AQA Physics: Additional content

SAMUEL WARD ACADEMY TRUST

Paper 1 Physics topics

- Energy and energy resources
  - Conservation and dissipation of energy
  - Energy transfer by heating*
  - Energy resources
- Particles at work
  - Electric circuits*
  - Electricity in the home
  - Molecules and matter*
  - Radioactivity*

Paper 2 Physics topics

- Forces in action
  - Forces in balance*
  - Motion
  - Forces and motion*
  - Forces and pressure (Physics topic only)*
- Waves and electromagnetism
  - Wave properties*
  - Electromagnetic waves
  - Light (Physics topic only)*
  - Electromagnetism*
  - Space (Physics topic only)*

*** Topics with extra content compared to Trilogy.**

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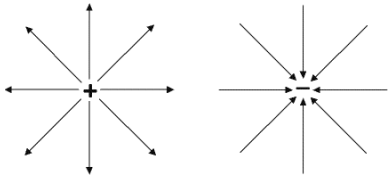
Key points to learn

Topic P2: Energy transfer by heating

1. Infrared radiation	A type of electromagnetic wave that transfers heat energy
	All objects absorb and emit infrared radiation
	The hotter the object the more infrared radiation in emits
2. Perfect black body	An object that absorbs all radiation that hits it (is incident on it). It is the best possible absorber
	Does not reflect or transmit any radiation
3. Relationship between absorption and emission	• Good absorbers are good emitters and vice versa • Poor absorbers are poor emitters and vice versa
4. Constant temperature	Is achieved when an object absorbs radiation at the same rate at which it emits it
5. Temperature of Earth	Depends on many factors including: • Rates of absorption and emission of infrared radiation • Reflection of infrared radiation into space
6. Increasing temperature	An object is absorbing radiation faster than it is emitting it

Key points to learn

Topic P4: Electric Circuits

7. Static charge	Some insulators become charged when rubbed together
	Electrons are scrapped off one material on to another
	Materials gaining electrons become negatively charged
	Materials losing electrons become positively charged
8. Electrostatic force	Opposite charges attract, like charges repel
	Electrostatic force is non-contact
9. Electrostatic spark	Electrons jumping from a negatively charged object to a positive one
10. Electric fields	An area in which electrically charged objects experience a force
	Is stronger when close to the charged object
	Fields around charged spheres  Positive Sphere Negative Sphere

Physics Additional Content Knowledge Organiser

Big picture (Physics Paper 1)

- Energy and energy resources
  - Conservation and dissipation of energy
  - **Energy transfer by heating***
  - Energy resources
- Particles at work
  - **Electric circuits***
  - Electricity in the home
  - Molecules and matter*
  - Radioactivity*

*** Topics with extra content compared to Trilogy.**

Background

How can we feel the heat of the Sun from so far away? What is the Physics behind trying to stay cool? How is lightening similar to a static shock and what causes it? This new content explores.

Additional information

When it comes to non-contact, electric and magnetic (electro-magnetic) and gravitational forces are the only ones. The electromagnetic spectrum of waves of which infrared (IR) is part uses these same invisibly force fields to travel through.

Key points to learn

Topic P6: Molecules and matter

1. Gas pressure	Caused by particles hitting surfaces producing net fore at right angles to surface
	If increased causes gases to compress or expand
2. Fixed mass of gas at constant pressure	Pressure x volume = constant p V = constant p is pressure [Pascals, Pa] V is Volume [metres cubed, m^3] *(You are given this equation)*
3. Increasing pressure of a gas	Doing work (providing energy using a force) on a gas: 1. increases the internal energy of the gas and 2. can increase its temperature if energy does not dissipate to surroundings quickly
	Eg a bike pump causes air to gain internal energy and get hot
	These factors will increase gas pressure if everything else is kept constant: 1. Increased number of particles 2. Increased temperature 3. Reduced volume

Topic P7: Radioactivity

4. Radiation dose	How much radioactive activity a person is exposed to
	Measured in Sieverts (Sv) (*you do not need to remember this)*

Key points to learn

5. Background radiation	Around us all the time. Comes from: • Natural sources such as rocks and cosmic rays from space • Man-made sources such as nuclear weapons and nuclear accidents
	Level of radiation dose depends upon occupation and location
6. Using half-lives	All radioactive isotopes have different half-lives. The length of half-life determines their use
	Smoke alarms - long half-lives
	Medical tracers – short half-lives
7. Nuclear radiation in medicine	Used for: • Exploring internal organs • Controlling unwanted tissue
	Used when the likely benefits outweigh the risks of use
8. Nuclear fission	Splitting of large unstable nuclei (usually Uranium or Plutonium)
	1. Unstable nuclei absorbs neutron 2. Nuclei splits into 2 bits and releases a 2 or 3 neutrons and gamma rays 3. These new neutrons may start a chain reaction
	Chain reactions are controlled in power stations but uncontrolled in nuclear bombs
9. Nuclear Fusion (Happens in stars)	The joining of two light nuclei to form a new heaver nucleus
	Mass is converted into energy

Physics Additional Content

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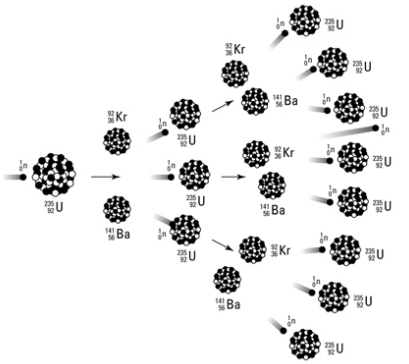
*** Topics with extra content compared to Trilogy.**

Background

Why do bike pumps get hot when you blow a tyre up? Are we exposed to much nuclear radioactivity and how do we use the power of the nucleus? This additional content explores all.

Additional information

Diagram of a chain reaction. Each fission event releases more neutrons which trigger more fission events



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Key points to learn

Topic P8: Forces in Balance

1. Moment of a force

The turning effect of a force measured in Newton metres (Nm)

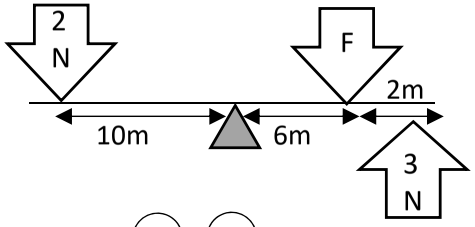
Moment of a Force = Force x Distance from pivot

$M = F \times d$

[Nm] [N] [m]

2. Balanced objects

Total clockwise moments = Total anticlockwise moments



M = M

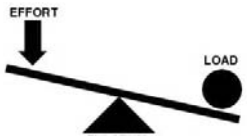
$(F \times 6) = (2 \times 10) + (3 \times 8)$

$6F = 44$

$F = 7.3N$ (2sf)

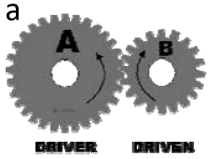
3. Levers

Apply a force at a distance from a pivot to move a load



4. Gears

Apply a moment at a distance (radius) from the centre of a gear



The bigger the radius the bigger the force experienced. In the example above, the driven gear will provide a lower force but at a higher speed that than the driver

Key points to learn

Topic P10: Forces and motion

5. Momentum, p

momentum = mass x velocity

$p = m \times v$

[kg m/s] [kg] [m/s]

6. Conservation of momentum

In a closed system the total momentum before an event is equal to the total momentum after the event

7. Momentum in explosions and collisions

Lay the question out like this

First work out how many objects there are before and after

Before	After	
Object A+B	A	B
m = 3kg	m = 1kg	m=2kg
v = 0m/s	v = -3m/s	v = **?**
p = 3 x 0 = 0 kg m/s	p =-3kgm/s	p = 2**v**

Total Momentum = Total Momentum

Before After

$0 = -3 + 2v$

$3 = 2v$

v = 1.5m/s

8. Forces during change in momentum

Force = rate of change of momentum

$$F = \frac{m\Delta v}{\Delta t}$$

You are given this equation

F = Force [N]

$m\Delta v$ = change in momentum [kgm/s]

Δt = time taken [s]

9. Crash safety devices

Reduce impact forces by:

1. Increasing time for collisions
2. Reduce rate of change of momentum
3. Reduce acceleration

Physics Additional Content Knowledge Organiser

Big picture (Physics Paper 2)

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*** Topics with extra content compared to Trilogy.**

Background

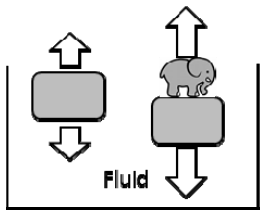
Balancing is all a question of moments. One of the fundamental ideas behind any thing that does not move.

The one thing airbags, seat belts, crash mats, cycle helmets, crumple zones and bending your knees all have in common is that they increase the time taken for collisions to happen. Why is this so important?

Maths skills

You will need to form equations here with both clockwise and anticlockwise moments and before and after collisions. The maths is not tricky but there are multiple steps so.. .Take care, don't rush and show all your working

Key points to learn

1. Fluid	Liquid or a gas
2. Pressure in fluids	Cause forces at a right angle to any solid surface they touch
	Pressure = Force on surface [N] / Area of surface [m²] [Pa] $p = \frac{F}{A}$
3. Pressure in column of liquid *(You are given this equation)*	Pressure = height of the columns x density of the liquid x gravitational field strength $p = h \rho g$ [Pa] [m] [kg/m³] [N/kg]
4. Pressure increases with depth	Pressure increase with depth due to the increasing weight of fluid above. Weight depends on density of the fluid
5. Upthrust	A resultant force on an object submerged in a fluid due to greater fluid pressure on its bottom than at top of the fluid
	Is equal to the weight of fluid displaced by an object
6. Upthrust and fluid displacement	 Weight: Low High Displacement: Low High Upthrust: Low High Floats or not: Floats Floats

Key points to learn

7. Sinking	Objects that have a weight greater than the upthrust on them
	Any object where density is greater than that of the fluid
8. Floating	Objects float when their weight is equal to the upthrust
	Any object with a lower density than the fluid
9. Factors affecting floating and sinking	Any factor that affects density of the fluid or object eg temperature, salt content, cargo load
10. Atmosphere	Thin layer of air around the Earth Gets less dense with altitude
11. Atmospheric pressure	Air particles collide with a surface Decreases with height as less air particles above result in less weight of air above

Physics Additional Content

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*** Topics with extra content compared to Trilogy.**

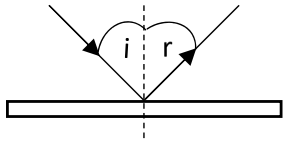
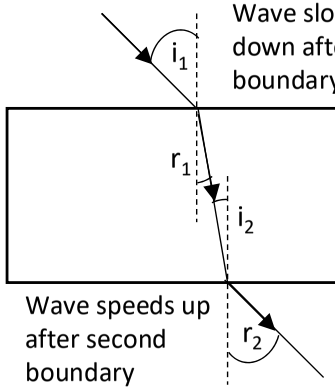
Background

We often forget about the pressure exerted by the air particles around us but they play a huge part in our lives. The pressure is intrinsically linked to weather patterns we experience and it helps us to extract oxygen from the air we breath. This topic explores everyday experiences of fluid pressure around us.

Maths skills

Take care with the symbols for pressure which is a lower case P (p) and density which is the lower case Greek symbol rho (ρ). They look very similar and its tricky having them both in the same equation

Key points to learn

1. Normal line	Drawn at right angle to surface at point where ray hits
2. Reflection	Angle of incidence = angle of reflection
	
3. Waves at material boundaries	Can be either 1. Reflected 2. Absorbed 3. Transmitted
4. Refraction	Waves change direction at a boundary if they change speed and are not on normal line
	
5. Sound waves	Are longitudinal waves Use particle vibrations to travel Can travel through solids
6. Human audible range	Humans can hear frequencies from 20Hz to 20000 Hz (20kHz)

Key points to learn

7. Human hearing	Sound waves cause vibrations in the ear drum and other parts of the ear
	Conversion of sound waves into vibrations is limited in frequency so human hearing is limited
8. Ultrasound	Sound waves above 20kHz
	Used for medical and industrial imaging
9. Ultrasound scanners and echo location	1. (Ultra)sound waves are transmitted into region 2. They are partially reflected at boundaries between materials 3. Reflection (echo) is collected by receiver near transmitter 4. Time taken for echo to return is used with wave speed to calculate total distance it has travelled 5. Total distance is halved to give distance from receiver to boundary
10. Seismic waves	Produced by earthquakes 1. P-waves. Longitudinal. Travel through liquids and solids 2. S-waves. Transverse. Travel through solids only
11. Using seismic waves	The shadow from S-waves provides evidence of Earth's liquid outer core

Physics Additional Content

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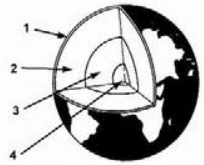
*** Topics with extra content compared to Trilogy.**

Background

Humans continue to use waves to explore the unseen World. From unborn babies to the deepest structure of our planet.

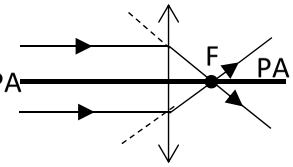
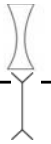
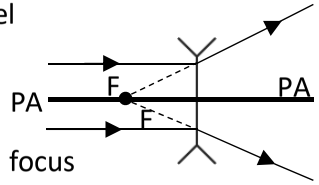


Maths skills

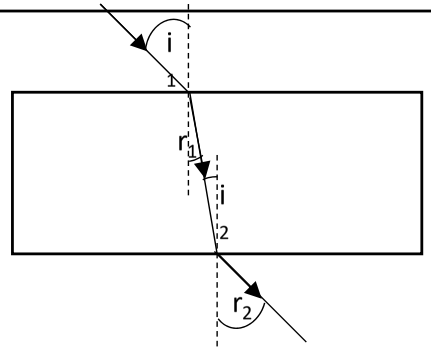
You will need to practice using your protractor for this topic. Make sure you can draw the normal and always find angles between it and rays.

Don't forget the arrow on the ray line. It will gain you a mark in the exam

Key points to learn

1. Lens	Forms images by refracting light Two types: • Convex lens • Concave lens
2. Convex lens	Thickest in middle 
	Drawn as 
	Bend parallel rays of light towards the principal focus  F = Principal focus PA = Principal axis - - - are virtual rays
	Sometimes called converging (convex) lenses
	Produce either real or virtual images
3. Concave lens	Thinnest in middle 
	Drawn as
	Bend parallel rays of light apart  F = Principal focus PA = Principal axis - - - are virtual rays
	Only produce virtual images
4 Real images	Can be projected. Made of real rays
5. Virtual images	Cannot be projected. Made of at least on virtual ray

Key points to learn

6. Magnification *(You are given this equation)*	Magnification = Image height / Object height
	A ratio so has no units
7. Colours	Each colour in visible spectrum has its own wavelength and frequency
8. Specular reflection	Reflection off a smooth surface in single direction eg mirror
9. Diffuse reflection	Reflection from rough surface causing scattering eg paper
10. Opaque objects	Reflect only the wavelengths of the colour they appear Absorb all other wavelengths
Black objects	Absorb all wavelengths
White objects	Reflect all wavelengths
13 Transparent	Transmit light through no scattering
14 Translucent	Transmit light through but scatter
15. Colour filters	Absorb certain wavelengths. Only transmit the wavelength of light they look eg red filters transmit red
16. Refraction	Waves change direction at a boundary if they change speed and are not on normal line
	

Physics Additional Content

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*** Topics with extra content compared to Trilogy.**

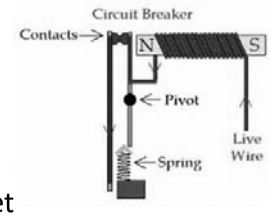
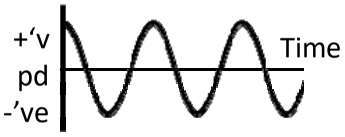
Background

Visible light is the section of the Electromagnetic Spectrum that we interpret as light. It play as huge part of life on Earth. But how do we manipulate it?

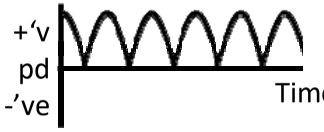
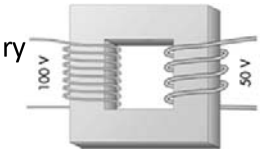
4 steps to drawing rays on a lens diagram

1. Ray 1: Real ray from top of object to lens, parallel to principal axis.
2. Put ruler on principal focus and end of Ray 1. Draw long line with real part opposite side of lens to object and virtual on same side
3. Ray 2: Draw long real ray from top of object through centre of lens.
4. Top of image is formed where Ray 1and 2 meet. Bottom of image is on Principal axis

Key points to learn

1. Electromag-net circuit breaker	• Wire is wrapped around an iron core to make an electromagnet • If current is too high electromagnet pulls on contact and breaks the circuit 
2. Electrom-agnetic relay	Similar to circuit breaker but uses electromagnet as a switch
3. Induced potential (the generator effect)	• Conductor cuts magnetic field lines • This induces a potential difference • This induces a current in the conductor
	The current induced generates its own magnetic field that opposes the original movement
	To increase the induced potential difference: 1. Increase speed of cutting 2. Increase strength of magnetic field 3. Increase coils of conductor
4. Alternator	A generator that generates alternating current
	
	0 pd when coils are at right angle to magnetic field lines
	Maximum pd when coils are parallel to magnetic field lines

Key points to learn

5. Dynamo	Same as alternator except uses split ring commutator to generate direct current
	
6. Microphone	Uses generator effect by sound wave vibrations moving coil/magnet, to cut magnetic field lines, to induce pd and current in a circuit
7. Transformer	Primary coil  Secondary coil Step up: Increase pd. $N_p<N_s$ Step down: Decrease pd. $N_p>N_s$
	1. Alternative current in primary coil 2. Induces alternating magnetic field in iron core 3. Induces alternating pd in secondary coil 4. Induces alternating current in secondary coil
	Iron is used as is easily magnetised
	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$ *(You are given this equation)* V is potential difference at coil N is number of turns in coil
8. 100% efficient transformer	Power in = Power out (no heat loss) $V_p \times I_p = V_s \times I_s$ I = current in coil Power measured in W *(You are given this equation)*

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  - **P13: Electromagnetism***
  - Space (Physics only)*

*** Topics with extra content compared to Trilogy.**

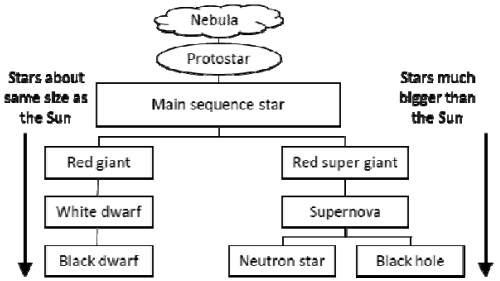
Background

This topic can cause confusion but stick with it. The principles are all the same. It's all about conductors cutting through magnetic field lines. It's the method most of our electricity is generated using so has huge relevance to our lives.

Maths skills

Lots of rearranging formulae and reading graph skills here. Make sure you notice that the Dynamo pd graph never gives a –'ve pd and that is why it can be described as direct current even though the pd changes all the time.

Key points to learn

1. Solar system	Made up the Sun, around which orbit eight planets and other dwarf planets. There are also moons that orbit planets
2. Milky way	Galaxy containing our solar system
3. Sun	A main sequence star
4. Life cycle of a star	
5. Nebula	Cloud of dust and gas. All stars start their life as a nebula
6. Protostar	Very young star that is still gaining mass through gravitational attraction
7. Main sequence	A stable star which mainly fusing Hydrogen into Helium
8. Red giant and supergiant	When a star runs out of Hydrogen it begins fusing larger elements such as Helium
9. White and black dwarf	After all the material that a star can fuse is used the core of a star cools
10. Supernova	A massive stellar explosion All elements heavier than iron are made and distributed through the Universe via supernova
11. Neutron star and black hole	The final remains of the cores of very large stars. Black holes are so dense not even light can escape its gravity

Key points to learn

12. Orbits	Paths which planets and satellites follow due to gravity Direction of satellite is always changing so velocity is changing If speed of satellite changes then the radius of orbit must also change
13. Satellites	Two types: 1. Artificial: weather, military, communications, telescopes 2. Natural: the Moon around Earth, the Earth around the Sun
14. Red shift	Wavelength of light from distant galaxies is stretched due to them moving away from us Provided evidence for the Big Bang theory
15. Big Bang Theory	That the Universe began from a very small region that was hot and dense
16. CMBR	Cosmic Microwave Background Radiation can be explained by the Big Bang Theory
17. Evidence for an expanding Universe	Since 1998 we found that very distant galaxies had greater red-shift suggesting that they are moving away even faster
18. Why is the Universe expanding faster?	We cannot explain why the Universe may be accelerating outwards. Dark matter and dark energy suggestions of things yet to be discovered that might help us understand
19. Dark mass	Matter we cannot see but still exerts gravitational attraction on objects in our Universe

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Background

Space. The final frontier. This are the voyages of our intrepid young Physicists as they boldly go where no young Physicist has been before!
This topic explores the life and death of stars over millions of years as well as considering what we know of our Universe. It's big, mind bogglingly big!

Other information

Look back over your notes for Fusion for this topic. It is the nuclear reaction that keeps the stars burning and creates the huge range of elements we see in the Universe.