Pregnancy tests
- Measuring hormone and other chemical levels in blood
- Detect pathogens
- Locate or identify specific molecules in a cell or tissue by binding to them with a fluorescent dye
- Treat diseases e.g. cancer

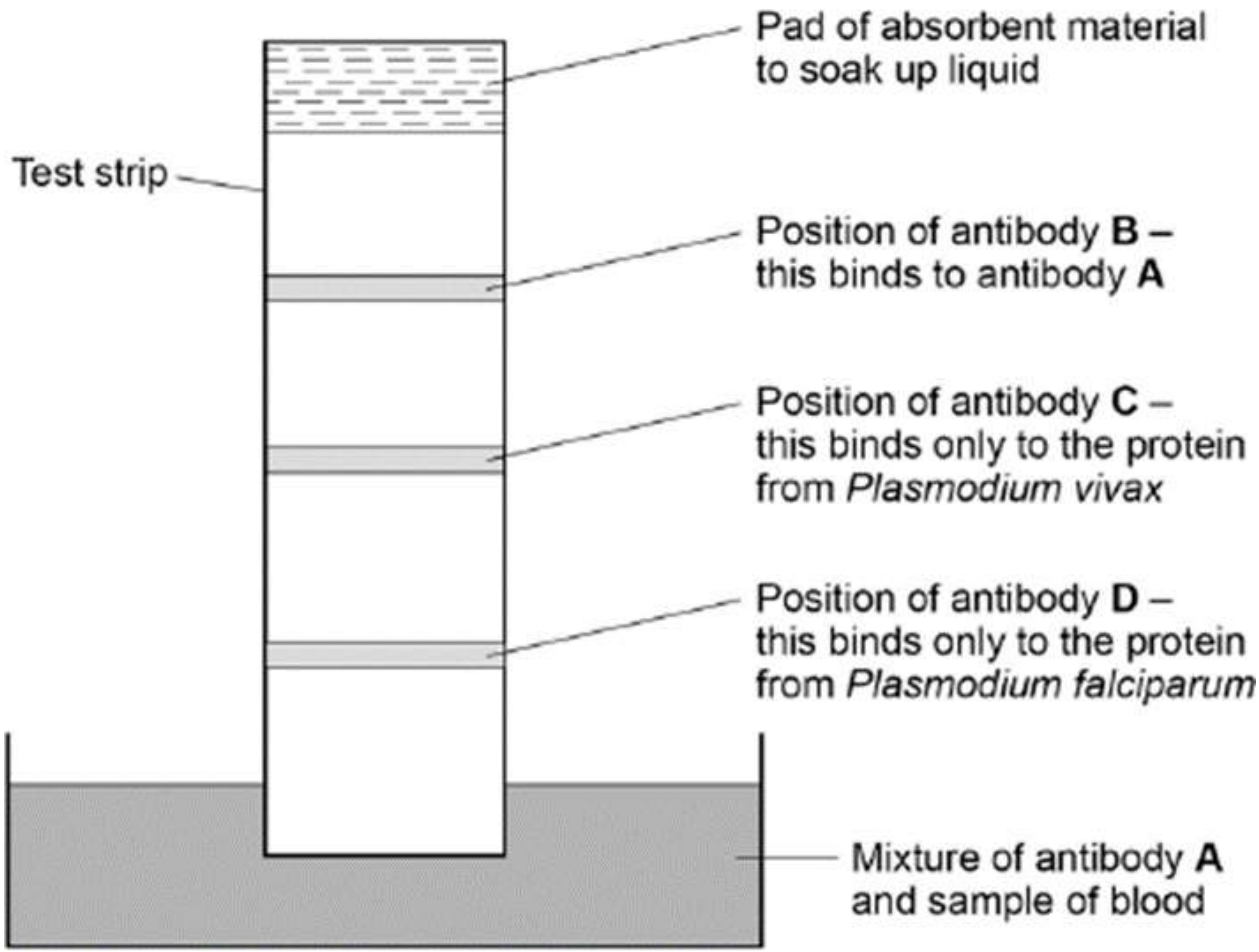
Advantages and Disadvantages of using monoclonal antibodies

Advantages

- Treatment of cancer
- Medical tests
- Healthy cells not affected

Disadvantages

- More side effects than expected
- Ethical issues (production involves the use of mice)
- Unexpected immune response


Pad of absorbent material to soak up liquid
Test strip
Position of antibody **B** – this binds to antibody **A**
Position of antibody **C** – this binds only to the protein from *Plasmodium vivax*
Position of antibody **D** – this binds only to the protein from *Plasmodium falciparum*
Mixture of antibody **A** and sample of blood

Round 1 – Structure of the atom

1. Compare the plum pudding and nuclear models of the atom.
2. Complete the table:

Name of particle	Relative charge	Relative mass
Proton		
	0	1
	-1	Very small

3. Define the term isotope.

Round 1 – Structure of the atom

1. Compare the plum pudding and nuclear models of the atom.

Plum pudding has a ball of positive charge with electrons embedded in it. There are no neutrons.

Nuclear model has a nucleus containing protons and neutrons and electrons in shells orbiting the nucleus.

2. Complete the table:

Name of particle	Relative charge	Relative mass
Proton	**+1**	**1**
Neutron	0	1
Electron	-1	Very small

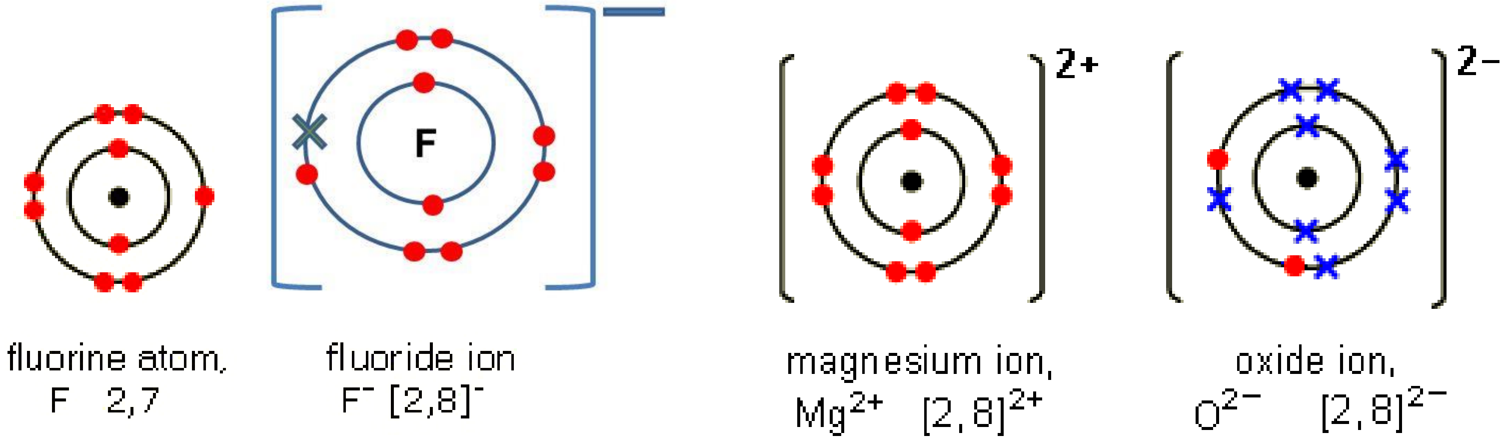
Isotopes: have the same numbers of protons and electrons but different numbers of neutrons.

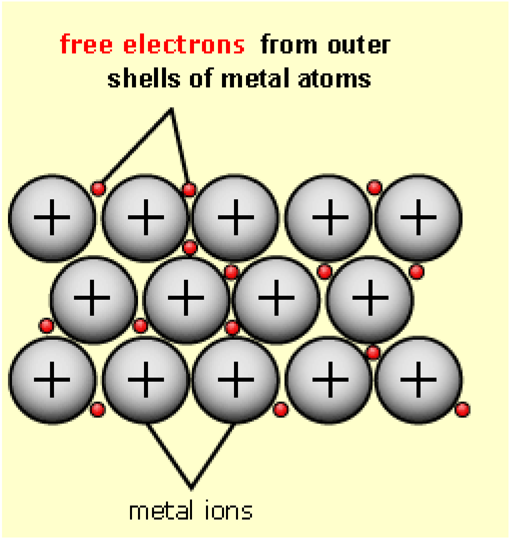
Round 2 - Bonding

1. Draw the electron arrangement in a fluorine atom and a fluoride ion. ${}^{19}_{9}F$
2. Draw the bonding in magnesium oxide.
3. Draw the bonding in sodium.
4. Explain why metals can conduct electricity.

${}^{24}_{12}Mg$ ${}^{16}_{8}O$

Round 2 - Bonding





3. Electrons in outer shell of metals are delocalised so are free to move throughout the structure.

N.B. Metallic bond is attraction between the positive metal ions and the delocalised electrons.

Round 3 - Bonding

1. Explain why ionic solids have high melting points.
2. Explain why ionic compounds can conduct electricity when molten or dissolved but not as a solid.
3. Why is graphite soft but diamond extremely hard?

Round 3 - Bonding

1. The ions are joined in a giant lattice with strong electrostatic attraction between oppositely charged ions. Each ion forms many strong bonds so lots of energy is needed to break these bonds.

2. Ions need to be free to move and carry the charge. In a solid they are in a fixed position.

3. Graphite has weak intermolecular forces between the layers that are easily broken. In diamond every atom is covalently bonded to 4 others. These bonds take a lot of energy to break.

Round 4 - Bonding

1. Identify the bonding in the following structures:

	Mp/bp (°C)	Conductivity	Solubility in water
A	3500	Yes when dissolved/molten	Yes
B	50	No	No
C	3000	Yes	No
D	2500	No	No

Round 4 - Bonding

1. Identify the bonding in the following structures:

	Mp/bp (°C)	Conductivity	Solubility in water
A	3500	Yes when dissolved/molten	Yes
B	50	No	No
C	3000	Yes	No
D	2500	No	No

A= ionic **B = Covalent (simple)** **C = Metallic** **D = Giant covalent**

Round 5 – Acids, bases and salts

1. Name the ions found in acids and alkalis.
2. Draw an ionic equation for neutralisation.
3. Why would we not make sodium chloride by putting sodium metal in hydrochloric acid?
4. Write a general equation for the reaction of an acid and a base.
5. Give the name of the acid and the base used to make zinc chloride.

Round 5 – Acids, bases and salts

1. Acid = hydrogen ions (H^+); alkalis = hydroxide ions (OH^-).
2. $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$.
3. Would be explosively reactive.
4. Acid + base → salt + water.
5. Zinc oxide (a base is a metal oxide) + hydrochloric acid

Round 6 – Electrolysis

1. Explain what happens to the ions during the electrolysis of NaCl (l).
2. When NaCl(aq) is electrolysed H_2 gas is formed at the negative electrode NOT Na metal. Why is this?
3. When Al is made the positive electrode has to be frequently replaced. Why?
4. Why is cryolite used in the electrolysis of Aluminium oxide?
5. Complete the half equations (HT):

   a) Mg^{2+} + ….e^- → Mg

   b) ….Cl- → Cl_2 + ….e^-

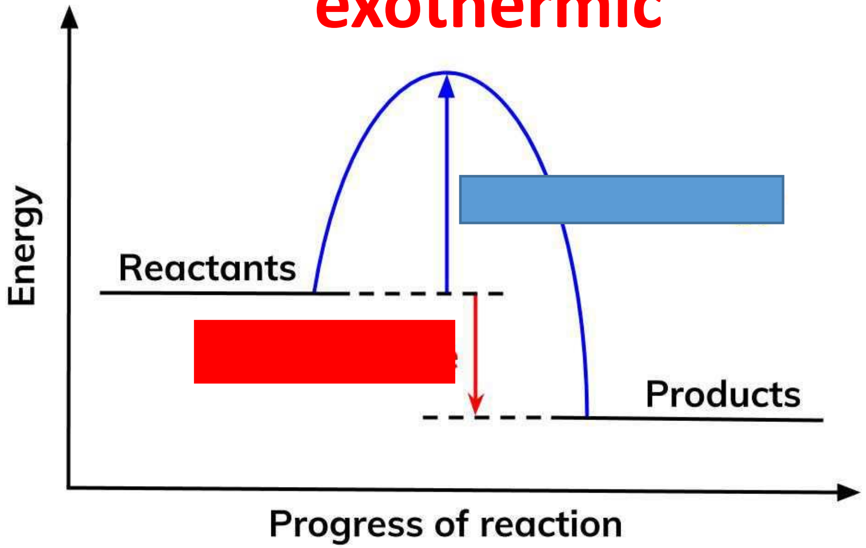
Round 6 – Electrolysis

1. Na^+ ions are attracted to the negative electrode. They gain 1 electron to form Na atoms. Cl^- ions are attracted to the positive electrode. They lose 1 electron, forming Cl_2 gas.
2. Some water is dissociated releasing H^+ ions. The least reactive ion is discharged.
3. O_2 formed there reacts with the graphite electrode, forming CO_2 gas.
4. Lowers melting temperature of aluminium oxide, so saves energy.
5. a) $Mg^{2+} + \mathbf{2}e^- \rightarrow Mg$ b) $\mathbf{2}Cl- \rightarrow Cl_2 + \mathbf{2}e^-$

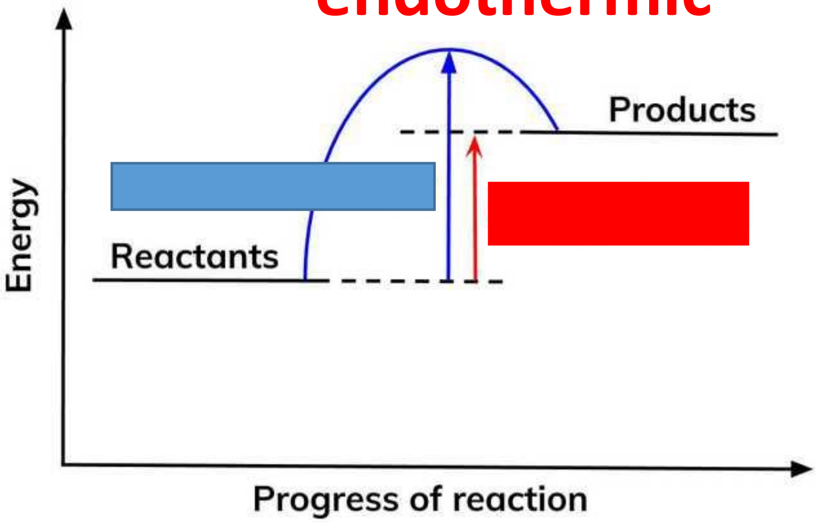
Round 7 - Energy in chemical reactions

- In an **exothermic** reaction the temperature **increases**.
- In an **endothermic** reaction the temperature **decreases**.

exothermic



endothermic

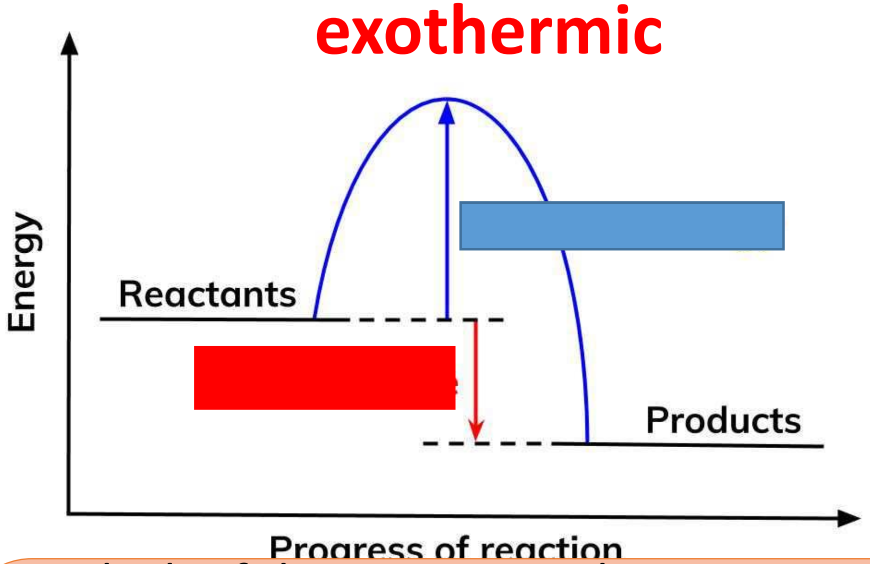


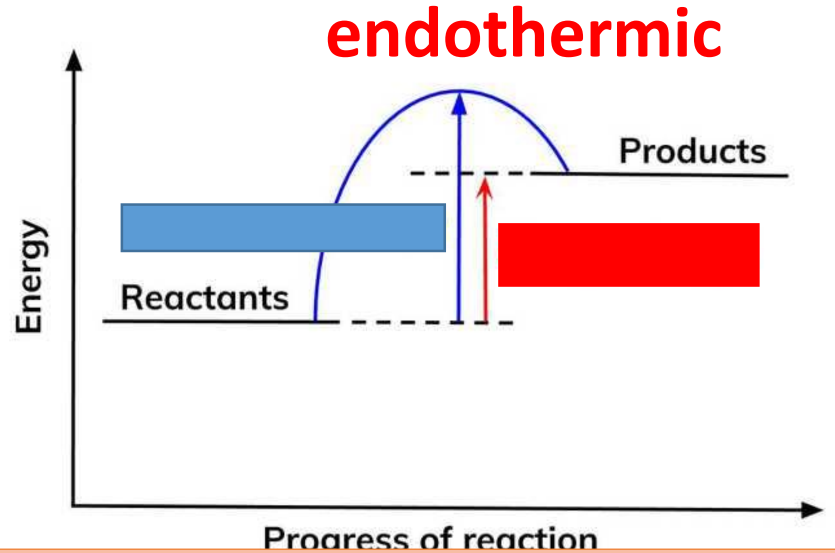
1. Which of these is an exothermic reaction and which is an endothermic reaction?
2. What are the blue and red arrows showing?
3. (HT) Is bond breaking exothermic or endothermic? Explain your answer.

Define the term: catalyst

Round 7 - Energy in chemical reactions

- In an **exothermic** reaction the temperature ___**increases**___.
- In an **endothermic** reaction the temperature ___**decreases**___.



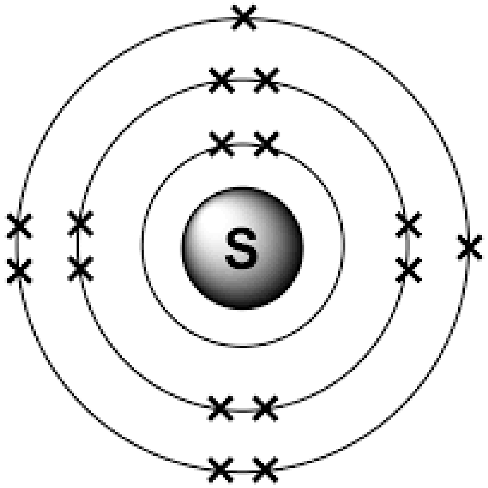


1. Which of these is an exothermic reaction and which is an endothermic reaction?
2. What are the blue and red arrows showing?
3. (HT) Is bond breaking exothermic or endothermic? Explain your answer. **Endothermic. Energy is needed to break bonds**

Define the term: catalyst. **Catalysts speed up a reaction by providing an alternative pathway with a lower activation energy. They are not used up.**

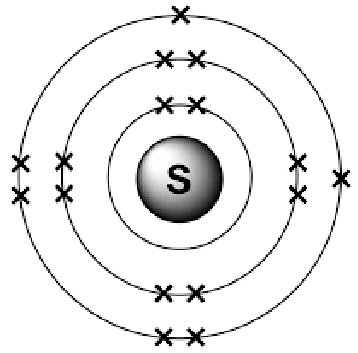
Round 8 – Periodic table

1. Newlands and Mendeleev both put the elements in order of ______________________.
2. Mendeleev produced a table that was more respected because……
3. The modern periodic table has elements in order of _________________
4. This element would be found in period ____ and group ____.



Round 8 – Periodic table

1. Newlands and Mendeleev both put the elements in order of ___**atomic mass**______.
2. Mendeleev produced a table that was more respected because…**he left gaps for undiscovered elements where the elements did not match the properties of the rest of the group. He predicted the properties of these element**s…
3. The modern periodic table has elements in order of __**atomic number**__
4. This element would be found in period _**3**_ and group _ **6** _.



Round 9 – Group 1 – Alkali Metals

1. Complete the equations:

Sodium + oxygen $\rightarrow$

Lithium + water $\rightarrow$

Potassium + chlorine $\rightarrow$

2. State and explain the trend in reactivity down group 1.

Round 9 – Group 1 – Alkali Metals

1. Complete the equations:

Sodium + oxygen → **sodium oxide**

Lithium + water → **lithium hydroxide + hydrogen**

Potassium + chlorine → **potassium chloride**

2. State and explain the trend in reactivity down group 1.

Reactivity increases. Outer shell electron is <u>further from nucleus</u>; and there is <u>more shielding</u>; meaning <u>less electrostatic attraction</u> between electron and positive nucleus; so electron is <u>more easily lost</u>.

Round 10 – Group 7 – Halogens

1. Complete the equations:

chlorine + sodium bromide $\rightarrow$

Bromine + sodium iodide $\rightarrow$

2. State and explain the trend in reactivity down group 7.

3. Explain why the boiling temperature increases down group 7 (also applies to group 0).

Round 10 – Group 7 – Halogens

1. Complete the equations:

chlorine + sodium bromide → **sodium chloride + bromine**

Bromine + sodium iodide → **sodium bromide + iodine**

2. State and explain the trend in reactivity down group 7.

Reactivity decreases. Outer electron shell is <u>further from nucleus</u>; meaning <u>less electrostatic attraction</u> between electron and positive nucleus; so electron is <u>less easily gained</u>.

3. Explain why the boiling temperature increases down group 7 (also applies to group 0).

Relative molecular mass increases down the group so strength of intermolecular forces increases.

Required practical – Measuring Energy Changes

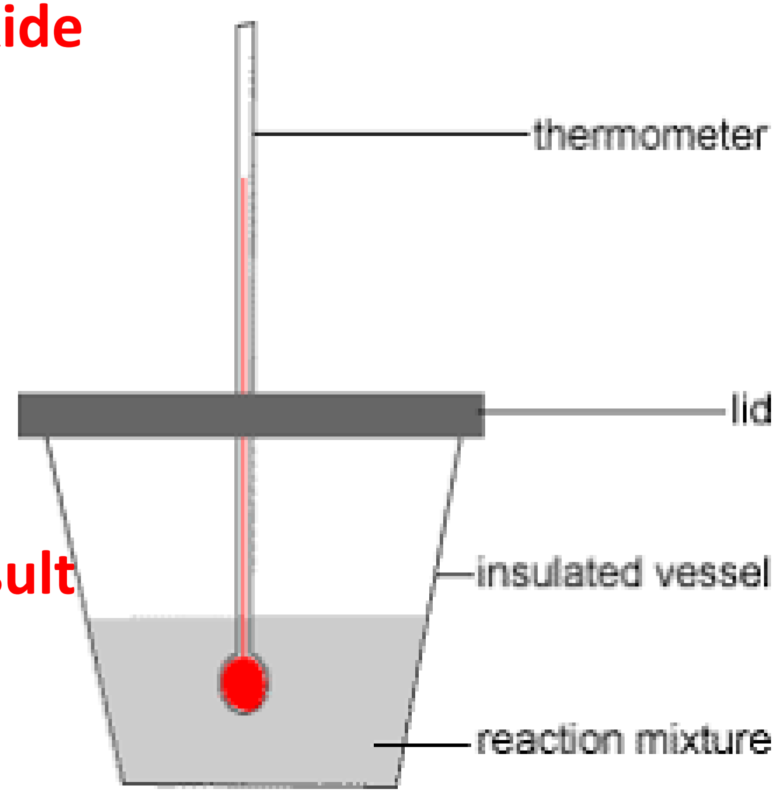
In the experiment acid (hydrochloric acid) is put into the cup. Alkali (sodium hydroxide) is added 1ml at a time and the temperature recorded.

1. Identify
   a) The independent variable **Volume of sodium hydroxide**
   b) The dependent variable **Temperature**
   c) The control variables. **Volume of acid, concentration of acid + alkali**

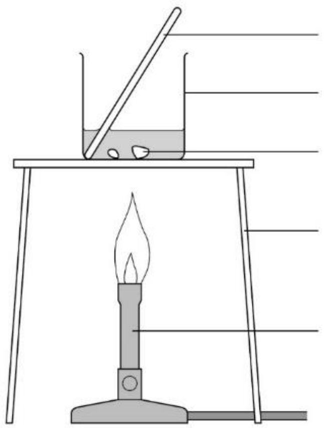
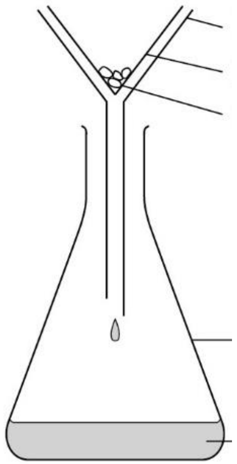
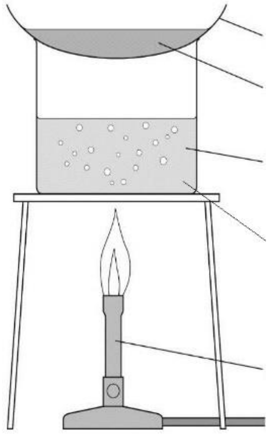
2. Is the temperature a continuous or categoric variable? **Continuous – it has number values**

3. Why do we use a polystyrene cup and not a beaker? **Prevents heat loss so we get a more accurate result**

4. What other steps do we take to ensure we get accurate results? **Use a lid. Stir solution before taking temperature reading.**



Required practical – Making Salts

Step 1	Step 2	Step 3
		

1. Why do we heat the acid?

   Speeds up reaction – ensures all acid will react.

2. Why do we add excess base?

   Ensures all acid will react. (SAFETY)

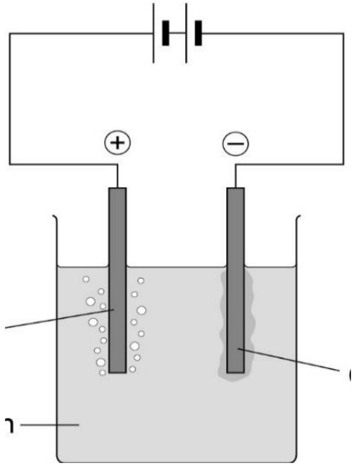
3. Why do we use a waterbath?

   It is safer, crystals can spit if evaporating basin is heated directly

4. Name the chemicals needed to make copper sulfate.

   Copper oxide + sulfuric acid

Required practical – electrolysis of solutions



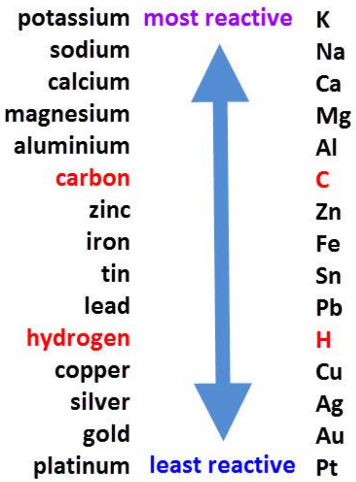
1. How can you test for the gases:

a) Oxygen b) Chlorine c) Hydrogen

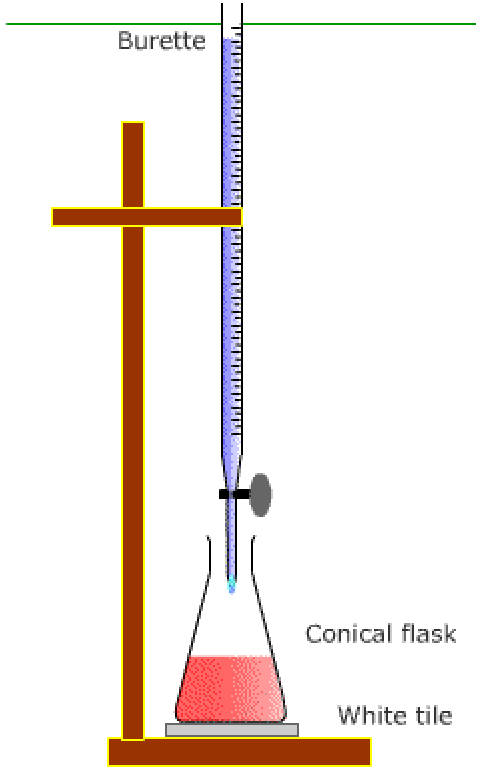
2. Explain why hydrogen is formed when electrolysing sodium sulfate.
3. Explain why the pH increases during the electrolysis of sodium chloride solution.
4. Predict what will be formed during the electrolysis of:

a) potassium bromide b) Silver nitrate

Solution	Observation at cathode	Substance formed at cathode	Observation at anode	Substance formed at anode
Copper chloride	Metal forms	Copper	bubbles	Chlorine
Copper sulfate	Metal forms	Copper	bubbles	oxygen
Sodium chloride	bubbles	hydrogen	bubbles	Chlorine
Sodium sulfate	bubbles	hydrogen	bubbles	oxygen



Required practical – titration (TRIPLE ONLY)



1. Describe how to carry out a titration.

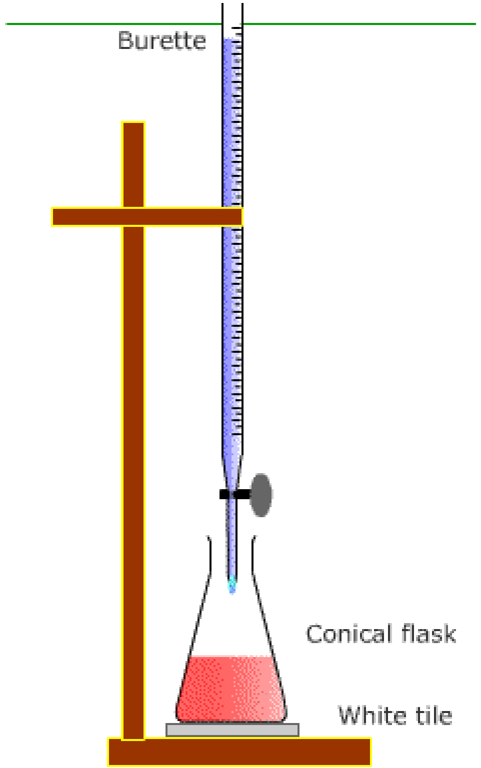
2. Why do we use a burette / pipette?

3. Why do we add the acid from the burette dropwise with swirling?

4. Why do we use a white tile?

5. Bromophenol blue is an indicator that is yellow in acids and purple in alkalis. Describe the end point of a titration where the sodium hydroxide is in the conical flaks and the acid is in the burette.

Required practical – titration (TRIPLE ONLY)



1. Describe how to carry out a titration.

2. Why do we use a burette / pipette?

Allows accurate measurement of a range of volumes (burette) or a fixed volume (pipette)

3. Why do we add the acid from the burette dropwise with swirling?

To ensure solution is thoroughly mixed to enable an accurate endpoint

4. Why do we use a white tile?

To see the colour change clearly

5. Bromophenol blue is an indicator that is yellow in acids and purple in alkalis. Describe the end point of a titration where the sodium hydroxide is in the conical flaks and the acid is in the burette.

Indicator starts purple in hydroxide solution. Turns yellow once the alkali is neutralised.

Round 1 – Structure of the atom

1. Compare the plum pudding and nuclear models of the atom.
2. Complete the table:

Name of particle	Relative charge	Relative mass
Proton		
	0	1
	-1	Very small

3. Define the term isotope.

Round 1 – Structure of the atom

1. Compare the plum pudding and nuclear models of the atom.

Plum pudding has a ball of positive charge with electrons embedded in it. There are no neutrons.

Nuclear model has a nucleus containing protons and neutrons and electrons in shells orbiting the nucleus.

2. Complete the table:

Name of particle	Relative charge	Relative mass
Proton	**+1**	**1**
Neutron	0	1
Electron	-1	Very small

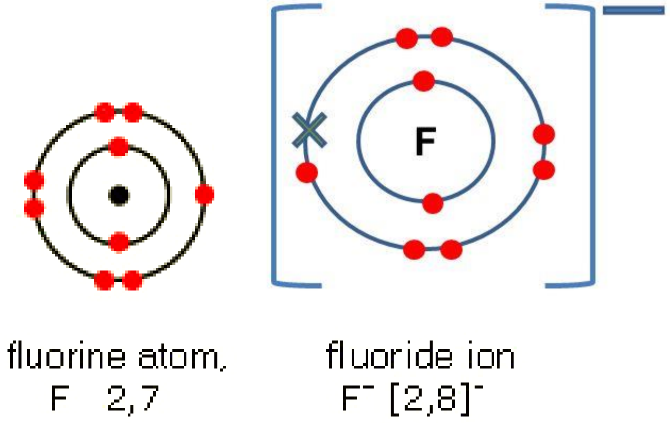
Isotopes: have the same numbers of protons and electrons but different numbers of neutrons.

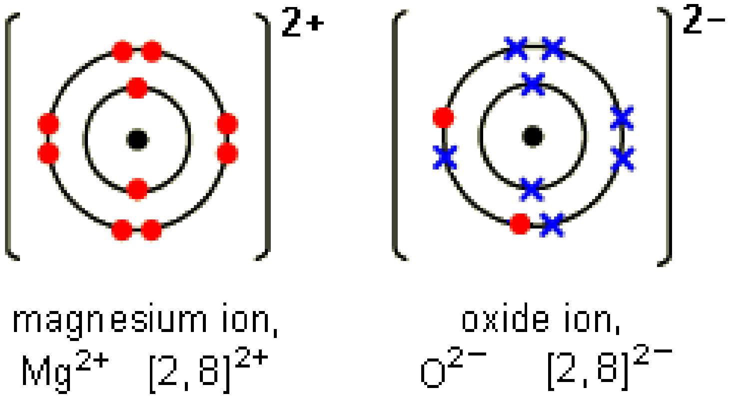
Round 2 - Bonding

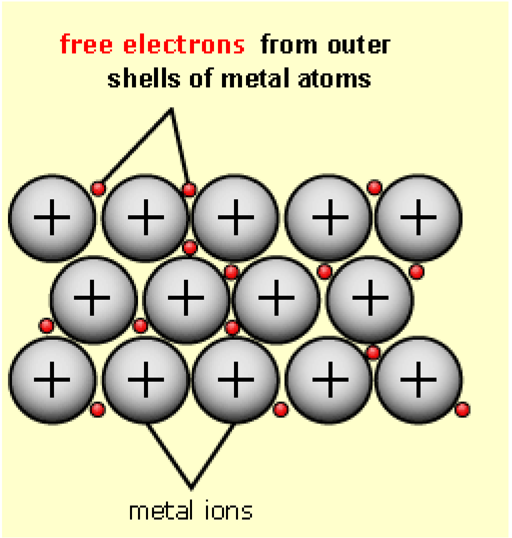
1. Draw the electron arrangement in a fluorine atom and a fluoride ion. $^{19}_{9}F$
2. Draw the bonding in magnesium oxide.
3. Draw the bonding in sodium.
4. Explain why metals can conduct electricity.

$^{24}_{12}Mg$ $^{16}_{8}O$

Round 2 - Bonding







3. Electrons in outer shell of metals are delocalised so are free to move throughout the structure.

N.B. Metallic bond is attraction between the positive metal ions and the delocalised electrons.

Round 3 - Bonding

1. Explain why ionic solids have high melting points.
2. Explain why ionic compounds can conduct electricity when molten or dissolved but not as a solid.
3. Why is graphite soft but diamond extremely hard?

Round 3 - Bonding

1. The ions are joined in a giant lattice with strong electrostatic attraction between oppositely charged ions. Each ion forms many strong bonds so lots of energy is needed to break these bonds.

2. Ions need to be free to move and carry the charge. In a solid they are in a fixed position.

3. Graphite has weak intermolecular forces between the layers that are easily broken. In diamond every atom is covalently bonded to 4 others. These bonds take a lot of energy to break.

Round 4 - Bonding

1. Identify the bonding in the following structures:

	Mp/bp (°C)	Conductivity	Solubility in water
A	3500	Yes when dissolved/molten	Yes
B	50	No	No
C	3000	Yes	No
D	2500	No	No

Round 4 - Bonding

1. Identify the bonding in the following structures:

	Mp/bp (°C)	Conductivity	Solubility in water
A	3500	Yes when dissolved/molten	Yes
B	50	No	No
C	3000	Yes	No
D	2500	No	No

A= ionic **B = Covalent (simple)** **C = Metallic** **D = Giant covalent**

Round 5 – Acids, bases and salts

1. Name the ions found in acids and alkalis.
2. Draw an ionic equation for neutralisation.
3. Why would we not make sodium chloride by putting sodium metal in hydrochloric acid?
4. Write a general equation for the reaction of an acid and a base.
5. Give the name of the acid and the base used to make zinc chloride.

Round 5 – Acids, bases and salts

1. Acid = hydrogen ions (H^+); alkalis = hydroxide ions (OH^-).
2. $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$.
3. Would be explosively reactive.
4. Acid + base → salt + water.
5. Zinc oxide (a base is a metal oxide) + hydrochloric acid

Round 6 – Electrolysis

1. Explain what happens to the ions during the electrolysis of NaCl (l).
2. When NaCl(aq) is electrolysed H_2 gas is formed at the negative electrode NOT Na metal. Why is this?
3. When Al is made the positive electrode has to be frequently replaced. Why?
4. Why is cryolite used in the electrolysis of Aluminium oxide?
5. Complete the half equations (HT):

   a) Mg^{2+} + ….e^- → Mg

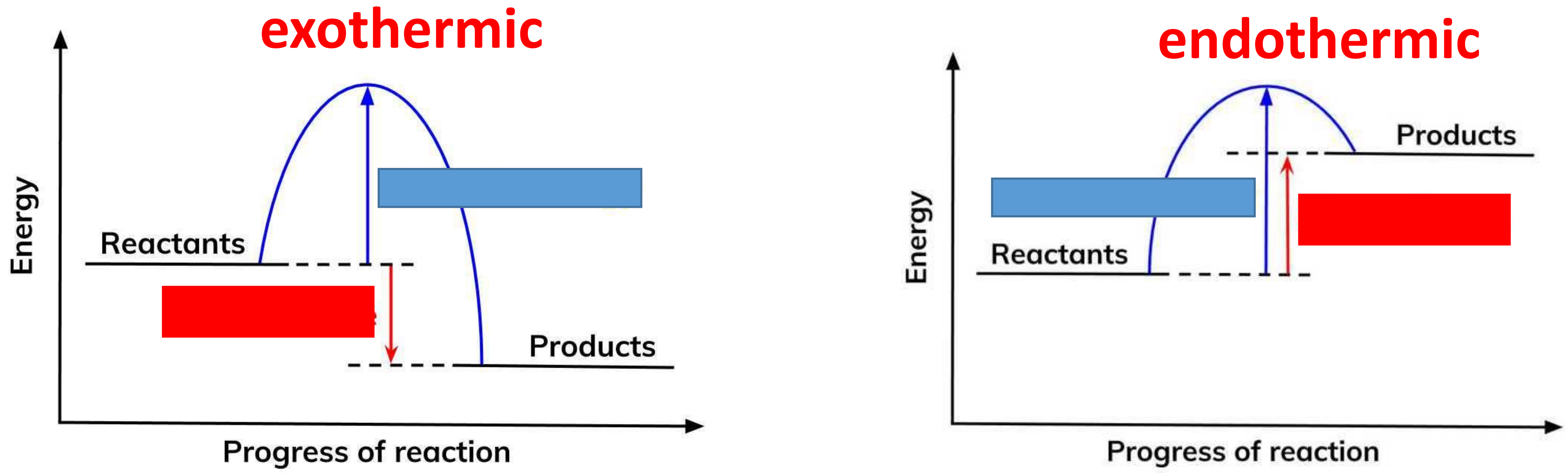
   b) ….Cl- → Cl_2 + ….e^-

Round 6 – Electrolysis

1. Na^+ ions are attracted to the negative electrode. They gain 1 electron to form Na atoms. Cl^- ions are attracted to the positive electrode. They lose 1 electron, forming Cl_2 gas.
2. Some water is dissociated releasing H^+ ions. The least reactive ion is discharged.
3. O_2 formed there reacts with the graphite electrode, forming CO_2 gas.
4. Lowers melting temperature of aluminium oxide, so saves energy.
5. a) $Mg^{2+} + \mathbf{2}e^- \rightarrow Mg$ b) $\mathbf{2}Cl- \rightarrow Cl_2 + \mathbf{2}e^-$

Round 7 - Energy in chemical reactions

- In an exothermic reaction the temperature ___increases___.
- In an endothermic reaction the temperature ___decreases___.



1. Which of these is an exothermic reaction and which is an endothermic reaction?
2. What are the blue and red arrows showing?
3. (HT) Is bond breaking exothermic or endothermic? Explain your answer.

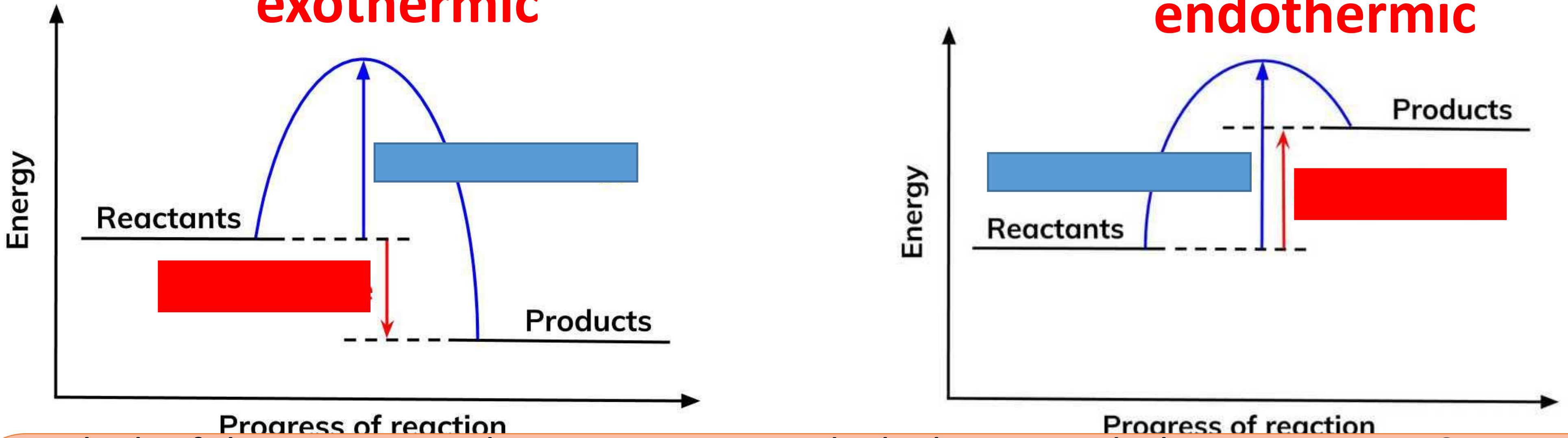
Define the term: catalyst

Round 7 - Energy in chemical reactions

- In an exothermic reaction the temperature __increases__.
- In an endothermic reaction the temperature __decreases__.

exothermic

endothermic



1. Which of these is an exothermic reaction and which is an endothermic reaction?
2. What are the blue and red arrows showing?
3. (HT) Is bond breaking exothermic or endothermic? Explain your answer. **Endothermic. Energy is needed to break bonds**

Define the term: catalyst. **Catalysts speed up a reaction by providing an alternative pathway with a lower activation energy. They are not used up.**

Bond energy calculation (HT)

hydrogen + chlorine → hydrogen chloride

$$H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}$$

$$H-H + Cl-Cl \rightarrow H-Cl + H-Cl$$

Bond type	Energy (KJ/mol)
H-H	436
Cl-Cl	243
H-Cl	432

Negative energy change means the reaction is exothermic

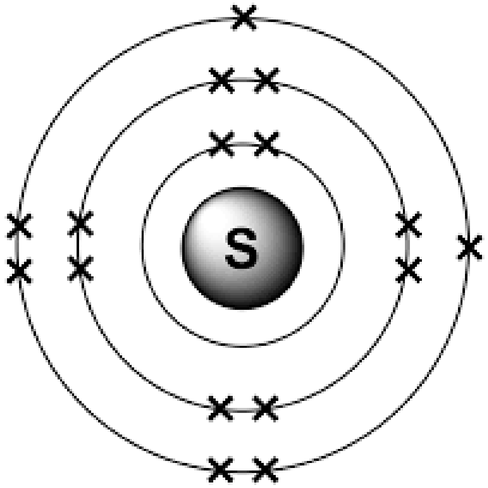
Energy needed to break reactant bonds
= 436 + 243 = 679 KJ/mol

Energy released when new bonds form
= 2 x 432 = 864 KJ/mol

Energy change = reactants – products
= 679 – 864
= -185 KJ/mol

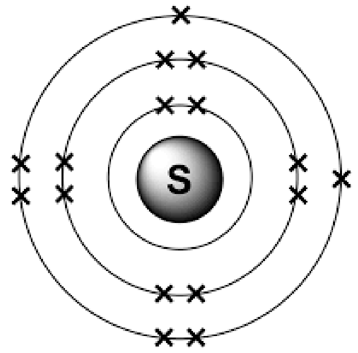
Round 8 – Periodic table

1. Newlands and Mendeleev both put the elements in order of ______________________.
2. Mendeleev produced a table that was more respected because……
3. The modern periodic table has elements in order of _________________
4. This element would be found in period ____ and group ____.



Round 8 – Periodic table

1. Newlands and Mendeleev both put the elements in order of ___**atomic mass**______.
2. Mendeleev produced a table that was more respected because…**he left gaps for undiscovered elements where the elements did not match the properties of the rest of the group. He predicted the properties of these element**s…
3. The modern periodic table has elements in order of __**atomic number**__
4. This element would be found in period _**3**_ and group _ **6** _.



Round 9 – Group 1 – Alkali Metals

1. Complete the equations:

Sodium + oxygen $\rightarrow$

Lithium + water $\rightarrow$

Potassium + chlorine $\rightarrow$

2. State and explain the trend in reactivity down group 1.

Round 9 – Group 1 – Alkali Metals

1. Complete the equations:

Sodium + oxygen → **sodium oxide**

Lithium + water → **lithium hydroxide + hydrogen**

Potassium + chlorine → **potassium chloride**

2. State and explain the trend in reactivity down group 1.

Reactivity increases. Outer shell electron is <u>further from nucleus</u>; and there is <u>more shielding</u>; meaning <u>less electrostatic attraction</u> between electron and positive nucleus; so electron is <u>more easily lost</u>.

Round 10 – Group 7 – Halogens

1. Complete the equations:

chlorine + sodium bromide →

Bromine + sodium iodide →

2. State and explain the trend in reactivity down group 7.

3. Explain why the boiling temperature increases down group 7 (also applies to group 0).

Round 10 – Group 7 – Halogens

1. Complete the equations:

chlorine + sodium bromide → **sodium chloride + bromine**

Bromine + sodium iodide → **sodium bromide + iodine**

2. State and explain the trend in reactivity down group 7.

Reactivity decreases. Outer electron shell is <u>further from nucleus</u>; meaning <u>less electrostatic attraction</u> between electron and positive nucleus; so electron is <u>less easily gained</u>.

3. Explain why the boiling temperature increases down group 7 (also applies to group 0).

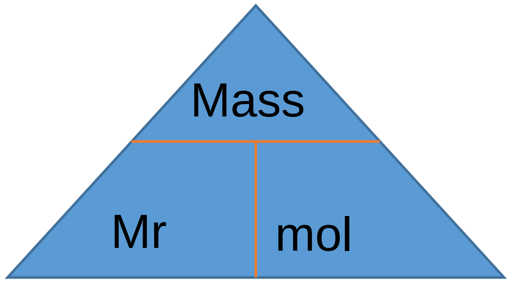
Relative molecular mass increases down the group so strength of intermolecular forces increases.

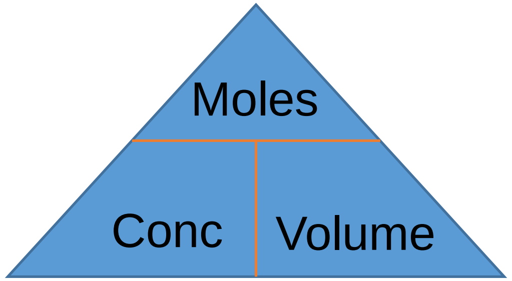
Round 11 – The Mole (HT and triple)

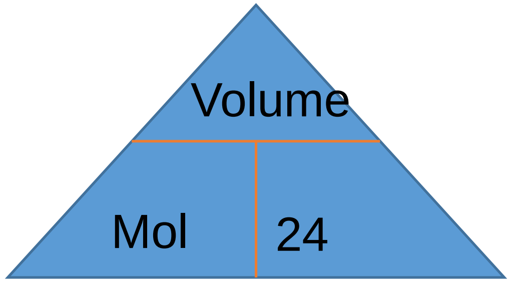
1. Write down the 3 mole triangles.
2. What mass of CO_2 will be formed when 4g of methane (CH_4) is combusted? $CH_4 + 2O_2 \rightarrow CO_2 + H_2O$
3. What volume of oxygen gas will be needed to react with 300cm^3 of propane gas? $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$
4. Convert 25cm^3 into dm^3
5. What is the concentration of 0.1mol/dm^3 of NaOH in g/dm^3.

Round 11 – The Mole (TRIPLE and HT)

1. Write down the 3 mole triangles.





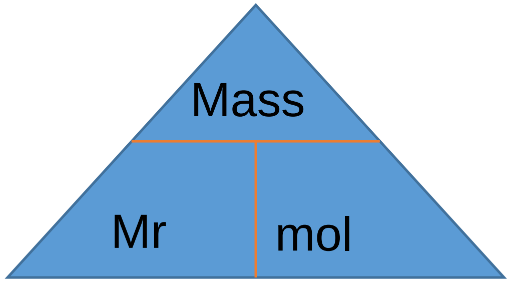


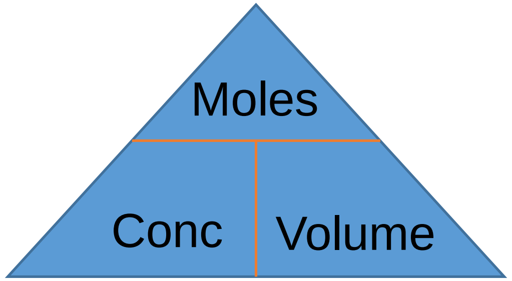
2. What mass of CO_2 will be formed when 4g of methane (CH_4) is combusted? $CH_4 + 2O_2 \rightarrow CO_2 + H_2O$

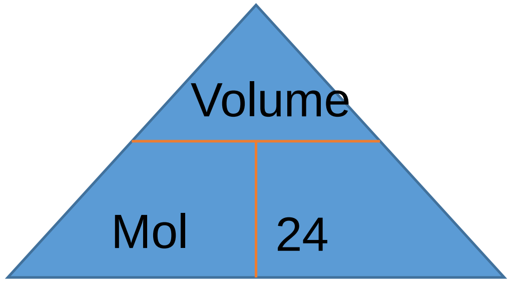
	CH_4	CO_2
Mass	4	
Mr	**16**	**44**
Mol		
Ratio	1	1

Round 11 – The Mole (TRIPLE and HT)

1. Write down the 3 mole triangles.





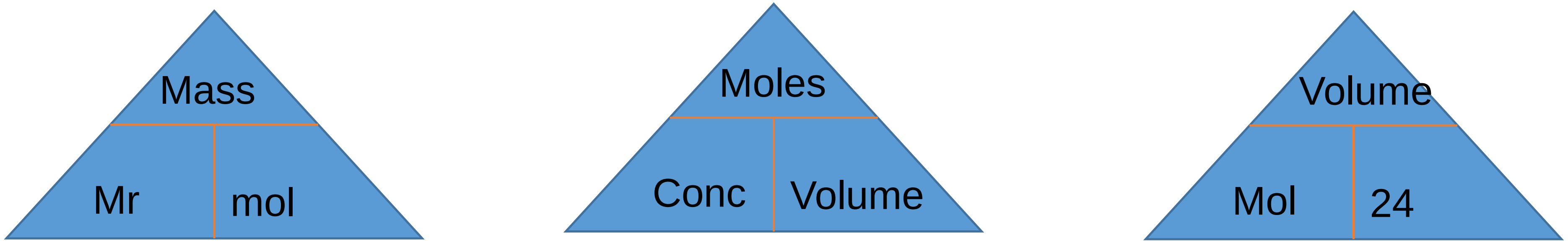


2. What mass of CO_2 will be formed when 4g of methane (CH_4) is combusted? $CH_4 + 2O_2 \rightarrow CO_2 + H_2O$

	CH_4	CO_2
Mass	4	
Mr	16	44
Mol	**=4 ÷16 = 0.25**	**= 0.25 (as 1:1 ratio)**
Ratio	1	1

Round 11 – The Mole (TRIPLE and HT)

1. Write down the 3 mole triangles.



2. What mass of CO_2 will be formed when 4g of methane (CH_4) is combusted? $CH_4 + 2O_2 \rightarrow CO_2 + H_2O$

	CH_4	CO_2
Mass	4	**= 0.25 x 44 = 11g**
Mr	16	44
Mol	=4 ÷16 = 0.25	= 0.25 (as 1:1 ratio)
Ratio	1	1

Round 11 – The Mole

1. What volume of oxygen gas will be needed to react with 100cm^3 of propane gas? $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

500cm^3. One mole of any gas occupies the same volume. This reaction would produce 300cm^3 of CO_2.

2. Convert 25cm^3 into dm^3 **= 25/1000 = 0.025dm^3**

3. What is the concentration of 0.1mol/dm^3 of NaOH in g/dm^3.

Mr NaOH = 23+16+1 = 40

Conc (g/dm3) = 0.1 x 40 = 4g/dm^3

Required practical – Measuring Energy Changes

In the experiment acid (hydrochloric acid) is put into the cup. Alkali (sodium hydroxide) is added 1ml at a time and the temperature recorded.

1. Identify

a) The independent variable **Volume of sodium hydroxide**

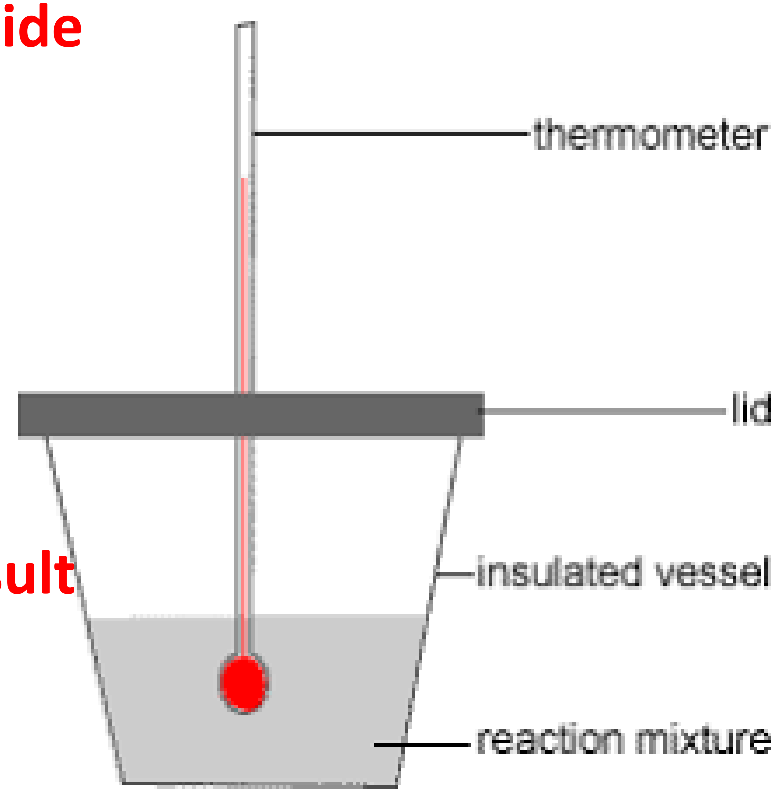
b) The dependent variable **Temperature**

c) The control variables. **Volume of acid, concentration of acid + alkali**

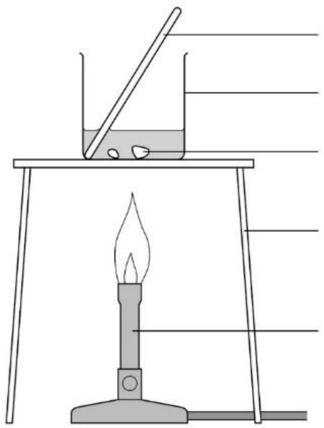
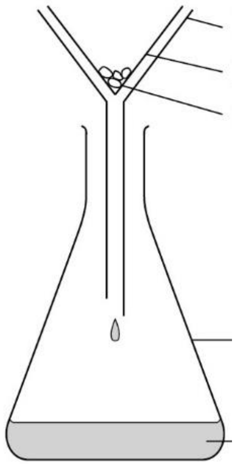
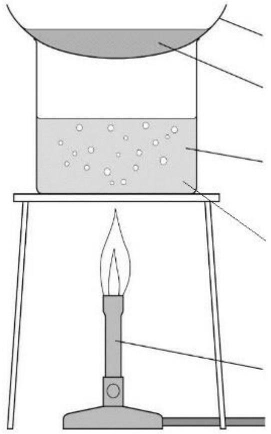
2. Is the temperature a continuous or categoric variable? **Continuous – it has number values**

3. Why do we use a polystyrene cup and not a beaker? **Prevents heat loss so we get a more accurate result**

4. What other steps do we take to ensure we get accurate results? **Use a lid. Stir solution before taking temperature reading.**

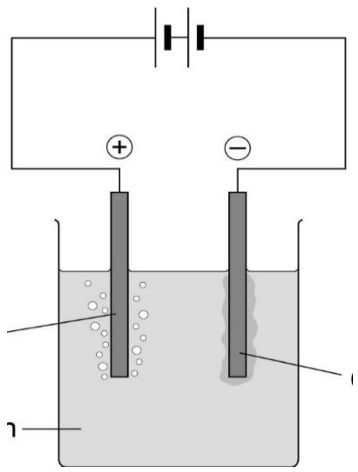


Required practical – Making Salts

Step 1	**Step 2**	**Step 3**
		

1. Why do we heat the acid?
   Speeds up reaction – ensures all acid will react.
2. Why do we add excess base?
   Ensures all acid will react. (SAFETY)
3. Why do we use a waterbath?
   It is safer, crystals can spit if evaporating basin is heated directly
4. Name the chemicals needed to make copper sulfate.
   Copper oxide + sulfuric acid

Required practical – electrolysis of solutions



1. How can you test for the gases:

a) Oxygen b) Chlorine c) Hydrogen

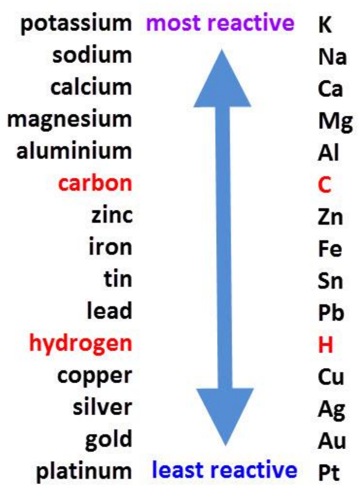
2. Explain why hydrogen is formed when electrolysing sodium sulfate.

3. Explain why the pH increases during the electrolysis of sodium chloride solution.

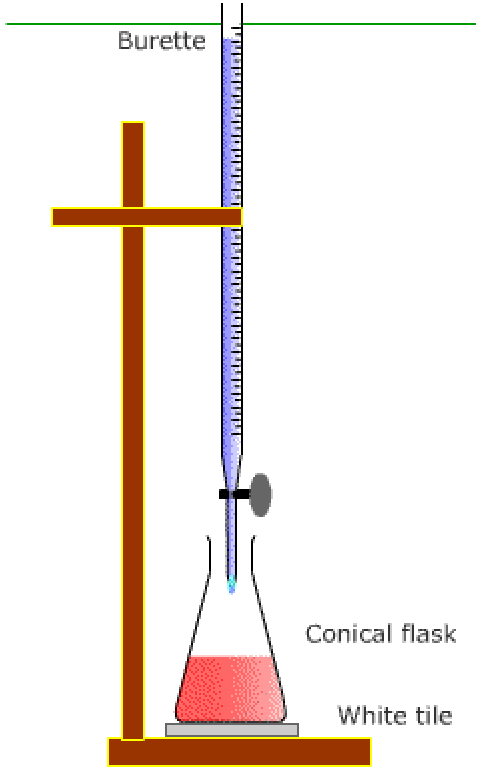
4. Predict what will be formed during the electrolysis of:

a) potassium bromide b) Silver nitrate

Solution	Observation at cathode	Substance formed at cathode	Observation at anode	Substance formed at anode
Copper chloride	Metal forms	Copper	bubbles	Chlorine
Copper sulfate	Metal forms	Copper	bubbles	oxygen
Sodium chloride	bubbles	hydrogen	bubbles	Chlorine
Sodium sulfate	bubbles	hydrogen	bubbles	oxygen



Required practical – titration (TRIPLE ONLY)



1. Describe how to carry out a titration.

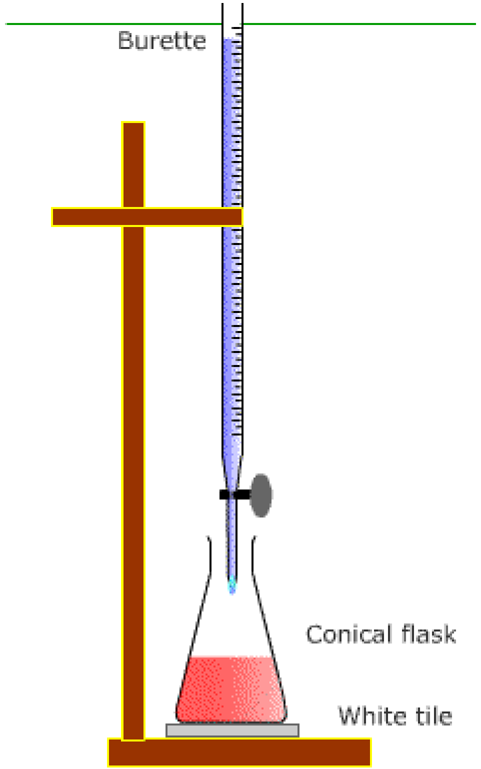
2. Why do we use a burette / pipette?

3. Why do we add the acid from the burette dropwise with swirling?

4. Why do we use a white tile?

5. Bromophenol blue is an indicator that is yellow in acids and purple in alkalis. Describe the end point of a titration where the sodium hydroxide is in the conical flaks and the acid is in the burette.

Required practical – titration (TRIPLE ONLY)



1. Describe how to carry out a titration.

2. Why do we use a burette / pipette?

Allows accurate measurement of a range of volumes (burette) or a fixed volume (pipette)

3. Why do we add the acid from the burette dropwise with swirling?

To ensure solution is thoroughly mixed to enable an accurate endpoint

4. Why do we use a white tile?

To see the colour change clearly

5. Bromophenol blue is an indicator that is yellow in acids and purple in alkalis. Describe the end point of a titration where the sodium hydroxide is in the conical flaks and the acid is in the burette.

Indicator starts purple in hydroxide solution. Turns yellow once the alkali is neutralised.

Round 1 – Rates of reaction

1. List the factors that affect the rate of a chemical reaction.
2. Predict what will happen to the rate of a chemical reaction if the concentration of a reactant is doubled.
3. Explain why a 10°C increase in the temperature can double the rate of a reaction.
4. Draw an energy profile for a catalysed reaction.
5. Identify the catalyst:

$$N_2 + 3H_2 \overset{Fe}{\rightleftharpoons} 2NH_3$$

Round 1 – Rates of reaction

1. List the factors that affect the rate of a chemical reaction.

Temperature, surface area, concentration, pressure, catalysts

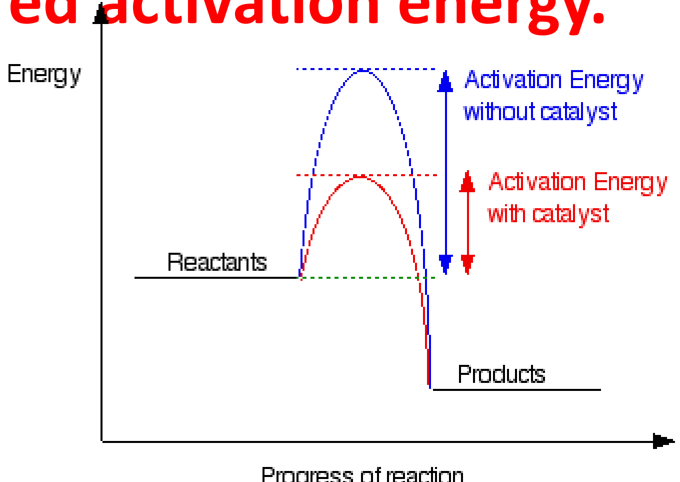
2. Predict what will happen to the rate of a chemical reaction if the concentration of a reactant is doubled.

The rate will double as there are double the number of particles in the same volume, so the frequency of collisions will double.

3. Explain why a 10°C increase in the temperature can double the rate of a reaction.

Particles have more kinetic energy so collide more frequently. These collision are also more energetic meaning more particles have the required activation energy.

3. Draw an energy profile for a catalysed reaction.



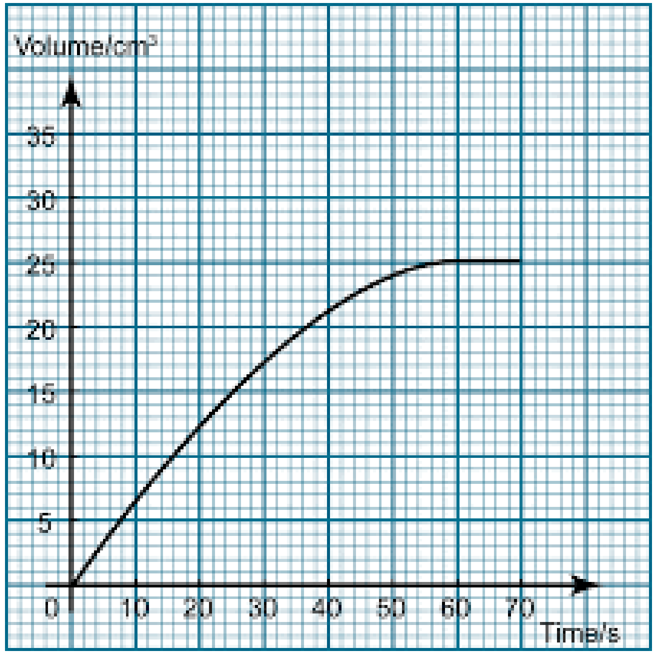
4. Identify the catalyst:

Fe – catalysts are written above the arrow

$$N_2 \quad + \quad 3H_2 \quad \rightleftharpoons \quad 2NH_3$$

Round 2 – Rates of reaction

1. Define the term mean rate of reaction.
2. Use the graph to calculate the mean rate of reaction:

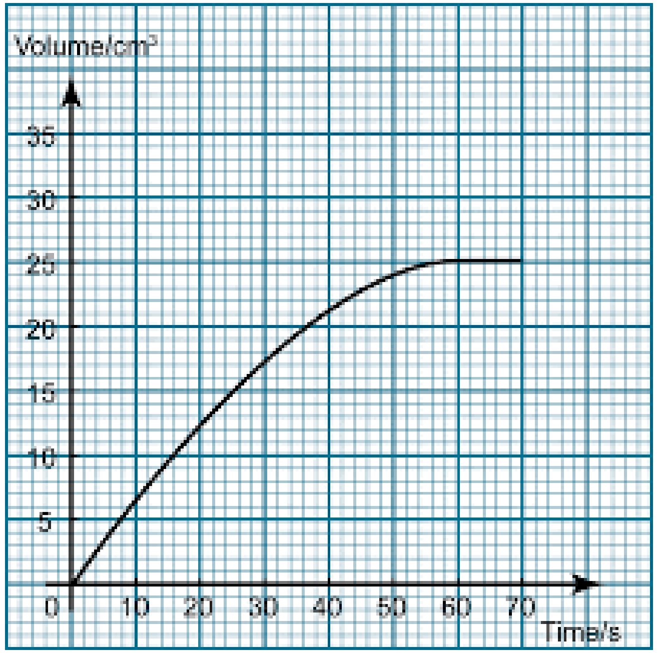


Round 2 – Rates of reaction

1. Define the term mean rate of reaction.

Mean rate = $\frac{\text{quantity of product made / reactant used up}}{\text{time}}$

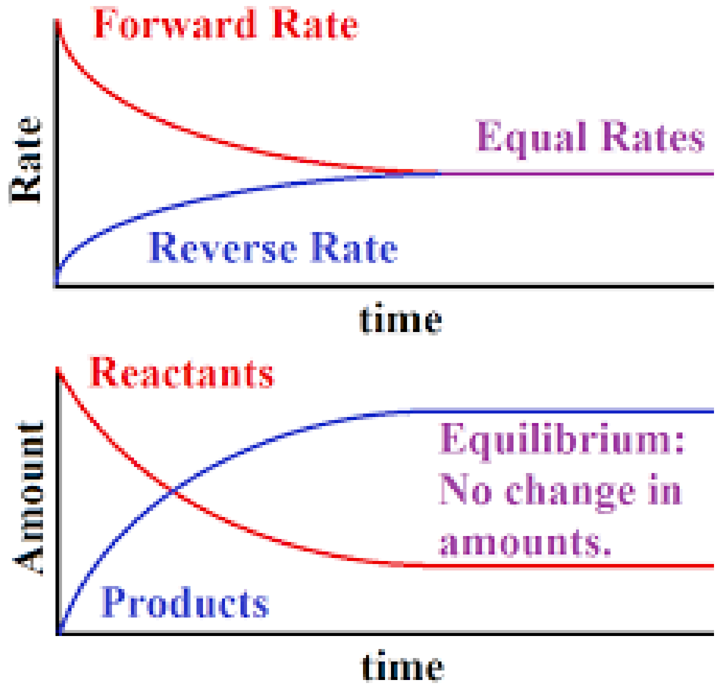
2. Use the graph to calculate the mean rate of reaction:



Mean rate
= 25 / 56
= 0.446 cm^3/s

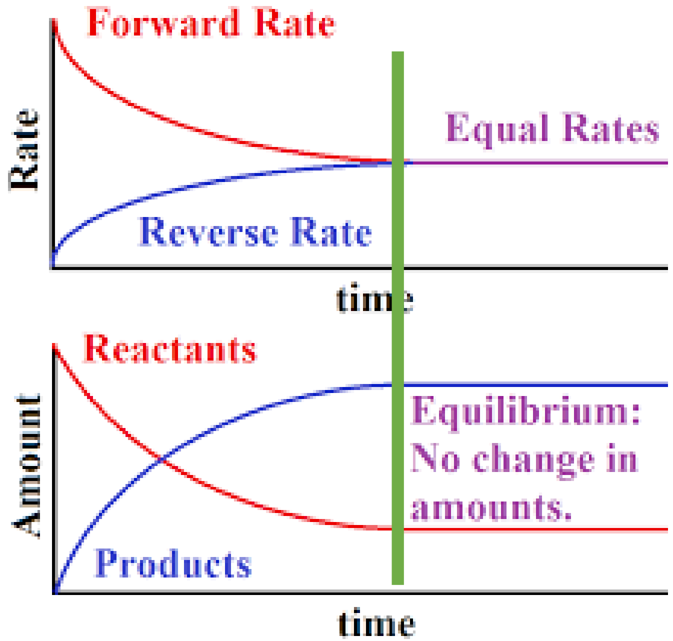
Round 3 – Equilibrium

1. Draw the symbol for a reversible reaction.
2. Define equilibrium.
3. Draw a line on each graph to show where equilibrium is established.



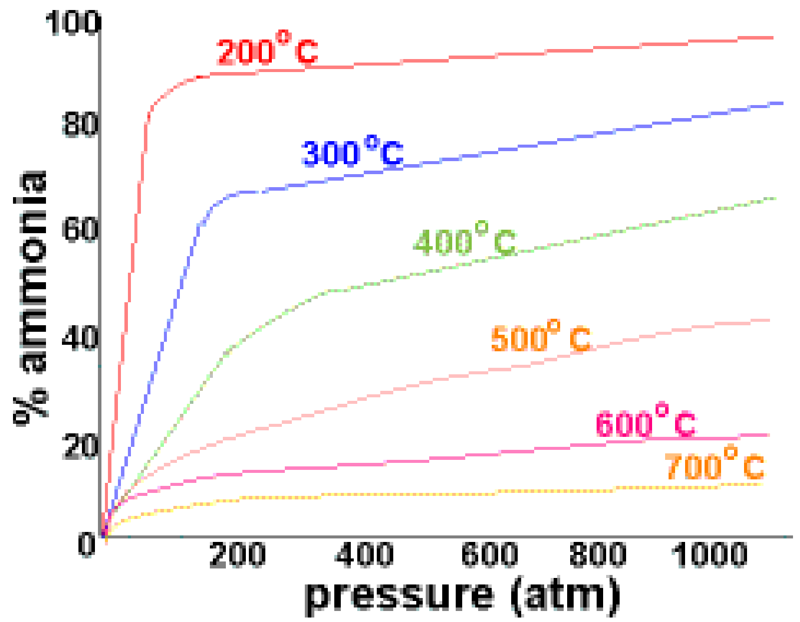
Round 3 – Equilibrium

1. Draw the symbol for a reversible reaction. **⇌**
2. Define equilibrium. **Occurs in a closed system, where the rate of the forward reaction is equal to the rate of the reverse reaction**
3. Draw a line on each graph to show where equilibrium is established. **Point where conc stops changing**



Round 4 – Haber Process (TRIPLE ONLY)

1. Write the equation for the Haber process.
2. State the conditions for the Haber process.
3. Why is 450°C a compromise temperature?
4. Using the graph below, identify the conditions that give the maximum yield of ammonia. Explain why these are not the conditions actually used.



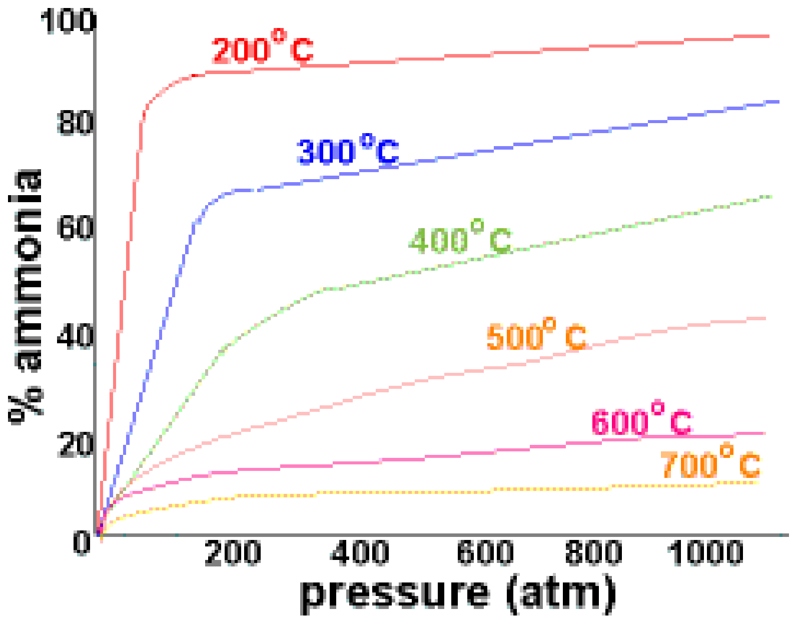
Round 4 – Haber Process (TRIPLE ONLY)

1. Write the equation for the Haber process. **$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$**
2. State the conditions for the Haber process. **200 atm, 450°C, Fe catalyst**
3. Why is 450°C a compromise temperature? **Rate is slow at lower temperatures. Yield decreases as temp increases as the forward reaction is exothermic. Compromise is between yield of ammonia and the rate at which it is formed.**
4. Using the graph below, identify the conditions that give the maximum yield of ammonia. Explain why these are not the conditions actually used.

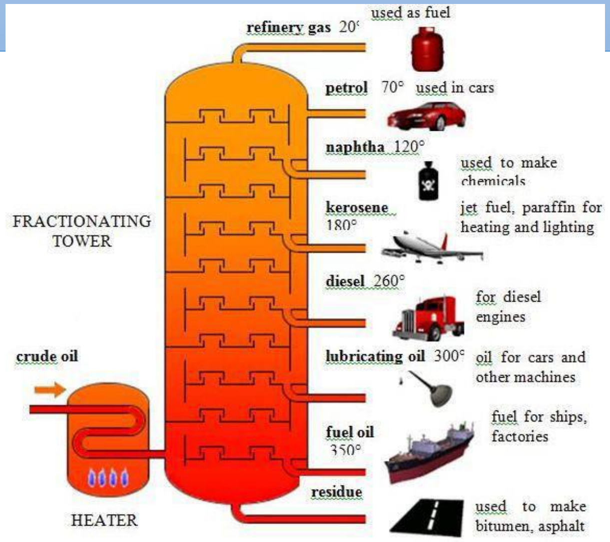
200°C + 1000atm pressure

☹ Low rate of formation at low temp.

☹ High pressures are dangerous and require lots of Energy to maintain.



Round 5 – Fractional distillation and hydrocarbons



1. Explain how crude oil is separated into fractions.
2. Define the term hydrocarbon.
3. Complete and balance the equation:

$$C_3H_8 + O_2 \rightarrow \_\_\_\_\_\_ + \_\_\_\_\_\_\_\_$$

4. Describe how boiling point, viscosity and flammability change with molecular size.
5. Give the general formula for the alkanes.
6. Name the first 4 alkanes.

Round 5 – Fractional distillation and hydrocarbons

1. Explain how crude oil is separated into fractions.

Crude oil is heated to vaporise it. Vapours rise up column and cool. Vapours condense at the boiling temperature of the molecule.

2. Define the term hydrocarbon. **A molecule made of carbon and hydrogen only**

3. Complete and balance the equation:

$$C_3H_8 + 5O_2 \rightarrow \_3CO_2\_\_ + \_\_4H_2O\_\_$$

4. Describe how boiling point, viscosity and flammability change with molecular size. **Boiling point and viscosity increase with Mr, flammability decreases.**

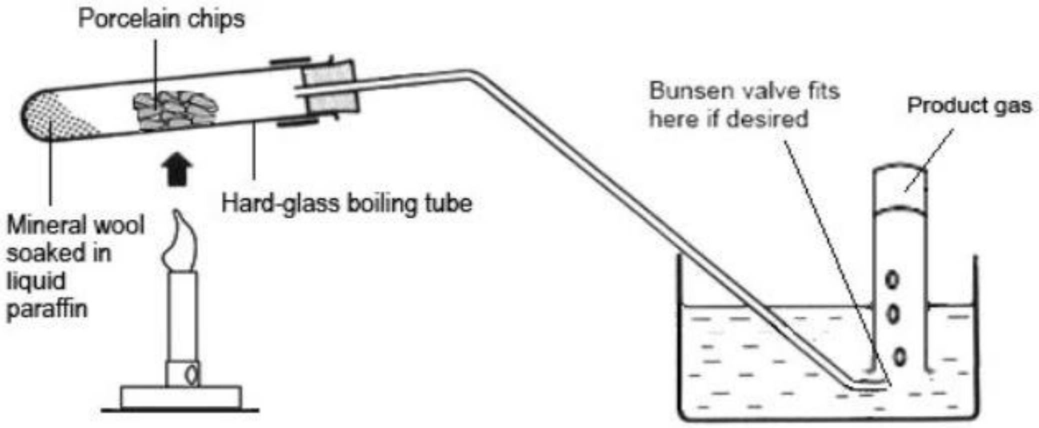
5. Give the general formula for the alkanes. **C_nH_{2n+2}**

6. Name the first 4 alkanes. **Methane (C1), ethane (C2), propane (C3), butane (C4)**

Round 6 – Cracking and alkenes

1. Give the conditions for catalytic cracking and steam cracking.
2. Why do we do cracking?
3. Describe how to test for alkenes.
4. Balance the equation:

$$C_{12}H_{26} \rightarrow C_6H_{14} + \_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_$$



Round 6 – Cracking and alkenes

1. Give the conditions for catalytic cracking **(heat to vapourise and pass vapours over a hot catalyst)** and steam cracking **(mix with steam, heat to a very high temperature).**
2. Why do we do cracking? **To make smaller alkanes that are useful as fuels and alkenes that can be used to make plastics**
3. Describe how to test for alkenes. **Add bromine water. Stays orange with alkanes and goes colourless with alkenes**
4. Balance the equation:

$$C_{12}H_{26} \rightarrow C_6H_{14} + \_\mathbf{C_2H_4}\_\_ + \_\_\ \mathbf{C_4H_8}\ \_\_$$

OR

$$C_{12}H_{26} \rightarrow C_6H_{14} + \_\mathbf{C_3H_6}\_\_ + \_\_\ \mathbf{C_3H_6}\ \_\_$$

Round 7 – Reactions of alkenes (TRIPLE ONLY)

1. Define the term: unsaturated.
2. Draw the functional group of the alkenes.
3. Draw the products formed with ethene reacts with

a) Water
b) Hydrogen
c) Bromine

4. Draw the polymer formed when propene polymerises.
5. Name the type of polymer formed.

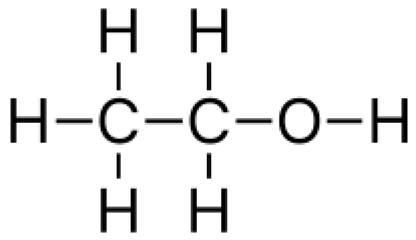
Round 7 – Reactions of alkenes (TRIPLE ONLY)

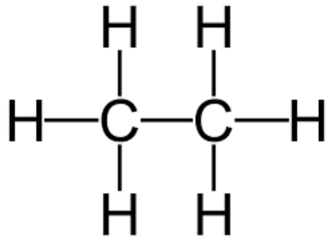
1. Define the term: unsaturated. **Contains at least one C=C**
2. Draw the functional group of the alkenes. **C=C**
3. Draw the products formed with ethene reacts with

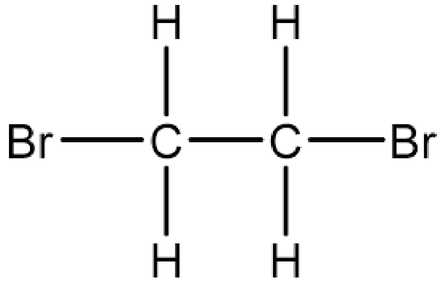
a) Water

b) Hydrogen

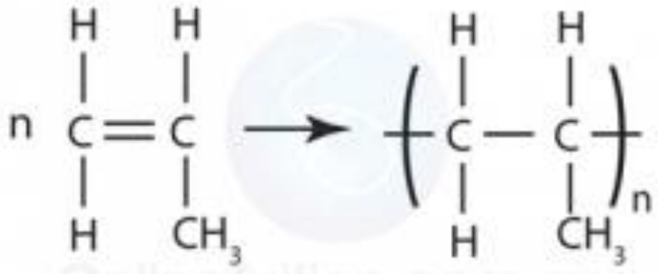
c) Bromine







4. Draw the polymer formed when propene polymerises.
5. Name the type of polymer formed. **Addition polymer**



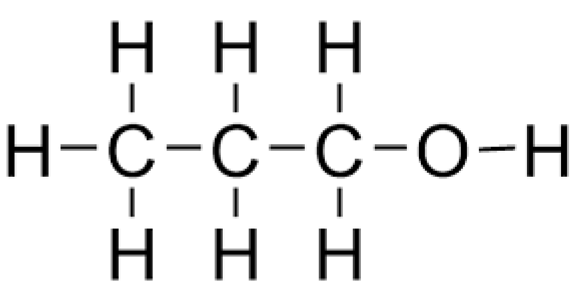
Propene Polypropene

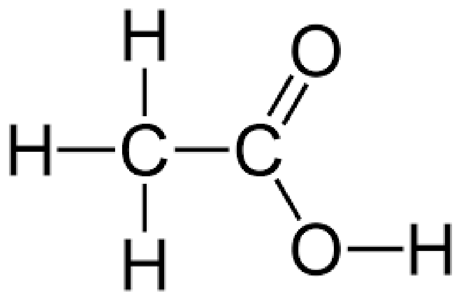
Round 8 – Reactions of alcohols and carboxylic acids (TRIPLE ONLY)

1. Give the functional group of alcohols and carboxylic acids.
2. Draw propanol and ethanoic acid.
3. Describe what happens when ethanol and ethanoic acid are added to separate samples of water.
4. Which gas is formed when sodium is added to an alcohol?
5. Which gas is formed when sodium carbonate is added to a carboxylic acid?

Round 8 – Reactions of alcohols and carboxylic acids (TRIPLE ONLY)

1. Give the functional group of alcohols **(O-H)** and carboxylic acids. **(COOH)**
2. Draw propanol and ethanoic acid.





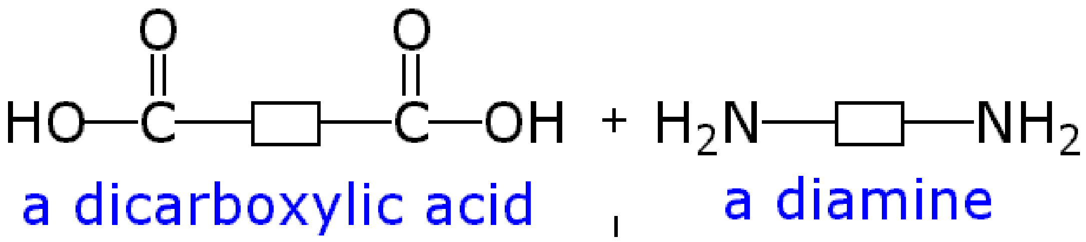
3. Describe what happens when ethanol and ethanoic acid are added to separate samples of water.

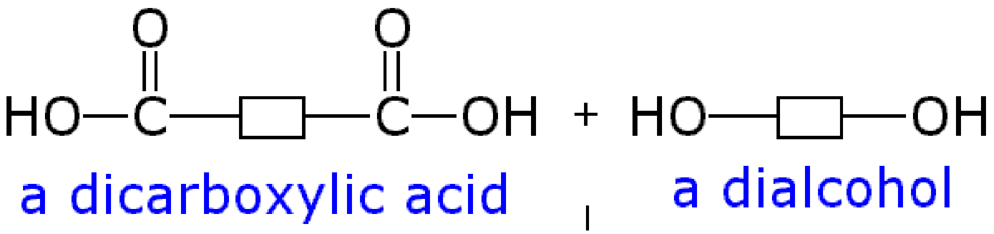
Ethanol dissolves, forming a neutral solution. Ethanoic acid dissolves forming a weakly acidic solution.

4. Which gas is formed when sodium is added to an alcohol? **hydrogen**
5. Which gas is formed when sodium carbonate is added to a carboxylic acid? **Carbon dioxide**

Round 9 – Polymers (TRIPLE ONLY)

1. Draw the condensation polymers made from:





2. Name the monomer used to make:

a) Polypeptides

b) DNA

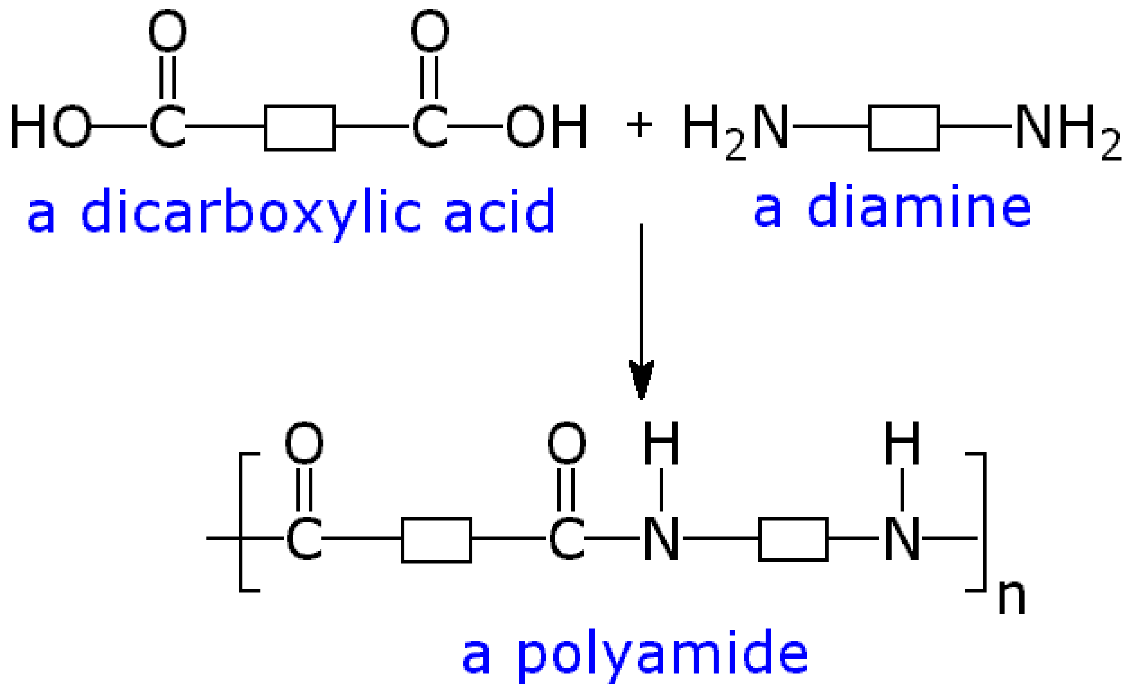
c) starch

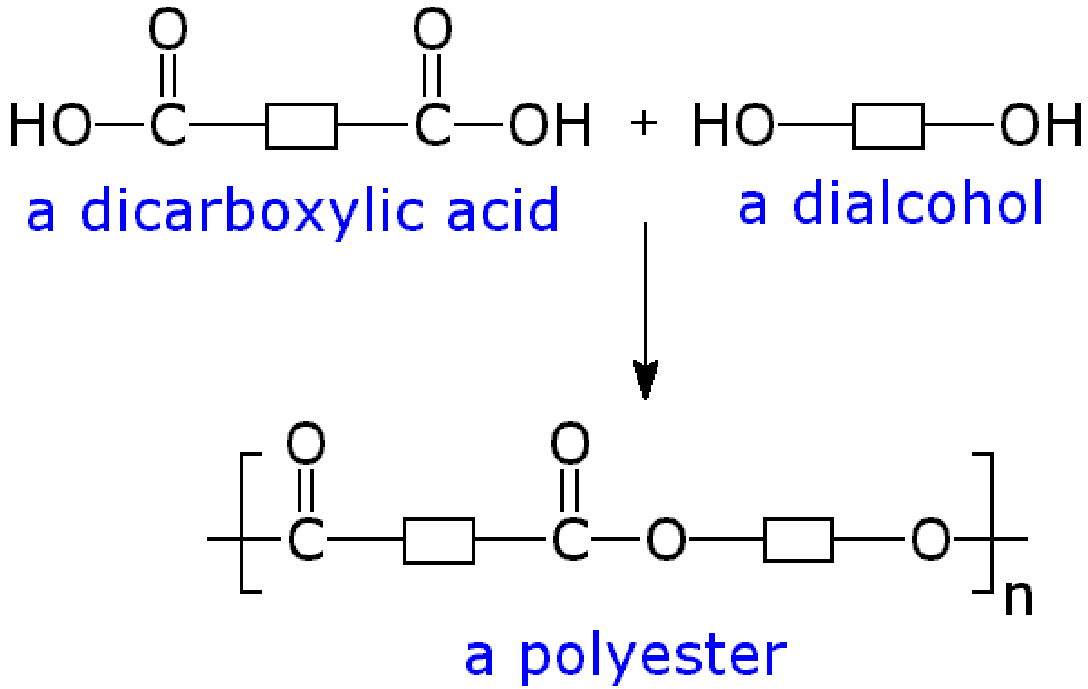
d) Cellulose

3. Name the structure of DNA

Round 9 – Polymers (TRIPLE ONLY)

1. Draw the condensation polymers made from:





Round 9 – Polymers (TRIPLE ONLY)

2. Name the monomer used to make:

a) Polypeptides **amino acids**

b) DNA **nucleotides**

c) Starch **glucose**

d) Cellulose **glucose**

3. Name the structure of DNA **double helix**

Round 10 – Formulations and testing for gases

1. A pure substance is made of a single ____________ or _____________.
2. Pure substances melt or _____ at a specific temperature.
3. Compared to pure substances, mixtures have _______ melting points and melt over a range of temperatures.
4. A formulation is a _______ that has been designed as a useful product.
5. Components are mixed in precise quantities to give desired ________.
6. Complete the table:

Gas	Test with…..	Result
Hydrogen		
Oxygen		
	Limewater	
	Damp blue litmus paper	

Round 10 – Formulations and testing for gases

1. A pure substance is made of a single __**element**__ or __**compound**__.
2. Pure substances melt or __**boil**__ at a specific temperature.
3. Compared to pure substances, mixtures have __**lower**__ melting points and melt over a range of temperatures.
4. A formulation is a __**mixture**__ that has been designed as a useful product.
5. Components are mixed in precise quantities to give desired __**properties**__.
6. Complete the table:

Gas	Test with…..	Result
Hydrogen	**Lit splint**	**Squeaky pop**
Oxygen	**Glowing splint**	**Splint relights**
Carbon dioxide	Limewater	**Limewater goes cloudy**
Chlorine	Damp blue litmus paper	**Litmus paper bleaches**

Round 11 – Testing for ions (TRIPLE ONLY)

1. Complete the table:

Metal	Flame colour
Lithium	
Sodium	
Potassium	
Calcium	
Copper	

2. What chemical is added to test for metal ions in a solution?
3. What are the colours of precipitate made by Cu^{2+}, Fe^{2+} and Fe^{3+}?
4. Describe how to test for carbonate ions and what you would expect to observe.
5. How do we test for halide ions? What colours are seen for Cl^-, Br^- and I^-?
6. What solution is used to test for sulfate ions?

Round 11 – Testing for ions (TRIPLE ONLY)

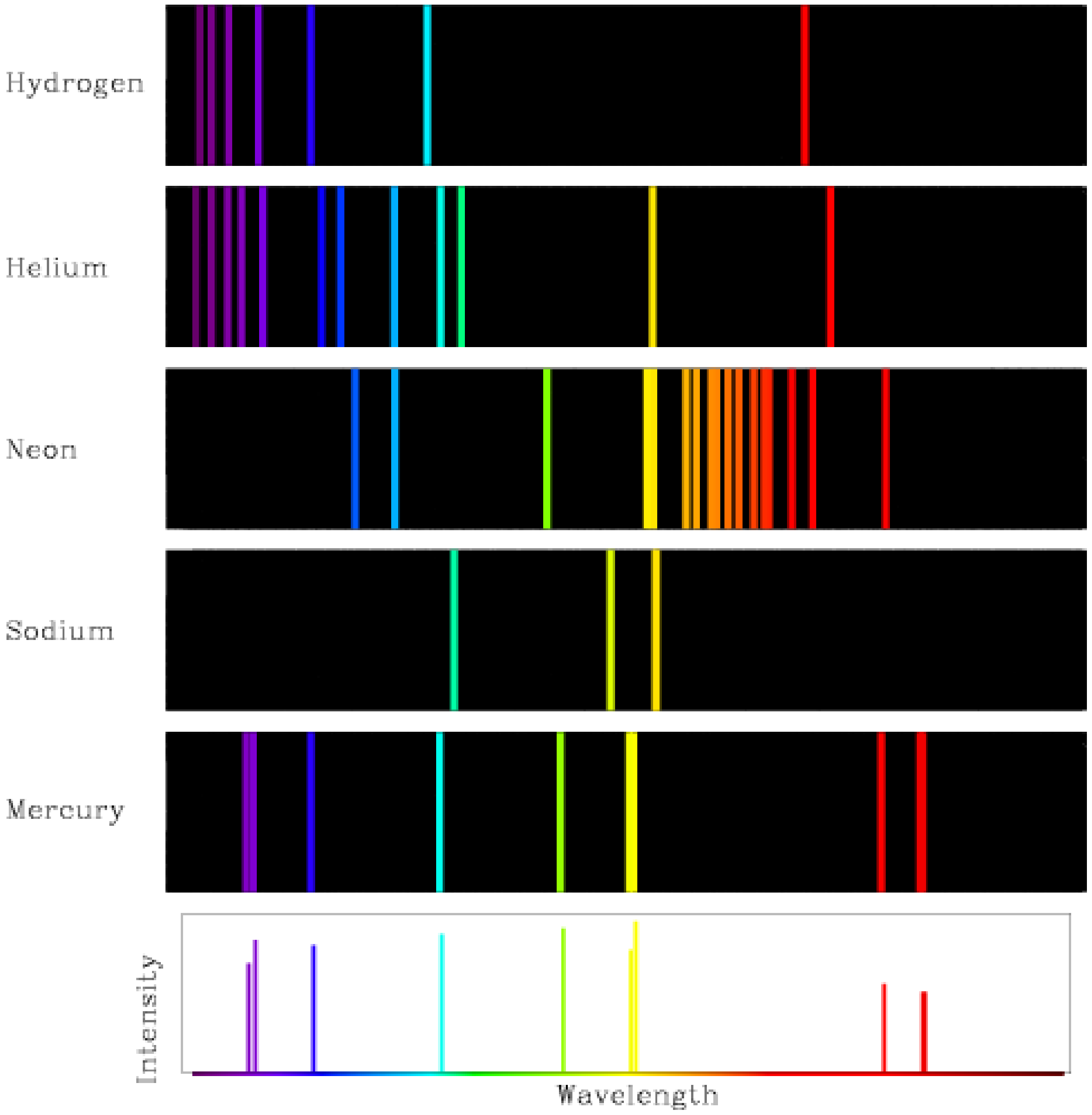
1. Complete the table:

Metal	Flame colour
Lithium	**Crimson**
Sodium	**Yellow**
Potassium	**Lilac**
Calcium	**Orange-red**
Copper	**green**

2. What chemical is added to test for metal ions in a solution? **Sodium hydroxide**
3. What are the colours of precipitate made by Cu^{2+} **(blue)**, Fe^{2+} **(green)**and Fe^{3+} **(brown)?**
4. Describe how to test for carbonate ions and what you would expect to observe. **Add dilute acid, bubbles of CO_2 form.**
5. How do we test for halide ions? **Add silver nitrate solution.** What colours are seen for Cl^- **(white)**, Br^- **(cream)** and I^-**(yellow)**?
6. What solution is used to test for sulfate ions? **Barium chloride solution**

Round 12 – Flame emission spectroscopy (TRIPLE ONLY)

1. List the advantages of using an instrumental method over using a flame test.
2. Which metals is present in this sample?



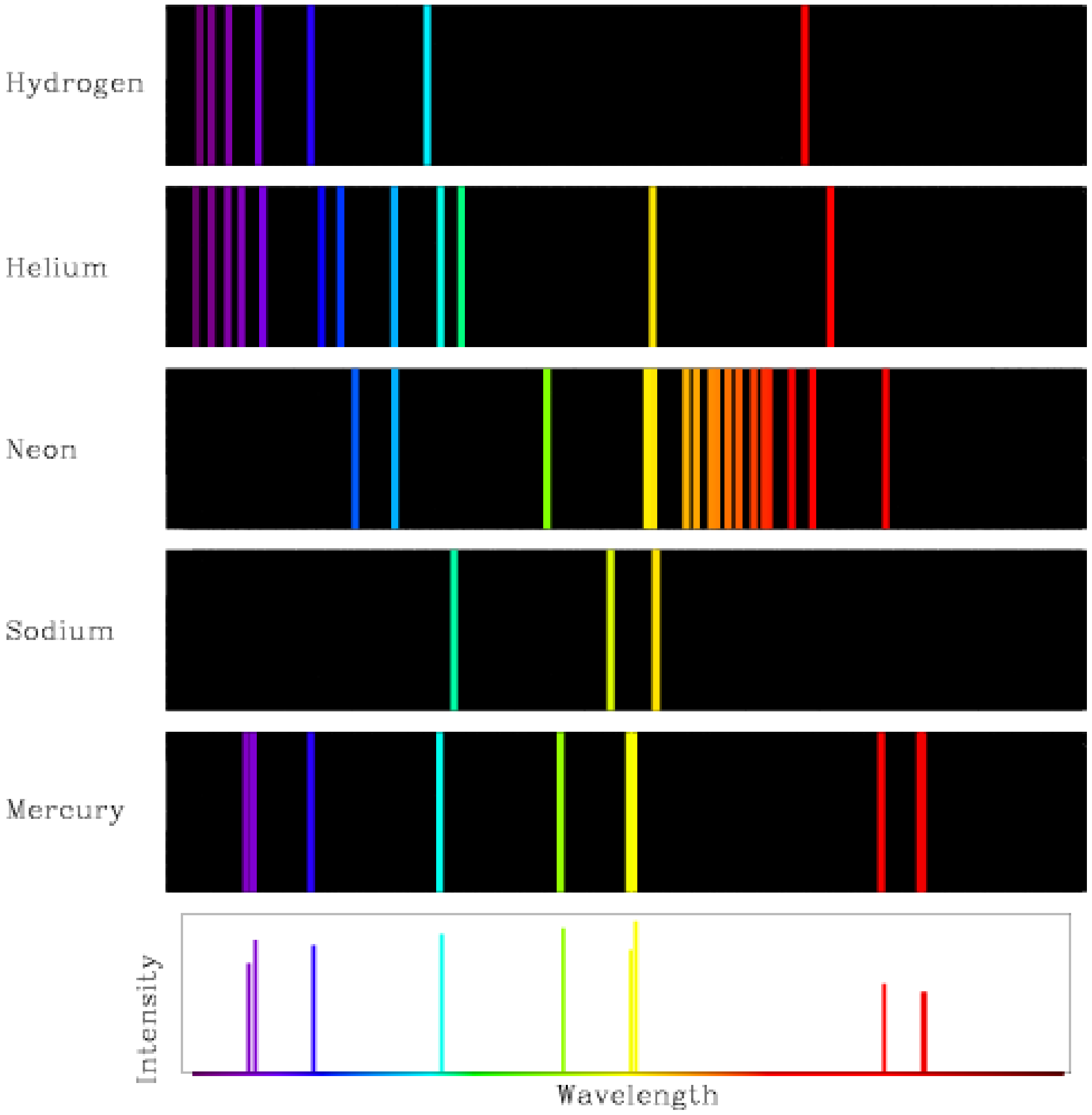
Round 12 – Flame emission spectroscopy (TRIPLE ONLY)

1. List the advantages of using an instrumental method over using a flame test.

Accurate, sensitive and rapid.

2. Which metals is present in this sample?

Mercury



Round 13 – Evolution of the atmosphere

Intense volcanic activity

Earth cools and oceans form

Plants evolve and photosynthesise

1. State what gases are present at each stage in the evolution o f the atmosphere flow diagram.
2. List 3 ways that carbon dioxide was removed from the atmosphere.
3. How do human activities produce carbon dioxide and methane?

Round 13 – Evolution of the atmosphere

Intense volcanic activity

Atmosphere consists of:

- Mainly CO_2.
- Volcanoes released N_2 and maybe CH_4 and NH_3.
- Little or no O_2.

Earth cools and oceans form

Changes to atmosphere:

- CO_2 levels drop
- As CO_2 is dissolved forming carbonates

Plants evolve and photosynthesise

Changes to atmosphere:

- O_2 levels increase as photosynthesis occurs

Round 13 – Evolution of the atmosphere

2. List 3 ways that carbon dioxide was removed from the atmosphere.

- **Dissolved in oceans forming carbonates**
- **Locked up in fossil fuels**
- **photosynthesis**

3. How do human activities produce carbon dioxide and methane?

Carbon dioxide – combustion and deforestation

Methane – landfill and intensive animal farming

Round 14 – Global climate change and pollutants

1. Define the term carbon footprint.
2. How can the carbon footprint be reduced for

a) A person
b) A company
c) A country

3. Why might these actions be limited?

4. Give 2 products from incomplete combustion. Why are they an issue?

5. How is sulfur dioxide formed from combustion? What problems does it cause?

Round 14 – Global climate change and pollutants

1. Define the term carbon footprint. – **total amount of carbon dioxide and methane emitted over the lifetime of a product, service or event.**
2. How can the carbon footprint be reduced for

a) A person – **turn off lights, walk, get public transport**

b) A company – **carbon offsetting, use carbon neutral fuels**

c) A country – **carbon capture, use taxation, invest in public transport systems**

3. Why might these actions be limited? **Cost and lack of political resolve**

4. Give 2 products from incomplete combustion. **Carbon (soot) and carbon monoxide** Why are they an issue? **Soot – causes global dimming and can cause asthma. Carbon monoxide - toxic**

5. How is sulfur dioxide formed from combustion? What problems does it cause?

Sulfur impurities in fuel react with oxygen. Acid rain.

Round 15 – Earths resources (potable water and LCAs)

1. Define the terms: pure water and potable water
2. State how potable water can be made from
   a) Freshwater
   b) Sea water
3. Which method would France use? Why?

4. Define the terms: sustainable development, finite resource and renewable resource.
5. Lifecycle assessments assess the environmental impact of a product. Explain why they are open to bias.

Round 15 – Earths resources (potable water and LCAs)

1. Define the terms: pure water **(contains only water molecules)** and potable water **(water that is safe to drink)**
2. State how potable water can be made from

a) Freshwater **(1. Filtered to remove solids. 2. Sterilised using chlorine / UV light / ozone)**

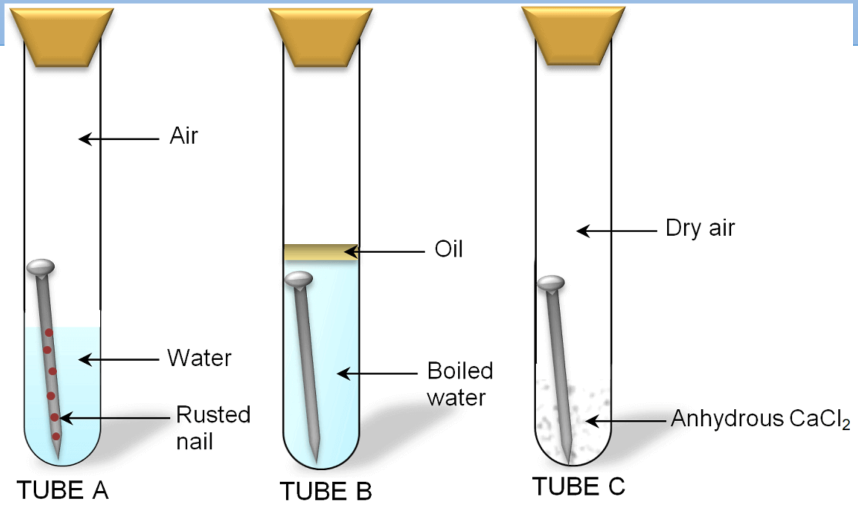
b) Sea water **(Distillation or reverse osmosis)**

3. Freshwater. France has a cool climate so has access to sufficient freshwater. It is cheaper / requires less energy to use freshwater.

4. Define the terms: sustainable development **(meeting the needs of our generation without compromising the ability of future generations to meet their needs)**, finite resource **(a resource that can not be replaced once it has been used)** and renewable resource **(a resource that can be replaced once it has been used)**.

5. Lifecycle assessments assess the environmental impact of a product. Explain why they are open to bias. **(LCAs assess use of water, resources, energy and waste production. Not all of these can be easily quantified leading to misrepresentation)**

Round 16 – using materials (TRIPLE ONLY)



1. Name 2 things that are needed for iron to rust.
2. Explain how sacrificial protection works
3. What are bronze and brass made of?
4. 24 carat gold is 100 % gold. What is the % gold in 18 carat gold?

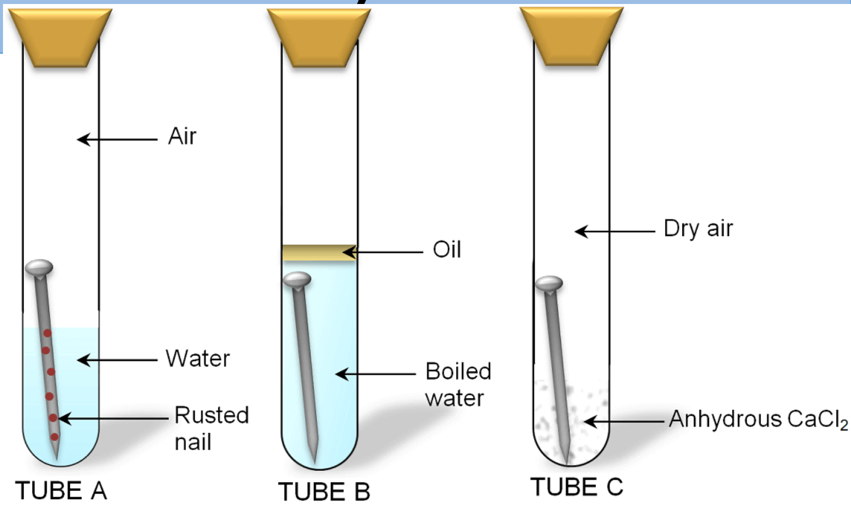
5. What are the differences in the conditions used to make high density and low density polyethene?

6. Which elements do NPK fertilisers contain?

7. Why can't phosphate rock be used directly as a fertilizer?

8. Name the salts formed when phosphate rock reacts with nitric acid, sulfuric acid and hydrochloric acid.

Round 16 – using materials (TRIPLE ONLY)



1. Name 2 things that are needed for iron to rust.

Water and oxygen

2. Explain how sacrificial protection works

More reactive metal reacts instead of iron

3. What are bronze and brass made of?

Bronze – copper and tin

Brass – copper and zinc

4. 24 carat gold is 100 % gold. What is the % gold in 18 carat gold? **75%**

Round 16 – using materials (TRIPLE ONLY)

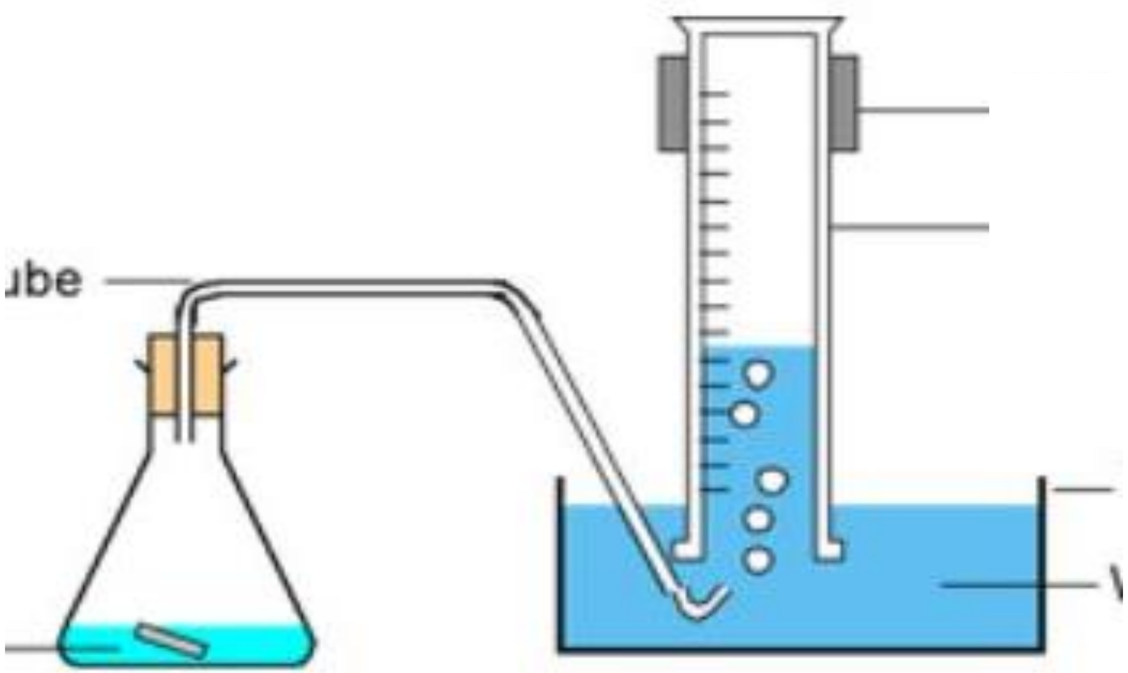
5. What are the differences in the conditions used to make high density and low density polyethene? **Different catalysts and LDPE made at a higher temperature**

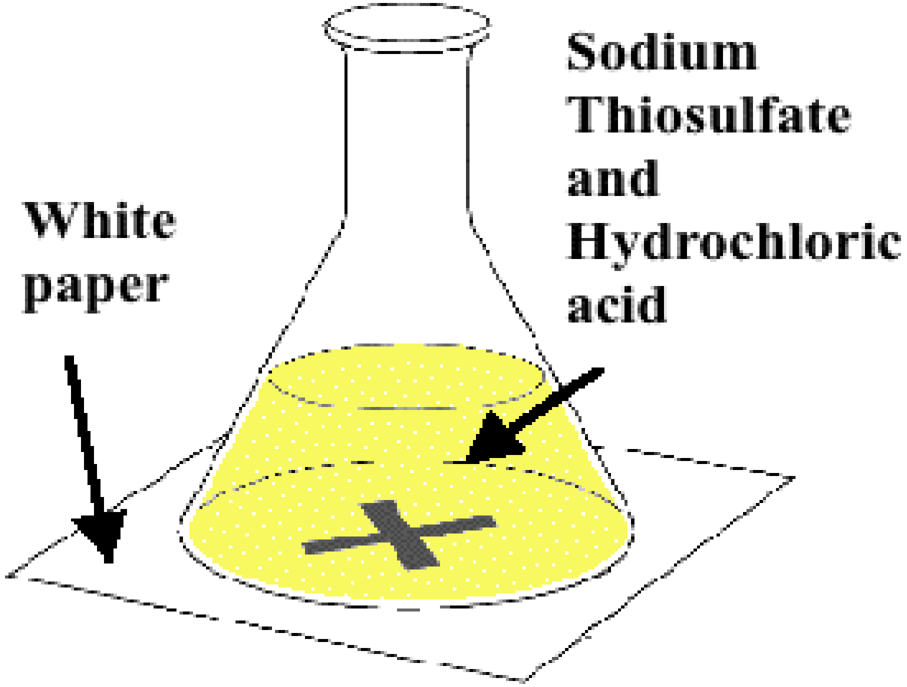
6. Which elements do NPK fertilisers contain? **Nitrogen, phosphorus and potassium**

7. Why can’t phosphate rock be used directly as a fertilizer? **insoluble**

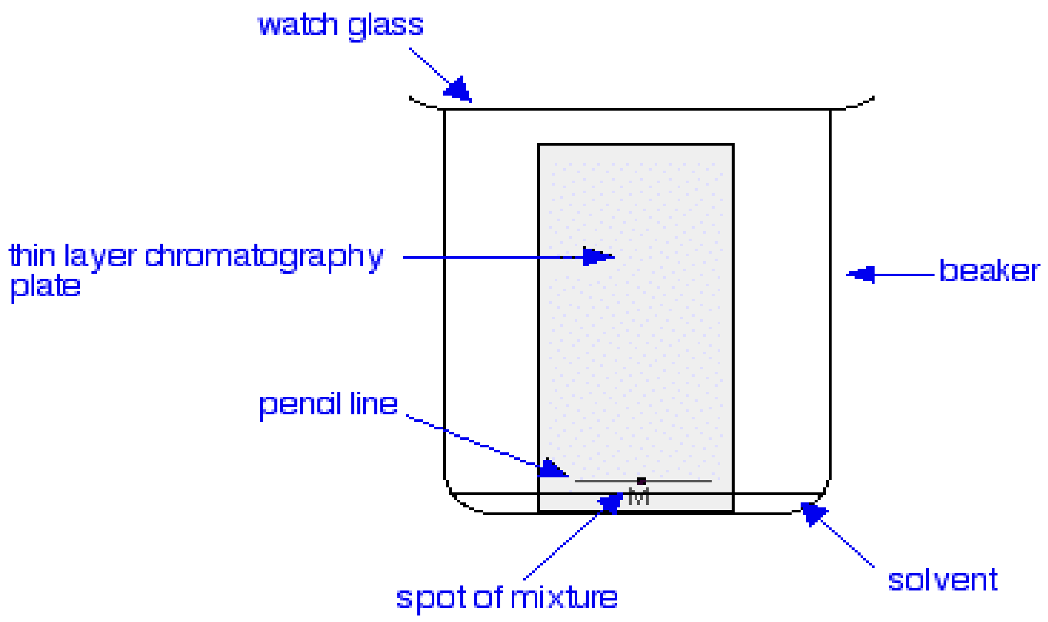
8. Name the salts formed when phosphate rock reacts with nitric acid, sulfuric acid and hydrochloric acid.

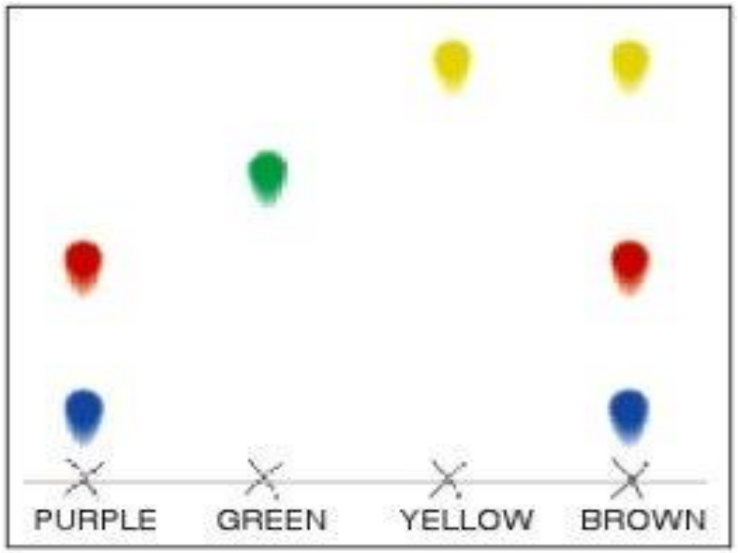
Required practical – rates of reaction





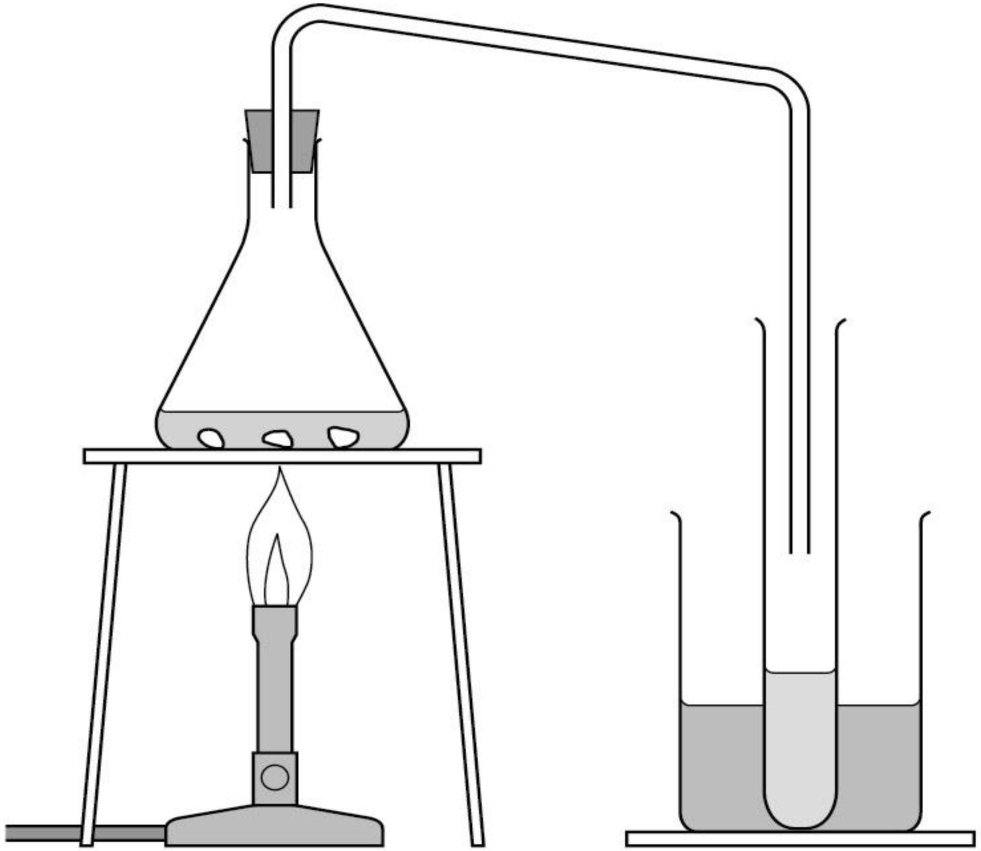
Required practical – chromatography

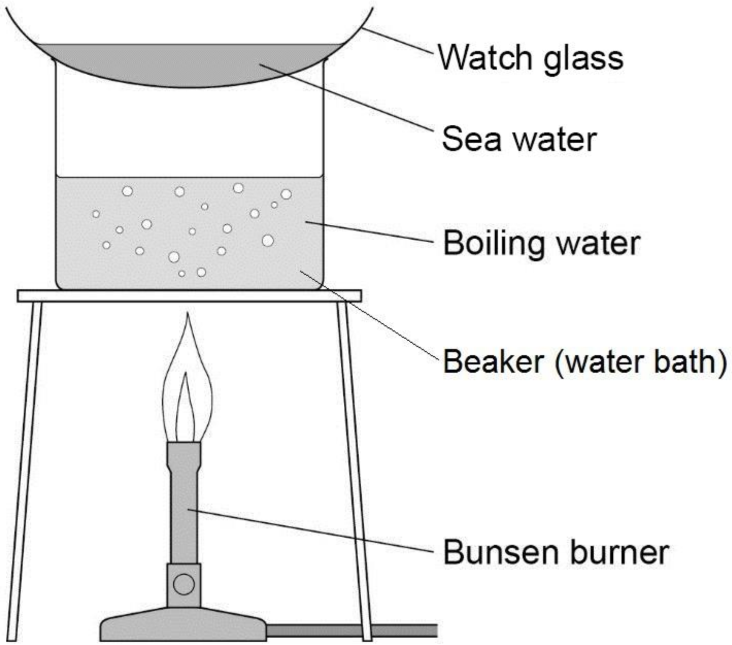




$$Rf = \frac{\text{distance travelled by spot}}{\text{distance travelled by solvent}}$$

Required practical – potable water





Required practical – ion tests (TRIPLE ONLY)

Ion	**Test**	**Positive result**
Fe^{2+}		
Fe^{3+}		
Cu^{2+}		
Mg^{2+}		
Ca^{2+}		
Al^{3+}		

Required practical – ion tests (TRIPLE ONLY)

Ion	**Test**	**Positive result**
Fe^{2+}	Add NaOH	Light blue precipitate
Fe^{3+}		Red-brown precipitate
Cu^{2+}		Light ‘dirty’ green precipitate
Mg^{2+}		White precipitate
Ca^{2+}		White precipitate
Al^{3+}		White precipitate – dissolves in excess NaOH

Required practical – ion tests (TRIPLE ONLY)

Ion	Test	Positive result
Li^{+}		
Na^{+}		
K^{+}		
Ca^{2+}		
Cu^{2+}		

Required practical – ion tests (TRIPLE ONLY)

Ion	**Test**	**Positive result**
Li^+	Flame test	Crimson
Na^+		Yellow
K^+		Lilac
Ca^{2+}		Orange –red
Cu^{2+}		Green

Required practical – ion tests (TRIPLE ONLY)

Ion	**Test**	**Positive result**
Carbonates **CO_3^{2-}**		
Sulphates **SO_4^{2-}**		
Halides **Cl^-, Br^-, I^-**		

Required practical – ion tests (TRIPLE ONLY)

Ion	Test	Positive result
Carbonates **CO_3^{2-}**	Add dilute acid	Fizzing – carbon dioxide produced. CO_2 turns limewater cloudy
Sulphates **SO_4^{2-}**	Add Barium Chloride	White precipitate
Halides **Cl^-, Br^-, I^-**	Add silver nitrate	Cl^- white precipitate Br^- cream precipitate I^- yellow precipitate

Round 1 – Rates of reaction

1. List the factors that affect the rate of a chemical reaction.
2. Predict what will happen to the rate of a chemical reaction if the concentration of a reactant is doubled.
3. Explain why a 10°C increase in the temperature can double the rate of a reaction.
4. Draw an energy profile for a catalysed reaction.
5. Identify the catalyst:

$$N_2 + 3H_2 \overset{Fe}{\rightleftharpoons} 2NH_3$$

Round 1 – Rates of reaction

1. List the factors that affect the rate of a chemical reaction.

Temperature, surface area, concentration, pressure, catalysts

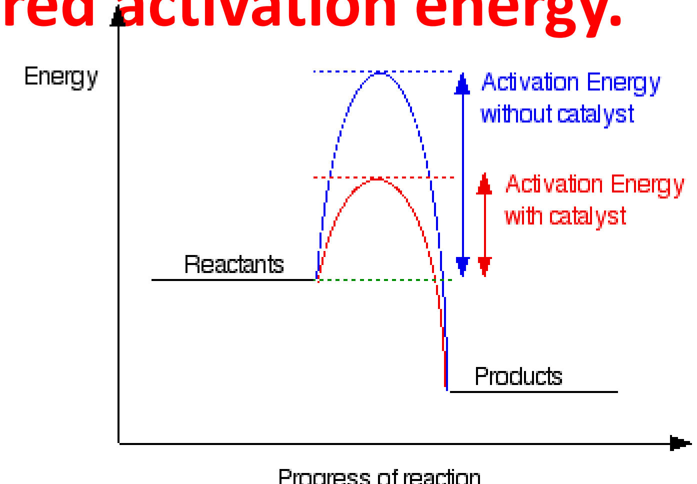
2. Predict what will happen to the rate of a chemical reaction if the concentration of a reactant is doubled.

The rate will double as there are double the number of particles in the same volume, so the frequency of collisions will double.

3. Explain why a 10°C increase in the temperature can double the rate of a reaction.

Particles have more kinetic energy so collide more frequently. These collision are also more energetic meaning more particles have the required activation energy.

3. Draw an energy profile for a catalysed reaction.



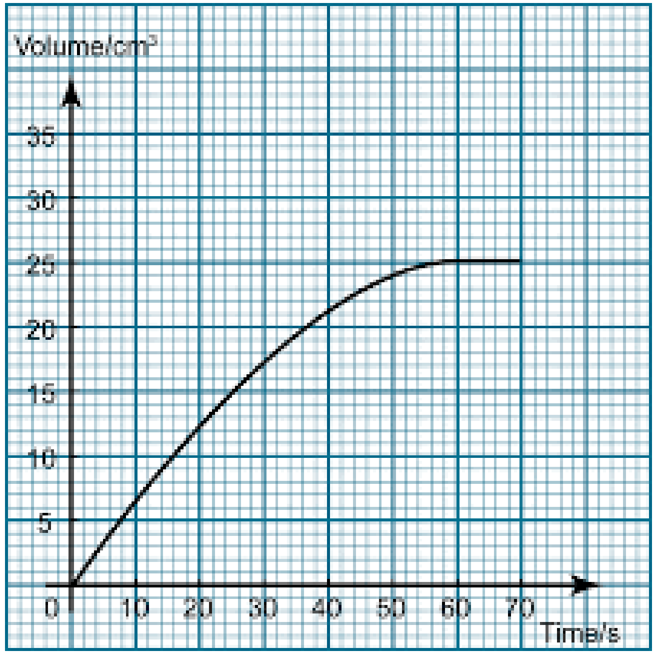
4. Identify the catalyst:

Fe – catalysts are written above the arrow

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Round 2 – Rates of reaction

1. Define the term mean rate of reaction.
2. Use the graph to calculate the mean rate of reaction:



3. How would you calculate the rate of reaction at 30 second (HT)?

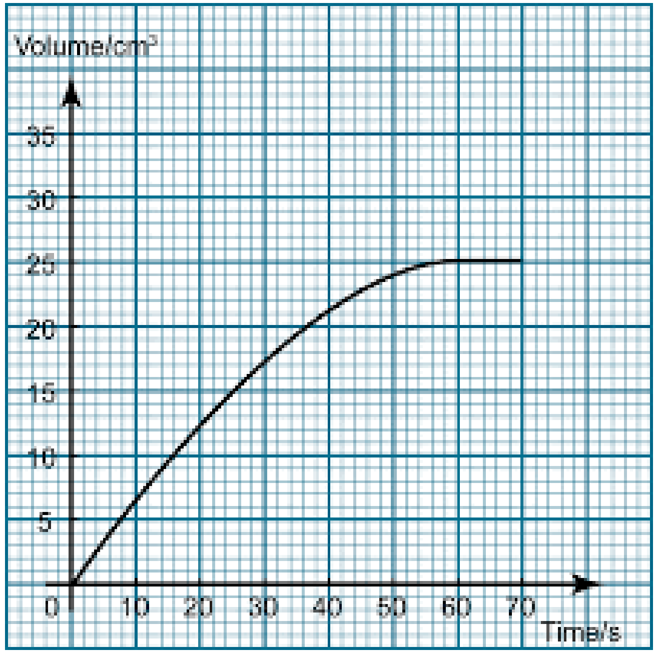
Round 2 – Rates of reaction

1. Define the term mean rate of reaction.

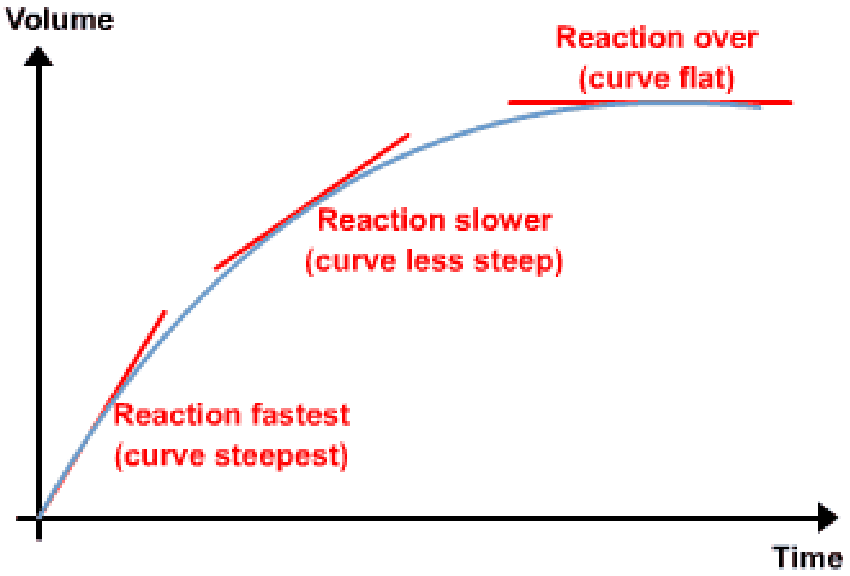
Mean rate = <u>quantity of product made / reactant used up</u>

time

2. Use the graph to calculate the mean rate of reaction:



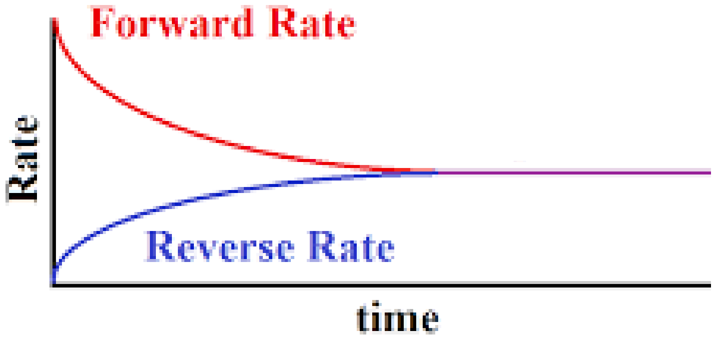
Mean rate
= 25 / 56
= 0.446 cm^3/s

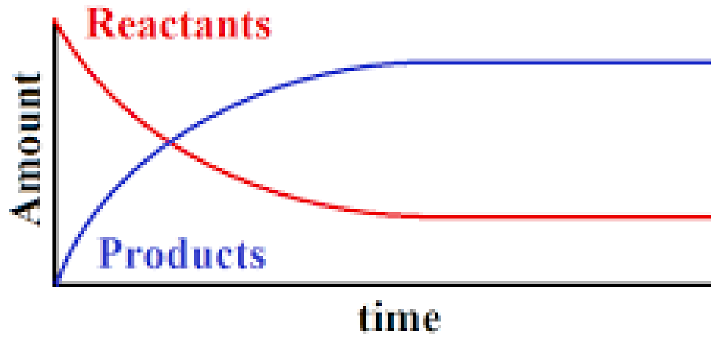


3. How would you calculate the rate of reaction at 30 second (HT)? **Draw a tangent line and calculate its gradient.**

Round 3 – Equilibrium

1. Draw the symbol for a reversible reaction.
2. Define equilibrium.
3. Draw a line on each graph to show where equilibrium is established.





4. (HT) Describe what happens to the equilibrium

$$N_{2(g)} + O_{2(g)} \xrightleftharpoons{\text{endothermic}} 2NO_{(g)}$$

when

a) the concentration of a reactant is increased.

b) The pressure is increased

c) The temperature is increased

Round 3 – Equilibrium

1. Draw the symbol for a reversible reaction. **⇌**
2. Define equilibrium. **Occurs in a closed system, where the rate of the forward reaction is equal to the rate of the reverse reaction**
3. Draw a line on each graph to show where equilibrium is established. **Point where conc stops changing**
4. (HT) Describe what happens to the equilibrium

$$N_{2(g)} + O_{2(g)} \underset{\textbf{endothermic}}{\rightleftharpoons} 2NO_{(g)}$$

when

a) the concentration of a reactant is increased.

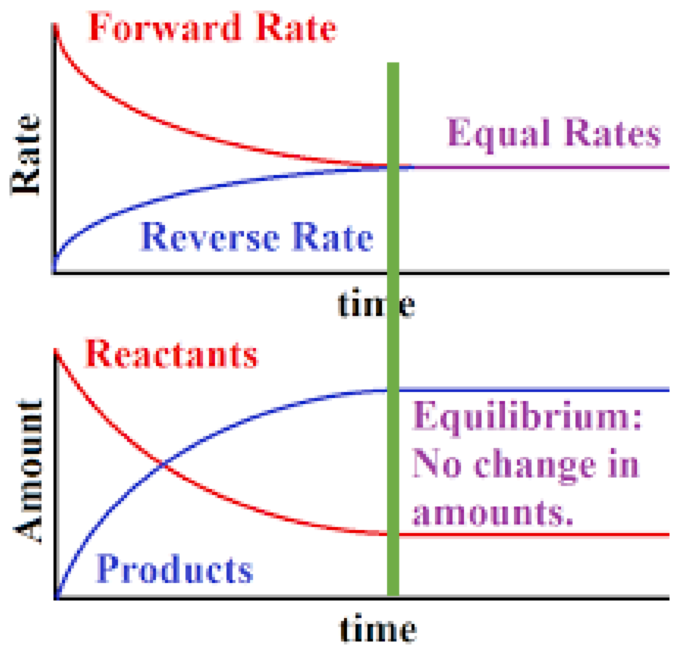
Eqm moves to right to oppose the change so amount of product increases

a) The pressure is increased

No change. There are equal number of gas particles on both sides.

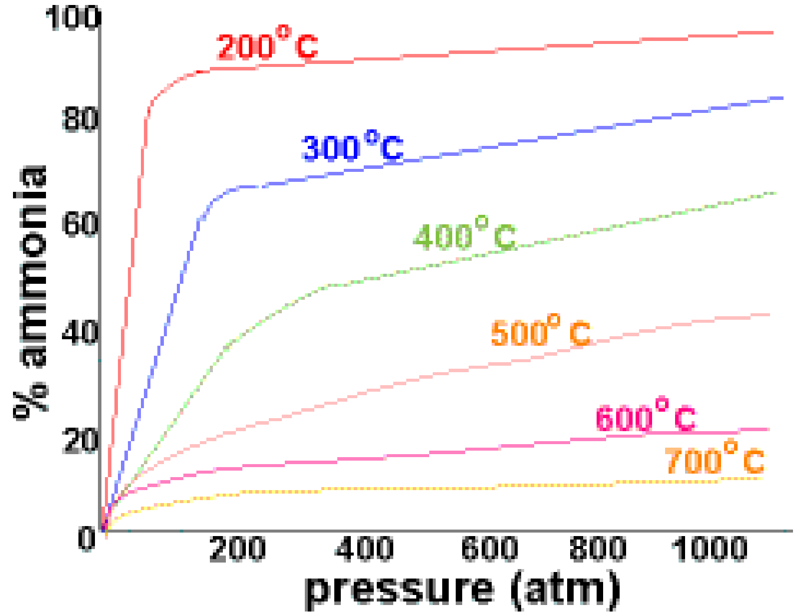
a) The temperature is increased

Eqm moves in endothermic direction so amount of product increases



Round 4 – Haber Process (TRIPLE ONLY)

1. Write the equation for the Haber process.
2. State the conditions for the Haber process.
3. Why is 450°C a compromise temperature?
4. Using the graph below, identify the conditions that give the maximum yield of ammonia. Explain why these are not the conditions actually used.



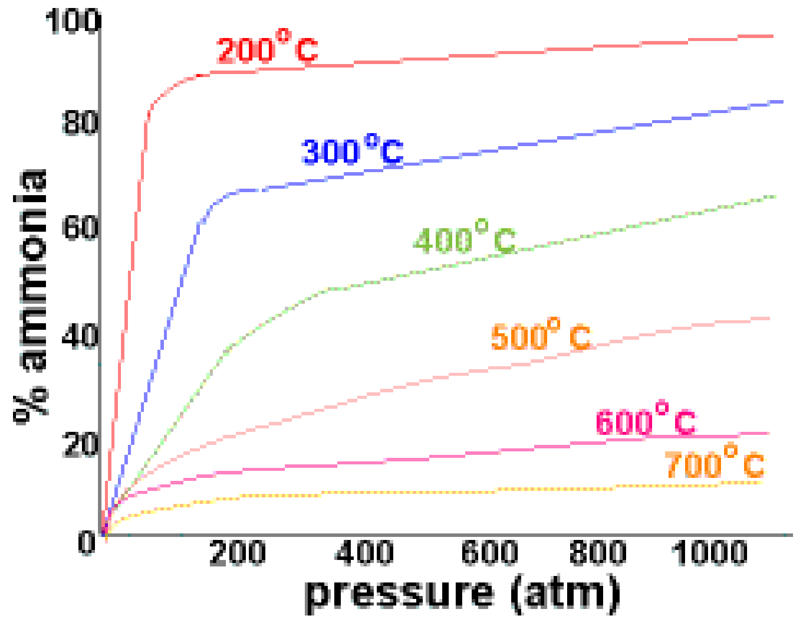
Round 4 – Haber Process (TRIPLE ONLY)

1. Write the equation for the Haber process. **$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$**
2. State the conditions for the Haber process. **200 atm, 450°C, Fe catalyst**
3. Why is 450°C a compromise temperature? **Rate is slow at lower temperatures. Yield decreases as temp increases as the forward reaction is exothermic. Compromise is between yield of ammonia and the rate at which it is formed.**
4. Using the graph below, identify the conditions that give the maximum yield of ammonia. Explain why these are not the conditions actually used.

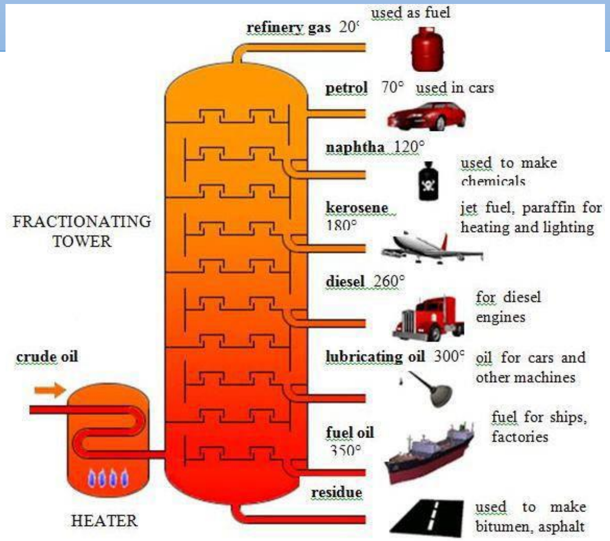
200°C + 1000atm pressure

☹ Low rate of formation at low temp.

☹ High pressures are dangerous and require lots of Energy to maintain.



Round 5 – Fractional distillation and hydrocarbons



1. Explain how crude oil is separated into fractions.
2. Define the term hydrocarbon.
3. Complete and balance the equation:

$$C_3H_8 + O_2 \rightarrow \_\_\_\_\_\_ + \_\_\_\_\_\_\_\_$$

4. Describe how boiling point, viscosity and flammability change with molecular size.
5. Give the general formula for the alkanes.
6. Name the first 4 alkanes.

Round 5 – Fractional distillation and hydrocarbons

1. Explain how crude oil is separated into fractions.

Crude oil is heated to vaporise it. Vapours rise up column and cool. Vapours condense at the boiling temperature of the molecule.

2. Define the term hydrocarbon. **A molecule made of carbon and hydrogen only**

3. Complete and balance the equation:

$$C_3H_8 + 5O_2 \rightarrow \_3CO_2\_\_ + \_\_4H_2O\_\_$$

4. Describe how boiling point, viscosity and flammability change with molecular size. **Boiling point and viscosity increase with Mr, flammability decreases.**

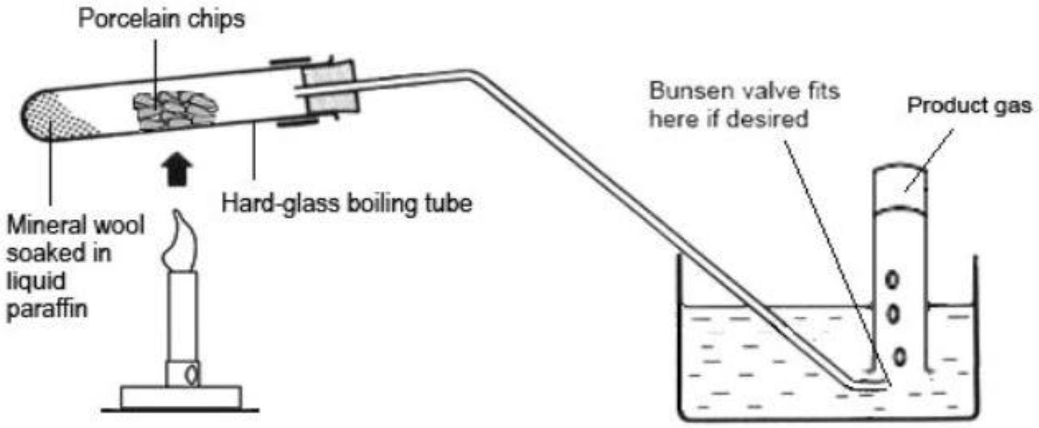
5. Give the general formula for the alkanes. **C_nH_{2n+2}**

6. Name the first 4 alkanes. **Methane (C1), ethane (C2), propane (C3), butane (C4)**

Round 6 – Cracking and alkenes

1. Give the conditions for catalytic cracking and steam cracking.
2. Why do we do cracking?
3. Describe how to test for alkenes.
4. Balance the equation:

$$C_{12}H_{26} \rightarrow C_6H_{14} + \_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_$$



Round 6 – Cracking and alkenes

1. Give the conditions for catalytic cracking **(heat to vapourise and pass vapours over a hot catalyst)** and steam cracking **(mix with steam, heat to a very high temperature).**
2. Why do we do cracking? **To make smaller alkanes that are useful as fuels and alkenes that can be used to make plastics**
3. Describe how to test for alkenes. **Add bromine water. Stays orange with alkanes and goes colourless with alkenes**
4. Balance the equation:

$$C_{12}H_{26} \rightarrow C_6H_{14} + \_\mathbf{C_2H_4}\_\_ + \_\_\ \mathbf{C_4H_8}\ \_\_$$

OR

$$C_{12}H_{26} \rightarrow C_6H_{14} + \_\mathbf{C_3H_6}\_\_ + \_\_\ \mathbf{C_3H_6}\ \_\_$$

Round 7 – Reactions of alkenes (TRIPLE ONLY)

1. Define the term: unsaturated.
2. Draw the functional group of the alkenes.
3. Draw the products formed with ethene reacts with

a) Water
b) Hydrogen
c) Bromine

4. Draw the polymer formed when propene polymerises.
5. Name the type of polymer formed.

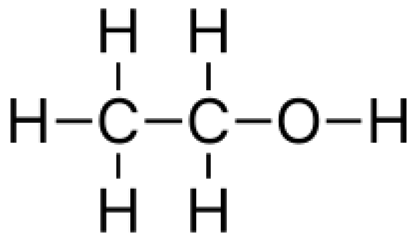
Round 7 – Reactions of alkenes (TRIPLE ONLY)

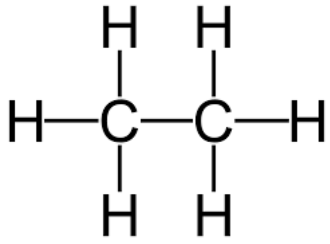
1. Define the term: unsaturated. **Contains at least one C=C**
2. Draw the functional group of the alkenes. **C=C**
3. Draw the products formed with ethene reacts with

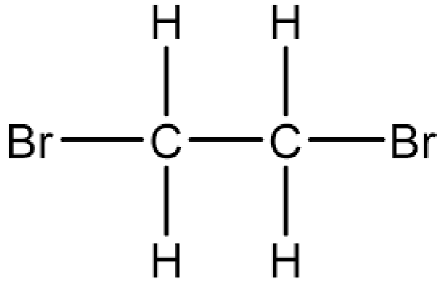
a) Water

b) Hydrogen

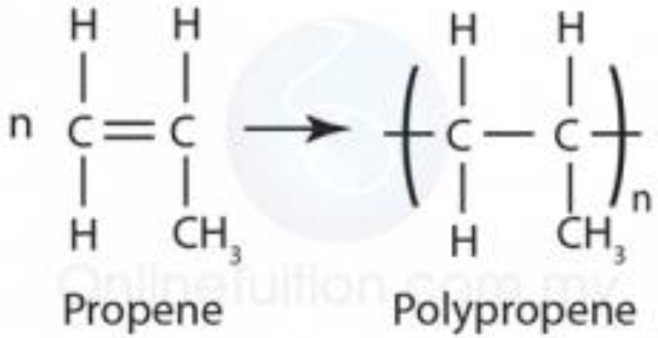
c) Bromine







4. Draw the polymer formed when propene polymerises.
5. Name the type of polymer formed. **Addition polymer**

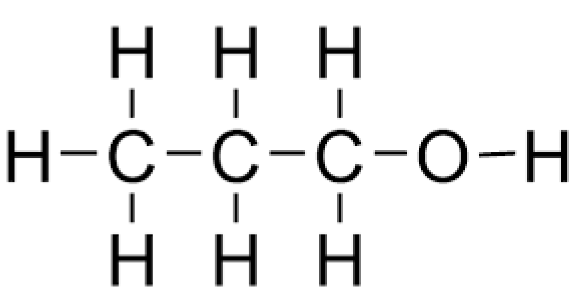


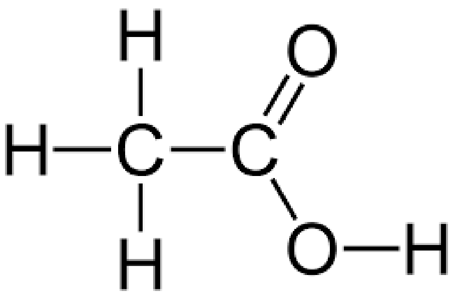
Round 8 – Reactions of alcohols and carboxylic acids (TRIPLE ONLY)

1. Give the functional group of alcohols and carboxylic acids.
2. Draw propanol and ethanoic acid.
3. Describe what happens when ethanol and ethanoic acid are added to separate samples of water.
4. Which gas is formed when sodium is added to an alcohol?
5. Which gas is formed when sodium carbonate is added to a carboxylic acid?

Round 8 – Reactions of alcohols and carboxylic acids (TRIPLE ONLY)

1. Give the functional group of alcohols **(O-H)** and carboxylic acids. **(COOH)**
2. Draw propanol and ethanoic acid.





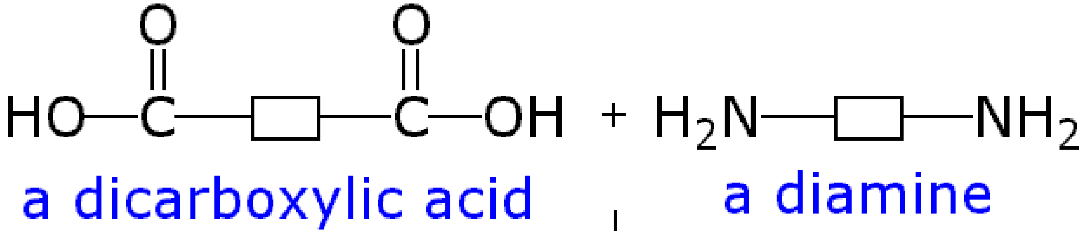
3. Describe what happens when ethanol and ethanoic acid are added to separate samples of water.

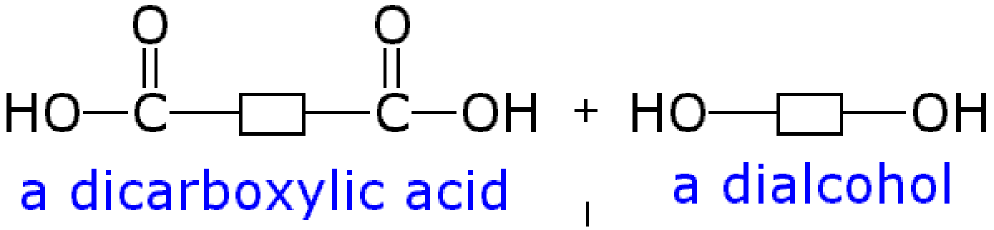
Ethanol dissolves, forming a neutral solution. Ethanoic acid dissolves forming a weakly acidic solution.

4. Which gas is formed when sodium is added to an alcohol? **hydrogen**
5. Which gas is formed when sodium carbonate is added to a carboxylic acid? **Carbon dioxide**

Round 9 – Polymers (TRIPLE ONLY)

1. Draw the condensation polymers made from:





2. Name the monomer used to make:

a) Polypeptides

b) DNA

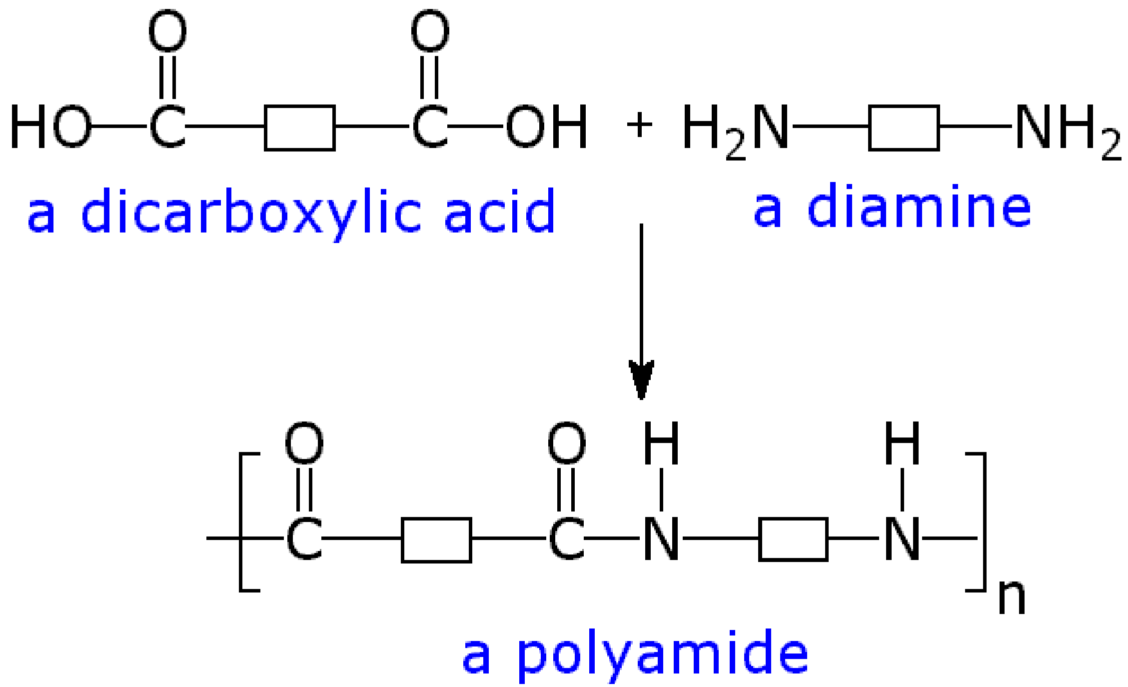
c) starch

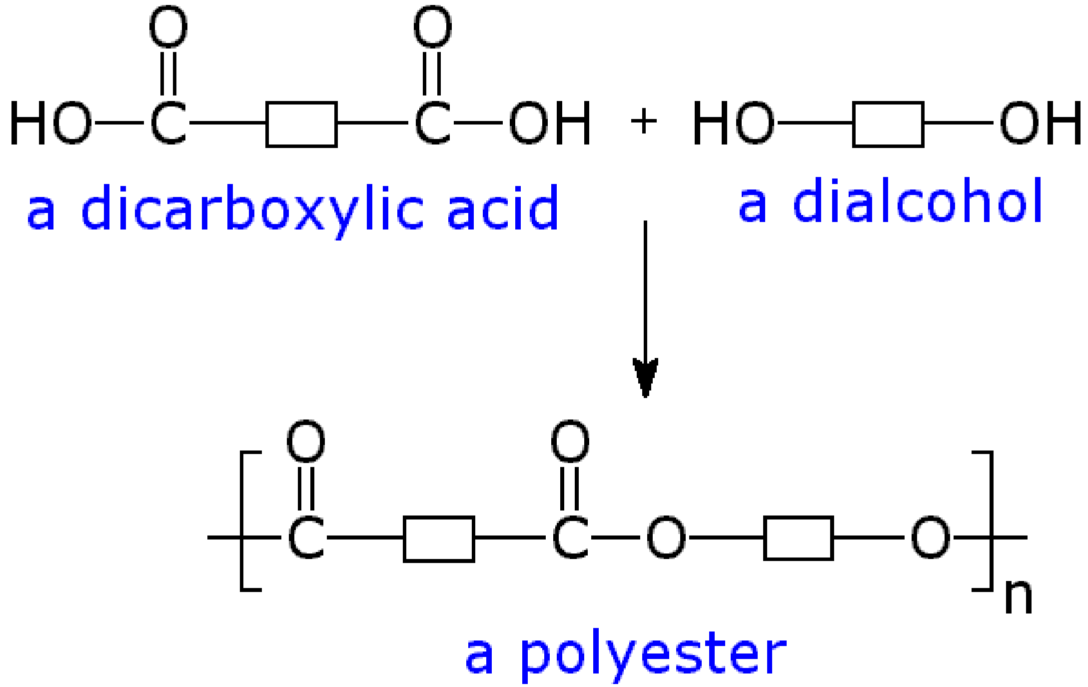
d) Cellulose

3. Name the structure of DNA

Round 9 – Polymers (TRIPLE ONLY)

1. Draw the condensation polymers made from:





Round 9 – Polymers (TRIPLE ONLY)

2. Name the monomer used to make:

a) Polypeptides **amino acids**

b) DNA **nucleotides**

c) Starch **glucose**

d) Cellulose **glucose**

3. Name the structure of DNA **double helix**

Round 10 – Formulations and testing for gases

1. A pure substance is made of a single ____________ or _____________.
2. Pure substances melt or _____ at a specific temperature.
3. Compared to pure substances, mixtures have _______ melting points and melt over a range of temperatures.
4. A formulation is a _______ that has been designed as a useful product.
5. Components are mixed in precise quantities to give desired ________.
6. Complete the table:

Gas	Test with…..	Result
Hydrogen		
Oxygen		
	Limewater	
	Damp blue litmus paper	

Round 10 – Formulations and testing for gases

1. A pure substance is made of a single __**element**__ or __**compound**__.
2. Pure substances melt or __**boil**__ at a specific temperature.
3. Compared to pure substances, mixtures have __**lower**__ melting points and melt over a range of temperatures.
4. A formulation is a __**mixture**__ that has been designed as a useful product.
5. Components are mixed in precise quantities to give desired __**properties**__.
6. Complete the table:

Gas	Test with.....	Result
Hydrogen	**Lit splint**	**Squeaky pop**
Oxygen	**Glowing splint**	**Splint relights**
Carbon dioxide	Limewater	**Limewater goes cloudy**
Chlorine	Damp blue litmus paper	**Litmus paper bleaches**

Round 11 – Testing for ions (TRIPLE ONLY)

1. Complete the table:

Metal	Flame colour
Lithium	
Sodium	
Potassium	
Calcium	
Copper	

2. What chemical is added to test for metal ions in a solution?
3. What are the colours of precipitate made by Cu^{2+}, Fe^{2+} and Fe^{3+}?
4. Describe how to test for carbonate ions and what you would expect to observe.
5. How do we test for halide ions? What colours are seen for Cl^-, Br^- and I^-?
6. What solution is used to test for sulfate ions?

Round 11 – Testing for ions (TRIPLE ONLY)

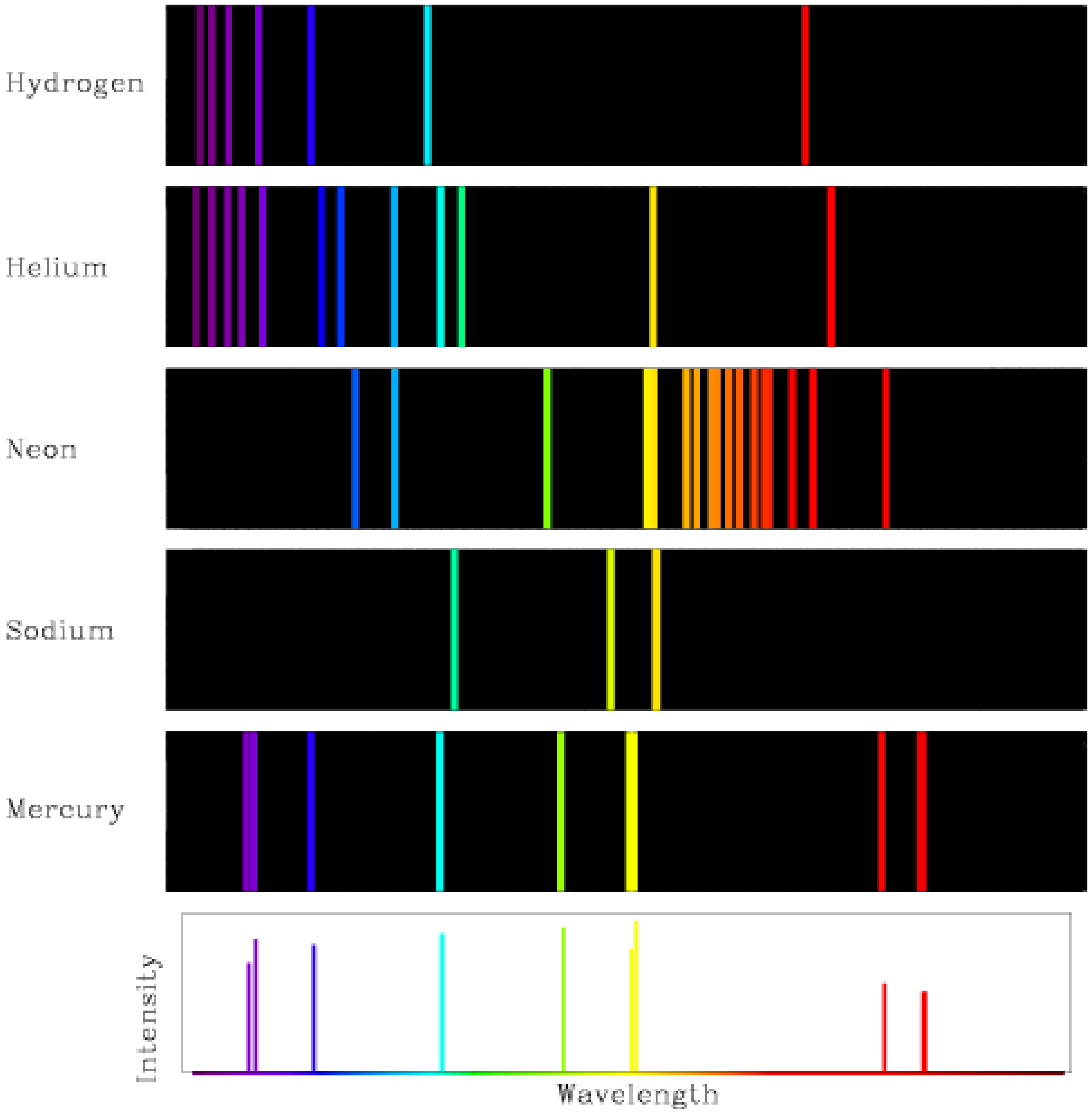
1. Complete the table:

Metal	Flame colour
Lithium	**Crimson**
Sodium	**Yellow**
Potassium	**Lilac**
Calcium	**Orange-red**
Copper	**green**

2. What chemical is added to test for metal ions in a solution? **Sodium hydroxide**
3. What are the colours of precipitate made by Cu^{2+} **(blue)**, Fe^{2+} **(green)**and Fe^{3+} **(brown)?**
4. Describe how to test for carbonate ions and what you would expect to observe. **Add dilute acid, bubbles of CO_2 form.**
5. How do we test for halide ions? **Add silver nitrate solution.** What colours are seen for Cl^- **(white)**, Br^- **(cream)** and I^-**(yellow)**?
6. What solution is used to test for sulfate ions? **Barium chloride solution**

Round 12 – Flame emission spectroscopy (TRIPLE ONLY)

1. List the advantages of using an instrumental method over using a flame test.
2. Which metals is present in this sample?



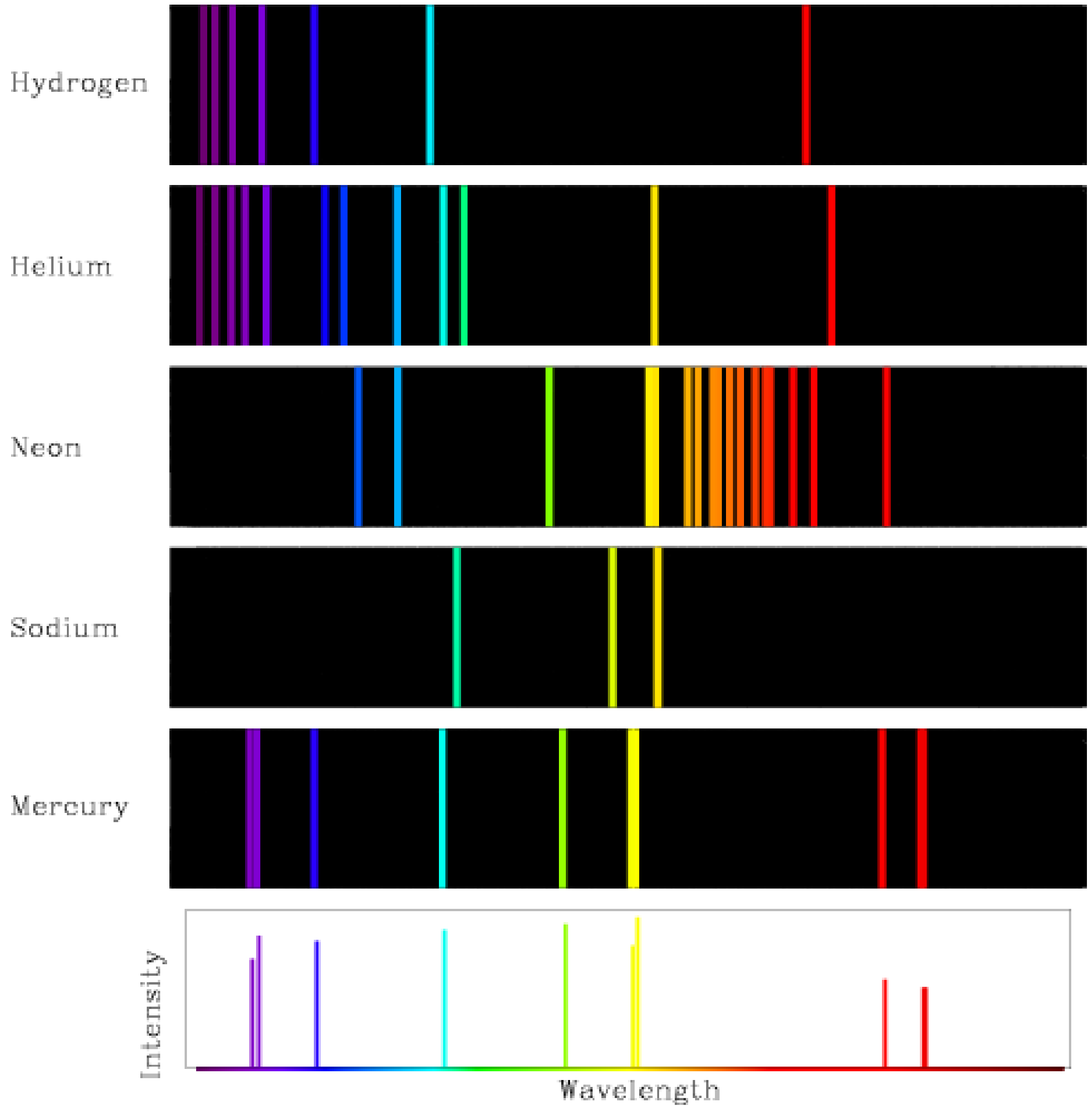
Round 12 – Flame emission spectroscopy (TRIPLE ONLY)

1. List the advantages of using an instrumental method over using a flame test.

Accurate, sensitive and rapid.

2. Which metals is present in this sample?

Mercury



Round 13 – Evolution of the atmosphere

Intense volcanic activity

Earth cools and oceans form

Plants evolve and photosynthesise

1. State what gases are present at each stage in the evolution o f the atmosphere flow diagram.
2. List 3 ways that carbon dioxide was removed from the atmosphere.
3. How do human activities produce carbon dioxide and methane?

Round 13 – Evolution of the atmosphere

Intense volcanic activity

Atmosphere consists of:

- Mainly CO_2.
- Volcanoes released N_2 and maybe CH_4 and NH_3.
- Little or no O_2.

Earth cools and oceans form

Changes to atmosphere:

- CO_2 levels drop
- As CO_2 is dissolved forming carbonates

Plants evolve and photosynthesise

Changes to atmosphere:

- O_2 levels increase as photosynthesis occurs

Round 13 – Evolution of the atmosphere

2. List 3 ways that carbon dioxide was removed from the atmosphere.

- **Dissolved in oceans forming carbonates**
- **Locked up in fossil fuels**
- **photosynthesis**

3. How do human activities produce carbon dioxide and methane?

Carbon dioxide – combustion and deforestation

Methane – landfill and intensive animal farming

Round 14 – Global climate change and pollutants

1. Define the term carbon footprint.
2. How can the carbon footprint be reduced for

a) A person
b) A company
c) A country

3. Why might these actions be limited?

4. Give 2 products from incomplete combustion. Why are they an issue?

5. How is sulfur dioxide formed from combustion? What problems does it cause?

Round 14 – Global climate change and pollutants

1. Define the term carbon footprint. – **total amount of carbon dioxide and methane emitted over the lifetime of a product, service or event.**
2. How can the carbon footprint be reduced for

a) A person – **turn off lights, walk, get public transport**

b) A company – **carbon offsetting, use carbon neutral fuels**

c) A country – **carbon capture, use taxation, invest in public transport systems**

3. Why might these actions be limited? **Cost and lack of political resolve**

4. Give 2 products from incomplete combustion. **Carbon (soot) and carbon monoxide** Why are they an issue? **Soot – causes global dimming and can cause asthma. Carbon monoxide - toxic**

5. How is sulfur dioxide formed from combustion? What problems does it cause?

Sulfur impurities in fuel react with oxygen. Acid rain.

Round 15 – Earths resources (potable water and LCAs)

1. Define the terms: pure water and potable water
2. State how potable water can be made from

a) Freshwater
b) Sea water

3. Which method would France use? Why?

4. Define the terms: sustainable development, finite resource and renewable resource.
5. Lifecycle assessments assess the environmental impact of a product. Explain why they are open to bias.

Round 15 – Earths resources (potable water and LCAs)

1. Define the terms: pure water **(contains only water molecules)** and potable water **(water that is safe to drink)**
2. State how potable water can be made from

a) Freshwater **(1. Filtered to remove solids. 2. Sterilised using chlorine / UV light / ozone)**

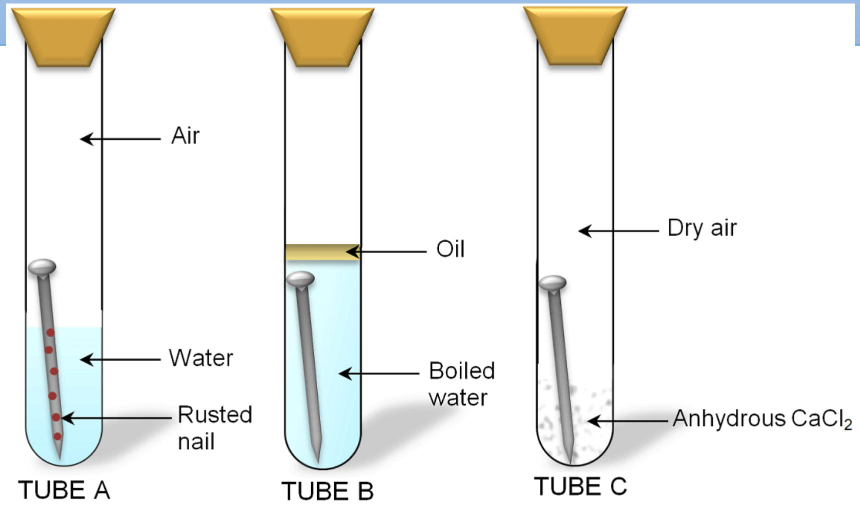
b) Sea water **(Distillation or reverse osmosis)**

3. Freshwater. France has a cool climate so has access to sufficient freshwater. It is cheaper / requires less energy to use freshwater.

4. Define the terms: sustainable development **(meeting the needs of our generation without compromising the ability of future generations to meet their needs)**, finite resource **(a resource that can not be replaced once it has been used)** and renewable resource **(a resource that can be replaced once it has been used)**.

5. Lifecycle assessments assess the environmental impact of a product. Explain why they are open to bias. **(LCAs assess use of water, resources, energy and waste production. Not all of these can be easily quantified leading to misrepresentation)**

Round 16 – using materials (TRIPLE ONLY)



1. Name 2 things that are needed for iron to rust.
2. Explain how sacrificial protection works
3. What are bronze and brass made of?
4. 24 carat gold is 100 % gold. What is the % gold in 18 carat gold?

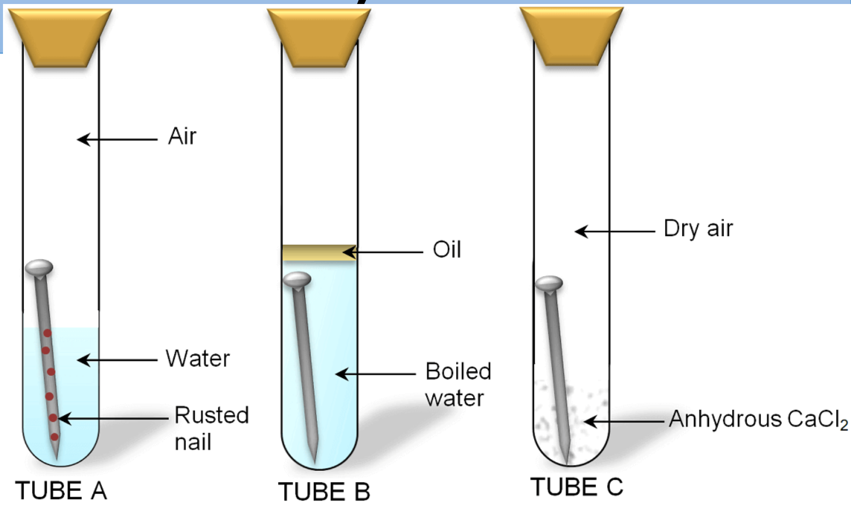
5. What are the differences in the conditions used to make high density and low density polyethene?

6. Which elements do NPK fertilisers contain?

7. Why can't phosphate rock be used directly as a fertilizer?

8. Name the salts formed when phosphate rock reacts with nitric acid, sulfuric acid and hydrochloric acid.

Round 16 – using materials (TRIPLE ONLY)



1. Name 2 things that are needed for iron to rust.

Water and oxygen

2. Explain how sacrificial protection works

More reactive metal reacts instead of iron

3. What are bronze and brass made of?

Bronze – copper and tin

Brass – copper and zinc

4. 24 carat gold is 100 % gold. What is the % gold in 18 carat gold? **75%**

Round 16 – using materials (TRIPLE ONLY)

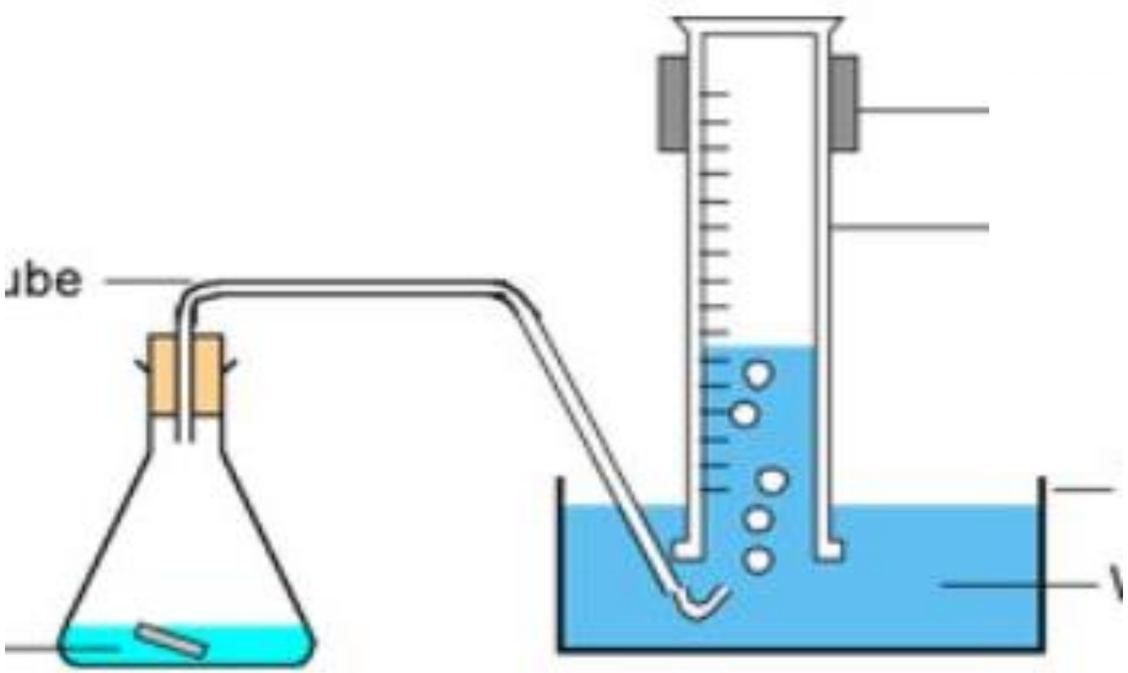
5. What are the differences in the conditions used to make high density and low density polyethene? **Different catalysts and LDPE made at a higher temperature**

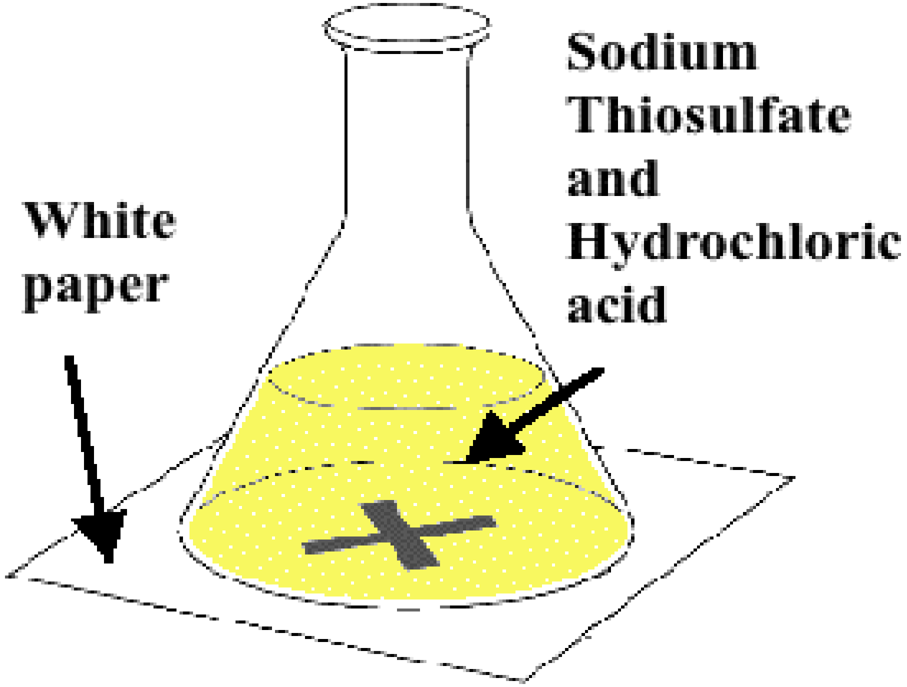
6. Which elements do NPK fertilisers contain? **Nitrogen, phosphorus and potassium**

7. Why can't phosphate rock be used directly as a fertilizer? **insoluble**

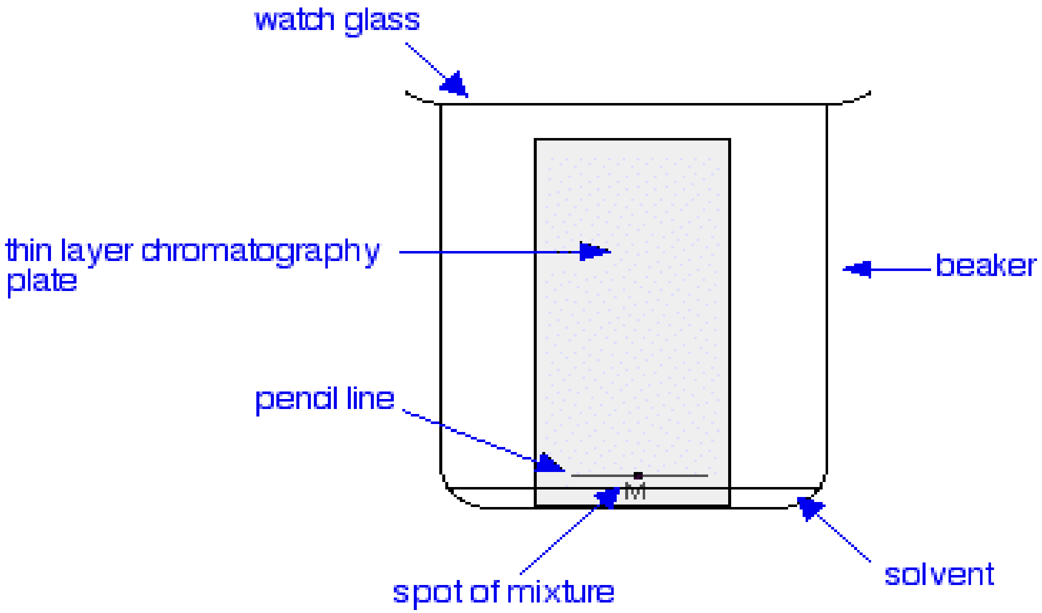
8. Name the salts formed when phosphate rock reacts with nitric acid, sulfuric acid and hydrochloric acid.

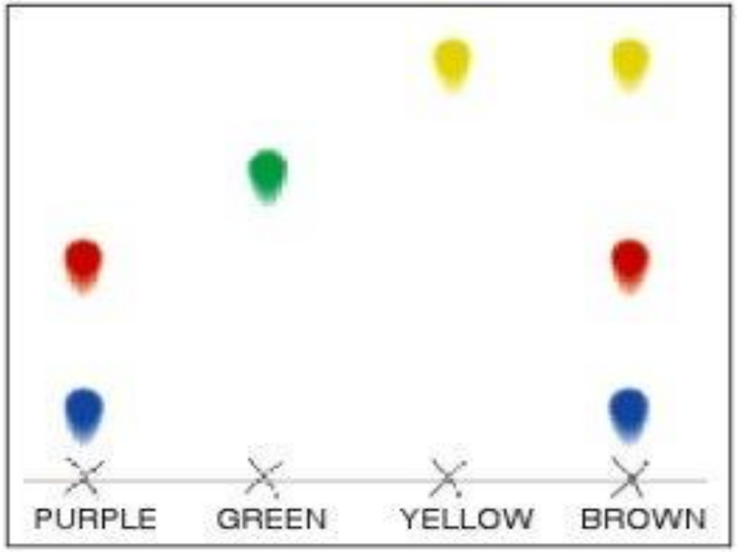
Required practical – rates of reaction





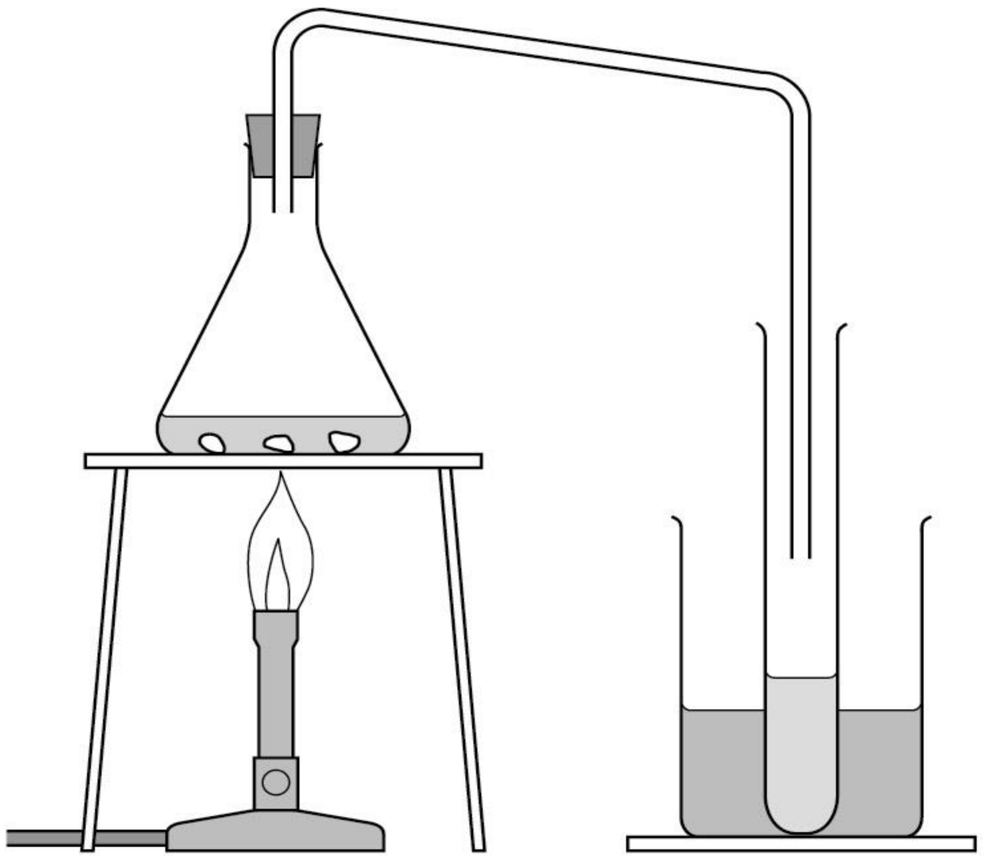
Required practical – chromatography

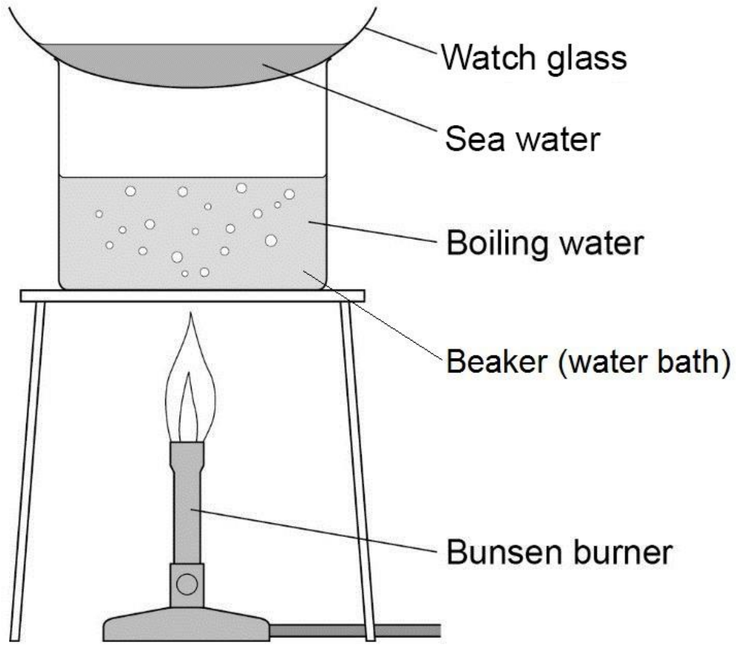




$$Rf = \frac{\text{distance travelled by spot}}{\text{distance travelled by solvent}}$$

Required practical – potable water





Required practical – ion tests (TRIPLE ONLY)

Ion	Test	Positive result
Fe^{2+}		
Fe^{3+}		
Cu^{2+}		
Mg^{2+}		
Ca^{2+}		
Al^{3+}		

Required practical – ion tests (TRIPLE ONLY)

Ion	**Test**	**Positive result**
Fe^{2+}	Add NaOH	Light blue precipitate
Fe^{3+}		Red-brown precipitate
Cu^{2+}		Light ‘dirty’ green precipitate
Mg^{2+}		White precipitate
Ca^{2+}		White precipitate
Al^{3+}		White precipitate – dissolves in excess NaOH

Required practical – ion tests (TRIPLE ONLY)

Ion	Test	Positive result
Li^{+}		
Na^{+}		
K^{+}		
Ca^{2+}		
Cu^{2+}		

Required practical – ion tests (TRIPLE ONLY)

Ion	Test	Positive result
Li^{+}	Flame test	Crimson
Na^{+}		Yellow
K^{+}		Lilac
Ca^{2+}		Orange –red
Cu^{2+}		Green

Required practical – ion tests (TRIPLE ONLY)

Ion	**Test**	**Positive result**
Carbonates CO_3^{2-}		
Sulphates SO_4^{2-}		
Halides Cl^-, Br^-, I^-		

Required practical – ion tests (TRIPLE ONLY)

Ion	Test	Positive result
Carbonates **CO_3^{2-}**	Add dilute acid	Fizzing – carbon dioxide produced. CO_2 turns limewater cloudy
Sulphates **SO_4^{2-}**	Add Barium Chloride	White precipitate
Halides **Cl^-, Br^-, I^-**	Add silver nitrate	Cl^- white precipitate Br^- cream precipitate I^- yellow precipitate

P1 Conservation & Dissipation of Energy

Gravitational Potential

The gravitational potential energy of an object i______________ when it moves up because w________ is done on it to overcome the force of g_____________.

Change in gravitational Potential (J)	=	mass (kg)	x	gravitational field strength (N/kg)	x	change in height (m)

Same thing can be written as:

Change in gravitational Potential (J)	=	Weight (N)	x	change in height (m)

e.g. Calculate the change in g.p when a student weighing 450N steps onto a box of height 0.8m.

Elastic potential energy

Elastic p_______ energy is the energy s_______ in an object when w_____ is done on that object.

Elastic Potential Energy (J)	=	0.5	x	spring constant (k)	x	extension^2 $(m)^2$

Calculate elastic potential energy in a trampoline spring with a spring constant of 5000N/m that has stretched 12cm.

Energy & Work

When an object is moved by f______, work is done is done.

Work done (J) = f__________ (N) x d____________ (m)

e.g. Calculate the work done when a force of 20N makes an object move 5m.

Work done to overcome f________ is t_____________ as energy to the t_____________ energy stores of the objects that rub together and the s________________

Wasted energy is energy that is not u_________ and is t____________ by an undesired pathway. It is eventually transferred to the s_____________ which become w________. As energy d___________ it gets less and less u___________.

The law of conservation of energy states that energy cannot be c______________ or d________________

Efficiency of a device = $\frac{\text{useful output (J)}}{\text{total input (J)}}$

Why can the efficiency of a device never be 100%?

Calculate the power of a motor that transfers 10,000J in 30s.

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

Name the energy stores:

- C_______________
- E_______________
- M______________
- E_______________
- N_______________
- T_______________
- G_______________
- K_______________

Name the ways energy can be transferred:

- H______________
- E______________
- R______________
- M______________

Kinetic energy

The energy stored in a m___________ object depends on its m_________ and s____________.

Kinetic Energy (J)	=	0.5	x	mass (kg)	x	speed^2 $(m/s)^2$

Calculate the kinetic energy of a 1200kg mini cooper moving at 13m/s.

P1 Conservation & Dissipation of Energy

Gravitational Potential

The gravitational potential energy of an object increases when it moves up because work is done on it to overcome the force of gravity.

Change in gravitational Potential (J) = mass (kg) x gravitational field strength (N/kg) x change in height (m)

Same thing can be written as:

Change in gravitational Potential (J) = Weight (N) x change in height (m)

e.g. 450N x 0.8 = 360J

Elastic potential energy

Elastic potential energy is the energy stored in an object when work is done on that object.

Elastic Potential Energy (J) = 0.5 x spring constant (k) x extension^2 (m)^2

Calculate elastic potential energy in a trampoline spring with a spring constant of 5000N/m that has stretched 12cm.

$0.5 \times 5000 \times 0.12^2 = 36$J

Energy & Work

When an object is moved by force, work is done is done.

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

e.g. Calculate the work done when a force of 20N makes an object move 5m.

20 x 5 = 100J

Work done to overcome friction is transferred as energy to the thermal energy stores of the objects that rub together and the surroundings.

Name the energy stores:

- Chemical
- Electrostatic
- Magnetic
- Elastic potential
- Nuclear
- Thermal
- Gravitational potential
- Kinetic

Name the ways energy can

- Heating
- Electrically (moving charge)
- Radiation (light & sound)
- Mechanically (a force)

Wasted energy is energy that is not useful and is transferred by an undesired pathway. It is eventually transferred to the surroundings which become warmer. As energy dissipates it gets less and less useful.

The law of conservation of energy states that energy cannot be created or destroyed

Efficiency of a device = $\frac{\text{useful output (J)}}{\text{total input (J)}}$

Why can the efficiency of a device never be 100%?

Because some energy is always lost (dissipates) to the surroundings.

Calculate the power of a motor that transfers 10,000J in 30s.

Power (W) = $\frac{\text{energy (J)}}{\text{time (s)}}$ $\frac{10000}{30}$ 333.3W

Kinetic energy

The energy stored in a moving object depends on its mass and speed.

Kinetic Energy (J) = 0.5 x mass (kg) x speed^2 (m/s)^2

Calculate the kinetic energy of a 1200kg mini cooper moving at 13m/s.

101,400J

P2 Energy Transfer by Heating

The energy transferred per second through an insulating material depends on:

- T____________ d___________ across the material
- T____________ of material
- T____________ c________________ of the material.

The rate of energy transfer from a house can be reduced by:

-
-
-
-
-

Specific heat capacity

The specific heat capacity of a substance is the energy needed to raise the t______________ of _____kg by ______ °C.

Energy Transferred (J) = mass (kg) x specific heat capacity (J/kg/ °C) x temperature change (°C)

A pot is filled with 9kg of water at 10°C. Calculate how much heat energy would be needed to raise the temperature to 60°C. [specific heat capacity of water = 4200J/kg°C]

The greater the thermal conductivity of a material, the more e___________ per s__________ it transfers by c______________

Required Practical – insulating materials

Equipment:

- Various insulating materials
- 100ml measuring cylinder
- Kettle
- Thermometer
- Stopwatch
- 250ml Beaker

Method:

____
____
____
____
____
____
____
____

Dependent variable:
Independent variable:
Control variables:

-
-
-

Infrared – GCSE Physics only

All objects e______________ and a_____________ infrared radiation. The hotter the object is, the m_____________ infrared radiation it e________________.
A perfect b_____________ is a theoretical object that a________ ALL the radiation that hits it and doesn't r____________ or t__________ any. As temperature increases, the w_______ of radiation d_________ (so white hot objects are hotter than red hot objects)
The temperature of an object will increase if it a______________ more radiation than it e____________.

P2 Energy Transfer by Heating

The energy transferred per second through an insulating material depends on:

- Temperature difference across the material
- Thickness of material
- Thermal conductivity of the material.

The rate of energy transfer from a house can be reduced by:

- Loft insulation
- Cavity wall insulation
- Foil between radiator & wall
- Double-glazed windows
- Thicker bricks on external walls

Specific heat capacity

The specific heat capacity of a substance is the energy needed to raise the temperature of 1kg by 1°C.

Energy Transferred (J) = mass (kg) x specific heat capacity (J/kg/ °C) x temperature change (°C)

A pot is filled with 9kg of water at 10°C. Calculate how much heat energy would be needed to raise the temperature to 60°C. [specific heat capacity of water = 4200J/kg°C]

9 x 4200 x 50 = 1,890,000J = 1,890kj

The greater the thermal conductivity of a material, the more energy per second it transfers by conduction.

Required Practical – insulating materials

Equipment:

- Various insulating materials
- 100ml measuring cylinder
- Kettle
- Thermometer
- Stopwatch
- 250ml Beaker

Method:

Use the measuring cylinder to measure out 100ml of hot water from the kettle. Pour this into the beaker which has one layer of insulating material wrapped around it. Record temperature. Time for 5 minutes. Re-record temperature. Repeat with different materials.

Dependent variable: temperature change
Independent variable: insulating material
Control variables:

- Time
- starting temperature of water
- Volume of water

Infrared – GCSE Physics only

All objects emits and absorbs infrared radiation. The hotter the object is, the more infrared radiation it emits.
A perfect blackbody is a theoretical object that absorbs ALL the radiation that hits it and doesn't reflect or transmit any. As temperature increases, the wavelength of radiation decreases (so white hot objects are hotter than red hot objects)
The temperature of an object will increase if it absorbs more radiation than it emits.

P3 Energy Resources

In a power station:

Fuel heats w________ → W______ Turns to s_______ → S______ Turns a t______ → The t_____ turns a g______

Non-renewable fuels are:

-
-
-
-

When f_____ f_______ are burnt they release c_____________ d_________ which is a g_____________ gas. This adds to g___________ warming and c____________ change. They also release s___________ dioxide which contributes to a_______ r________

Energy source	How it works	Advantages	Disadvantages
Solar cells/ panels	Cells: transfer l_____ into e______ energy. Panels: heat w_____ to supply a house or a generator.	Renewable. Cheap to run.	Unreliable. E_______ to buy. Lots are needed to generate enough power to be useful.
Geo-thermal	R_______ material in the E______	Reliable Renewable	Limited where it can be used.
Nuclear	Nuclear power station uses p___________ and u_________. When the n______ of these atoms split in two, e___________ is t_______ and it becomes hot.	No g_________ gases. Much more e___________ is transferred from each kg of fuel than f_____ fuel.	Creates r__________ waste. Safe in normal c_______, but an explosion could release radioactive waste. Expensive to d___________

A biofuel is made from a l__________ thing. M__________ gas can be collected from manure, sewage or decaying rubbish and burned. Biofuels are r____________ because the biological material can regrow. They are also c_________ n__________ as the carbon the living thing takes in balances the amount that is released.

Energy source	How it works	Advantages	Disadvantages
Wind	Wind turns the blades which turns the g_______ on top of a narrow tower.	Renewable. No greenhouse gases.	U_______ Some people think they are u_________. Make n______
Wave	Waves make a floating g______ move up and down. A cable delivers e_________ to the shore.	Renewable. No greenhouse gases.	Need to withstand s_____. Lots of cables and buildings are needed, this can spoil areas of coastline. Can affect h_____.
Hydro-electric	R_______ water flows d_______ which drives a generator.	Renewable No greenhouse gases.	Need large a_____ which can f_____ habitats
T_____	Water is trapped behind a barrage at h______ tide. This is then released through a generator.	Renewable No greenhouse gases.	Can affect river e________ and h___________

In a power station:

Fuel heats water → water Turns to steams → steams Turns a turbine → The turbine turns a generator

Non-renewable fuels are:

- Oil
- Gas
- Coal
- Nuclear

When fossil fuels are burnt they release carbon dioxide which is a greenhouse gas. This adds to global warming and climate change. They also release sulphur dioxide which contributes to acid rain.

P3 Energy Resources

Energy source	How it works	Advantages	Disadvantages
Solar cells/ panels	Cells: transfer light into electrical energy. Panels: heat water to supply a house or a generator.	Renewable. Cheap to run.	Unreliable. Expensive to buy. Lots are needed to generate enough power to be useful.
Geo-thermal	Radioactive material in the Earth	Reliable Renewable	Limited where it can be used.
Nuclear	Nuclear power station uses Plutonium and uranium. When the nucleus of these atoms split in two, energy is transferred and it becomes hot.	No greenhouse gases. Much more energy is transferred from each kg of fuel than fossil fuel.	Creates radioactive waste. Safe in normal conditions but an explosion could release radioactive waste. Expensive to decommission.

A biofuel is made from a living thing. Methane gas can be collected from manure, sewage or decaying rubbish and burned. Biofuels are renewable because the biological material can regrow. They are also carbon neutral as the carbon the living thing takes in balances the amount that is released.

Energy source	How it works	Advantages	Disadvantages
Wind	Wind turns the blades which turns the generator on top of a narrow tower.	Renewable. No greenhouse gases.	Unreliable. Some people think they are ugly. Make noise.
Wave	Waves make a floating generators move up and down. A cable delivers electricity to the shore.	Renewable. No greenhouse gases.	Need to withstand storms. Lots of cables and buildings are needed, this can spoil areas of coastline. Can affect habitats.
Hydro-electric	Reservoir water flows downhill which drives a generator.	Renewable No greenhouse gases.	Need large area which can flood habitats
Tidal	Water is trapped behind a barrage at high tide. This is then released through a generator.	Renewable No greenhouse gases.	Can affect river estuary and habitats.

P4 Electrical circuits

Complete the equations:

Charge flow, Q = __________,I___x _____________,t
(Coulombs, C) (amperes, A) (seconds, s)

Potential difference = __________________,E (joules, j)
(Volts, V) ,Q (coulombs, c)

Resistance, R = __________________, V (Volts, V)
(ohms, Ω) , I (amperes, A)

Current is the flow of c_______, which is caused by millions of e_______ passing through a component.

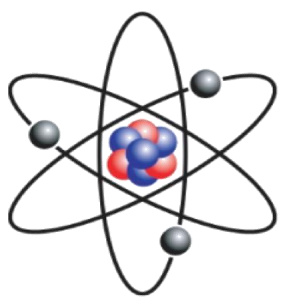
- In a s______ circuit, the c______ is the same through each component.
- In a s_____ circuit, the v____ of the power supply is s_______ between all component.
- The total resistance in a s______ circuit is equal to the s_____ of the resistance of each c_______.

- The total current In a p_______ circuit, is e_________ to the sum of the current through each b_____.
- In a p_______ circuit, the v_______ across each component is the same.

- Ammeters are connected in __________.
- Voltmeters are connected in ___________.
- As temperature increases in a lamp, resistance i___________.
- As temperature increases in a thermistor, the resistance d__________.

Infrared – GCSE Physics only

Label the atom with the particle names and charges.

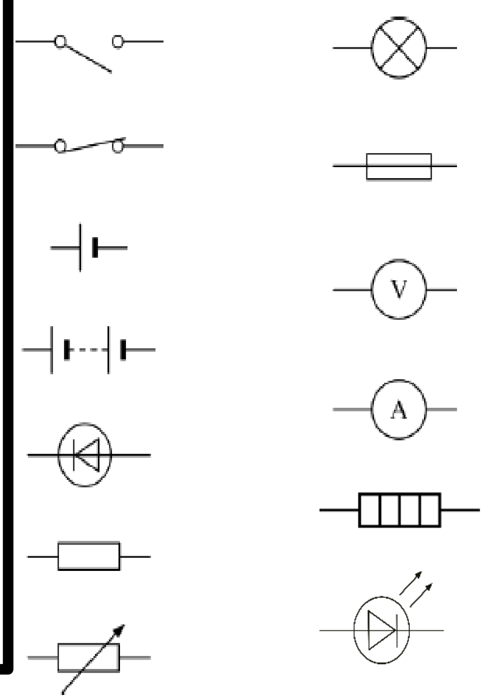


A charged atom is called an ______. Some i___________ become c_________ when they are rubbed as e_________ are transferred.

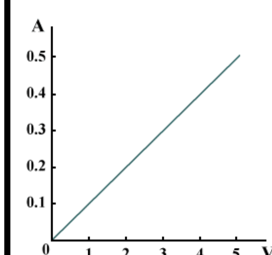
Two charged objects exert a non-c_______ force on each other due to their e___________ f_______. The force becomes stronger the c_______ the objects are.

Like charges ______, unlike charges _________.

Name the electrical symbols:



Current is d_________ p_________ to voltage. The gradient of the line shows r_________. The less steep the line, the g_________ the resistance..



P4 Electrical circuits

Complete the equations:

Charge flow, Q = _current ,I__ x __time___,t
(Coulombs, C) (amperes, A) (seconds, s)

Potential difference = _Energy transferred (joules, j)
(Volts, V) charge, Q (coulombs, c)

Resistance, R = ___potential difference, V (Volts, V)
(ohms, Ω) current, I (amperes, A)

Current is the flow of charge, which is caused by millions of electrons passing through a component.

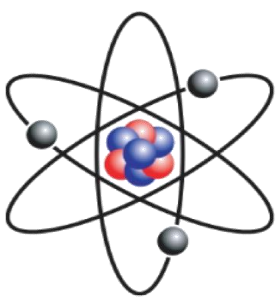
- In a series circuit, the current is the same through each component.
- In a series circuit, the voltage of the power supply is spread between all component.
- The total resistance in a series circuit is equal to the sum of the resistance of each component.

- The total current In a parallel circuit, is e_________ to the sum of the current through each b_____.
- In a parallel circuit, the v________ across each component is the same.

- Ammeters are connected in series.
- Voltmeters are connected in parallel.
- As temperature increases in a lamp, resistance increases.
- As temperature increases in a thermistor, the resistance decreases.

Infrared – GCSE Physics only

Label the atom with the particle names and charges.

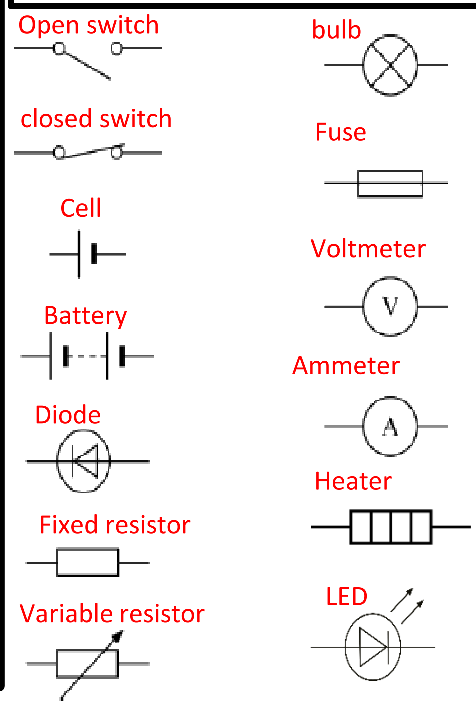


A charged atom is called an ion. Some insulators become charged when they are rubbed as electrons are transferred.

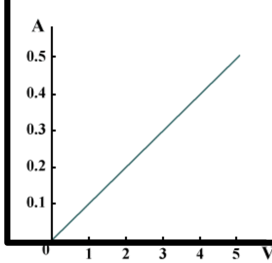
Two charged objects exert a non-contact force on each other due to their electric field. The force becomes stronger the closer the objects are.

Like charges repel, unlike charges attract.

Name the electrical symbols:



Current is directly proportional to voltage. The gradient of the line shows resistance. The less steep the line, the greater the resistance..



P5 Electricity in the Home

Complete the equations:

Power, P = ___________, E (joules, J)
(watts, W) time , t (seconds, s)

e.g. How much energy does a 40W light bulb transfer in 30 minutes?

Power, P = ___________, I x ___________, V
(watts, W) (amperes, A) (volts, V)

e.g. Calculate the power to a computer that has a current of 1.5A and 230V.

Charge flow, Q = ___________, I x _____________, t
(coulombs, C) (amperes, A) (seconds, s)

e.g. Calculate the charge flow in 40seconds when the current is 4A.

e.g. Calculate the current through a 600W, 230V hairdryer.

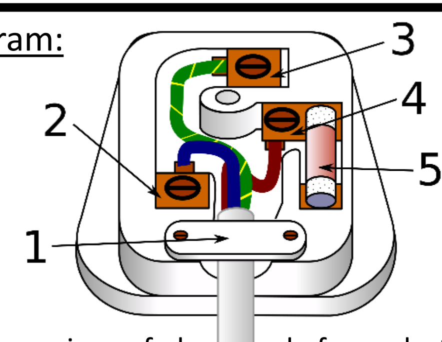
The correct fuse rating = watts/volts

e.g. Calculate which fuse (1A, 3A, 5A or 13A) you would use for the hairdryer above.

Give definitions:

- Direct current:
- Alternating current:
- Live wire:
- Neutral wire:
- The National Grid:
- Step-up transformers:
- Step-down transformers:
- Fuse:
- Short circuit:

Label the diagram:



Why are the outer casings of plugs made from plastic?

What does the longest pin in a plug connect to?

What metal are the pins made from? Why?

What metal are the wire made from? Why?

P5 Electricity in the Home

Complete the equations:

Power, P = energy transferred, E (joules, J)
(watts, W) time , t (seconds, s)

$$P = \frac{E}{t}$$

e.g. How much energy does a 40W light bulb transfer in 30 minutes? 40W x 1800S = 72,000J

Power, P = _current_, I x __potential difference_, V
(watts, W) (amperes, A) (volts, V)

e.g. Calculate the power to a computer that has a current of 1.5A and 230V. 1.5 x 230 =

Charge flow, Q = _current_, I x __time_____, t
(coulombs, C) (amperes, A) (seconds, s)

e.g. Calculate the charge flow in 40seconds when the current is 4A.
4x40 = 160C

e.g. Calculate the current through a 600W, 230V hairdryer.
600/230 = 2.6A

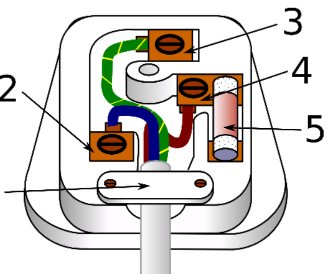
The correct fuse rating = watts/volts

e.g. Calculate which fuse (1A, 3A, 5A or 13A) you would use for the hairdryer above. 3A fuse because it would not melt with a 2.6A current. 5A would be too high.

Give definitions:

- Direct current: The current goes around the circuit in one direction only. E.g. in a torch.
- Alternating current: The current repeatedly reverses its direction. E.g. when you switch on a light at home.
- Live wire: This wire is dangerous as the voltage repeated switches from about -325V to +325V.
- Neutral wire: This wire is earthed at the local substation.
- The National Grid: A nationwide network of cables and transformers to get electricity to homes from power stations.
- Step-up transformers: Used at power stations to increase voltage in cables from 25,000V to 132,000V
- Step-down transformers: Used to supply electricity from the grid to consumers, it reduces the voltage.
- Fuse: A device between the live pin and live wire which melts with too much current to prevent damage.
- Short circuit: Where a live wire touches a neutral wire and a large current flows between them.

Label the diagram:



3 Earth wire
4 Live wire
2 Neutral wire
5 Fuse
1 Cable grip

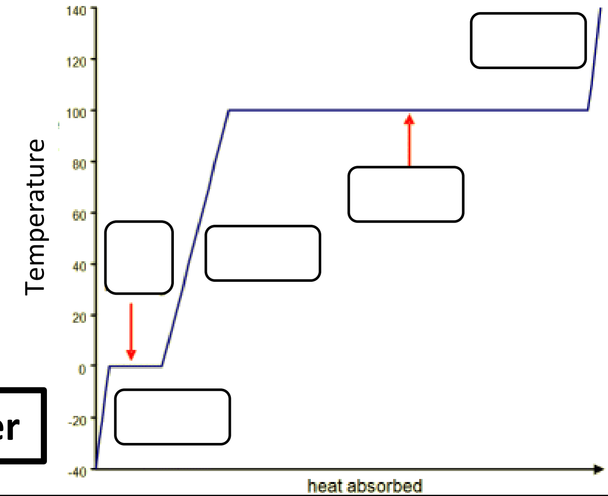
Why are the outer casings of plugs made from plastic? Plastic is an electrical insulator to protect against the live wires inside.

What does the longest pin in a plug connect to? The earth wire so the metal case is earthed when plugged in.

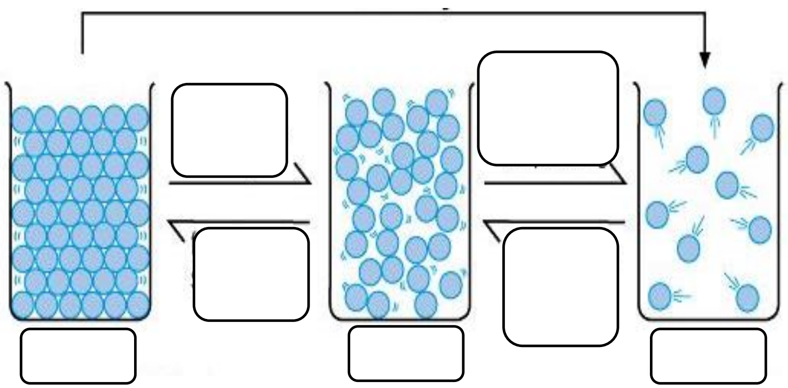
What metal are the pins made from? Why? Brass, because it's a good conductor and doesn't rust. Copper isn't as hard as brass, although it is a better conductor.

What metal are the wire made from? Why? Copper, because it is a good electrical conductor and bends easily.

State	Flow?	Fixed shape?	Fixed volume?	Density	Particle energy	Particle movement	Forces between particles
Solid							
Liquid							
Gas							



P6 Molecules & Matter



Density of a substance is defined as its mass per unit volume.

Density, $\rho = \dfrac{\text{mass, m (kilograms, kg)}}{\text{volume, V (metres}^2\text{, m}^2\text{)}}$

e.g. what is the density of a 20kg wooden post with a volume of $0.5m^2$?

- The freezing point of a substance is the same temperature as the_______________point.
- The energy transferred to a substance as it changes state is called its ____________ heat.
- The energy stored by particles in a substance is its ____________ energy.
- This energy is sum of the k__________ energy of particles and their p___________energy.
- The specific latent heat of fusion is the energy needed to change ___kg of a substance from s______ to l_________ at its m_________ p__________ (without a change in temperature)
- The specific latent heat of vaporisation of a substance is the energy needed to change ____kg from l_____________ to v__________, at its b_____________ p______ (without a change in temperature)
- Specific latent heat = $\dfrac{\text{energy, J}}{\text{mass, kg}}$

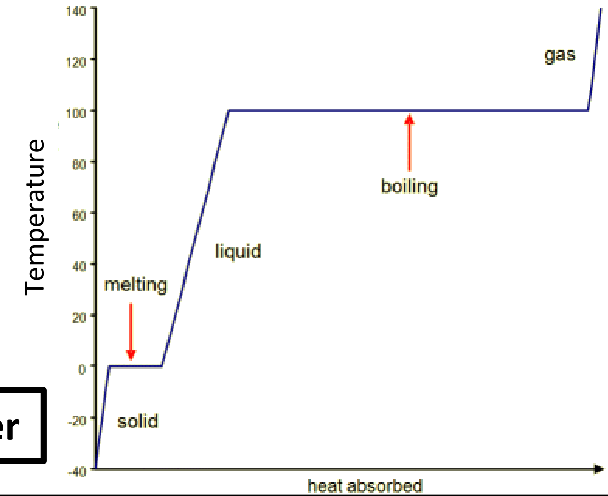
1. What is gas pressure caused by?
2. What happens to gas pressure in a sealed container if temperature increases and why?

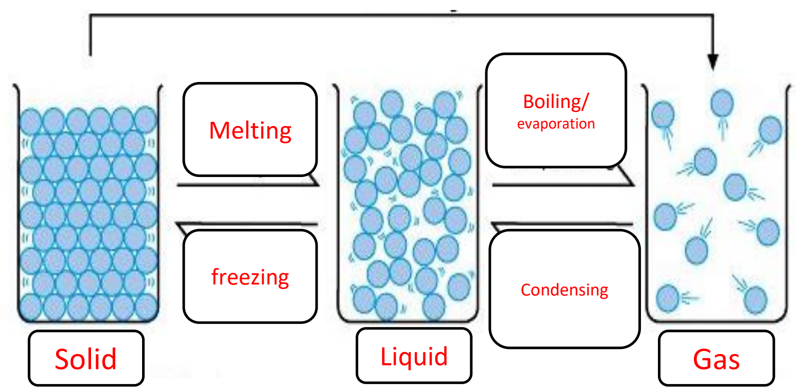
GCSE Physics only – gas pressure & volume

1. What happens to the pressure in gas if its volume is decreased? Why?

2. What is the formula for Boyle's Law?

State	Flow?	Fixed shape?	Fixed volume?	Density	Particle energy	Particle movement	Forces between particles
Solid	No	Yes	Yes	High	Low	Vibrate	High
Liquid	Yes	No	Yes	Med	Med	Medium	Med
Gas	Yes	No	No	Low	High	Lots	Low





P6 Molecules & Matter

Density of a substance is defined as its mass per unit volume.

Density, $\rho = \dfrac{\text{mass, m (kilograms, kg)}}{\text{volume, V (metres}^2\text{, m}^2\text{)}}$

e.g. what is the density of a 20kg wooden post with a volume of $0.5m^2$? $20/0.5 = 40kg/m^3$

- The freezing point of a substance is the same temperature as the melting point.
- The energy transferred to a substance as it changes state is called its latent heat.
- The energy stored by particles in a substance is its internal energy.
- This energy is sum of the kinetic energy of particles and their potential energy.
- The specific latent heat of fusion is the energy needed to change 1kg of a substance from solid to liquid at its melting point (without a change in temperature)
- The specific latent heat of vaporisation of a substance is the energy needed to change 1kg from liquid to vapour, at its boiling point (without a change in temperature)
- Specific latent heat = $\dfrac{\text{energy, J}}{\text{mass, kg}}$

1. What is gas pressure caused by?

Random impacts of gas molecules on surfaces.

1. What happens to gas pressure in a sealed container if temperature increases and why? It increases as the molecules move faster so collide with more force, and there are more collisions per second.

GCSE Physics only – gas pressure & volume

1. What happens to the pressure in gas if its volume is decreased? Why?

It increases due to more molecular impacts per second on the surfaces.

2. What is the formula for Boyle's Law? Pressure x volume = constant

Give definitions:

- Radioactive decay:
- Atomic number:
- Mass number:
- Isotope:
- Irradiated:
- Ionisation:
- Peer review:
- Count rate:
- Half-life:
- Becquerel (Bq):

Changes in the nucleus

What happens to the nucleus of an atom when it emits alpha radiation?

What happens to the nucleus of an atom when it emits beta radiation?

P7 Radioactivity

Radiation	Symbol	What is it stopped by?	What is made from?	Range in air
Alpha				
Beta				
Gamma				

Models of the atom

P____ p______ model: Before 1914, scientists thought the a_____ was arranged with p_______ charged matter e_______ spread out and n_________ charged electrons buried inside.

Rutherford's model: There is a p______ charged n_____ which makes up most of the m______ of the atom.

Bohr's model: E______ orbit the n______ in specific distances and energy. E________ move to a higher o_______ by a_________ radiation, or move to a l________ orbit by e_____ radiation.

Uses of radiation:

How do smoke alarms use radiation?

How is radiation used to control the thickness of metal foil?

Give definitions:

- Radioactive decay: The random event of a radioactive atom emitting radiation.
- Atomic number: The number of protons n an atom.
- Mass number: The number of protons and neutrons in an atom.
- Isotope: A version of an element with a different number of neutrons.
- Irradiated: When an object has been exposed to ionising radiation.
- Ionisation: Atoms that have become charged by their electrons being knocked off by radiation.
- Peer review: Data is published and checked by other scientists.
- Count rate: The number of counts on a Geiger counter per second.
- Half-life: The average time taken for the count rate to fall by half for a particular isotope.
- Becquerel (Bq): Unit of activity, which is 1 decay/second.

Changes in the nucleus

What happens to the nucleus of an atom when it emits alpha radiation?
Atomic number goes down by 2, mass number goes down by 4.
What happens to the nucleus of an atom when it emits beta radiation?
Atomic number goes up by one, mass number is unchanged.

P7 Radioactivity

Radiation	Symbol	What is it stopped by?	What is made from?	Range in air
Alpha	α	Paper	2 protons & 2 neutrons	5cm
Beta	β	Aluminium sheet	Electron	1m
Gamma	γ	Thick lead sheet/concrete	Electromagnetic wave	unlimited

Models of the atom

Plum pudding model: Before 1914, scientists thought the atom was arranged with positively charged matter evenly spread out and negatively charged electrons buried inside.

Rutherford's model: There is a positively charged nucleus which makes up most of the mass of the atom.

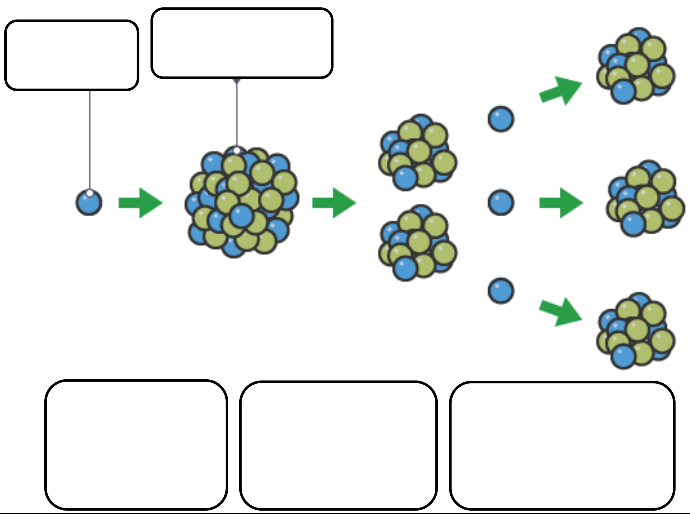
Bohr's model: Electrons orbit the nucleus in specific distances and energy. Electrons move to a higher orbit by absorbing radiation, or move to a lower orbit by emitting radiation.

Uses of radiation:

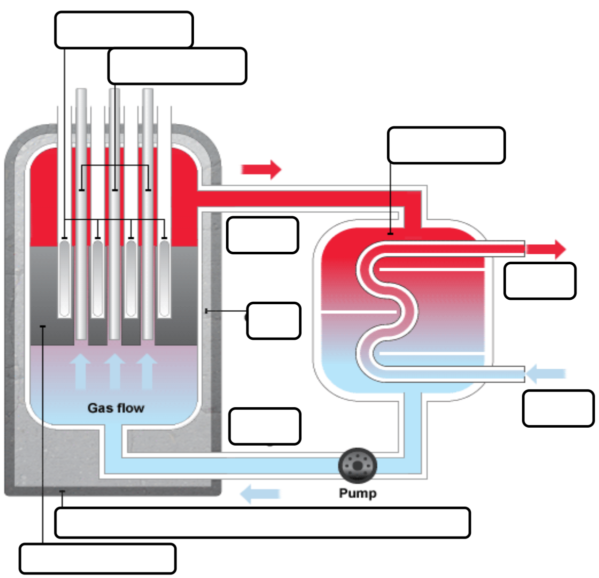
How do smoke alarms use radiation? Alpha particles are emitted across a gap. This ionises the air so a current flows. When smoke absorbs the ions, the current stops and an alarm sounds.
How is radiation used to control the thickness of metal foil? Beta radiation is emitted through foil and detected the other side. If it stops, the foil is too thick and the rollers increase pressure and vice versa.

P7 Radioactivity – GCSE Physics only

Label the diagram of fission:



Label the diagram:



1. What is nuclear fusion?

2. Where does fusion happen naturally? Why can it happen here?

3. What are the technical difficulties with making fusion a useful source of energy?

4. Why would fusion be such a useful energy source if it were possible?
-
-
-

5. Name 4 sources of background radiation.

6. Why is it important to store nuclear waste securely and for many years?

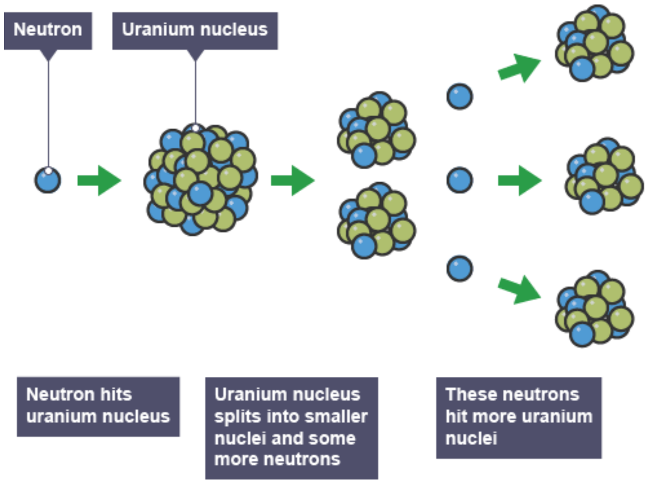
7. What is radon gas and why is it dangerous?

8. What is a chain reaction?

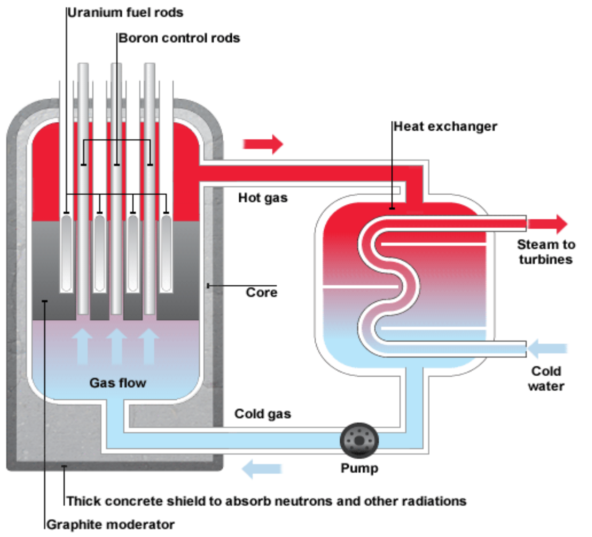
Use	Type of radiation	How it works	Why use this type of radiation?
Tracers			
Gamma cameras			
Radiation to kill cancer			
Radioactive implants			

P7 Radioactivity – GCSE Physics only

Label the diagram of fission:



Label the diagram:



1. What is nuclear fusion? Two small nuclei release energy when they fuse together to form a larger nucleus.
2. Where does fusion happen naturally? Why can it happen here? In stars, because the core is so hot that atoms are bare nuclei which fuse when they collide.
3. What are the technical difficulties with making fusion a useful source of energy? It needs very high temperatures and pressures to occur.
4. Why would fusion be such a useful energy source if it were possible?

- Fuel is easily available as heavy Hydrogen is in sea water.
- The product, helium, is a harmless, non-radioactive gas.
- The energy released could be used to generate electricity.

5. Name 4 sources of background radiation. Cosmic rays, ground & buildings, food & drink, air, medical applications, nuclear weapons tests, air travel, nuclear power.

6. Why is it important to store nuclear waste securely and for many years? Some radiation has a half-life of more than a billion years so remains dangerous.

7. What is radon gas and why is it dangerous? Radioactive gas that seeps through rocks and into buildings. It emits alpha radiation so is hazardous if breathed in.

8. What is a chain reaction? A fission event can release several neutrons, which hit other nuclei and so on.

Use	How it works	Why use this type of radiation?
Gamma Tracers	Patient drinks water containing the tracer, it can be tracked through the kidney.	It can be detected outside the body. Half-life of 8 days so it is gone from body quickly, decays to a stable product.
Gamma cameras	Patient injected with gamma, absorbed into organ, camera detects an image.	Half-life long enough to give an image, short enough to decay afterwards.
Gamma to kill cancer	Narrow beam of gamma aimed at a tumour.	Can penetrate deep into the body.
Gamma or beta implants	Small radioactive seeds or rods implanted into a tumour to kill it.	Half-life long enough to irradiate a tumour over a given time, short enough to so it decays soon afterwards.

P1 Conservation & Dissipation of Energy

Gravitational Potential

The gravitational potential energy of an object i______________ when it moves up because w________ is done on it to overcome the force of g______________.

Change in gravitational Potential (J)	=	mass (kg)	x	gravitational field strength (N/kg)	x	change in height (m)

Same thing can be written as:

Change in gravitational Potential (J)	=	Weight (N)	x	change in height (m)

e.g. Calculate the change in g.p when a student weighing 450N steps onto a box of height 0.8m.

Elastic potential energy

Elastic p_______ energy is the energy s_______ in an object when w_____ is done on that object.

$$\text{Elastic Potential Energy (J)} = 0.5 \times \text{spring constant (k)} \times \text{extension}^2\ (\text{m})^2$$

Calculate elastic potential energy in a trampoline spring with a spring constant of 5000N/m that has stretched 12cm.

Energy & Work

When an object is moved by f_______, work is done is done.

Work done (J) = f__________ (N) x d____________ (m)

e.g. Calculate the work done when a force of 20N makes an object move 5m.

Work done to overcome f________ is t_____________ as energy to the t_____________ energy stores of the objects that rub together and the s________________

Wasted energy is energy that is not u_________ and is t_____________ by an undesired pathway. It is eventually transferred to the s_____________ which become w________. As energy d____________ it gets less and less u___________.

The law of conservation of energy states that energy cannot be c______________ or d________________

Efficiency of a device = $\dfrac{\text{useful output (J)}}{\text{total input (J)}}$

Why can the efficiency of a device never be 100%?

Calculate the power of a motor that transfers 10,000J in 30s.

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

Name the energy stores:

- C________________
- E________________
- M________________
- E________________
- N________________
- T________________
- G________________
- K________________

Name the ways energy can be transferred:

- H_______________
- E_______________
- R_______________
- M_______________

Kinetic energy

The energy stored in a m___________ object depends on its m_________ and s____________.

$$\text{Kinetic Energy (J)} = 0.5 \times \text{mass (kg)} \times \text{speed}^2\ (\text{m/s})^2$$

Calculate the kinetic energy of a 1200kg mini cooper moving at 13m/s.

P1 Conservation & Dissipation of Energy

Gravitational Potential

The gravitational potential energy of an object increases when it moves up because work is done on it to overcome the force of gravity.

Change in gravitational Potential (J) = mass (kg) x gravitational field strength (N/kg) x change in height (m)

Same thing can be written as:

Change in gravitational Potential (J) = Weight (N) x change in height (m)

e.g. 450N x 0.8 = 360J

Elastic potential energy

Elastic potential energy is the energy stored in an object when work is done on that object.

Elastic Potential Energy (J) = 0.5 x spring constant (k) x extension^2 (m)^2

Calculate elastic potential energy in a trampoline spring with a spring constant of 5000N/m that has stretched 12cm.

$0.5 \times 5000 \times 0.12^2 = 36J$

Energy & Work

When an object is moved by force, work is done is done.

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

e.g. Calculate the work done when a force of 20N makes an object move 5m.

20 x 5 = 100J

Work done to overcome friction is transferred as energy to the thermal energy stores of the objects that rub together and the surroundings.

Name the energy stores:

- Chemical
- Electrostatic
- Magnetic
- Elastic potential
- Nuclear
- Thermal
- Gravitational potential
- Kinetic

Name the ways energy can

- Heating
- Electrically (moving charge)
- Radiation (light & sound)
- Mechanically (a force)

Wasted energy is energy that is not useful and is transferred by an undesired pathway. It is eventually transferred to the surroundings which become warmer. As energy dissipates it gets less and less useful.

The law of conservation of energy states that energy cannot be created or destroyed

Efficiency of a device = $\frac{\text{useful output (J)}}{\text{total input (J)}}$

Why can the efficiency of a device never be 100%?
Because some energy is always lost (dissipates) to the surroundings.

Calculate the power of a motor that transfers 10,000J in 30s.

Power (W) = $\frac{\text{energy (J)}}{\text{time (s)}}$ $\frac{10000}{30}$ 333.3W

Kinetic energy

The energy stored in a moving object depends on its mass and speed.

Kinetic Energy (J) = 0.5 x mass (kg) x speed^2 (m/s)^2

Calculate the kinetic energy of a 1200kg mini cooper moving at 13m/s.

101,400J

P2 Energy Transfer by Heating

The energy transferred per second through an insulating material depends on:

- T___________ d__________ across the material
- T___________ of material
- T___________ c______________ of the material.

The rate of energy transfer from a house can be reduced by:

-
-
-
-
-

Specific heat capacity

The specific heat capacity of a substance is the energy needed to raise the t_____________ of _____kg by ______ °C.

Energy Transferred (J) = mass (kg) x specific heat capacity (J/kg/ °C) x temperature change (°C)

A pot is filled with 9kg of water at 10°C. Calculate how much heat energy would be needed to raise the temperature to 60°C. [specific heat capacity of water = 4200J/kg°C]

The greater the thermal conductivity of a material, the more e__________ per s_________ it transfers by c_____________

Required Practical – insulating materials

Equipment:

- Various insulating materials
- 100ml measuring cylinder
- Kettle
- Thermometer
- Stopwatch
- 250ml Beaker

Method:

____

____

____

____

____

____

____

____

Dependent variable:

Independent variable:

Control variables:

-
-
-

Infrared – GCSE Physics only

All objects e_____________ and a____________ infrared radiation. The hotter the object is, the m____________ infrared radiation it e_______________.
A perfect b____________ is a theoretical object that a_______ ALL the radiation that hits it and doesn't r___________ or t_________ any. As temperature increases, the w_______ of radiation d________ (so white hot objects are hotter than red hot objects)
The temperature of an object will increase if it a_____________ more radiation than it e___________.

P2 Energy Transfer by Heating

The energy transferred per second through an insulating material depends on:

- Temperature difference across the material
- Thickness of material
- Thermal conductivity of the material.

The rate of energy transfer from a house can be reduced by:

- Loft insulation
- Cavity wall insulation
- Foil between radiator & wall
- Double-glazed windows
- Thicker bricks on external walls

Specific heat capacity

The specific heat capacity of a substance is the energy needed to raise the temperature of 1kg by 1°C.

Energy Transferred (J) = mass (kg) x specific heat capacity (J/kg/ °C) x temperature change (°C)

A pot is filled with 9kg of water at 10°C. Calculate how much heat energy would be needed to raise the temperature to 60°C. [specific heat capacity of water = 4200J/kg°C]

9 x 4200 x 50 = 1,890,000J = 1,890kj

The greater the thermal conductivity of a material, the more energy per second it transfers by conduction.

Required Practical – insulating materials

Equipment:

- Various insulating materials
- 100ml measuring cylinder
- Kettle
- Thermometer
- Stopwatch
- 250ml Beaker

Method:

Use the measuring cylinder to measure out 100ml of hot water from the kettle. Pour this into the beaker which has one layer of insulating material wrapped around it. Record temperature. Time for 5 minutes. Re-record temperature. Repeat with different materials.

Dependent variable: temperature change
Independent variable: insulating material
Control variables:

- Time
- starting temperature of water
- Volume of water

Infrared – GCSE Physics only

All objects emits and absorbs infrared radiation. The hotter the object is, the more infrared radiation it emits.
A perfect blackbody is a theoretical object that absorbs ALL the radiation that hits it and doesn't reflect or transmit any. As temperature increases, the wavelength of radiation decreases (so white hot objects are hotter than red hot objects)
The temperature of an object will increase if it absorbs more radiation than it emits.

In a power station:

Fuel heats w________ → W______ Turns to s_______ → S_______ Turns a t_______ → The t______ turns a g_______

A biofuel is made from a l___________ thing. M__________ gas can be collected from manure, sewage or decaying rubbish and burned. Biofuels are r____________ because the biological material can regrow. They are also c_________ n__________ as the carbon the living thing takes in balances the amount that is released.

Non-renewable fuels are:

-
-
-
-

When f_____ f_______ are burnt they release c_____________ d_________ which is a g_____________ gas. This adds to g___________ warming and c____________ change. They also release s___________ dioxide which contributes to a_______ r________

P3 Energy Resources

Energy source	How it works	Advantages	Disadvantages
Solar cells/ panels	Cells: transfer l_____ into e_______ energy. Panels: heat w_____ to supply a house or a generator.	Renewable. Cheap to run.	Unreliable. E_______ to buy. Lots are needed to generate enough power to be useful.
Geo-thermal	R_______ material in the E_______	Reliable Renewable	Limited where it can be used.
Nuclear	Nuclear power station uses p___________ and u_________. When the n_______ of these atoms split in two, e___________ is t_______ and it becomes hot.	No g_________ gases. Much more e___________ is transferred from each kg of fuel than f_____ fuel.	Creates r__________ waste. Safe in normal c_______, but an explosion could release radioactive waste. Expensive to d____________

Energy source	How it works	Advantages	Disadvantages
Wind	Wind turns the blades which turns the g_______ on top of a narrow tower.	Renewable. No greenhouse gases.	U________ Some people think they are u_________. Make n_______
Wave	Waves make a floating g______ move up and down. A cable delivers e_________ to the shore.	Renewable. No greenhouse gases.	Need to withstand s_____. Lots of cables and buildings are needed, this can spoil areas of coastline. Can affect h_____.
Hydro-electric	R_______ water flows d_______ which drives a generator.	Renewable No greenhouse gases.	Need large a_____ which can f_____ habitats
T_____	Water is trapped behind a barrage at h______ tide. This is then released through a generator.	Renewable No greenhouse gases.	Can affect river e________ and h___________

In a power station:

Fuel heats water → water Turns to steams → steams Turns a turbine → The turbine turns a generator

A biofuel is made from a living thing. Methane gas can be collected from manure, sewage or decaying rubbish and burned. Biofuels are renewable because the biological material can regrow. They are also carbon neutral as the carbon the living thing takes in balances the amount that is released.

Non-renewable fuels are:

- Oil
- Gas
- Coal
- Nuclear

When fossil fuels are burnt they release carbon dioxide which is a greenhouse gas. This adds to global warming and climate change. They also release sulphur dioxide which contributes to acid rain.

P3 Energy Resources

Energy source	How it works	Advantages	Disadvantages
Solar cells/ panels	Cells: transfer light into electrical energy. Panels: heat water to supply a house or a generator.	Renewable. Cheap to run.	Unreliable. Expensive to buy. Lots are needed to generate enough power to be useful.
Geo-thermal	Radioactive material in the Earth	Reliable Renewable	Limited where it can be used.
Nuclear	Nuclear power station uses Plutonium and uranium. When the nucleus of these atoms split in two, energy is transferred and it becomes hot.	No greenhouse gases. Much more energy is transferred from each kg of fuel than fossil fuel.	Creates radioactive waste. Safe in normal conditions but an explosion could release radioactive waste. Expensive to decommission.

Energy source	How it works	Advantages	Disadvantages
Wind	Wind turns the blades which turns the generator on top of a narrow tower.	Renewable. No greenhouse gases.	Unreliable. Some people think they are ugly. Make noise.
Wave	Waves make a floating generators move up and down. A cable delivers electricity to the shore.	Renewable. No greenhouse gases.	Need to withstand storms. Lots of cables and buildings are needed, this can spoil areas of coastline. Can affect habitats.
Hydro-electric	Reservoir water flows downhill which drives a generator.	Renewable No greenhouse gases.	Need large area which can flood habitats
Tidal	Water is trapped behind a barrage at high tide. This is then released through a generator.	Renewable No greenhouse gases.	Can affect river estuary and habitats.

P4 Electrical circuits

Complete the equations:

Charge flow, Q = __________,I___x ____________,t
(Coulombs, C) (amperes, A) (seconds, s)

Potential difference = ____________________,E (joules, j)
(Volts, V) ,Q (coulombs, c)

Resistance, R = ___________________, V (Volts, V)
(ohms, Ω) , I (amperes, A)

Current is the flow of c_______, which is caused by millions of e______ passing through a component.

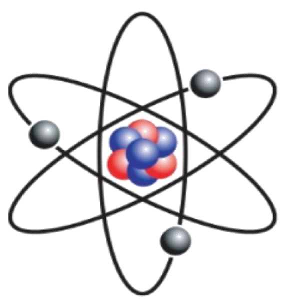
- In a s______ circuit, the c______ is the same through each component.
- In a s_____ circuit, the v____ of the power supply is s_______ between all component.
- The total resistance in a s______ circuit is equal to the s_____ of the resistance of each c_______.

- The total current In a p_______ circuit, is e_________ to the sum of the current through each b_____.
- In a p_______ circuit, the v_______ across each component is the same.

- Ammeters are connected in __________.
- Voltmeters are connected in ___________.
- As temperature increases in a lamp, resistance i___________.
- As temperature increases in a thermistor, the resistance d__________.

Infrared – GCSE Physics only

Label the atom with the particle names and charges.

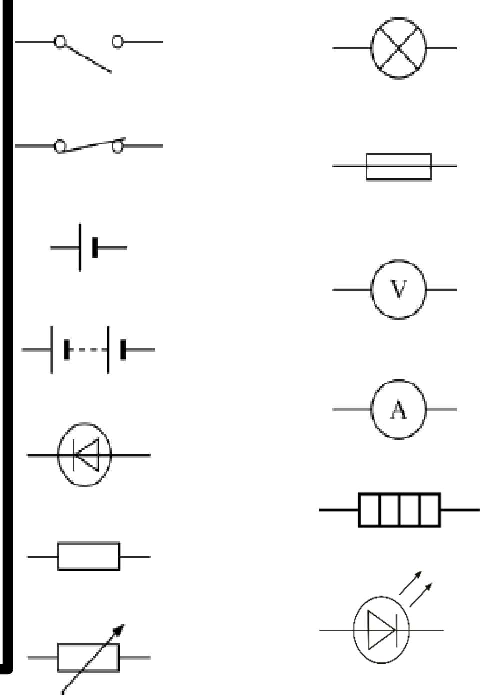


A charged atom is called an ______. Some i___________ become c_________ when they are rubbed as e_________ are transferred.

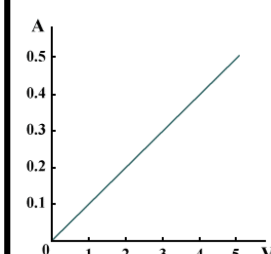
Two charged objects exert a non-c_______ force on each other due to their e___________ f_______. The force becomes stronger the c_______ the objects are.

Like charges ______, unlike charges _________.

Name the electrical symbols:



Current is d________ p________ to voltage. The gradient of the line shows r________. The less steep the line, the g________ the resistance..



P4 Electrical circuits

Complete the equations:

Charge flow, Q = _current ,I___x __time___,t
(Coulombs, C) (amperes, A) (seconds, s)

Potential difference = _Energy transferred (joules, j)
(Volts, V) charge, Q (coulombs, c)

Resistance, R = ___potential difference, V (Volts, V)
(ohms, Ω) current, I (amperes, A)

Current is the flow of charge, which is caused by millions of electrons passing through a component.

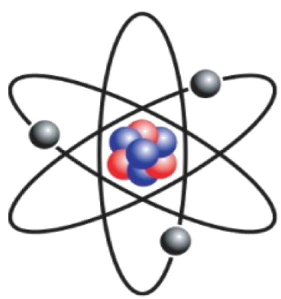
- In a series circuit, the current is the same through each component.
- In a series circuit, the voltage of the power supply is spread between all component.
- The total resistance in a series circuit is equal to the sum of the resistance of each component.

- The total current In a parallel circuit, is e_________ to the sum of the current through each b______.
- In a parallel circuit, the v________ across each component is the same.

- Ammeters are connected in series.
- Voltmeters are connected in parallel.
- As temperature increases in a lamp, resistance increases.
- As temperature increases in a thermistor, the resistance decreases.

Infrared – GCSE Physics only

Label the atom with the particle names and charges.

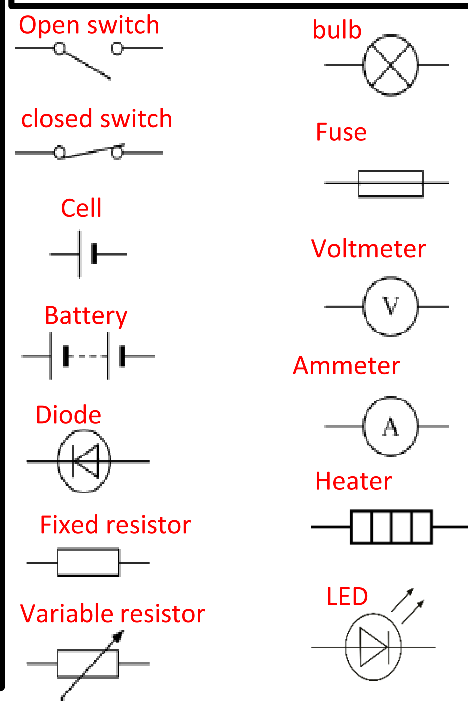


A charged atom is called an ion. Some insulators become charged when they are rubbed as electrons are transferred.

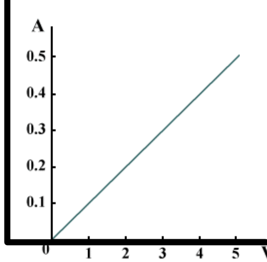
Two charged objects exert a non-contact force on each other due to their electric field. The force becomes stronger the closer the objects are.

Like charges repel, unlike charges attract.

Name the electrical symbols:



Current is directly proportional to voltage. The gradient of the line shows resistance. The less steep the line, the greater the resistance..



P5 Electricity in the Home

Complete the equations:

Power, P = ___________, E (joules, J)
(watts, W) time , t (seconds, s)

e.g. How much energy does a 40W light bulb transfer in 30 minutes?

Power, P = ___________, I x ___________, V
(watts, W) (amperes, A) (volts, V)

e.g. Calculate the power to a computer that has a current of 1.5A and 230V.

Charge flow, Q = ___________, I x _____________, t
(coulombs, C) (amperes, A) (seconds, s)

e.g. Calculate the charge flow in 40seconds when the current is 4A.

e.g. Calculate the current through a 600W, 230V hairdryer.

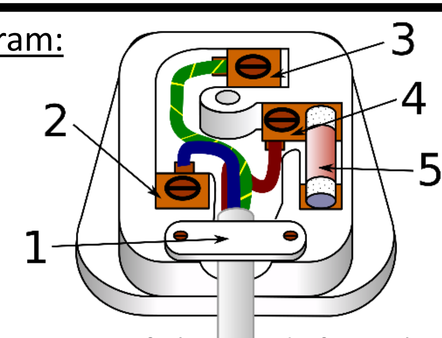
The correct fuse rating = watts/volts

e.g. Calculate which fuse (1A, 3A, 5A or 13A) you would use for the hairdryer above.

Give definitions:

- Direct current:
- Alternating current:
- Live wire:
- Neutral wire:
- The National Grid:
- Step-up transformers:
- Step-down transformers:
- Fuse:
- Short circuit:

Label the diagram:



Why are the outer casings of plugs made from plastic?

What does the longest pin in a plug connect to?

What metal are the pins made from? Why?

What metal are the wire made from? Why?

P5 Electricity in the Home

Complete the equations:

Power, P = energy transferred, E (joules, J)
(watts, W) time , t (seconds, s)

e.g. How much energy does a 40W light bulb transfer in 30 minutes? 40W x 1800S = 72,000J

Power, P = current , I x potential difference , V
(watts, W) (amperes, A) (volts, V)

e.g. Calculate the power to a computer that has a current of 1.5A and 230V. 1.5 x 230 =

Charge flow, Q = current , I x time , t
(coulombs, C) (amperes, A) (seconds, s)

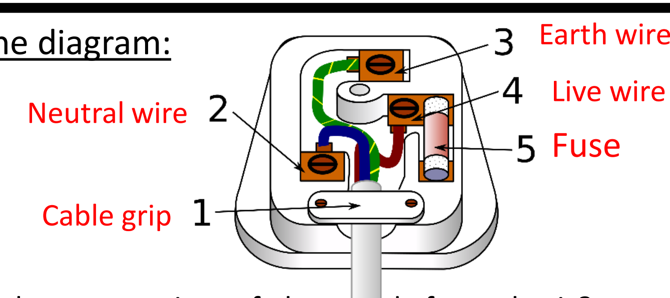
e.g. Calculate the charge flow in 40seconds when the current is 4A.
4x40 = 160C
e.g. Calculate the current through a 600W, 230V hairdryer.
600/230 = 2.6A
The correct fuse rating = watts/volts

e.g. Calculate which fuse (1A, 3A, 5A or 13A) you would use for the hairdryer above. 3A fuse because it would not melt with a 2.6A current. 5A would be too high.

Give definitions:

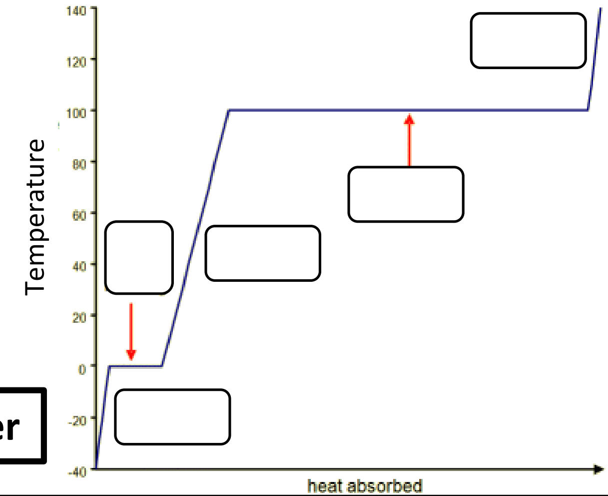
- Direct current: The current goes around the circuit in one direction only. E.g. in a torch.
- Alternating current: The current repeatedly reverses its direction. E.g. when you switch on a light at home.
- Live wire: This wire is dangerous as the voltage repeated switches from about -325V to +325V.
- Neutral wire: This wire is earthed at the local substation.
- The National Grid: A nationwide network of cables and transformers to get electricity to homes from power stations.
- Step-up transformers: Used at power stations to increase voltage in cables from 25,000V to 132,000V
- Step-down transformers: Used to supply electricity from the grid to consumers, it reduces the voltage.
- Fuse: A device between the live pin and live wire which melts with too much current to prevent damage.
- Short circuit: Where a live wire touches a neutral wire and a large current flows between them.

Label the diagram:

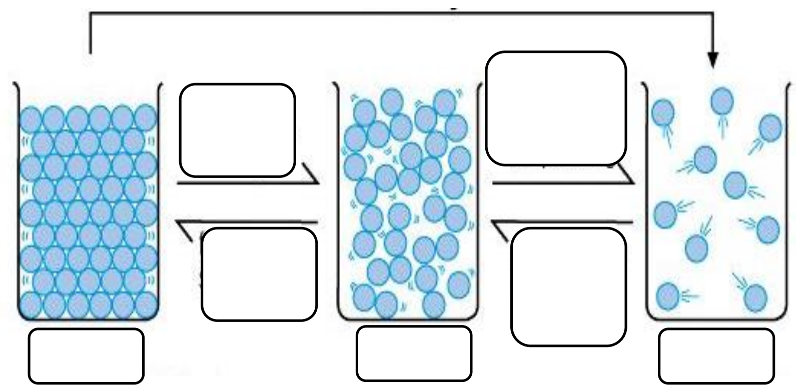


Why are the outer casings of plugs made from plastic? Plastic is an electrical insulator to protect against the live wires inside.
What does the longest pin in a plug connect to? The earth wire so the metal case is earthed when plugged in.
What metal are the pins made from? Why? Brass, because it's a good conductor and doesn't rust. Copper isn't as hard as brass, although it is a better conductor.
What metal are the wire made from? Why? Copper, because it is a good electrical conductor and bends easily.

State	Flow?	Fixed shape?	Fixed volume?	Density	Particle energy	Particle movement	Forces between particles
Solid							
Liquid							
Gas							



P6 Molecules & Matter



- The freezing point of a substance is the same temperature as the________________point.
- The energy transferred to a substance as it changes state is called its _____________ heat.
- The energy stored by particles in a substance is its _____________ energy.
- This energy is sum of the k___________ energy of particles and their p____________energy.
- The specific latent heat of fusion is the energy needed to change ___kg of a substance from s______ to l_________ at its m__________ p___________ (without a change in temperature)
- The specific latent heat of vaporisation of a substance is the energy needed to change ____kg from l______________ to v___________, at its b______________ p______ (without a change in temperature)
- Specific latent heat = $\frac{\text{energy, J}}{\text{mass, kg}}$

Density of a substance is defined as its mass per unit volume.

Density, $\rho = \frac{\text{mass, m (kilograms, kg)}}{\text{volume, V (metres}^2\text{, m}^2\text{)}}$

e.g. what is the density of a 20kg wooden post with a volume of $0.5m^2$?

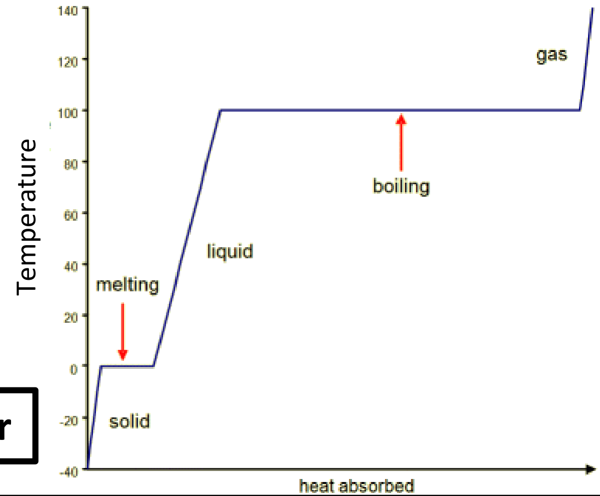
1. What is gas pressure caused by?
2. What happens to gas pressure in a sealed container if temperature increases and why?

GCSE Physics only – gas pressure & volume

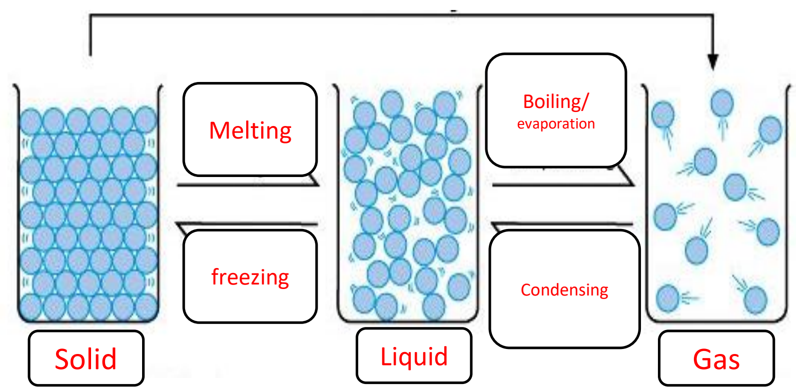
1. What happens to the pressure in gas if its volume is decreased? Why?

2. What is the formula for Boyle's Law?

State	Flow?	Fixed shape?	Fixed volume?	Density	Particle energy	Particle movement	Forces between particles
Solid	No	Yes	Yes	High	Low	Vibrate	High
Liquid	Yes	No	Yes	Med	Med	Medium	Med
Gas	Yes	No	No	Low	High	Lots	Low



P6 Molecules & Matter



Density of a substance is defined as its mass per unit volume.

Density, $\rho = \dfrac{\text{mass, m (kilograms, kg)}}{\text{volume, V (metres}^2\text{, m}^2\text{)}}$

e.g. what is the density of a 20kg wooden post with a volume of 0.5m^2? $20/0.5 = 40\text{kg/m}^3$

1. What is gas pressure caused by?

Random impacts of gas molecules on surfaces.

1. What happens to gas pressure in a sealed container if temperature increases and why? It increases as the molecules move faster so collide with more force, and there are more collisions per second.

- The freezing point of a substance is the same temperature as the melting point.
- The energy transferred to a substance as it changes state is called its latent heat.
- The energy stored by particles in a substance is its internal energy.
- This energy is sum of the kinetic energy of particles and their potential energy.
- The specific latent heat of fusion is the energy needed to change 1kg of a substance from solid to liquid at its melting point (without a change in temperature)
- The specific latent heat of vaporisation of a substance is the energy needed to change 1kg from liquid to vapour, at its boiling point (without a change in temperature)
- Specific latent heat = $\dfrac{\text{energy, J}}{\text{mass, kg}}$

GCSE Physics only – gas pressure & volume

1. What happens to the pressure in gas if its volume is decreased? Why?

It increases due to more molecular impacts per second on the surfaces.

2. What is the formula for Boyle's Law? Pressure x volume = constant

P7 Radioactivity

Give definitions:

- Radioactive decay:
- Atomic number:
- Mass number:
- Isotope:
- Irradiated:
- Ionisation:
- Peer review:
- Count rate:
- Half-life:
- Becquerel (Bq):

Changes in the nucleus

What happens to the nucleus of an atom when it emits alpha radiation?

What happens to the nucleus of an atom when it emits beta radiation?

Radiation	Symbol	What is it stopped by?	What is made from?	Range in air
Alpha				
Beta				
Gamma				

Higher:

An isotope has a half-life of 6 years. A sample has 60,000 radioactive nuclei. Calculate the number of radioactive nuclei remaining after 24 hours.

Models of the atom

P____ p______ model: Before 1914, scientists thought the a_____ was arranged with p_______ charged matter e______ spread out and n_________ charged electrons buried inside.

Rutherford's model: There is a p______ charged n_____ which makes up most of the m______ of the atom.

Bohr's model: E______ orbit the n______ in specific distances and energy. E________ move to a higher o_______ by a_________ radiation, or move to a l________ orbit by e_____ radiation.

Uses of radiation:

How do smoke alarms use radiation?

How is radiation used to control the thickness of metal foil?

P7 Radioactivity

Give definitions:

- Radioactive decay: The random event of a radioactive atom emitting radiation.
- Atomic number: The number of protons n an atom.
- Mass number: The number of protons and neutrons in an atom.
- Isotope: A version of an element with a different number of neutrons.
- Irradiated: When an object has been exposed to ionising radiation.
- Ionisation: Atoms that have become charged by their electrons being knocked off by radiation.
- Peer review: Data is published and checked by other scientists.
- Count rate: The number of counts on a Geiger counter per second.
- Half-life: The average time taken for the count rate to fall by half for a particular isotope.
- Becquerel (Bq): Unit of activity, which is 1 decay/second.

Changes in the nucleus

What happens to the nucleus of an atom when it emits alpha radiation?

Atomic number goes down by 2, mass number goes down by 4.

What happens to the nucleus of an atom when it emits beta radiation?

Atomic number goes up by one, mass number is unchanged.

Higher:

An isotope has a half-life of 6 years. A sample has 60,000 radioactive nuclei. Calculate the number of radioactive nuclei remaining after 24 hours.

$60{,}000/2^4$

$= 60{,}000/16$

$= 3750$

Radiation	Symbol	What is it stopped by?	What is made from?	Range in air
Alpha	α	Paper	2 protons & 2 neutrons	5cm
Beta	β	Aluminium sheet	Electron	1m
Gamma	γ	Thick lead sheet/concrete	Electromagnetic wave	unlimited

Models of the atom

Plum pudding model: Before 1914, scientists thought the atom was arranged with positively charged matter evenly spread out and negatively charged electrons buried inside.

Rutherford's model: There is a positively charged nucleus which makes up most of the mass of the atom.

Bohr's model: Electrons orbit the nucleus in specific distances and energy. Electrons move to a higher orbit by absorbing radiation, or move to a lower orbit by emitting radiation.

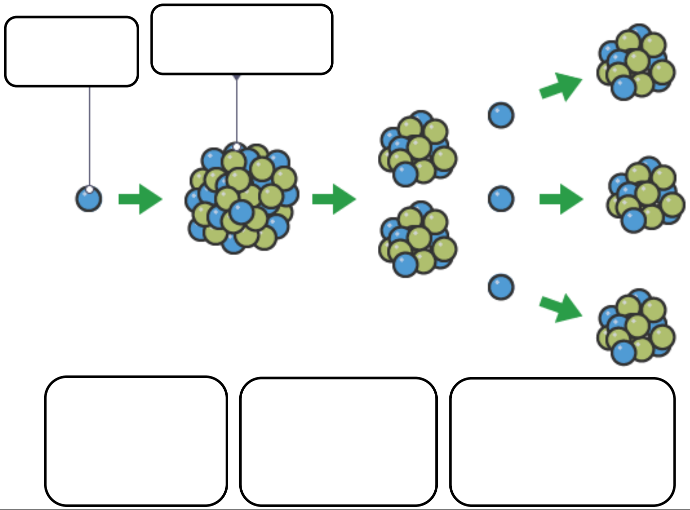
Uses of radiation:

How do smoke alarms use radiation? Alpha particles are emitted across a gap. This ionises the air so a current flows. When smoke absorbs the ions, the current stops and an alarm sounds.

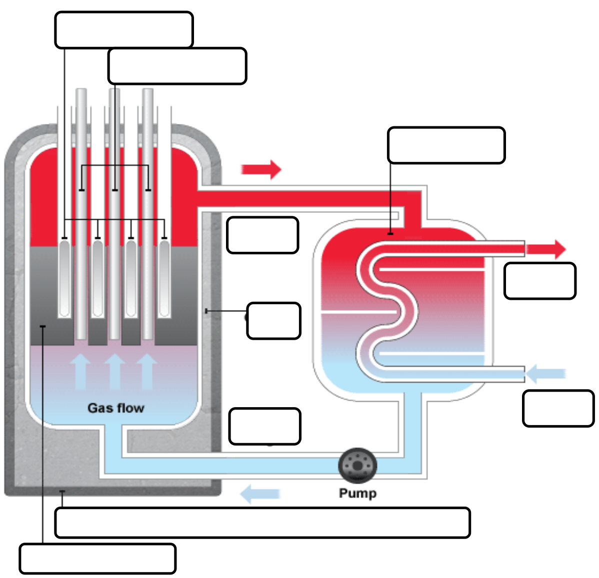
How is radiation used to control the thickness of metal foil? Beta radiation is emitted through foil and detected the other side. If it stops, the foil is too thick and the rollers increase pressure and vice versa.

P7 Radioactivity – GCSE Physics only

Label the diagram of fission:



Label the diagram:



1. What is nuclear fusion?

2. Where does fusion happen naturally? Why can it happen here?

3. What are the technical difficulties with making fusion a useful source of energy?

4. Why would fusion be such a useful energy source if it were possible?

-
-
-

5. Name 4 sources of background radiation.

6. Why is it important to store nuclear waste securely and for many years?

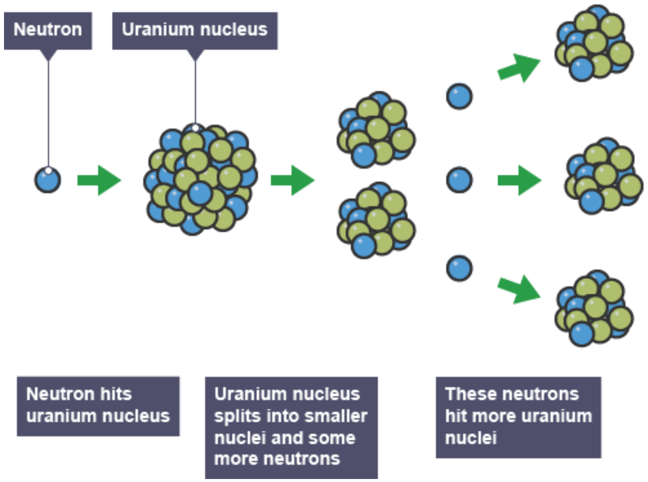
7. What is radon gas and why is it dangerous?

8. What is a chain reaction?

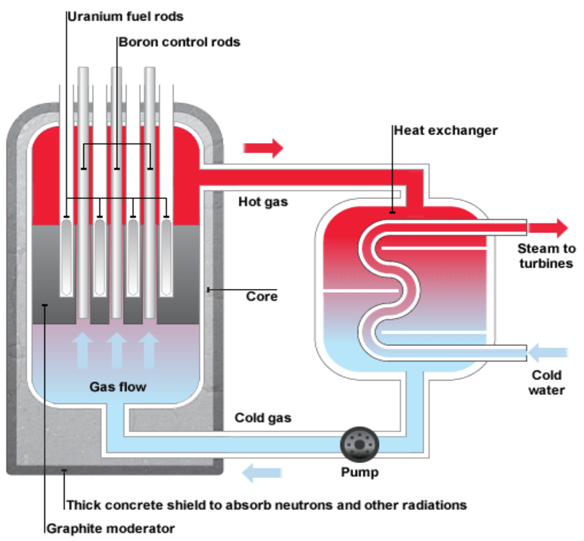
Use	Type of radiation	How it works	Why use this type of radiation?
Tracers			
Gamma cameras			
Radiation to kill cancer			
Radioactive implants			

P7 Radioactivity – GCSE Physics only

Label the diagram of fission:



Label the diagram:



1. What is nuclear fusion? Two small nuclei release energy when they fuse together to form a larger nucleus.
2. Where does fusion happen naturally? Why can it happen here? In stars, because the core is so hot that atoms are bare nuclei which fuse when they collide.
3. What are the technical difficulties with making fusion a useful source of energy? It needs very high temperatures and pressures to occur.
4. Why would fusion be such a useful energy source if it were possible?
   - Fuel is easily available as heavy Hydrogen is in sea water.
   - The product, helium, is a harmless, non-radioactive gas.
   - The energy released could be used to generate electricity.

5. Name 4 sources of background radiation. Cosmic rays, ground & buildings, food & drink, air, medical applications, nuclear weapons tests, air travel, nuclear power.

6. Why is it important to store nuclear waste securely and for many years? Some radiation has a half-life of more than a billion years so remains dangerous.

7. What is radon gas and why is it dangerous? Radioactive gas that seeps through rocks and into buildings. It emits alpha radiation so is hazardous if breathed in.

8. What is a chain reaction? A fission event can release several neutrons, which hit other nuclei and so on.

Use	How it works	Why use this type of radiation?
Gamma Tracers	Patient drinks water containing the tracer, it can be tracked through the kidney.	It can be detected outside the body. Half-life of 8 days so it is gone from body quickly, decays to a stable product.
Gamma cameras	Patient injected with gamma, absorbed into organ, camera detects an image.	Half-life long enough to give an image, short enough to decay afterwards.
Gamma to kill cancer	Narrow beam of gamma aimed at a tumour.	Can penetrate deep into the body.
Gamma or beta implants	Small radioactive seeds or rods implanted into a tumour to kill it.	Half-life long enough to irradiate a tumour over a given time, short enough to so it decays soon afterwards.

1

a. State the equation that links wave speed, frequency and wavelength
b. The speed of light is 3.0×10^8 m/s. Calculate the frequency of a microwave with a wavelength of 2.7 cm

2.

a. State the equation that links weight, mass and gravitational field strength
b. Calculate the mass of a car with a weight of 3.2 kN on Earth ($g = 9.8$ N/kg)

3.

a. State the equation that links resultant force, mass and acceleration
b. A tennis ball falls from a table. The weight of the tennis ball is 0.56 N and the drag acting on it is 0.34 N. The mass of the tennis ball is 57 g
   i. Calculate the resultant force on the ball
   ii. Calculate the acceleration experienced by the ball

4.

a. State the equation that links acceleration, change in velocity and time
b. A car accelerates from 12 m/s to 30 m/s in 2.4 seconds. Calculate the acceleration

1

a. State the equation that links wave speed, frequency and wavelength

Wave speed = frequency x wavelength

a. The speed of light is 3.0 x 10^8 m/s. Calculate the frequency of a microwave with a wavelength of 2.7 cm 1.1 x10^{10} Hz

2.

a. State the equation that links weight, mass and gravitational field strength

Weight = mass x gravitational field strength

a. Calculate the mass of a car with a weight of 3.2 kN on Earth (g = 9.8 N/kg)

327 kg

3.

a. State the equation that links resultant force, mass and acceleration

Resultant force = mass x acceleration

a. A tennis ball falls from a table. The weight of the tennis ball is 0.56 N and the drag acting on it is 0.34 N. The mass of the tennis ball is 57 g
   i. Calculate the resultant force on the ball 0.22 N
   ii. Calculate the acceleration experienced by the ball 3.9 m/s

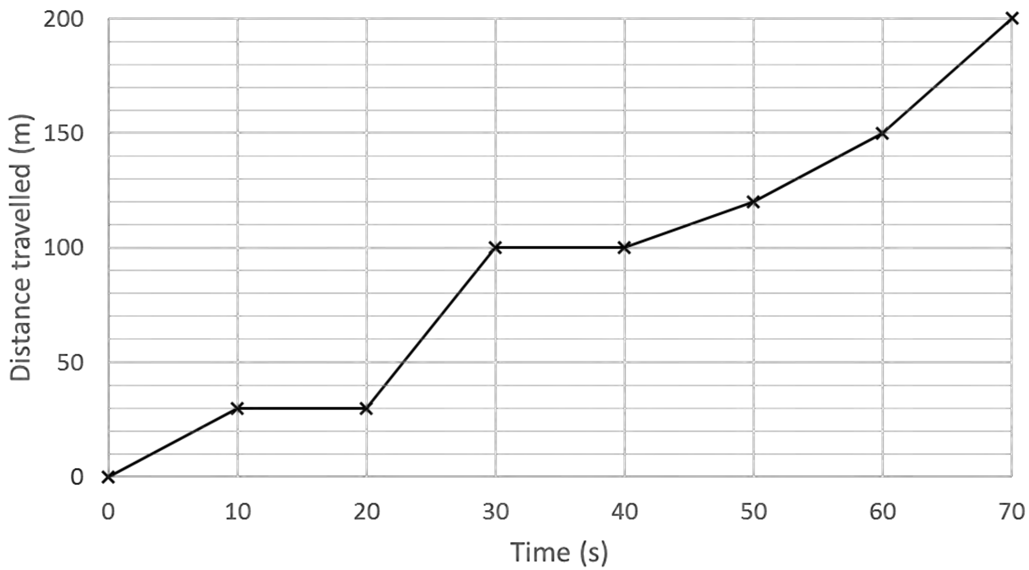
4.

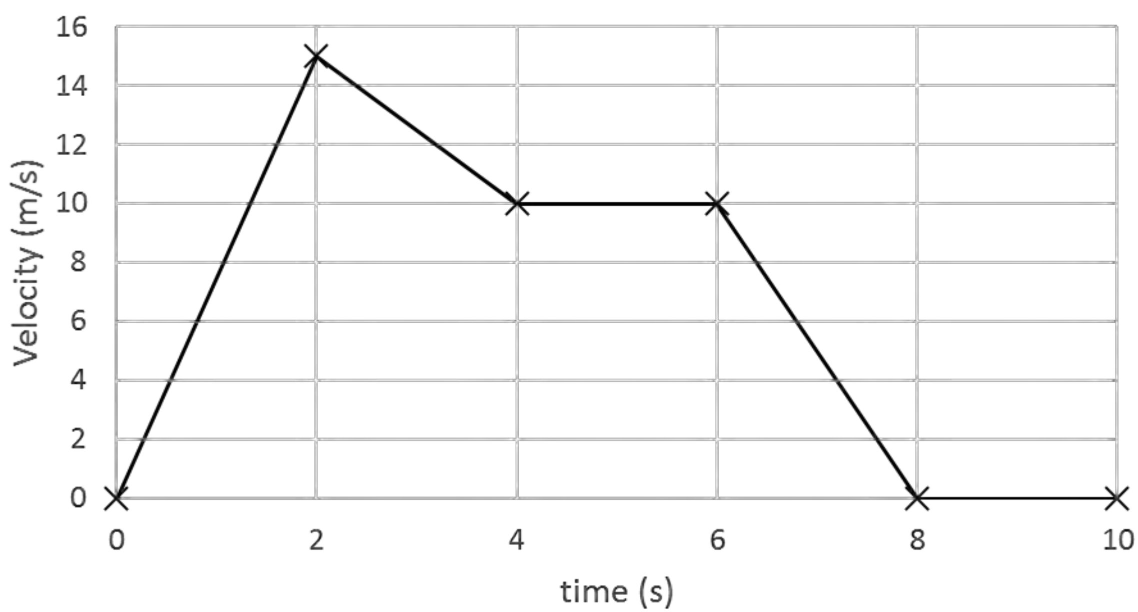
a. State the equation that links acceleration, change in velocity and time

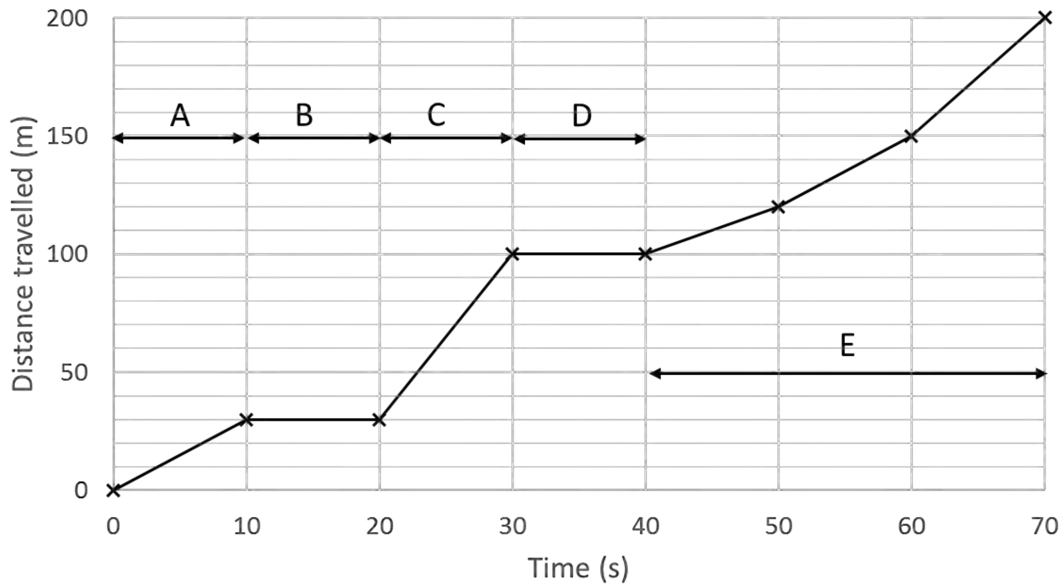
Acceleration = change in velocity/time

a. A car accelerates from 12 m/s to 30 m/s in 2.4 seconds. Calculate the acceleration 7.5 m/s^2

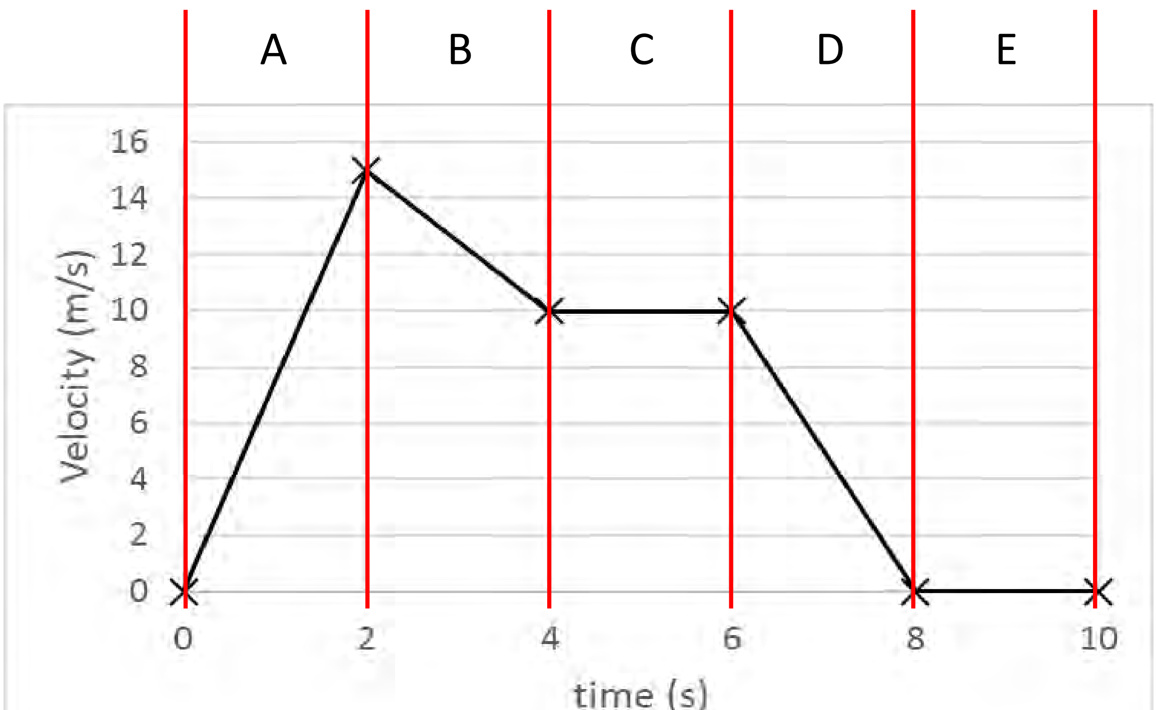
Describe these graphs







A. Constant speed
B. Stopped
C. (Higher) constant speed
D. Stopped
E. Accelerating



A. Accelerating
B. Decelerating
C. Constant speed
D. Decelerating
E. Stopped

Vectors or scalars?

Distance

Displacement

Speed

Velocity

Force

Acceleration

Mass

Vectors or scalars?

Distance

Displacement

Speed

Velocity

Force

Acceleration

Mass

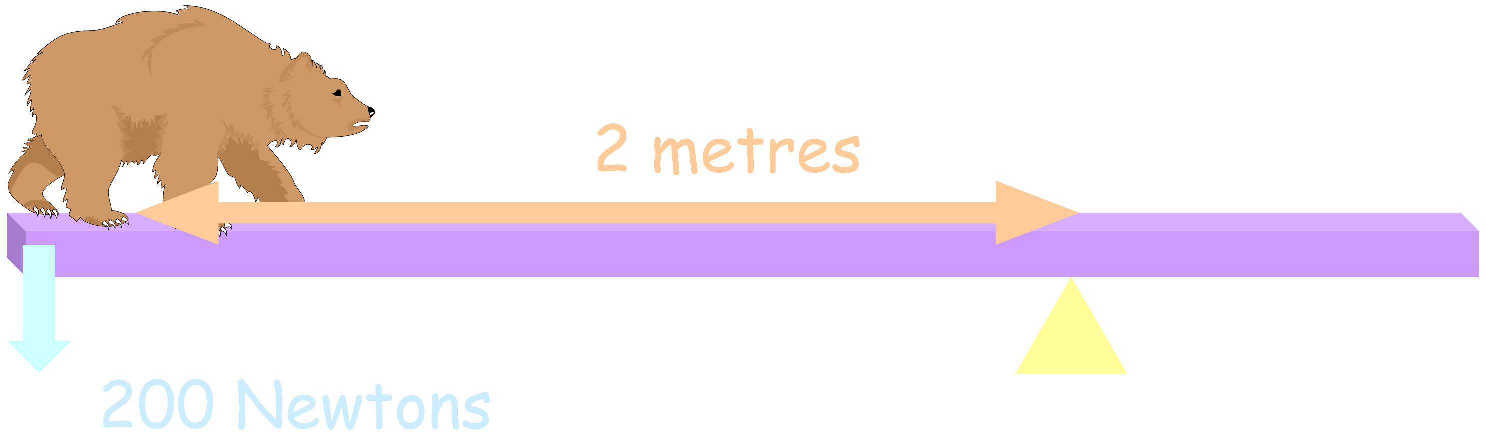
Turning Moments

A moment is a "turning force", e.g. trying to open or close a door or using a spanner. The size of the moment is given by:

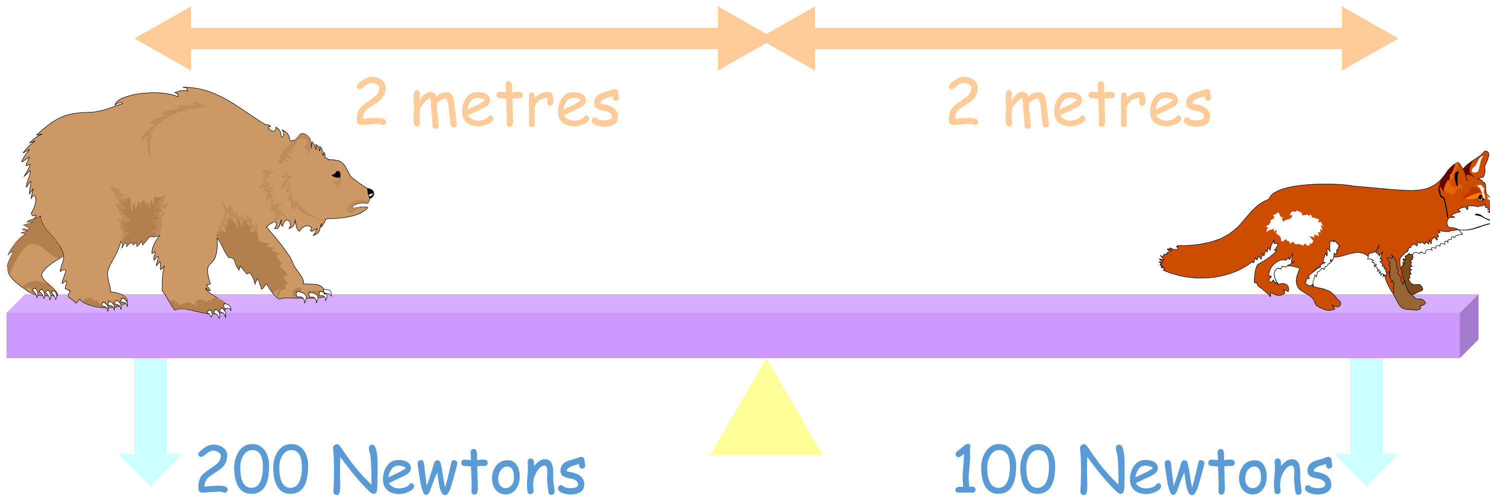
Moment (in Nm) = force (in N) x PERPENDICULAR distance from pivot (in m)

You need to learn this equation!!

Calculate the following turning moments:



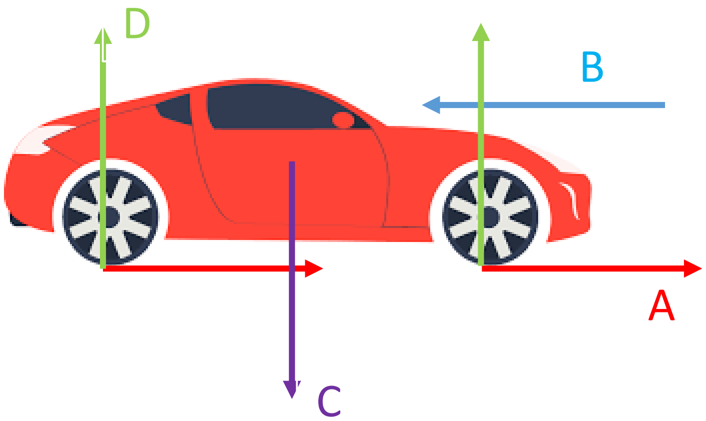
Turning Moments



Total ANTI-CLOCKWISE turning moment = 200x2 = 400Nm

Total CLOCKWISE turning moment = 100x2 = 200Nm

The anti-clockwise moment is bigger so the seesaw will turn anti-clockwise



1. Force A is between the wheels and the road. What is force A called?

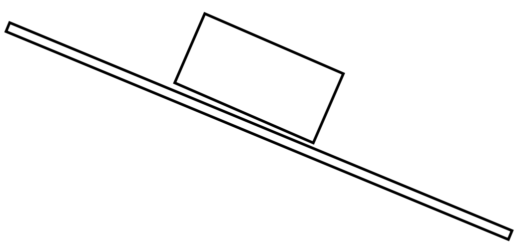
2. Force B is caused by air particles hitting the car What is force B called?

3. Force C is trying to pull the car down. What is force C called?

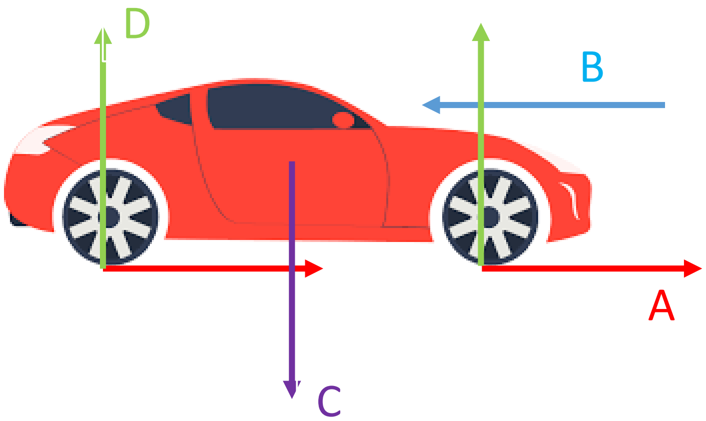
4. Force D is caused by the road pushing up on the car What is force D called?

5. Which of those forces is a non-contact force?

6. The total for force A is 500 N. If the car is moving at a constant speed what is the value of force B?

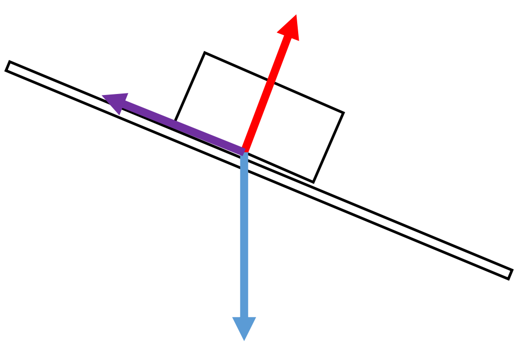


7. A block is placed on a slope, it is not moving. Draw force arrows on the block and label each force



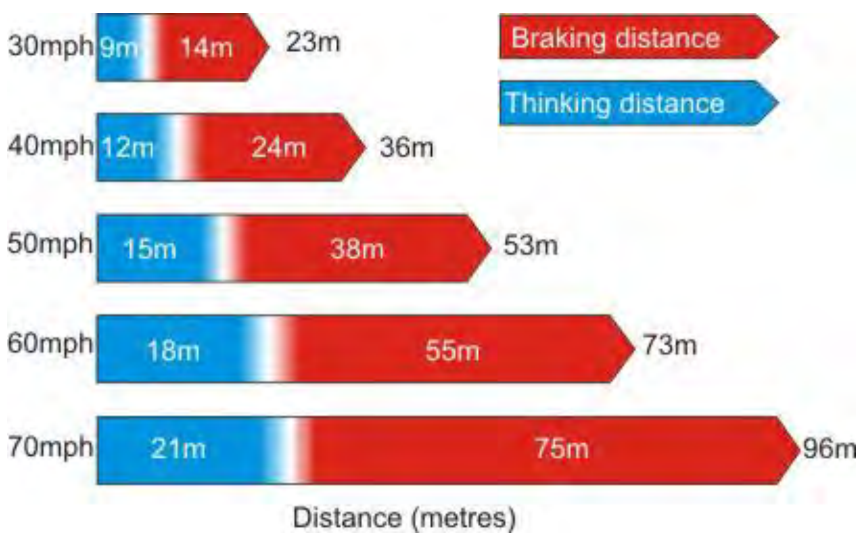
1. Force A is between the wheels and the road.
What is force A called? **Friction**
2. Force B is caused by air particles hitting the car
What is force B called? **Air resistance**
3. Force C is trying to pull the car down.
What is force C called? **Weight**
4. Force D is caused by the road pushing up on the car
What is force D called? **Normal contact force**

5. Which of those forces is a non-contact force? Weight
6. The total for force A is 500 N. If the car is moving at a constant speed what is the value of force B? 500N



7. A block is placed on a slope, it is not moving. Draw force arrows on the block and label each force Normal contact force, Weight, Friction

1. State what is meant by the thinking distance
2. State what is meant by the braking distance
3. State what is meant by the stopping distance?
4. What factors affect thinking distance?
5. What factors affect braking distance?
6. Why does drinking alcohol affect your stopping distance?
7. Why do worn tyres affect your stopping distance?



1. State what is meant by the thinking distance

Distance travelled during the reaction time

2. State what is meant by the braking distance

Distance travelled whilst the braking force is applied

3. State what is meant by the stopping distance?

Thinking distance + breaking distance

4. What factors affect thinking distance?

Distractions, age, tiredness, drugs, speed

5. What factors affect braking distance?

Conditions of: brakes, tyres, road. Going uphill or downhill, mass of the car, speed

6. Why does drinking alcohol affect your stopping distance?

Increases (**NOT** slower) reaction time

Increases thinking distance

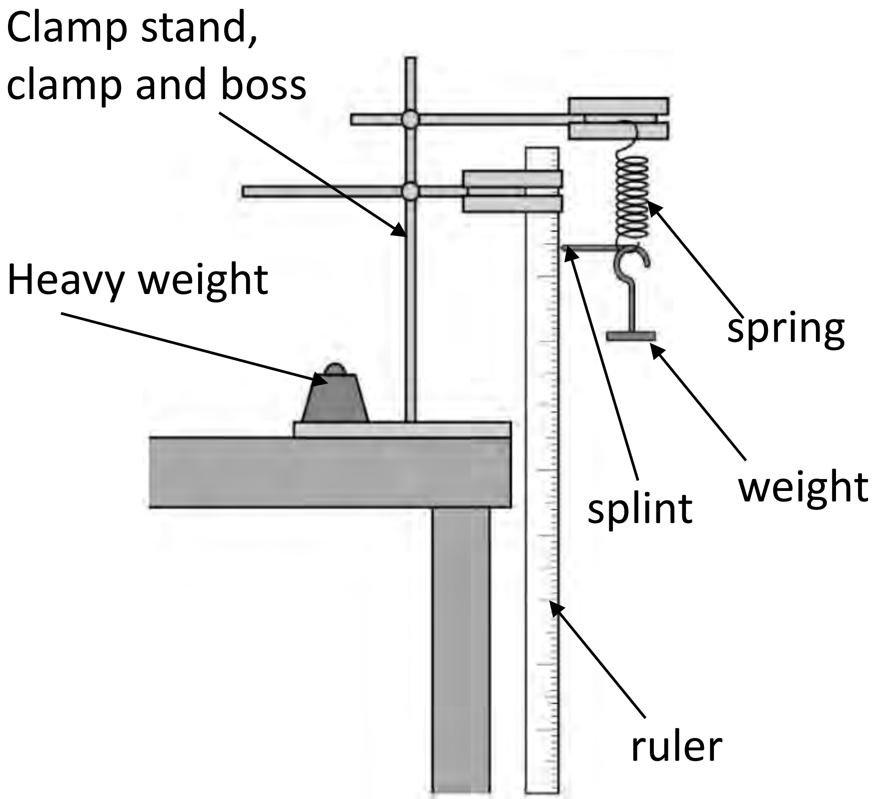
Stopping distance = thinking distance + braking distance

7. Why do worn tyres affect your stopping distance?

Reduces braking force/friction

Increases braking distance

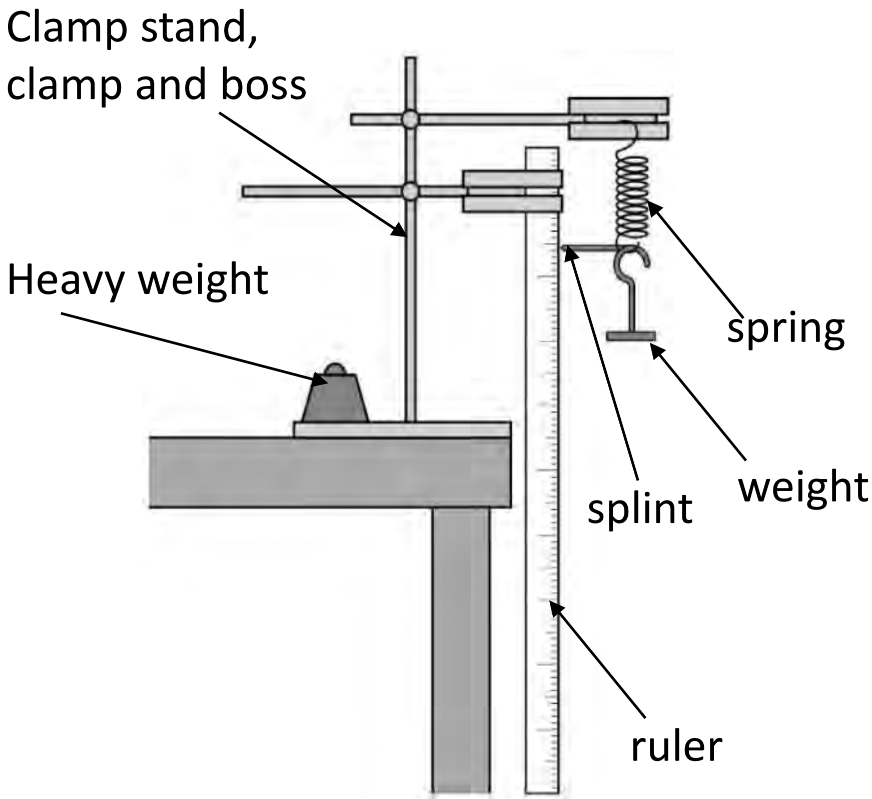
Stopping distance = thinking distance + braking distance



This experiment is to determine how the weight placed on a spring affects its extension.

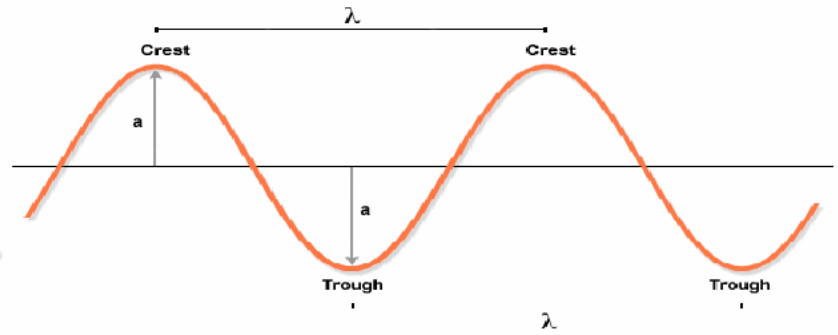
1. What is the:
   a. Independent variable
   b. Dependent variable

2. The spring will go back to its original length once the weight is removed. Is this as example of elastic or plastic deformation?

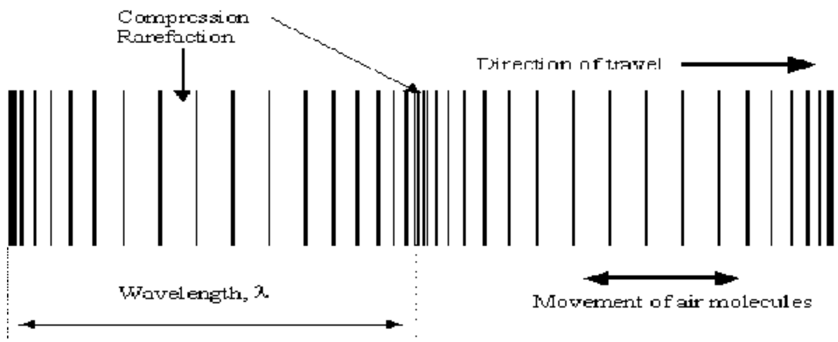


This experiment is to determine how the weight placed on a spring affects its extension.

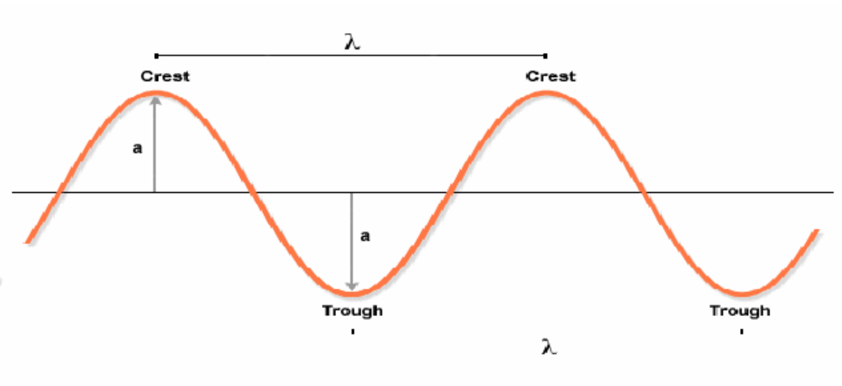
1. What is the:
   a. Independent variable
   weight
   a. Dependent variable
   extension
2. The spring will go back to its original length once the weight is removed. Is this as example of elastic or plastic deformation? Elastic deformation



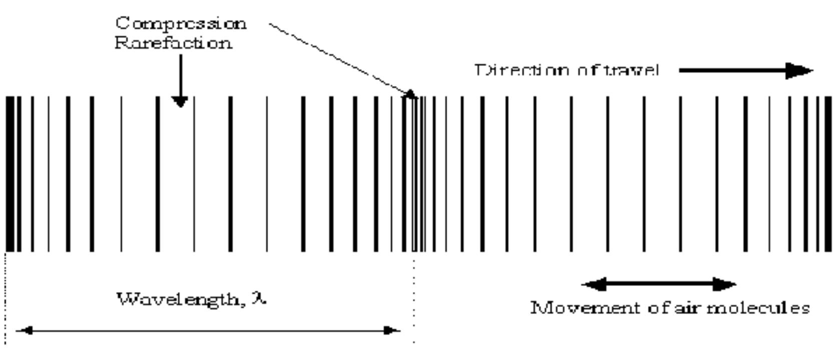
A transverse wave means the direction of oscillation is_________ to the direction of ________ transfer
An example of a transverse wave is….



A longitudinal wave means the direction of oscillation is_________ to the direction of ________ transfer
An example of a longitudinal wave is….



A transverse wave means the direction of oscillation is perpendicular to the direction of energy transfer
An example of a transverse wave is….light, water wave, seismic



A transverse wave means the direction of oscillation is parallel to the direction of energy transfer
An example of a longitudinal wave is….sound, seismic

Radio waves		**Infra-red**	**Visible**			**Gamma Rays**

1. Complete the missing waves in the electromagnetic spectrum

2. Which has the (a) Highest frequency (b) Lowest wavelength (c) fastest speed

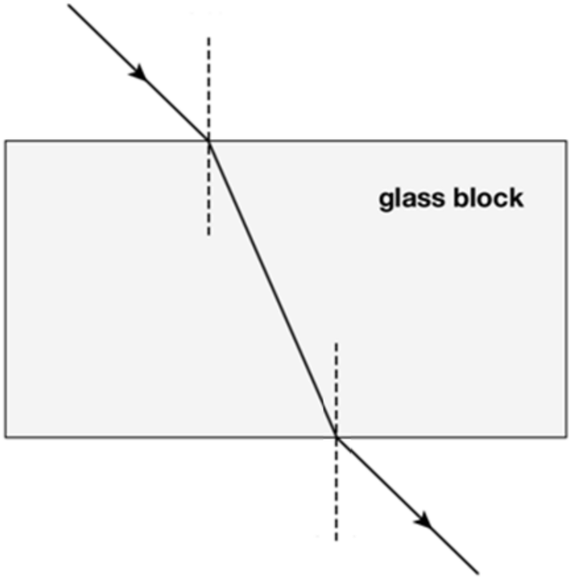
(a) Gamma, (b) Radio waves, (c) They all travel at the speed of light

3. Which ones are dangerous? Why?

Gamma, X-rays and Ultraviolet. They are <u>ionising</u> so cause cancer

4. Which ones can be used for communication?

Radio waves – TV and radio
Microwaves – Satellite communication (eg mobile phone signals)
Infra red – TV remotes
Visible – Optical fibres for fast broadband

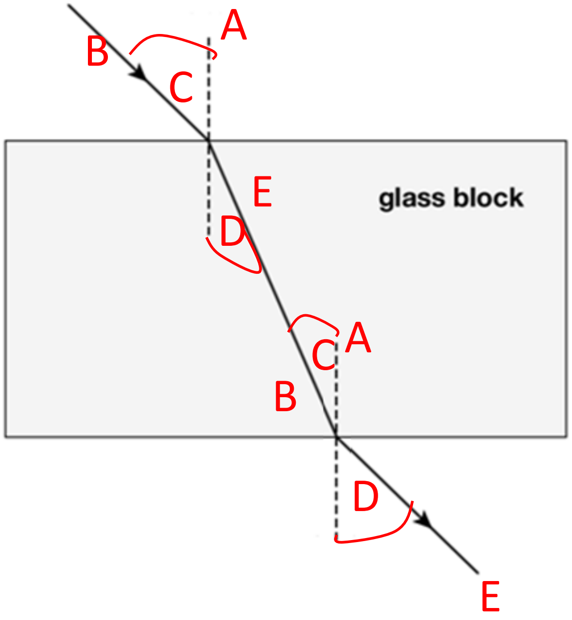


1. Draw the diagram and label with the following key terms

Normal
Incident ray
Angle of incidence
Angle of refraction
Refracted ray

You should use each term **twice,** once each time the ray reaches a boundary

2. Describe what happens to the speed at each boundary
3. Describe how the angle of incidence compares with the angle of incidence at each boundary
4. Apart from refraction, what two other things can happen to light when it hits a surface?



1. Draw the diagram and label with the following key terms

Normal - A
Incident ray -B
Angle of incidence - C
Angle of refraction - D
Refracted ray - E

You should use each term **twice,** once each time the ray reaches a boundary

2. Describe what happens to the speed at each boundary
At it goes into the block it slows down, as it leaves it speeds up
3. Describe how the angle of incidence compares with the angle of incidence at each boundary
Going into the block the angle of incidence is bigger than the angle of refraction
Leaving the block the angle of incidence is smaller than the angle of refraction
4. Apart from refraction, what two other things can happen to light when it hits a surface?
Absorbed or reflected

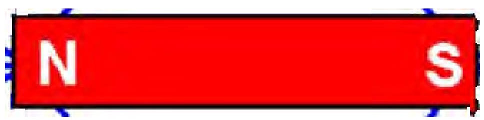
1.Draw the magnetic field around:

A wire

N

A solenoid

S



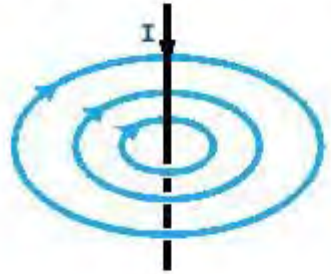
A bar magnet

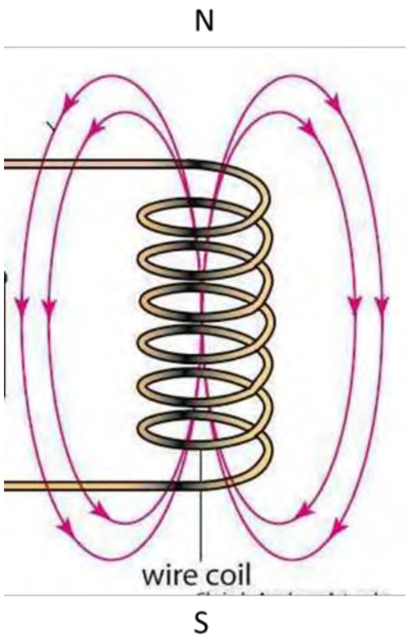
2. Add arrows to show the direction of the magnetic field

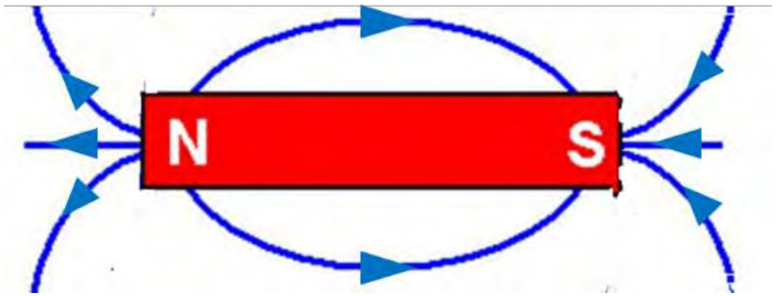
3. What happens to the magnetic field as you go further away from the magnet?

4. How do the field lines show this?

5. How can you make the solenoid stronger?







2. Add arrows to show the direction of the field

   North to south

3. What happens to the magnetic field as you go further away from the magnet?

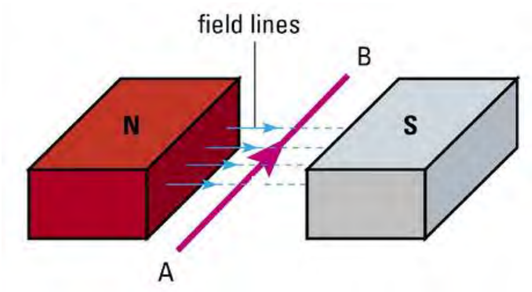
   The further from the magnet the weaker the field

4. How do the field lines show this?

   The further apart the field lines the weaker the field

5. How can you make the solenoid stronger?

   More current, more coils, tighter coils, <u>iron</u> core



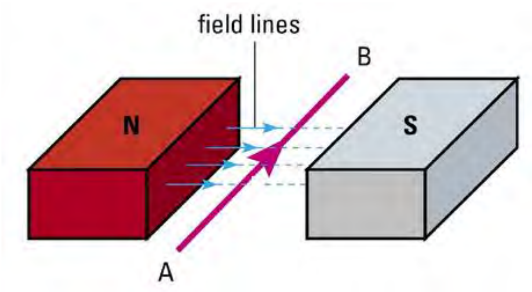
1. The current produces a ___________ field

The wire's field ______________ with the field of the permanent magnet

This causes a _________ on the wire

2. Which way will the force act?

3. How could you make the force bigger?



1. The current produces a magnetic field

The wire's field interacts with the field of the permanent magnet

This causes a force on the wire

2. Which way will the force act?
Downwards

3. How could you make the force bigger?
Bigger current, stronger magnets

Pressure equation

$$\text{Pressure} = \frac{\text{force}}{\text{area}}$$

pressure in Pascals Or N/m^2
force in Newtons
area in metres squared (m^2)

Example

A force of 10 N is applied on a table with a base of area 2 m^2 . Calculate the pressure.

1- state equation
2- put in the numbers you know
3- do the calculation
4- units

Calculate the **force** if:

1) 10 Pa of pressure is applied on a 10 m^2 surface
2) 30 N/cm^2 is applied to a 5 cm^2 surface
3) 20 Pa is applied on a square that is 30 cm by 10 cm

Calculate the **force** if:

1) 10 Pa of pressure is applied on a 10 m^2 surface

Force = Pressure x area

= 10 x 10

=100N

1) 30 N/cm^2 is applied to a 5 cm^2 surface

= Pressure x area

= 30 x 5

= 150N

1) 20 Pa is applied on a square that is 30 cm by 10 cm

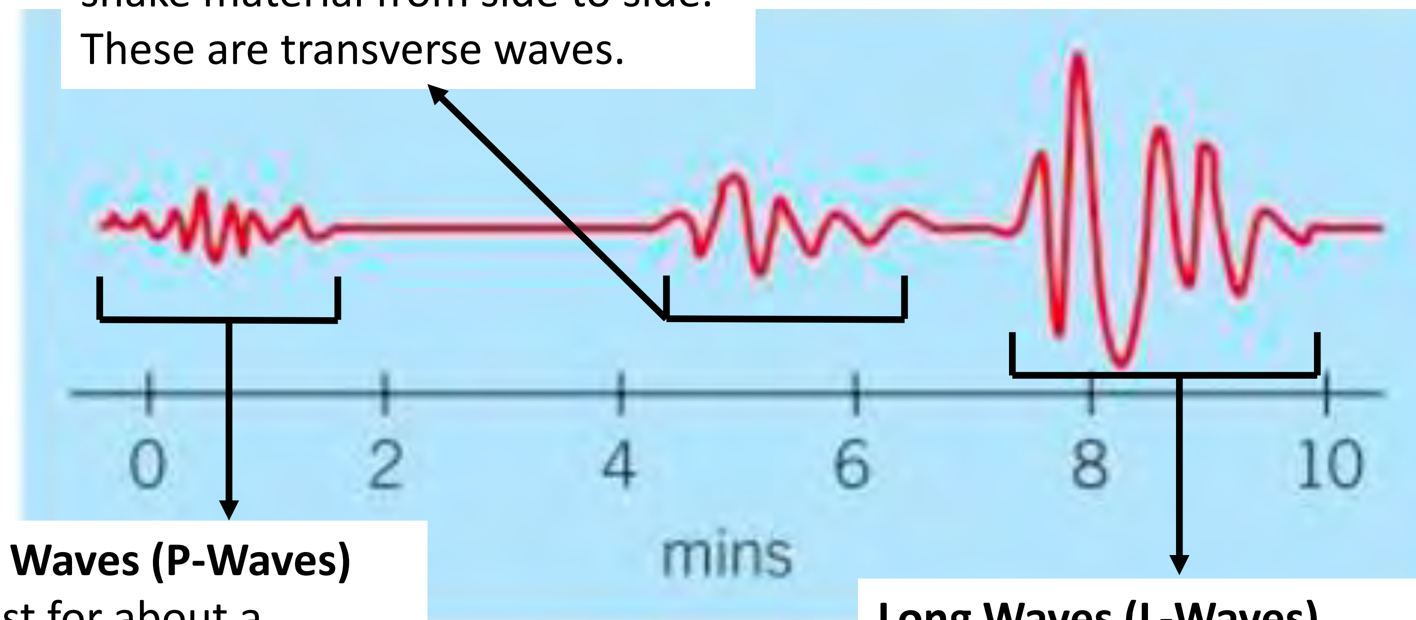
= Pressure x area

= 20 x 300

= 6000N

Key Words – crust, mantle, outer core, inner core, focus, epicentre, primary waves, secondary waves, long waves, transverse, longitudinal, seismic, seismometer, refract, speed, shadow zone

shake material from side to side. These are transverse waves.



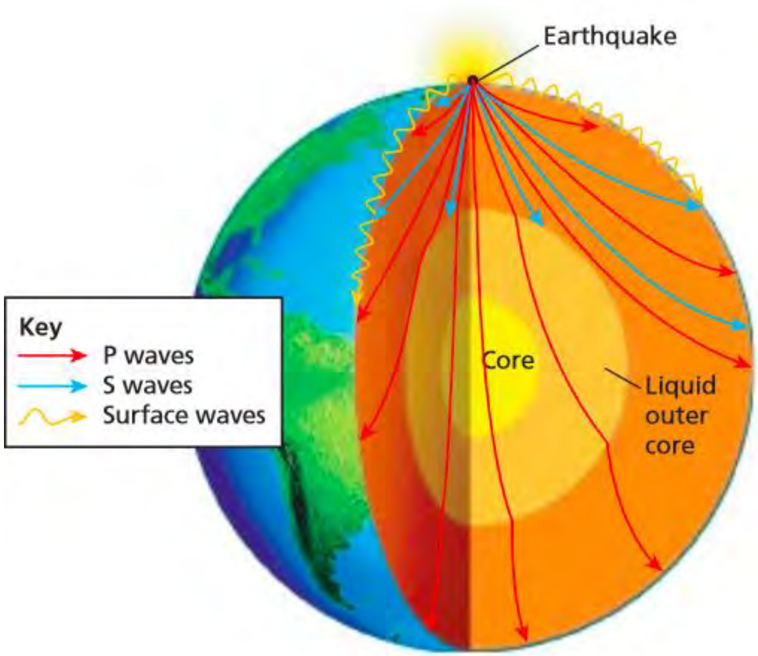
Primary Waves (P-Waves)
These last for about a minute. They are longitudinal waves that push and pull the Earth's crust

Long Waves (L-Waves)
Only occur at the Earth's crust and are violent waves. Move the crust back and forth as well as up and down.

Primary Waves (P-Waves) -

Key Words – crust, mantle, outer core, inner core, focus, epicentre, primary waves, secondary waves, long waves, transverse, longitudinal, seismic, seismometer, refract, speed, shadow zone

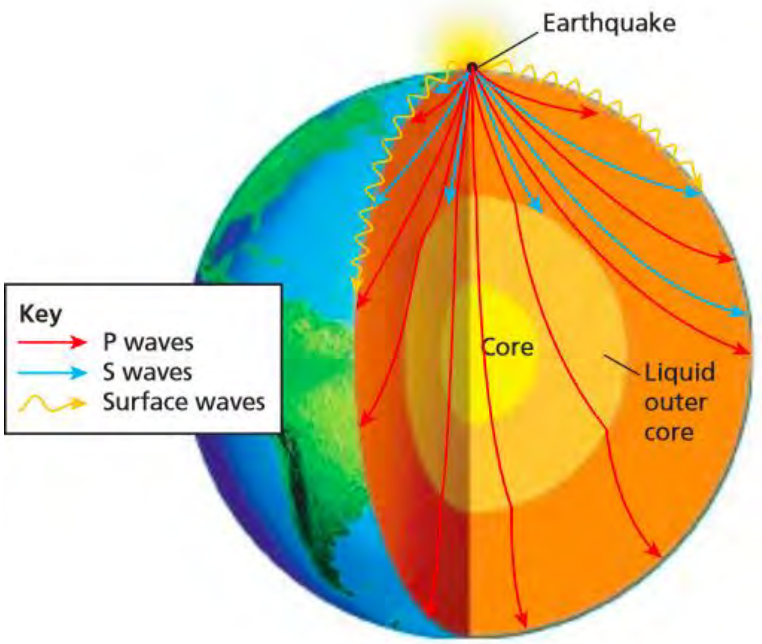
- P-waves bend as they travel from the focus through the mantle, this is because their speed is increasing with depth.
- They refract when they meet the outer core. This is because the mantle is solid and the outer core is liquid.
- The speed of the wave decreases dramatically at the outer core.



Secondary Waves (S-Waves) -

Key Words – crust, mantle, outer core, inner core, focus, epicentre, primary waves, secondary waves, long waves, transverse, longitudinal, seismic, seismometer, refract, speed, shadow zone

- S-waves bend as they travel from the focus through the mantle, this is because their speed is increasing with depth.
- They cannot travel through the liquid outer core because they are transverse waves.
- They travel slower than P-waves.



CALCULATING THE DISTANCE

Rearrange the formula s=d/t,

$$s = \frac{d}{t} \qquad d = s \times t$$

This distance is twice the distance of the ocean so we divide it by two.

$$d = \frac{s \times t}{2}$$

The speed of sound in water is 1,500 m/s, and knowing the time it takes to transmit and receive the sound we can calculate the distance.

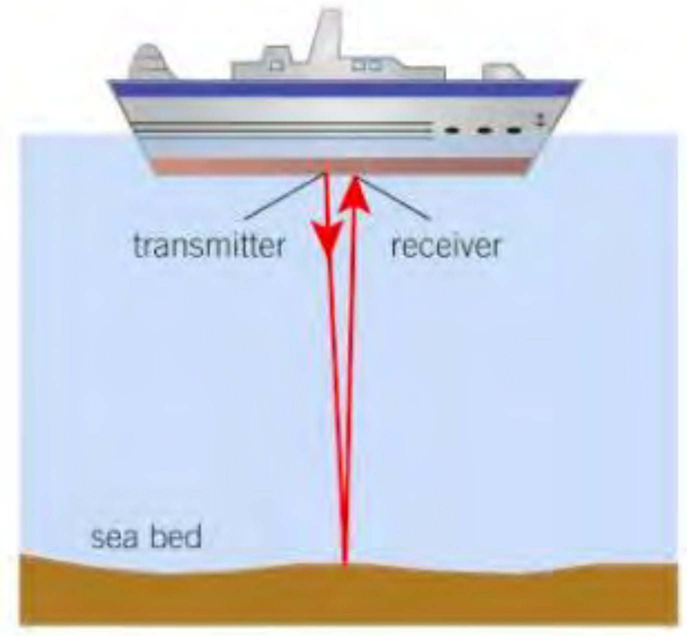
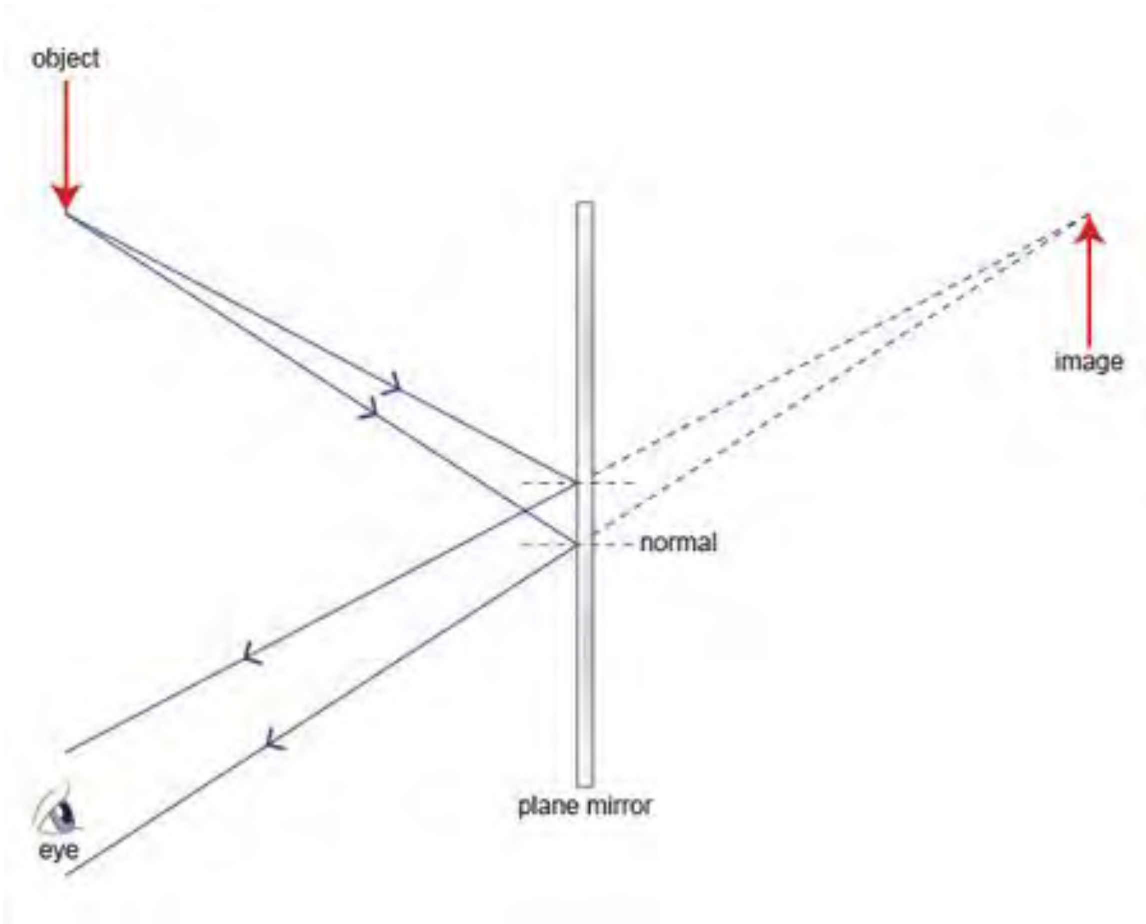
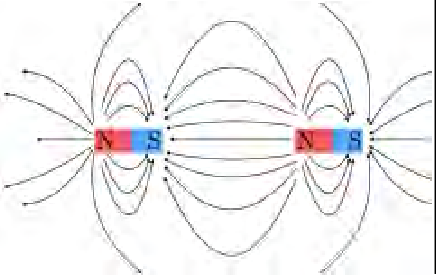


Image formation



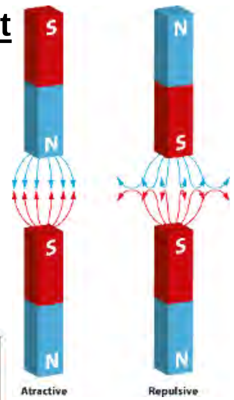
Paper 2: Topic 12: Magnetism and the motor effect



Opposite poles **attract**, **like** poles **repel**.

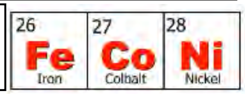
Magnetic **field lines** point from **north to south**.

The **closer** the field lines the **stronger** the magnetic field, and the **greater force** it can produce.

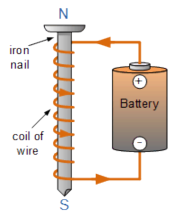


3 elements are magnetic: Iron, Cobalt and Nickel.

Steel, which is made from Iron, is also magnetic.



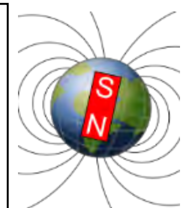
Magnets made from magnetic elements are called **permanent magnets** or fixed magnets.



A flow of **electric current** also produces a magnetic field. We can make an **induced magnet** (also called an electromagnet) with a battery and a coil of wire.

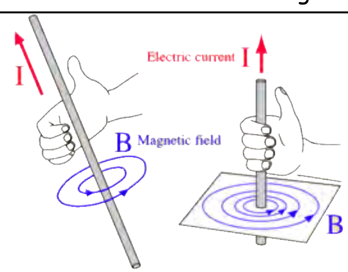
Placing an iron rod or nail inside the coil makes the induced magnet stronger.

A **compass** is a small magnet which will line up with a magnetic field. We can use a compass for **navigation** because the **Earth** has a magnetic field that lines up well with the north and south poles. The Earth has a magnetic field because it has iron in the core. A compass can also be used to draw the **magnetic field lines** around a magnet.



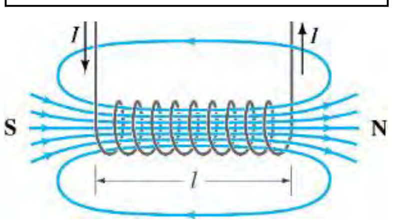
The magnetic field around a **straight conductor** (usually a wire) forms **circles**.

Imagine holding the wire in your **right hand**. When the **current** goes **up** with your **thumb**, the **field** wraps round in the same direction as your **fingers**.



The field is strongest near to the conductor.

The field strength can be increased by increasing the current.



A **solenoid** is a type of electromagnet (induced magnet).

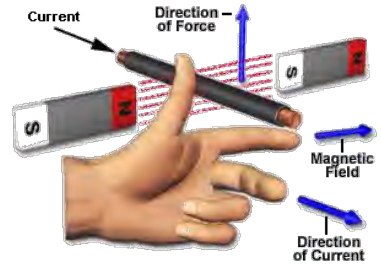
Inside the solenoid the fields from coils of wire **add** together which produces a **strong** and **uniform** field. **Outside** the solenoid the fields from the coils cancel out meaning there is a much **weaker** field.

Solenoids are useful as they can act as **switches**.

Magnets and induced magnets can exert a **force** on each other and on any conductor (e.g. a wire) carrying a current. We use this in **electric motors** to transform electrical energy into kinetic energy (rotation).

When any magnet exerts a force on a current carrying conductor, an **equal** (but **opposite**) force acts on the magnet.

The interaction between the current, the magnetic field, and the direction of the force can be shown using **Fleming's left hand rule**.



On your left hand point you thumb upwards, your first finger forwards and your second finger to the right.

Your **first** finger shows the direction of the **field**.
Your **second** finger shows the direction of the **current**.
Your **thumb** shows the direction of the **force** (movement).

You will be asked to carry out calculations using the equation $F=BIl$. You do **not** need to memorise this.

F is the **force**, measured in **N**ewtons
B is the **magnetic flux density**, measured in **T**eslas
I is the **current**, measured in **A**mps
l is the **length** of the conductor that is cutting through the field, measured in **m**etres

$$F = BIl$$

Where:
B = Flux Density
I = Current
l = Length

Magnetic field lines never cross each other. They are like contour lines, but where contour lines show height, field lines show the field.

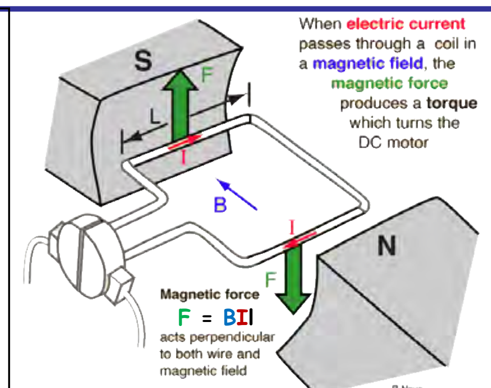
Triple Only

A motor uses 2 magnets to produce a magnetic field. Inside the field is a coil of wire.

When a current passes through the coil of wire we can apply F=BIl.

The coil of wire experiences an upwards force on one side and a downwards on the other.

This produces rotation.

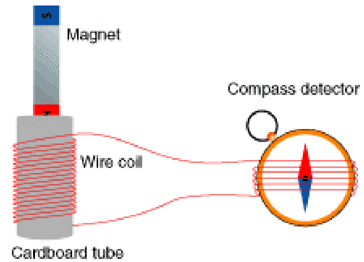


Paper 2: Topic 13: Electromagnetic induction

An **electrical generator** works a lot like a motor (see topic 12) in reverse.

When a **magnet** is moved inside a **coil of wire** (or a coil is moved through a magnetic field) the coils of wire cut through the **magnetic field lines**.

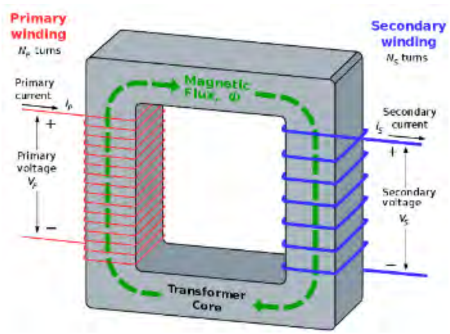
This **induces a voltage**, and the induced voltage produces a **current** (if there is a complete circuit).



To increase the induced voltage we can **increase the number of coils**, we can move the **magnet faster**, or we can make the **magnet stronger**.

A **transformer** uses an **alternating current** to generate a **magnetic field**. The magnetic field is then used to **induce a voltage** in a **second conductor**.

The induced voltage in the second conductor depends upon the number of coils of wire the second conductor has around the magnet.



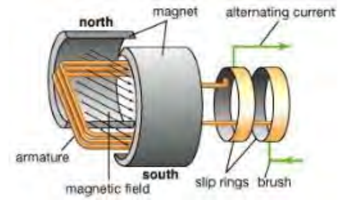
We can control the **voltage** in the second conductor by changing the **number of coils**. This allows us to increase voltage (by having more coils on the secondary) or decrease voltage (fewer coils on the secondary). A transformer **only** works with an **alternating current**. It will **not** work with a **direct current** (e.g. the current from a battery).

We use transformers in the **national grid** which transmits electricity around the country.

The wires have resistance which slows the flow of current and turns electrical energy into heat. To increase the **power** without increasing the **current** we use **step-up transformers** to **increase** the voltage.

We then use **step-down transformers** near our homes to **decrease the voltage** to a level safe to use.

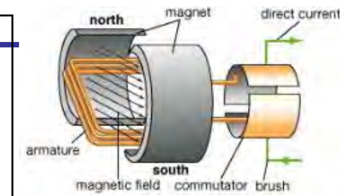
Triple Only

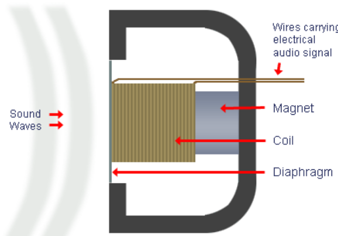


We can produce both A.C. current and D.C. using generators.

Alternators produce **alternating current** (A.C.)

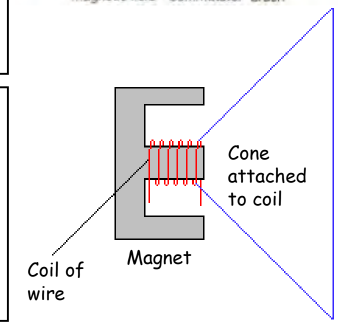
Dynamos produce **direct current** (D.C.)





Microphones turn movement (caused by vibrations in the air) into current.

Speakers turn current into movement which creates pressure waves in air (i.e. sound)



The number of turns in a transformer can be used to calculate voltage and vice versa, using the following formula. You do **not** need to memorise this formula.

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

In **addition** to the 2 formulae already given (above and at the bottom right) for calculations with transformers the following 3 formulae will also be needed for this topic and must be **memorised**. These formulae are also needed in topic 10 so if you have memorised them for that you can simply use them again here.

$P = E / t$	*power = energy transformed ÷ time*
$P = I\ V$	*electrical power = current × potential difference*
$P = I^2\ R$	*electrical power = current^2 × resistance*

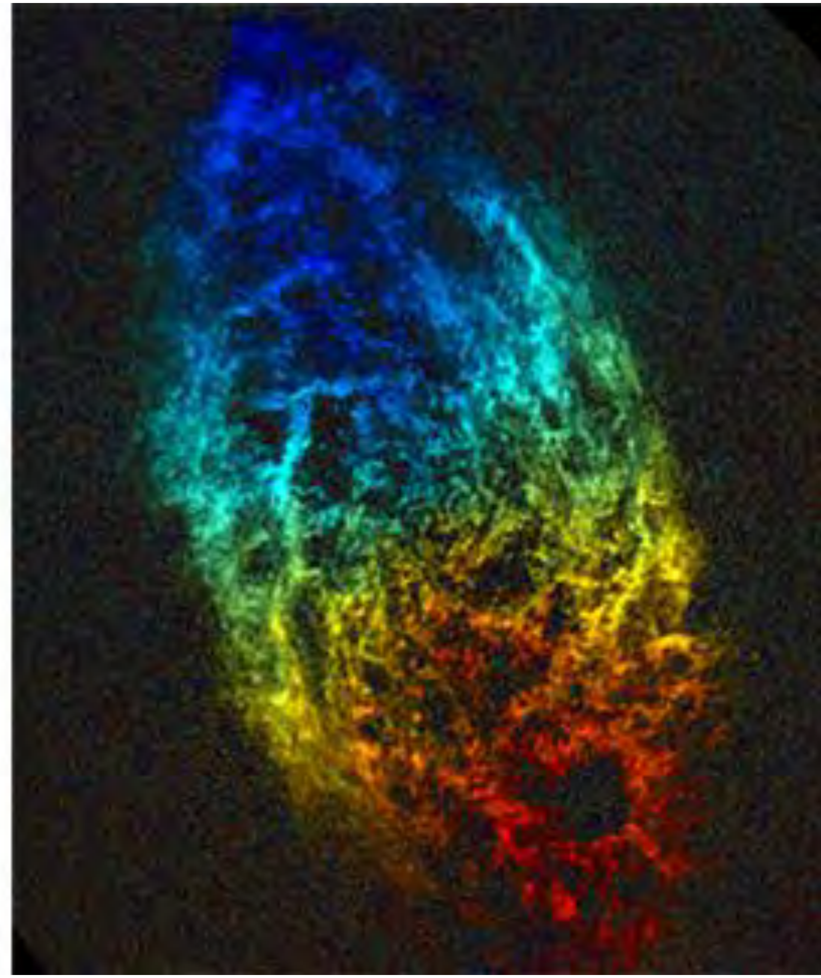
These formulae can be used to explain why it is important to transmit electricity in the national grid at high voltages. We wish to transmit a lot of power. From P=IV this means that either V or I (or both) will need to be high to have a lot of power. **E=I²R** tells us that a **high current** (I) will result in a lot of **energy** being **wasted** as heat. So to increase the **power** we use a transformer to increase the **voltage** (V), rather than the current (I).

High voltages can result in electricity 'jumping', so pylons have to be **high** off the ground. It is also necessary for **safety** to reduce the voltage (and increase current) near to homes.

We can calculate the input and output voltage and current for a transformer using the following formula. You do **not** need to memorise this formula.

$$\text{p.d. across primary coil} \times \text{current in primary coil} = \text{p.d. across secondary coil} \times \text{current in secondary coil}$$

Galaxy moving away…
RED SHIFTED!



What's this galaxy doing if we get areas of red and blue shift??