Exam dates

Paper 2 : 6 Jun 2022
Paper 4 : 8 Jun 2022
Paper 6 : 9 Jun 2022
Second Semester Examination Schedule, June 2022

Biology

Characteristics of living organisms

Completed

Movement - An action by an organism or part of an organism causing a change of position or place

Respiration - The chemical reactions in cells that break down nutrients molecules and releases energy for metabolism

Sensitivity - The ability to detect or sense stimuli in the internal or external environment and make appropriate responses

Growth - The permanent increase in size and dry mass by an increase in cell number or cell size or both

Reproduction - The process that makes more of the same kind of organism

Excretion - Removal of waste products from metabolism, toxic chemicals, and substances in excess of requirement

Nutrition - Taking in of material for energy, growth and development

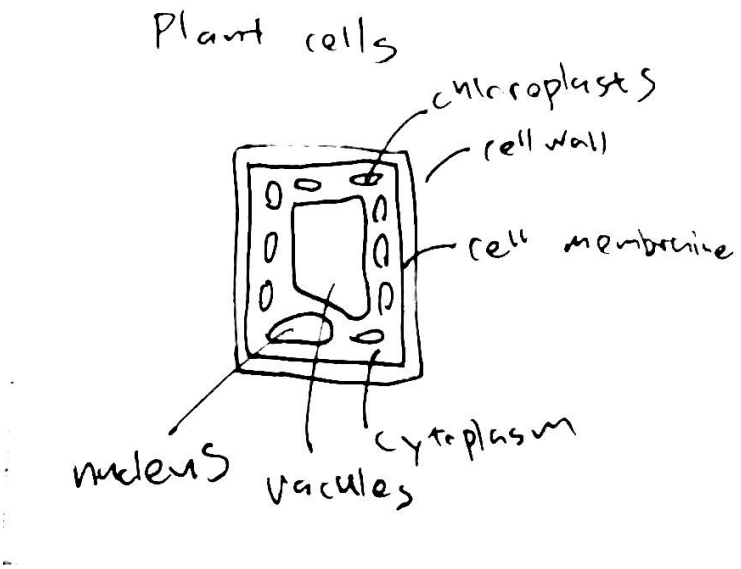
- Plants needs water, sunlight, carbon dioxide, and ions
- Animals need organic compounds, ions and water

Cells

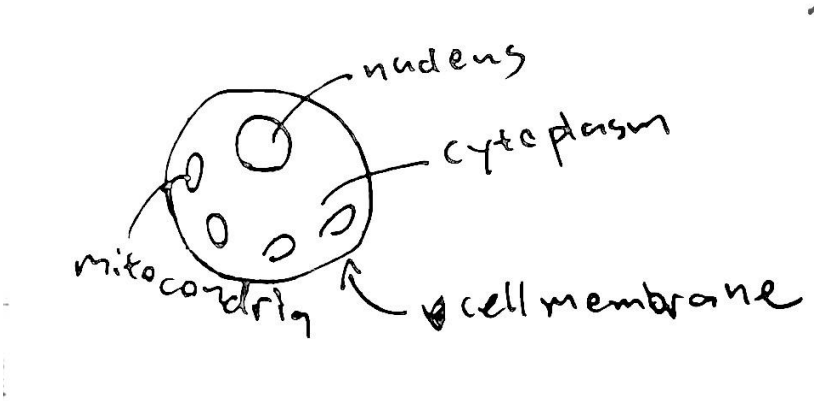
Completed

Living organisms are made up of cells

Plant cells



Animal cells



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Chloroplasts - Photosynthesis (chlorophyll pigments) Only found in cells specialised for photosynthesis

Vacuoles - Store water and sugars as sap

Cell membrane - Controls what goes in and out of cell, and hold cell together

Cell wall - Maintains cell structure and provides protection, also resists turgor pressure.

Cytoplasm - Where chemical reactions take place, and contains water and other solutes

Nucleus - Contains genetic materials (chromosomes), controls the cell and controls cell division

Mitochondria - Aerobic respiration (provides energy). The powerhouse of the cell (classic phrase).
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Movement in and out of the cell

Completed

Diffusion - The net movement of particles from a region of their higher concentration to a region of their lower concentration down a concentration gradient, as a result of their random movement

Substances move in and out of cells through **diffusion**, water moves in and out through **osmosis**.

Osmosis - The net movement of water molecules from a region of high water potential (dilute solution) to a region of low water potential (concentrated solution) through a partially permeable membrane.

High solute = low water potential (less water molecules as its displaced by solute)
Low solute = high water potential (more water molecules as less displacement by solute)

Hypotonic solution - Osmosis in is at a higher rate. lower mineral concentration, high water potential, causes animal cells to swell and become **lyzed**. Causes plant cells to become

turgid. The cell wall of plants can resist turgor pressure and allows for rigidity within the plant structure. Ideal for plants.

Hypertonic solution - Osmosis out is higher rate. higher solute concentration, low water potential, causes animal cells **to shrink and shrive**l, causes plant cells to become **plasmolyzed** - when the cell membrane detaches from the cell wall.

Isotonic solution - Osmosis in and out have an equal rate. Same mineral concentration and water potential as cell, causes animal cells to be **normal**, and causes plant cells to become **flaccid**. Flaccid plant cells cause the plant structure to become weak due to loss of rigidity and causes plants to wilt.

Diffusion is affected by:

- Temperature (higher temp = more diffusion due to higher kinetic energy of the particles allowing for faster movement and therefore faster diffusion)
- Diffusion distance (higher distance = slower diffusion, since more time is needed for particles to spread out completely throughout the substance)
- Concentration (higher concentration = higher diffusion, more particles with random movement, causing a overall faster rate of movement to the region with low concentration) Particles bump into each other more and are forced through the membrane
- Surface area to volume ratio - higher surface area allows more particles to diffuse through at once. Higher surface area to volume ratio allows for faster rate of diffusion into and throughout the substance

Investigate and describe the effects on plant tissues of immersing them in solutions of different concentrations

Turgor pressure - The pressure applied by excess cell sap on the cell wall
(plant cell only, animal cells just burst)

Plants drink water through osmosis as the water particles move up the plant due to osmosis

The importance of water potential and osmosis in the uptake of water by plants

- It is important that the water potential is higher outside the plant cells than inside, so that osmosis of water into the plant cells can occur. This increases the turgor pressure within the plant cell, increases the pressure between the cells and allows the plant tissue to maintain its rigidity.
- Lower water potential within the plant allows for osmosis of water (and dissolved minerals) to occur into the roots.

Also important in transport of water in plants

The importance of water potential and osmosis on animal cells and tissues

- Water and dissolved minerals diffuse into the animal cell via osmosis and bring energy, nutrients and minerals to the cells.

Boiled potato strip experiment (alt to practical)

- Plant tissue in a hypotonic solution causes it to grow in length and width, also makes it become stiff.
- Plant tissue in isotonic solution is control - doesn't change
- Plant tissue in hypertonic solution causes plant tissue to shrink in length and width, also making it flaccid and floppy.

Fish in freshwater absorbs water through osmosis
Fish in salt water needs to drink water to avoid dehydration

Biological molecules

Completed

Carbohydrates

- Monosaccharides, used as a type of energy source
    - Bread/Pasta
- CHO (Carbon Hydrogen Oxygen)

Lipids

- Glycerol/ Fatty Acids, used as a long term of energy sources, cushioning vital organs, dissolve fat soluble vitamins, insulation
    - Butter/oil
- CHO (Carbon Hydrogen Oxygen)

Proteins

- Amino acids, build antibodies/Enzymes/Muscles
    - Meat/Beans
- CHON (Carbon Hydrogen Oxygen Nitrogen)

Monosaccharides : single sugar molecules

- Glucose
- Fructose
- Galactose

Disaccharide : Two sugar molecules

- Maltose
- Sucrose
- Lactose

Polysaccharide : Many sugar molecules

- Starch
- Glycogen
- Cellulose

Iodine solution - used to test for starch.

1. Few drops are added.

- If solution is purple/black starch is present
- If solution is yellow/brown starch is not present

Benedict's solution - Test for reducing sugars.

1. Few drops are added into a test tube, which is placed into a water bath between 80-100c

- Blue - None
- Green - Trace sugars
- Orange - Moderate
- Red - Lots of sugar

Biuret Reagent - Test for proteins.

1. Biuret reagent added into test tube with sample.
2. Shake.

- If the solution turns from light blue to purple/violet proteins are present.
- If the solution does not have protein it stays light blue or becomes a colour other than purple.

Ethanol Emulsification - Test for lipids.

1. Add equal volume ethanol to the sample.
2. Shake well.
3. Add the same volume of water as the ethanol previously added.
4. Shake mixture again.

- If the solution becomes a thick white colour that stays for several minutes, the solution has been emulsified and is positive for lipids. (Alcohol dissolves lipids, but water emulsifies the lipids and releases them in droplets, causing them to be suspended in the liquid and turns it cloudy white)

- If the solution becomes a white colour and quickly disappears it does not have lipids.

Water is an important biological solvent, can dissolve many crucial minerals and nutrients needed. Present in blood, cells and bodily fluids.

Enzymes

Completed

Enzymes are proteins that function as biological catalysts. They are folded into complex shapes to allow smaller molecules called substrates to fit into them.

How does temperature affect enzyme activity?

- A higher temperature allows for increased enzyme activity.
- This is because of increased kinetic energy that both the enzymes and the substrates have. This allows for a higher net total of successful collisions.
- Only applies up to a temperature called the **ideal temperature.**
- Beyond that, the enzymes start to get denatured, so even if the number collisions increase, the number of successful reactions decrease and enzyme activity drops rapidly.

As temperature increases, enzyme activity increases gradually up until the ideal temperature. Beyond that, enzyme activity drops rapidly as they get denatured

How does pH affect enzyme activity?

- Enzyme activity is highest when the pH is in their ideal range.
- Enzyme activity increases gradually as the pH increases, until their ideal pH is reached. Beyond that, enzyme activity gradually decreases.
- Outside the ideal pH range, the enzyme's active sites change shape and decreases the number of successful collisions
- Extreme pH's causes the enzymes to become denatured

The shape of the enzyme **active site** matches that of the **substrate** (key and lock theory)

Active site - portion of the enzyme that has a specific shape that latches onto the substrate

Substrate - The reactant that fits into the active site.

Denature - The permanent deformation of an enzyme's active site such that it can no longer complement its substrate.

The substrate attaches to an enzyme's active site. The active site weakens the bonds within the substrate and causes it to split into products.

Plant Nutrition

Completed

Photosynthesis - Process by which plants manufacture carbohydrates from raw materials from light. Transforms light energy into chemical energy in molecules for the synthesis of carbohydrates

Carbon dioxide + water ------> (Light + Chlorophyll) ---> glucose + oxygen
$6CO_2 + 6H_20$ ----> (Light + Chlorophyll) $\rightarrow C_6H_{12}O_6 + 6O_2$

Carbohydrates are stored as starch and transported as sucrose (as glucose is too unstable)

Glucose used to make:

1. starch (for storage),
2. for respiration,
3. to build cellulose for cell walls,
4. to build amino acids for protein with the addition of nitrates from soil,
5. Sucrose for transport and fruits,
6. Build nucleic acids (DNA and genetic material),
7. Fats and oils for storage and cell membranes.

Experiments

Chlorophyll test and its necessity

1. Destarch a plant with variegated leaves for 24 hours (leaves with green and white areas)
2. Move the plant into a warm and sunny area
3. Test one of the leaves for starch using iodine

The areas with purple/black colour will coincide with the green parts of the leaf (with chlorophyll, where starch was produced) and the areas that are yellow/brown will coincide with the white areas of the leaf (without chlorophyll, where no starch was produced).

Carbon Dioxide test and its necessity

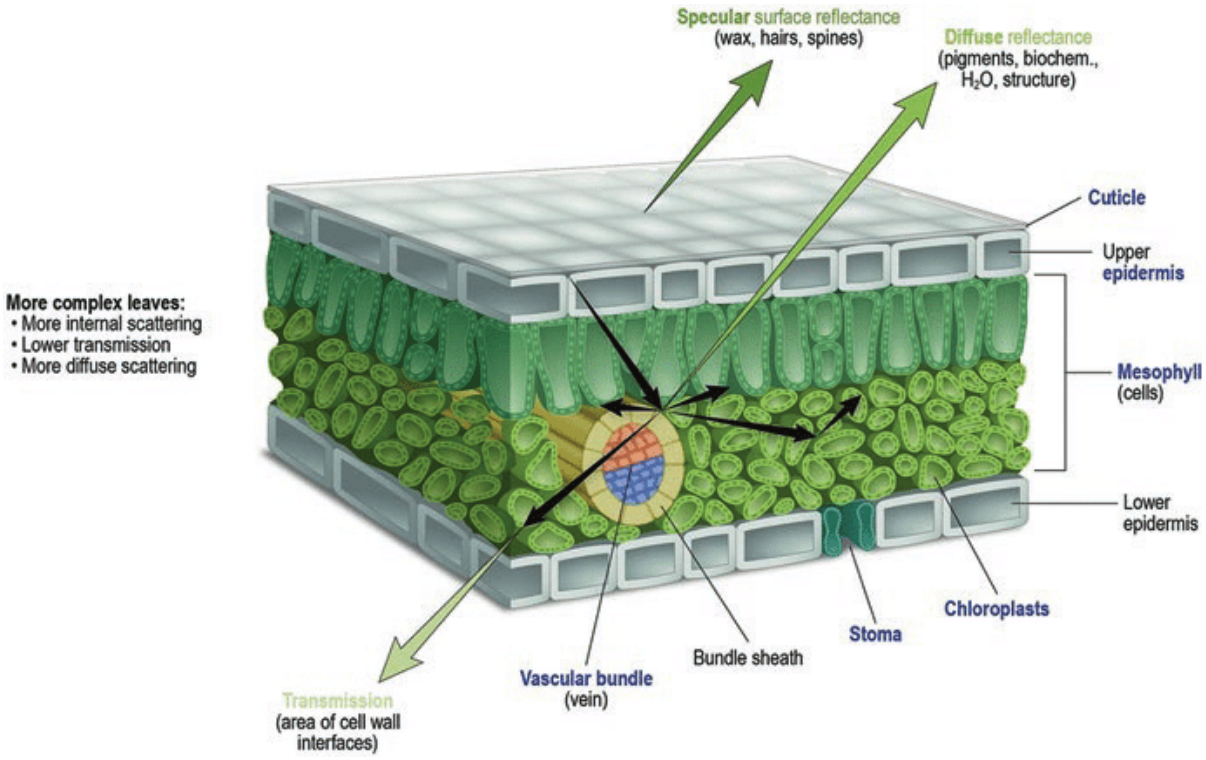
1. Destarch a plant with green leaves for 24 hours
2. Put the destarched leaf into a sealed flask with lime water on the bottom (lime water absorbs carbon dioxide) Leaf should still be attached to the plant
3. Ensure that no air enters the flask. Leave the plant and flask in a sunny location for 48 hours.
4. Carry out the starch test on the leaf in the flask.

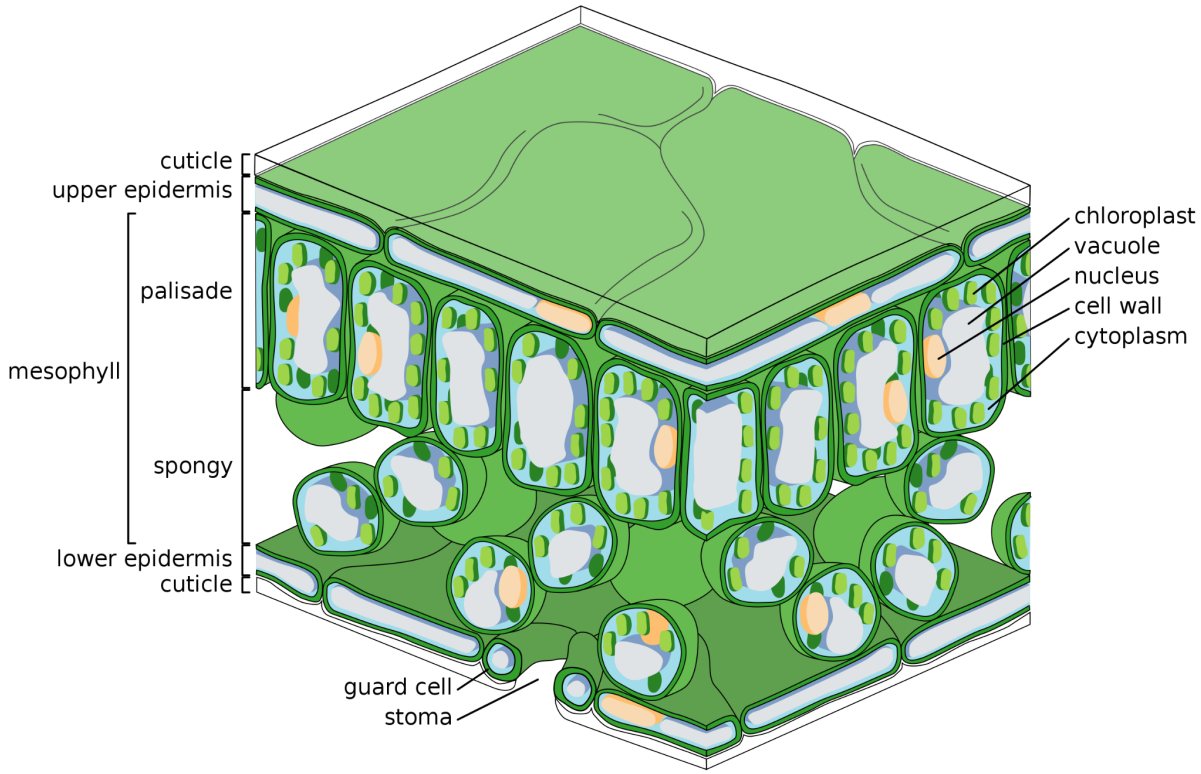
The leaf inside the flask should not produce any starch (entire leaf will be brown/yellow) whilst the outside leaves should have starch and be purple/black.

Necessity of light for photosynthesis

1. Destarch a plant with green leaves for 24 hours
2. Use paper clips to fix aluminium foil onto a part of the leaf. Leaf should still be attached
3. Leave the plant in a sunny place for 48 hours
4. Remove the aluminium foil and test the leaf for starch

The part of the leaf covered by aluminium foil should not have any starch (yellow/brown) whilst the part of the leaf left uncovered will have starch (purple/black)





Parts of a leaf

Leaf functions:

Palisade Mesophyll - a layer of tightly packed cells right below the upper epidermis. Most photosynthesis takes place here. Tightly packed with lots of chloroplasts to maximize efficiency.
Upper epidermis- Second top layer of leaf, below the cuticle. Provides protection and aids in preventing water loss.
Cuticle - A wax layer to prevent water loss via transpiration. Also protects the leaf.
Guard cells - Control the opening and closing of the stoma
Stomata - Pores that allow for the gas exchange of carbon dioxide and oxygen between the leaf and the environment. CO2 in and O2 out
Spongy mesophyll - Allows for the interchange of CO2 to allow for photosynthesis
Vascular bundles - Transports minerals and water to leaves and carbohydrates out.
Xylem - Transport water and dissolved minerals to leaves
Phloem - Transports sucrose out of the leaf.

Nitrate ions are needed to synthesize amino acids
Magnesium ions are needed to synthesize chlorophyll

Nitrate deficiency causes leaves to turn pale yellow, stunted growth.
Magnesium deficiency causes yellowing between the leaves veins and stunted growth

Animal Nutrition

In progress

Balance diet - consists of different nutrients in the correct amount to keep us healthy

Nutrients:	**Functions:**	**Food sources:**
Carbohydrate:	To provide short term energy	Bread, cereals, pasta
Protein:	For growth and repair	Fish, meat, eggs, beans
Fat (lipid) :	Insulation and energy storage	Oil, butter, nuts
Minerals:	Needed in small quantity to maintain health	Salt, milk (for calcium), liver (for iron)
Vitamins:	Needed in small quantity to maintain health	Fruits and vegetables, meats and dairy products
Water:	Needed for cells and body fluids	Fruit juice, milk, water

Factors that affect dietary needs:

1) **Age:**

- The amount of energy that young people need increases towards adulthood as this energy is needed for growth
- Children need a higher proportion of protein as this is required for growth
- Energy needs for adults decrease as they get older

2) **Gender:**

- Man tend to need more energy than woman as they have more muscles and larger body.

3) **Activity level:**

- The more active, the more energy required for movement as muscles are contracting more and repairing faster

4) **Pregnancy:**

- Energy requirements increase as energy is needed to support the growth of the developing foetus, as well as the larger mass the mother need to carry around
- Extra calcium and iron are also needed to help build the bones, teeth and blood of the fetus

5) **Breastfeeding**

- Energy requirements increase and extra calcium still need to make high quality breast milk

Ingestion

-Taking of substances into the body through the mouth

Digestion

-Breakdown of large insoluble food molecules into small water soluble molecules

Liver

-Produces bile

-The bile causes emulsification of fat (where large droplets of fat are turned into small droplets of fat) (this is chemical digestion)

- Also neutralises stomach acid pH

Gallbladder

- Stores bile

- Release bile into the duodenum in small amounts

Pancreas

- Produce pancreatic juice

- Neutralises stomach acid pH

- Also contains all three types enzymes (amylase, protease and lipase)
- Also produces hormones which controls the blood sugar (insulin & glucagon)

Large intestine

- Regulates the amount of water in faeces

- Also involved in production/absorption of vitamins eg. vitamin K

~ The faeces is stored in the rectum before egestion through the anus

Teeth

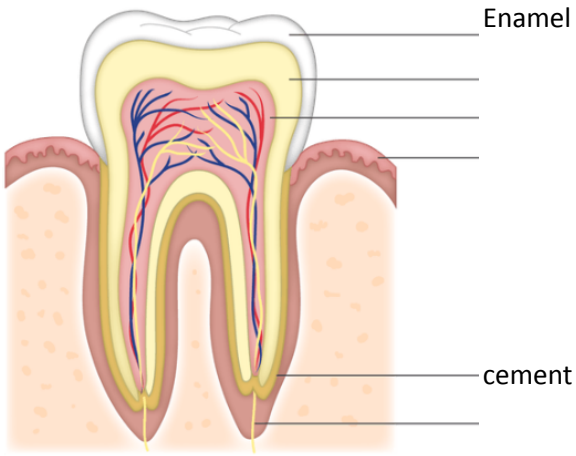
Types of teeth

- Canine (2 teeth next to incisors on either side of incisor)

-Incisor (front 4)

- premolar (4 teeth after canine, clustered into 2 groups of 2 on either side of canine)

- molar (6 teeth after premolar, clustered into 2 groups of 3 on either side of premolar)



Chemistry

The Particulate nature of matter

In progress

Properties of each state:

State	**Solid**	**Liquid**	**Gas**
Forces of attraction	Forces of attraction very strong	Forces of attraction strong	Forces of attraction weak
Shape	Fixed, regular structure	No defined shape	No defined shape
Movement of particles	Vibrate about fixed point	Slip and slide over each other	Move rapidly in random directions and frequently collide with each other and the containers
Can flow?	Cannot flow	Can flow	Can flow

Measurement

Not started

Criteria of purity

Not started

Methods of purification

Not started

Physical and chemical changes

Not started

Elements, compounds and mixtures

Not started

Atomic Structure and the Periodic Table

Not started

ions and ionic Bonds

Not started

Molecules and covalent bonds

Not started

Macromolecules

Not started

The mole

Not started

Electricity and chemistry

Not started

The Periodic Table

Not started

Periodic trends

Not started

Group properties

Not started

Transition elements

Not started

Noble gases

Not started

Physics

Motion

Completed

Distance and Volume

- Rulers
- Measuring cylinders

Time

- Analogue clocks
    - Needle cannot be read to high degrees of accuracy
- Digital clocks
    - Digital clocks have more accuracy as they can measure time up to milliseconds

Fair test

Measure multiple times and calculate the average

micrometre screw gauge

- Accurately measure distances

speed = distance/time (capitalization is intended)

speed - scalar

velocity - vector

For example, a person moving forward and backward from a point and returning to it will have a total velocity of zero, however, the speed is constantly changing from positive to negative.

acceleration = change of velocity/total time

Mass and Weight

Completed

Mass - amount of matter in an object

Weight - force of gravity acting on an object

Mass in kg
Weight in N
Gravitational field ? N/kg
g - gravitational force acting on objects
On earth g = 10 N/kg (unless stated in the question)

weight = mass x gravitational force
W = mg

On the moon g = 1.6 N/kg
5kg on earth is 50N, on the moon is 8N

Density

Completed

density = mass/volume
ρ = m/v
p = rho

Find volume
Use water (displacement)

Find Mass
Scale, tare the container

Density of liquid
Measure volume, and weigh it, remove container weight

Forces

In progress

F = ma
Force in N
Mass in kg
Acceleration in m/s^2

Hooke's law

Extension of any elastic object is directly proportional to the load applied on it
F = kx
Where k is the spring constant
And x is the extension
Limit of proportionality - when the spring no longer obey Hooke's law
Elastic limit - when the spring deforms and does not return to its original length when the force is removed.

Resistive forces:
- Friction
- Air/ water resistance
- Drag

Effect of force on an object:
- change shape, size, directions
- accelerate/ decelerate
- rotate

Resultant force:
When resultant force = 0N, the object is either stationary or moving at a constant speed

Turning force:
moment = force x mass
Clockwise movement (f *d) = anti clockwise movement (f *d)

Centre of mass - the point at which all the mass of an object assears to act
Plane lamina - flat 3D object/shape

Energy

Completed

work done = energy transferred
$GPE = mgh$
m = mass (kg)
g = gravitational field strength (N/kg)
h = height (m) or change of height (Δh)
KE = $\frac{1}{2} mv^2$
KE measured in J joules

Power

Completed

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

$power = \frac{energy}{time}$

power (watts, W) - Rate at which energy is used

P = power (W)

E = energy (J)

t = time (sec)

Energy Resources

Completed

Renewable	Non renewable
Solar	Coal
Wind	Natural gas
H.E.P	Crude oil
Tidal Power	Nuclear
Wave	
Biomass	
Geothermal	

= directly / indirectly energy from the sun

Energy Resource	**Advantages**	**Disadvantages**
wave	It does not produce CO2 when generating energy. It is a renewable type of energy. It have a high energy potent	You need to build new infrastructure to harvest the energy. The cost when setting up initially is high. It has a high maintenance cost, as the generators need to be placed in the sea. The energy generated can unreliable at times
coal	The infrastructure is already there, so there is no need to create new infractures. It is a very reliable source of energy, you can create more electricity just by adding in more fuel	The generators produce CO2 when operating, and can contribute to global warming. The fuel is a nonrenewable type of energy, and needs thousands of years to form
H.E.P	It's a type of renewable energy, so it doesn't produce pollution when generating power. Energy can be generated anytime, and you can always allow more water to flow. It can be stored in a water reservoir.	High cost involved in building the dam, settling cement can cause CO2 to be produced. You might need to relocate people behind the dam. The dam can damage wildlife already existing in the area, and also might affect fish migration.
Biomass	Lower cost compared to fossil fuels, renewable energy source, carbon neutral (the amount of CO2 released are absorbed by the plant when grown)	It has a low energy density compared to fossil fuels, and also produces CO2.

wind	No CO2 produced when generating energy, high scalability, renewable source of energy	Unreliable as sometimes there might not be wind blowing, causing no energy to be generated
geothermal	It is a reliable source of energy, and it is very easy to predict energy output. It does not produce CO2 when operating, and no fuel is needed	High maintenance cost, high cost when setting up, building the power plant might contribute to global warming by releasing the gases underground into the atmosphere
oil	Infrastructure are already there, no need to create new infractures	Creates CO2 by burning fuel, contributing to global warming, non renewable
tidal	Uses the energy from the moon, does not create CO2 when generating energy, reliable energy cycle	may disrupt wildlife, additional building needed to allow normal wildlife activities and shipping to commerce. Settling cement may release CO2
nuclear	Super high energy density, can generate a lot of energy with a small amount of fuel, does not produce CO2	If accidents happen, it can be fatal, releasing toxic radioactive material into the surrounding area. The infrastructure is expensive to develop and build, especially the generator.
natural gas	The infrastructure is already there, and it has decent energy density. It is a reliable energy source	Creates CO2 by burning fuel, contributes to global warming, non renewable
solar	Uses the light from the sun, no carbon dioxide produced when generating energy, high scalability	Unreliable at times, and solar panels are expensive to buy and set up.

Tidal energy is from the moon not the sun (at least for igcse)
Solar energy : nuclear fusion from the sun

$$efficiency = \frac{useful\ energy\ output}{energy\ input} \times 100\%$$

Nothing can be 100% efficient, as there will be always power loss due to friction

Simple kinetic molecular model of matter

Completed

Solid - Has a fixed shape, fixed volume, cannot be compressed, vibrate around a fix point
Liquid - No fixed shape, has a fixed volume, cannot be compressed , free to move and flow over each other
Gas - No fixed shape, no fixed volume, can be compressed, particles have completely overcome the forces of attraction and are free to move randomly

Melting - solid to liquid
Boiling/evaporation - liquid to gas
Condensing - gas to liquid
freezing/solidifying - liquid to solid
Sublimation - solid to gas/ gas to solid

Brownian Motion - The random movement of large pollen grain in a suspension of water

Latent heat - heat supplied is not used to change the temperature, instead the energy is used to change the state of matter

In solids, energy gained are used to increase the particle's KE, however, at its melting point, energy are then used to overcome the forces of attraction to turn the solid into a liquid

Thermal Expansion

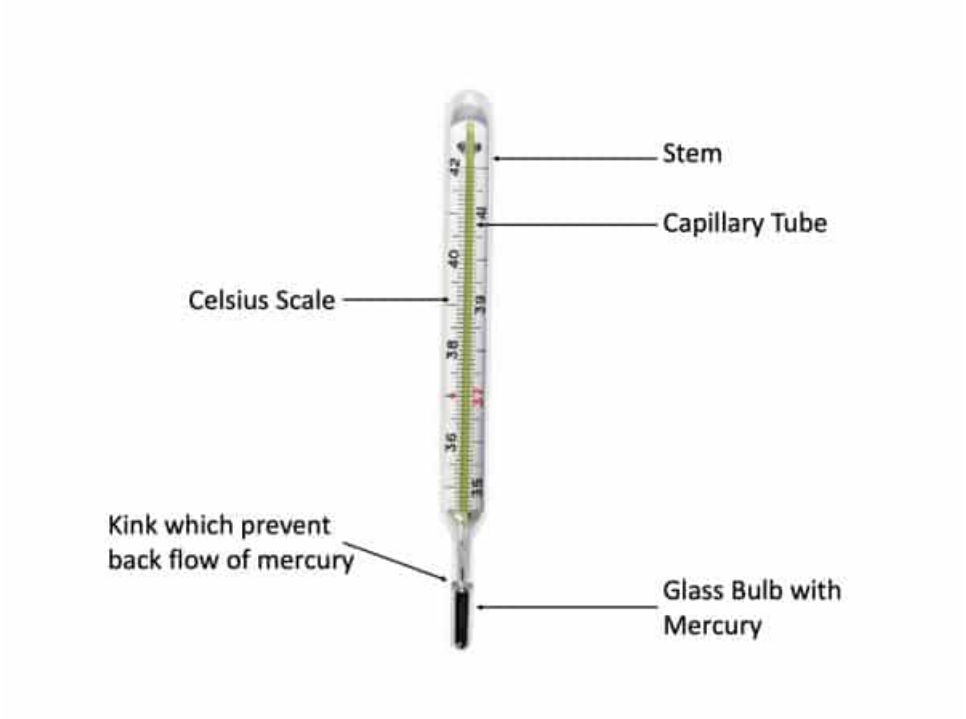
When a solid object is heated, the particle gains KE and vibrate faster and more farther apart. This causes expansion in the solid

The more energy the particles have, the further apart the can move

Most expanding
Gases
Liquids
Solids
Least expanding

Problems of thermal expansion	Useful thermal expansion
Buildings	Fixing the axis into a wheel
Highway	Hot air balloon
Ice	Thermometer
Electricity cable, cables might become too tight and break	Air in a car tyre increases its pressure

Measuring temperature



Liquid can be Mercury or Alcohol
Alcohol have lower freezing point than mercury

Thermal Processes

Not started

The nuclear atom

Not started

Radioactivity

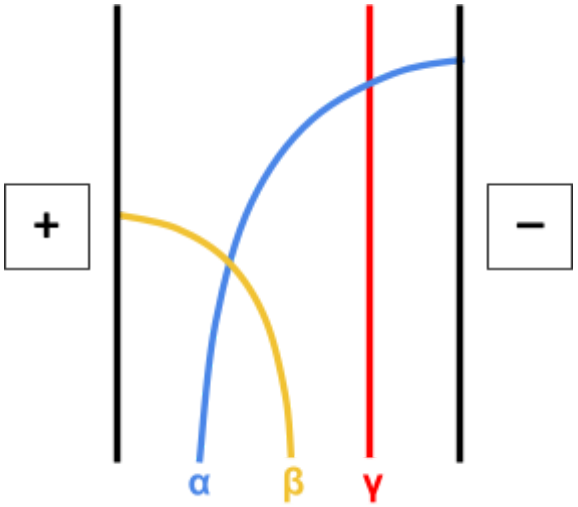
In progress

Nuclear radiation - The nuclei of some isotopes of some elements are unstable. They can become more stable by releasing energy in the form of α or β particles or γ ray.

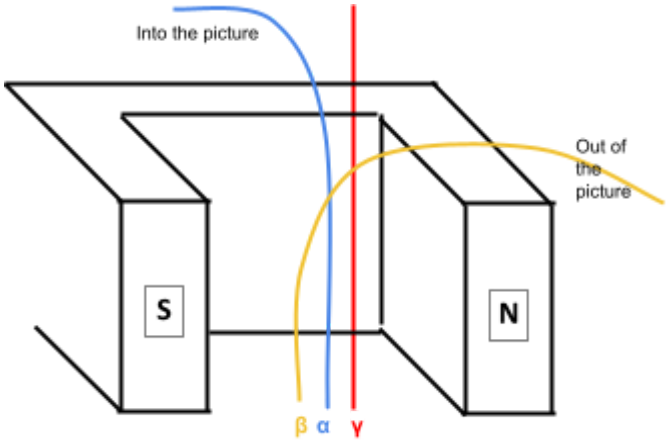
Types of nuclear radiation:

Type	Nature	Penetration	Ionisation	Speed	Detectors
Alpha (α)	Helium nucleus (2p 2n) 2+ charge	Stopped by - 10cm of air - skin - paper	Most ionising	10% speed of light	- thin screen GM tube - photo paper - cloud chamber
Beta (β)	Electron (e-)	Stopped by - 3mm of aluminium	Ionising	50% - 90% speed of light	- GM tube - photo paper - cloud chamber
Gamma (γ)	Electro-magnetic wave (no charge)	Slowed/reduced by - a few cm of lead - a few m of concrete	Least ionising	3×10^{8} m/s (speed of light) (c)	- GM tube - photo paper - cloud chamber

Behaviour in an electric field:



Behaviour in a magnetic field:



- Gamma unaffected
- Alpha deflected
- Beta deflected more in the opposite direction

Background radiation - radiation that is found in the environment

- Sources: cosmic rays, rocks and soil, food and drink, medical weapons testing, radon in the air.

Half life - The time taken for half of the radioactive nuclei to decay or time taken for count rate to drop by a half

Radioactive decay - when a nucleus emits an α or β particles it will decay into another element. [unit to measure decay = becquerel (Bq)]

Radioactive decay equations:

Alpha decay:

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

$$^{228}_{90}Th \rightarrow {}^{224}_{88}Rn + {}^{4}_{2}He^{2+}$$

Beta decay:

- 1 neutron changes into 1 proton and 1 electron
- Electron goes away in the form of beta radiation
- Protons stay in the nucleus

$$^{218}_{84}Po \rightarrow {}^{218}_{85}At + {}^{0}_{-1}\beta$$

$$^{40}_{19}K \rightarrow {}^{40}_{20}At + {}^{0}_{-1}e^{-}$$

Gamma decay:

- If a nucleus emits an alpha or beta particle has any excess energy it will emit this energy as a gamma ray

Ionising radiation - radiation with enough energy to remove electrons from atoms
Dangerous as it can damage DNA and cause cancer

Frequency	Uses (Think examples yourself)
Radio	Long range communication
Microwave	Long range communication, heating up water molecules
Infra-red	Short range communication
Visible light	Seeing LED screens (basically everything we can see), photography, television, signalling using visible light communication
Ultra-violet	Killing bacteria, sun tanning
X-ray	Metal detectors, medical uses
Gamma ray	Medical trasor, high penetrating low ionising radiation