pg 145 - 148

CP1 Revision Mat:

Vectors and Scalars:

Define scalar:

Has magnitude (size) but no specific direction

Give 2 examples of scalar quantities:

Speed, distance, mass, energy, temperature, time

Define vector:

Has both magnitude and a specific direction

Give 2 examples of vector quantities

Force, velocity, displacement, weight, acceleration, momentum

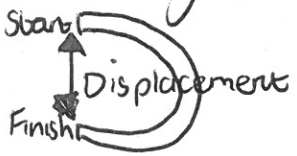
Give a pair of quantities where one is a vector and the other a scalar

Velocity is vector but speed is scalar

What is meant by the term 'displacement'

The distance and direction in a straight line from an objects starting point to its finishing point.

Draw a diagram to show an example of displacement.



Distance-Time Graphs

What is the equation that links time, speed and distance?

$$\text{Speed} = \frac{\text{Distance}}{\text{time}}$$

What are the units of speed? m/s

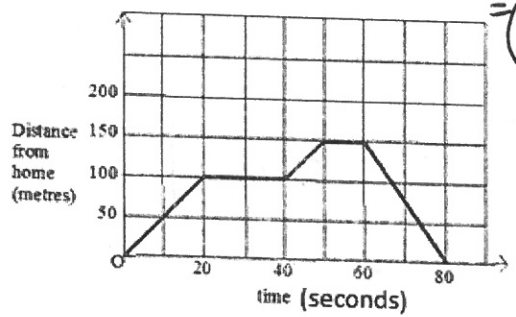
	Estimate of speed
Walking	1.4m/s
Cycling	5.5m/s

An object travels 10m in 2 seconds. Calculate the speed.

$$\text{Speed} = \frac{10}{2} = 5\text{m/s}$$

How far would ThrustSSC travel in 5 seconds if the speed was 341m/s?

$$\text{Distance} = S \times t = 341 \times 5 = 1705\text{m}$$



What does a horizontal line represent on a distance time graph?

Stationary (stopped)

Calculate the speed in the first 20 seconds.

$$S = D/t = 100/20 = 5\text{m/s}$$

Acceleration:

What is the equation that links the change in velocity, acceleration and time?

$$a = \frac{(v) - (u)}{t}$$ (final, initial)

What are the units of acceleration? m/s^2

An object accelerates from 10m/s to 20m/s in 5 seconds. Calculate the acceleration.

$$a = \frac{20 - 10}{5} = \frac{10}{5} = 2\text{m/s}^2$$

A car slows down from 30m/s to 10m/s in 4 seconds. Calculate the acceleration.

$$a = \frac{10 - 30}{4} = \frac{-20}{4} = -5\text{m/s}^2$$

Acceleration can be linked to initial velocity, final velocity and distance:

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

Rearrange the equation to calculate distance (x)

$$\frac{v^2 - u^2}{2a}$$

What is the acceleration due to gravity?

roughly equal to 10m/s^2 (in free fall)

Velocity-Time Graphs

What does a sloping line represent on a velocity-time graph?

acceleration (constant - straight line, curved - increasing acceleration)

What does a horizontal line represent on a velocity-time graph?

Constant speed (steady speed)

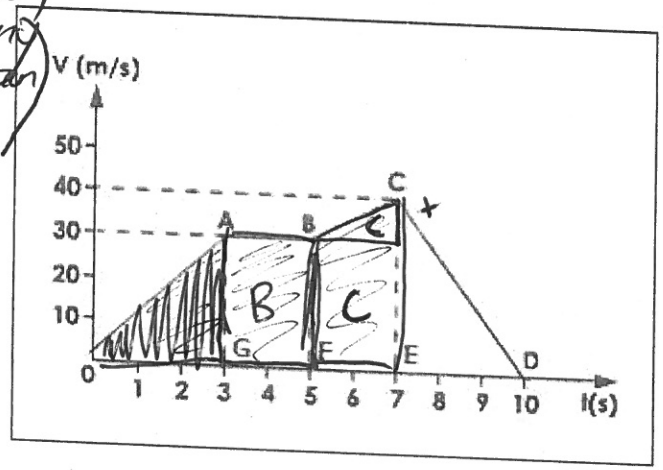
How do you calculate the distance travelled on a sloped part of the graph?

Area under the graph - triangle

How do you calculate the distance travelled on a horizontal part of the graph?

Area under the graph - rectangle

Velocity-Time Graphs



Calculate the distance travelled:

Part A $\frac{b \times h}{2} = \frac{3 \times 30}{2} = 45m$

Part B $b \times h = 2 \times 30 = 60m$

Part C $\frac{b \times h}{2} = \frac{2 \times 10}{2} = 10m$

$b \times h = 2 \times 30 = 60m$

Total = 175m

CP2 Revision Mat pg 149-155

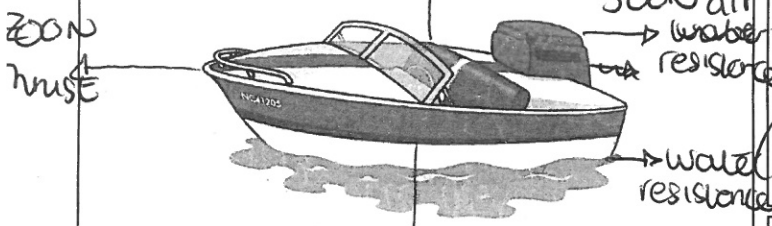
Resultant Forces

Calculating resultant forces:

- If the forces are in the same direction you need to add them together
- If the forces are in opposite directions you need to subtract them from one another

Add arrows to the diagram to show the following forces

- 1000N of upthrust
- 1000N of weight
- 700N thrust
- 300N water resistance
- 100N air resistance



Calculate the resultant force and state the direction.

(700N - 400N) = 300N Thrust

What forces on the boat are balanced?

upthrust & weight.

Newton's First Law

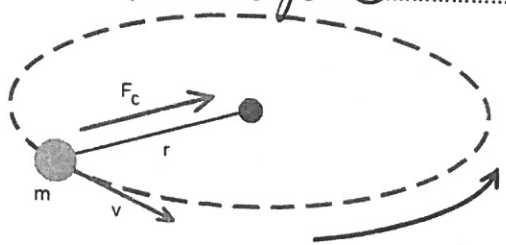
What are the two possible outcomes if an object has a resultant force of 0 N?

1) remain stationary
2) move at a constant speed

Higher:

What is the force labelled Fc in the diagram?

centripetal force



How can an object moving in a circle have different velocities but travel at the same speed?

If an object is travelling in a circle at a constant speed it is constantly changing direction, so it is constantly changing velocity. This means it is accelerating.

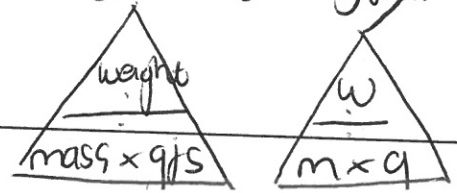
Mass and Weight

What equation links weight, mass and gravitational field strength?

Don't forget the units

weight (N) = mass (kg) × g/s (N/kg)

Draw a triangle to help you change the subject.



Mass and Weight cont.

Calculate the weight of an object on Earth (10N/kg) if the mass is 1000g

W = m × g = 1kg × 10 = 10N

Forces on falling bodies:

1) Label the forces in each diagram
2) Explain what happens in each diagram

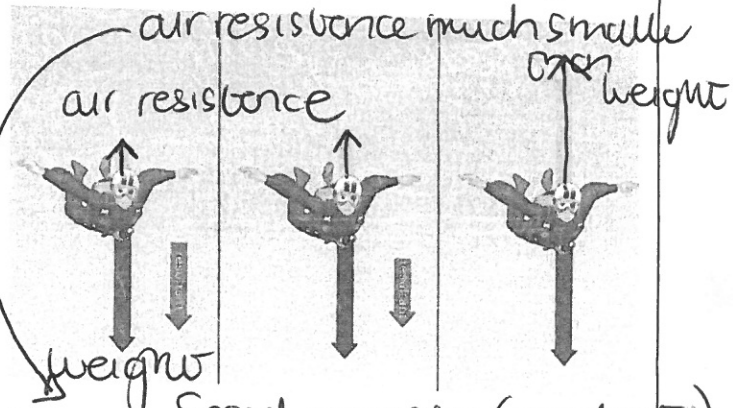


Diagram 1: Speed increases (accelerates) due to gravity (large resultant force downwards) air resistance increases with speed

Diagram 2: air resistance is larger but he weight stays the same resultant force is smaller - still accelerating (gaining speed) She is moving so fast that air resistance balances her weight. Falls at constant speed (terminal velocity)

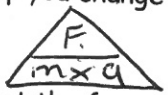
Ratio of force over acceleration inertial $m = \frac{F}{a}$

Newton's Second Law:

What equation links mass, acceleration and force.
Don't forget the units.

$F = m \times a$
(N) (kg) (m/s^2)

Draw a triangle to help you change the subject.



What can be said about the forces needed to accelerate a lorry and a car by $5m/s^2$?
The Force for the Lorry will be greater.

A car accelerates at $2m/s^2$. The resultant force is 3000N. Calculate the mass of the car.

$m = F/a = \frac{3000}{2} = 1500kg$

Define inertial mass.
A measure of how difficult it is to change the velocity of an object (including from rest)

Describe how you could measure the acceleration of a toy car ***(Practical Skills)***
Ramp - light gates - trolley with card - masses ↳ initial speed = first light gate
final speed = second light gate
Mass given
time = between 2 light gates

Newton's Third Law

$a = \frac{v-u}{t}$

What is the difference between action reaction forces and balanced forces?
action - reaction force - act on different objects
balanced forces - act on same objects.

Action reaction forces act in different directions and are the same size

Newton's Third Law

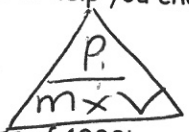
Higher:
Explain why in a collision between a footballer's head and the ball the action-reaction forces are the same size but the effects are different.
because the objects have different masses.

Momentum

What equation links mass, momentum and velocity?
Don't forget the units

momentum = mass x velocity
(kg m/s) (kg) (m/s)
$p = m \times v$

Draw a triangle to help you change the subject



A car has a mass of 1000kg and travels at 4m/s. Calculate the momentum.

$p = 1000 \times 4 = 4000kgm/s$

What equation links change in momentum, force and time?

$Force = \frac{change\ in\ momentum}{time}$

$F = \frac{(mv - mu)}{t}$

A 2000kg car accelerates from 10m/s to 25m/s in 10 seconds. What force is needed to produce this acceleration?

$F = \frac{(2000 \times 25) - (2000 \times 10)}{10}$

$\frac{50\,000 - 20,000}{10} = 30,000 - [3000N]$

Momentum and collisions

What is meant by the term conservation of momentum?
Momentum stays the same before and after a collision (as long as there are no external forces)

Stopping distances

Stopping distance = thinking distance + braking distance

Name factors that affect the thinking distance
- Speed
- Tiredness
- Alcohol
- Drugs (distractions)

Name factors that increase braking distance and explain why
- Speed
- mass (won't stop as quickly)
- Poor condition of brakes/tyres
- Friction between tyres + road

Crash Hazards

What safety features in cars reduce the large deceleration in crashes?
1) Air bags
2) Seat belts
3) Crumple zones

CP3 Revision Mat pg 156 - 162

Energy Stores and transfers

Complete the table summarising types of energy and examples

Energy	Example
Light	Bulb
Sound	Radio
Chemical	Food, batteries, fuel
Kinetic	anything moving
Thermal	Hot objects
Gravitational Potential	An object up high
Elastic potential	anything stretched
Nuclear	atomic nuclei in nuclear reactions

What does the law of conservation of energy state?

Energy cannot be created or destroyed it can be stored, transferred + dissipated (Total energy stays the same)

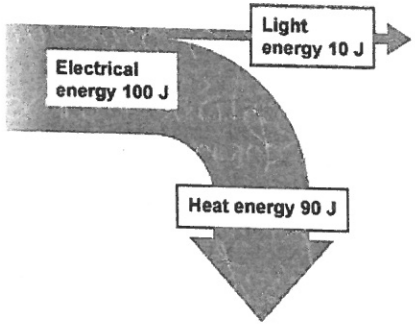
What are the energy transfers in a battery torch?

Chemical → Light
→ Heat

What are the energy transfers when a ball is thrown upwards into the air and then falls back down?

Kinetic energy store in ball → (mechanically work against gravity) → gravitational potential energy
→ (mechanically work done against air resistance) → thermal energy of ball + surroundings

Sankey Diagrams:



What is the equation for calculating the efficiency of an object?

efficiency = useful energy / total energy

Calculate the efficiency for the above Sankey diagram.

= 10 / 100 = 0.1

What is efficiency?

Is a way of describing how good a machine is at transforming energy into useful forms

What happens to wasted energy?

It is dissipated (spreads out) into the surroundings + is no longer useful.

How can you reduce the amount of wasted energy on an engine?

Lubrication → reduces friction
Thermal insulation → reduces rate of energy transfer by heating.

Metals = high thermal conductivity

Keeping Warm: air = low thermal conductivity

What does thermal conductivity mean?

It describes how well a material transfers energy by conduction

State a material that has poor thermal conductivity.

air

State a material that has high thermal conductivity.

metals

Describe how energy is transferred by heating for the following processes:

1) Conduction

Vibrations are passed on between particles in a solid

2) Convection

Part of a fluid that is warmer than the rest rises and sets up a convection current

3) Radiation

Vacuum (as well as other states of matter)
IR - absorbed + emitted

Explain ways in which walls can be built to keep a house warmer

Cavity wall - wall is thicker + contains air gap (air is a better insulator than brick)
→ Cavity wall insulation (foam) top

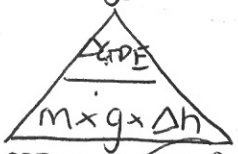
Stored energies:

What is the equation to calculate GPE?
Don't forget the units.

ΔGPE = mass × g/s × change in height

ΔGPE = m × g × Δh J/kg/N/kg/m

Draw a triangle to change the subject



Calculate the GPE when a 30kg object is lifted 2m high on Earth.

= 30 × 10 × 2 = 600J

A 4kg box stores 400J of GPE when it is lifted on Earth (10N/kg). Calculate how high it was lifted.

$\Delta h = \frac{\Delta GPE}{m \times g} = \frac{400J}{4 \times 10} = 10m$

What is the equation to calculate KE?
Don't forget the units

$KE = 1/2 \times m \times v^2$

Draw a triangle to change the subject

A 50kg girl is running at 2m/s. Calculate the KE.

$KE = 0.5 \times 50 \times 2^2$

$= 0.5 \times 50 \times 4$

= 100J

Renewable and Non-renewable resources

What is meant by the terms renewable and non-renewable?

Renewable - will no run out
Non-renewable - they will run out one day

Complete the table stating examples of renewable and non-renewable resources

Renewable Resources	How it works	Non-renewable resources
wind	generator inside it - wind rotates the blades which turn the generator	coal
Solar	use energy transferred by light to create electrical current	oil
Hydro-electricity	Flooding valley - big dam. water allowed through turbine	Gas
Tidal barrages	Big dams built across river estuaries with turbines	Nuclear
Biofuels	plant/animal dung - burnt to produce electricity	

What are the disadvantages of using fossil fuels?

CO_2 - greenhouse effect/global warming
Sulphur dioxide - acid rain

What are the disadvantages of using nuclear energy?

Nuclear waste - very dangerous + difficult to dispose of
Always a risk of major catastrophe

What are the disadvantages of wind and solar energy?

Spoil view/noisy/only work when windy/can't respond to high demand

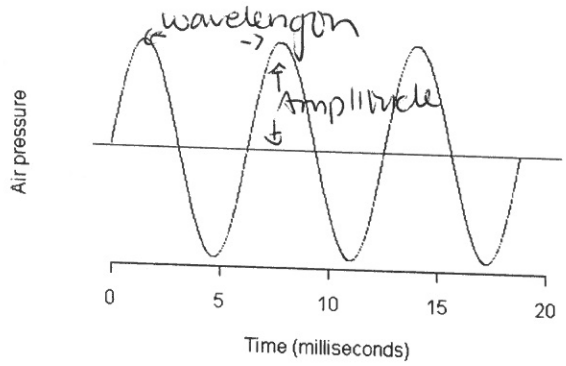
Bio-fuels are said to be carbon neutral. Explain what this means.

Don't increase levels of CO_2 in atmosphere. keep growing plants at the same rate as burning them

CP4 Revision Mat: pg 164 - 167

Waves:

Label amplitude and wavelength on the diagram



Define frequency and state the unit

Number of complete waves passing a point per second
Hertz (Hz)

Describe how longitudinal waves travel

The vibrations are parallel to the direction the wave travels

State an example of a longitudinal wave

Sand waves / seismic wave

Describe how transverse waves travel

The vibrations are perpendicular (90°) to the direction the wave travels

State examples of transverse waves

All EM waves
S-waves / Ripples + waves on water.

Calculating wave speeds

What are the two equations that can be used to calculate wave speeds:

1) $V = \frac{x}{t}$ (m/s) — x - distance (m), t - time (s)

2) $V = f \times \lambda$ (m/s) — f (Hz), λ (m)

Draw triangles to help you rearrange to get the subject

A wave travels 10m in 2 seconds. Calculate the speed.

$V = \frac{10}{2} =$ 5m/s

A wave has a speed of 330m/s and a wavelength of 16m. Calculate the frequency.

$f = \frac{v}{\lambda} = \frac{330}{16} =$

Describe how you could measure the speed of water waves between two buoys floating in the sea

Measure the time it takes for a wave to travel between 2 fixed points (2 buoys). The speed can then be calculated from the time and the distance between

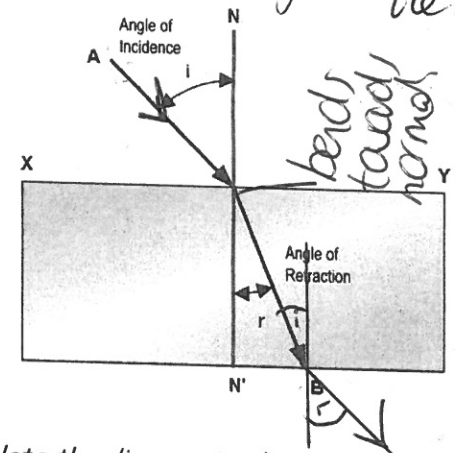
Refraction:

Define refraction

Waves changing direction at a boundary

What is the normal?

An imaginary line that's perpendicular to the point where the incoming wave hits the boundary



Complete the diagram to show what happens to light when it leaves the glass block

Describe what happens when a light travels from air to glass

The ray of light bends towards the normal as it enters the block (slows down) Angle of refraction less than angle of incidence

Describe what happens when a light travels from glass to air

Ray of light bends away from normal as it leaves the block (speeds up) Angle of refraction is greater than angle of

CP5 Revision Mat: pg 168 - 171

Some radio waves can be refracted. + all microwaves pass through the ionosphere

EM Waves:

What type of wave are all EM waves?
Transverse

What is the speed of all EM waves in a vacuum?
Same speed = 3×10^8 m/s

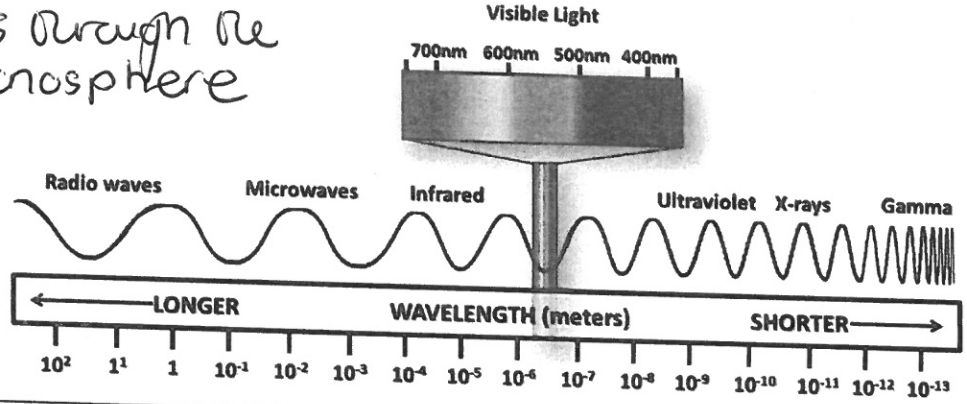
What can be used to split white light?
Prism

How was infrared discovered?
Herschel - prism to split light + put a thermometer in each of the colours in turn. He also measured the temperature just beyond the red end of the spectrum where there was no visible light

What happens to the frequency and energy as the wavelength becomes shorter on the EM spectrum?
↑ frequency = ↑ energy

How are radiowaves produced and detected? (Higher)
Made by oscillating ~~electrons~~ charges
Use an a.c. in an electrical circuit (transmitter)
Receive - radio waves are absorbed + cause electrons in receiver to oscillate - a.c. is produced in receiver.

Explain why some telescopes are placed outside the Earth's atmosphere
Stars + other space objects can emit energy at all wavelengths
Astronomers use telescopes to study this radiation. Some wavelengths don't pass through the atmosphere (they are absorbed)



EM Spectrum

Part of EM Spectrum	Uses	Dangers
Radio	- Communication + broadcasting - Satellites (high frequency R. waves) - Bluetooth (short wavelength)	Transmitted through body - without being absorbed
Microwave	- Satellites - Microwave ovens - absorbed by water molecules - heat up.	Absorbed by cells - heating
Infrared	- Increase / monitor temperature - Transfer information (remotes / optical fibres)	Mostly reflected or absorbed by the skin causing heating
Visible light	Photography - film / digital Illuminating things	IR - can cause burns if skin gets too hot.
Ultraviolet	- Fluorescent lamps - Security pens (ink will glow) - bank notes / passports / sterilise water.	Absorbed by skin - higher frequency so more dangerous (ionising) Skin cancer / damage eyes - blindness
X ray	→ see inside things x-rays - transmitted by flesh but absorbed by bone (white) → airport security	Ionising - mutations + damage cells - cancer
Gamma	Sterilise medical instruments (kill microbes) / Food kill cancer cells - radiotherapy medical imaging - tracers (detect cancer)	higher frequencies - more energy - more damage Pass through skin

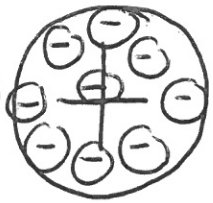
CP6 Radioactivity

pg 172 - 177

Atomic Models

Draw a labelled diagram of the Plum Pudding Model

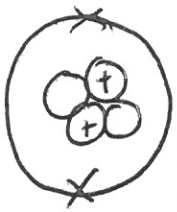
(solid)



atoms were spheres of positive charge with negative electrons

Draw a labelled diagram of Rutherford's model

Mostly empty space



Mass of mass concentrated at centre in tiny nucleus (+ve charge)

repelled positive alpha particles

Describe the experiment Rutherford carried out which allowed him to come up with his model.

Fired a beam of alpha (+) particles at thin gold foil. Most particles went straight through, some were deflected and some bounced back

What is the radius of a nucleus? 1×10^{-15} m

What is the radius of an atom? 1×10^{-10} m

How is Rutherford's model of the atom similar to today's model?

Inside Atoms

Draw a labelled diagram of the modern day structure of an atom

	Mass	Charge
Proton	1	+1
Neutron	1	0
Electron	0.0005 (1/1835)	-1

Complete the table

	C	N	Mg	Ca
Mass number	12	14	24	40
Atomic number	6	7	12	20
Protons	6	7	12	20
Neutrons	6	7	12	20
Electrons	6	7	12	20

Define an isotope

Atoms with the same N° of protons (atomic N°) but a different N° of neutrons (mass N°)

Electrons and Orbits

Define an ion

An atom that has lost or gained an electrons

Describe how a magnesium atom becomes a magnesium ion

Loses 2 electrons $Mg \rightarrow Mg^{2+}$

(group 2)

Electrons and Orbits (Bohr)

Describe what happens when an atom absorbs electromagnetic radiation

The electron can move up to a higher energy level - empty or partially filled - it is excited

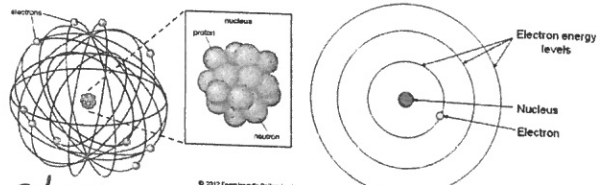
Describe what happens when an atom emits electromagnetic radiation

Quickly fall back to its original energy level - will emit the same amount of energy it absorbed

What is the difference between emission and absorption spectra

Absorption lines are where light has been absorbed by the atom (dark spectrum) whereas emission spectra have spikes due to atoms releasing those wavelengths

How is Niels Bohr model of the atom different to Rutherfords?



electrons can only be in certain fixed orbits (electron shells) around the nucleus. They cannot be any way between 2 orbits

Lithium has an atomic number of 3 and loses an electron to form an ion. How many protons and electrons are there?

$^{7}_{3}Li \rightarrow Li^{+}$

3 protons 4 neutrons

Background Radiation

What is meant by background radiation?
low-level radiation that's around us all the time

State 2 sources of **natural** background radiation;
Radon gas / cosmic rays / food / building materials / rocks

State 2 sources of background radiation that does not occur naturally
Nuclear explosions / nuclear waste

How can radiation be measured and describe how the equipment works.
- Geiger-Muller tube - clicks each time it detects radiation
- Becquerels (Bq) 1 Bq = 1 decay per second
- Photographic film (darkens)

Types of radiation

Describe the structure of an alpha particle
2 protons + 2 neutrons

What is the charge on an alpha particle? +2

Describe the structure of a beta particle
electrons or positrons (positive (-))

What is the charge on a beta particle? -1 or +1

Types of radiation

Describe the structure of a gamma ray
EM waves (short wavelength)

What does unstable mean?
Can easily change or decay

	Alpha	Beta	Gamma
Ionising	very	moderately	Weak
Penetrating	5cm (short distance)	medium distance (m)	km in air
Stopped by	paper	thin aluminium	thick lead

Explain why alpha particles are more ionising than beta particles
emitted at high speeds - due to this + their high mass they transfer a lot more energy + so are good at ionising

Radioactive decay

Complete the table

Particle	Symbol	
Alpha	α	$^{4}_{2}He$
Beta	ß-	$^{0}_{-1}e$
Positron	ß+	$^{0}_{+1}e$
Neutron		n

What happens to the atomic and mass number when a neutron is emitted?
mass N° ↓ by 1
atomic N° stays the same

Radioactive decay

Describe what happens during ß+ decay and the effect on the nucleus
Proton changes to a neutron + a positron
- Mass N° doesn't change
- Atomic N° decreases by 1

Describe what happens during ß- decay and the effect on the nucleus
Neutron changes into a proton + electron
- Mass N° doesn't change
- Atomic N° increases by 1

Complete the table summarising what happens to the mass and atomic number during radioactive decay

	Mass number	Atomic number
Alpha	decreases by 4	decreases by 2
ß+	No change	decreases by 1
ß-	No change	Increases by 1

Radium has a mass number of 226 and an atomic number of 88.

Write a nuclear equation when this nucleus emits an alpha particle

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

Write a nuclear equation if Iodine-131 undergoes ß- decay.

$$^{131}_{53}I \longrightarrow {}^{131}_{54}Xe + {}^{0}_{-1}\beta \text{ or } {}^{0}_{-1}e$$

Write a nuclear equation if Potassium-37 undergoes ß+ decay.

$$^{37}_{19}K \longrightarrow {}^{37}_{18}Ar + {}^{0}_{+1}\beta \text{ or } {}^{0}_{+1}e$$

Half-life

Define half life

The time taken for half the nuclei in a sample to decay

What is the unit of activity of a radioactive substance? Becquerels (Bq)

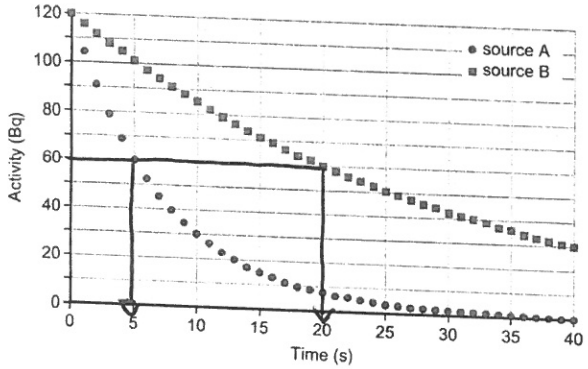
One Bq = 1 nuclear decay each second

Strontium has a half life of 29 years. How many half-lives is 58 years? 2

Calculate the half-life of both sources

Source A: 5 secs

Source B: 20 secs



Dangers of radioactivity

What happens to the intensity of radiation with increasing distance?

decreases with distance from source

Explain other precautions people should take when handling radioactive sources

→ handled with tongs

→ don't point source at person

→ store in lead-lined containers

Explain how medical staff working with radioactive sources minimise exposure

→ exposure limited - increasing distance from source / shielding the source + minimising the time they spend in presence of it. (Dosimeter badges)

Describe the difference between contamination and irradiation

- Exposure to radiation is irradiation - if you move away it stops
- Contamination is radioactive particles getting onto objects (or your skin or in your body)

Dangers of radioactivity

What are the dangers of exposure to ionising radiation?

Damage the DNA inside cells

Mutation - cell to malfunction + may cause cancer