This is your starting point . . .

. . . the end is up to you!

'I will take responsibility for my learning, be intellectually curious and work independently at school and at home.'

The Regis School
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Year 10

SCIENCE: PHYSICS

EXAM BOARD: AQA **COURSE CODE: 8463**

TOPIC NUMBER	TOPIC
1	ENERGY
2	ELECTRICITY
3	PARTICLE MODEL
4	ATOMIC STRUCTURE
5	WAVES
6a	FORCES
6b	FORCES IN MOTION
7	MAGNETISM AND ELECTROMAGNETISM
8	SPACE PHYSICS (TRIPLE ONLY)

These parts of the Physics SP will be covered in Year 11

- The contents of the SP is taken directly from the exam specification.
- Learning and quizzing yourself on this information will increase your grades in science.
- Staff will set you sections to learn for homework and test you in lessons.
- The best ways to learn the information are to use 'look, cover, write, check' or to make flashcards.
- Please look after this document a replacement will incur a charge.
- Combined science students please do not learn the boxes marked 'triple only'.

Name: .... Tutor Group: ....

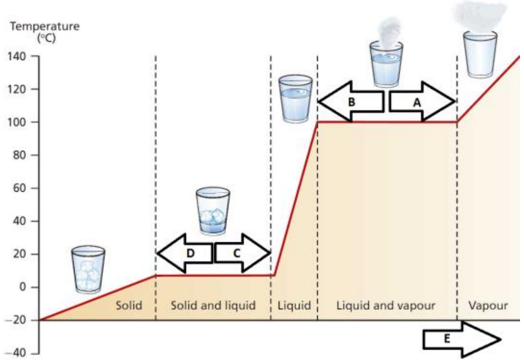
Physics Topic 1: Particle model

1. Density

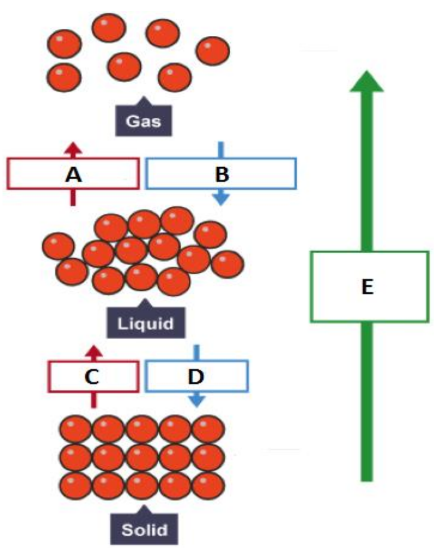
$$\rho = \frac{m}{V}$$

Symbol	Meaning	Unit
ρ	density	kg/m^3
m	mass	kg
V	volume	m^3

2. Changes of state



A. Evaporation/ Vaporisation
B. Condensation
C. Melting/ Fusion
D. Freezing
E. Increasing internal energy



3. The specific heat capacity

Energy transferred, ΔE (joules, J) **= mass, m** (kilograms, kg) **x Specific heat capacity, c** (joule per kilogram per degree Celsius, J/kg°C) **x Temperature change, Δθ** (degree Celsius, °C)

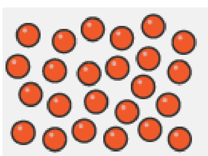
To find the specific heat capacity of a substance the equation can be rearranged to: $c = \frac{\Delta E}{m\Delta\theta}$

4. The specific latent heat

Energy transferred, ΔE (joules, J) **= mass, m** (kilograms, kg) **x Latent heat, L** (joule per kilogram J/kg)

To find the specific latent heat of a substance the equation can be rearranged to: $L = \frac{\Delta E}{m}$

5. Gas properties

Diagram	
Arrangement of particles	Randomly arranged Far apart
Movement of particles	Brownian motion
Energy of particles	Very high energy
Density of substance	Very low density

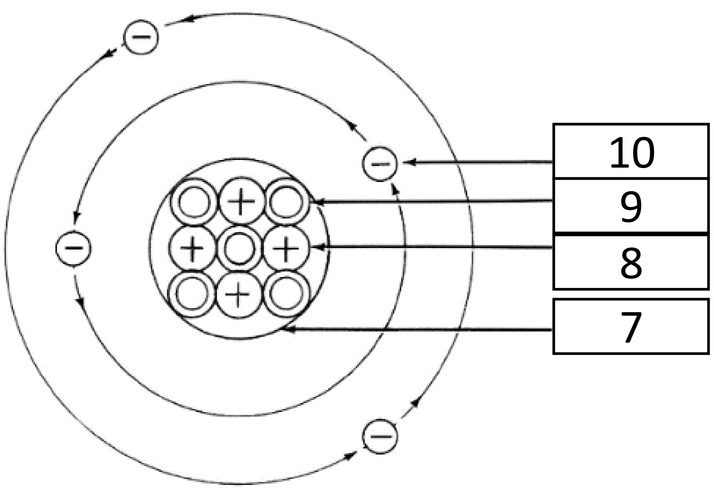
6. Pressure in gases (TRIPLE ONLY)

change	effect	reason
Increase Pressure	Increase volume	More particles so more collisions Increase the force stretching the balloon until the forces balance
Decrease pressure	Decrease volume	Less particles so less collision. Decrease the force causing the balloon to contract until the forces balance
Formula	**pV=constant**	**If fixed mass and constant temperature**

Physics topic 2: Atomic structure

1. Keywords

1. Atom	The smallest possible piece of an element. Has a radius of 0.1nm (or $1x10^{-10}$m).
2. Element	A substance in which all the atoms have the same atomic number.
3. Isotope	Atoms with the same number of protons but different numbers of neutrons.
4. Molecule	Two or more atoms bonded together
5. Compound	Two or more <u>different</u> atoms bonded together
6. Mixture	At least two different elements or compounds together. Can be separated easily.
7. Nucleus	The centre of an atom. Contains protons and neutrons
8. Proton	A positively charged particle found in the nucleus
9. Neutron	A neutral particle found in the nucleus. Has no charge
10. Electron	A negatively charged particle found in energy levels (shells) around the nucleus



2. Properties of sub-atomic particles

Particle	Relative mass	Relative charge	Location
Proton	1	+1	Nucleus
Neutron	1	0	Nucleus
Electron	0	-1	Shells

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

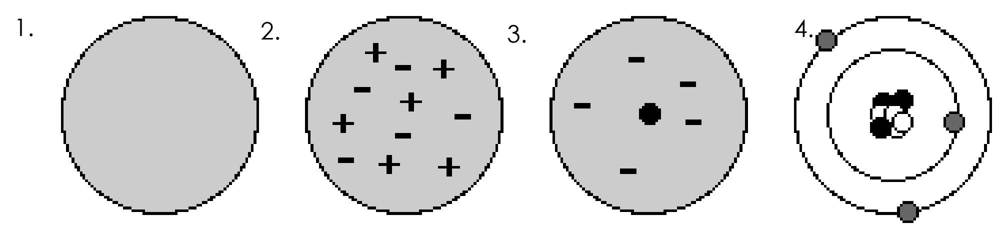
1
H
hydrogen
1

3. Using the periodic table

Number of..	Is the…	Found by..
Protons	Atomic (proton) number	Smaller number on periodic table
Electrons	Atomic (proton) number	Smaller number on periodic table
Neutrons	Difference between the atomic mass and atomic number	Big number – small number

4. History of the atom

Discovery	By	Model	Diagram
Solid particle called atom	John Dalton	Particle: solid spheres	1
The electron	JJ Thompson	Plum pudding: positive ‘cake’ with negative ‘plums’	2
Nucleus	Rutherford	Nuclear: Positive nucleus surrounded by electrons	3
Neutron	James Chadwick	Nuclear: Now with protons and neutrons in nucleus	3
Energy levels (shells)	Niels Bohr	Planetary: Electrons now ‘orbit’ in different shells	4



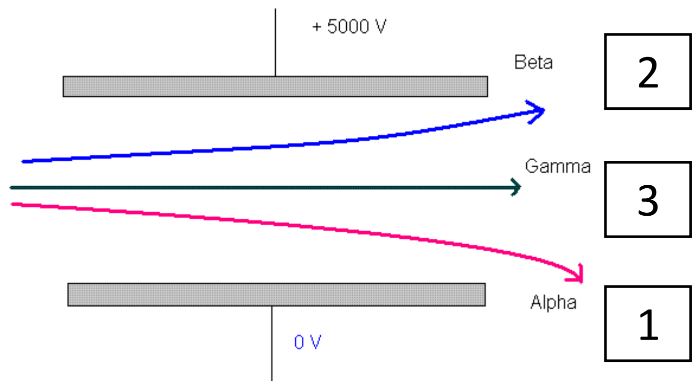
5. Radioactive decay keywords

Unstable	The ability for a nucleus to decay
Radioactive decay	The RANDOM process of radiation being released by a nucleus. A different element in formed
Nuclear radiation	The energy and particles released when an unstable nucleus decays
Activity	How quickly a radioactive sample decays
Becquerel	The unit of activity
Geiger-Muller tube	A device to measure the count rate of a radioactive source
Count rate	The number of radioactive decays per second
Ionising power	How well it knocks off electrons and damages cells
Half life	The time it takes half of a group of radioactive nuclei to decay
Radioactive contamination	Unwanted hazardous materials containing radioactive atoms
Peer review	When the findings of one expert are double checked by another expert to make sure they are correct

7. Background radiation (TRIPLE ONLY)

Background radiation is the radiation all around us all the time

Natural sources:	Man-made sources:
• Rocks	• Fallout from weapons testing
• Cosmic rays	• Fallout from nuclear incidents



6. Ionising radiation

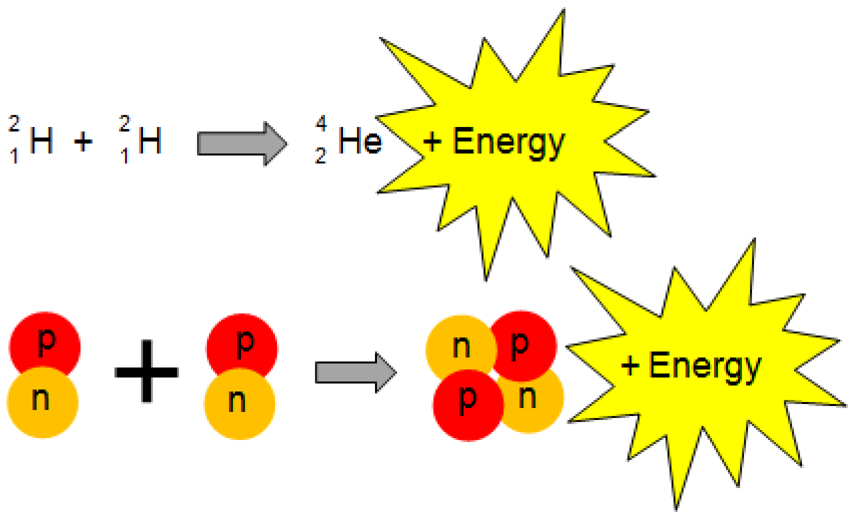
	Name	Symbol	Made of	Charge	Range in air	Penetration	Ionising power
1	Alpha	α	Helium nucleus $^{4}_{2}He$	**+2**	5 cm	Blocked by paper and skin	High
2	Beta	β	Fast moving electron $^{0}_{-1}e$	**-1**	15 cm	Blocked by thick aluminium	Medium
3	Gamma	γ	Electromagnetic wave	N/A	Very long	Blocked by thick lead	low

8. Uses of nuclear radiation (TRIPLE ONLY)

Use	Half life	Penetration power	Ionising power	Preferred emitter
Exploring internal organs	A few hours	Med-high	Low	Gamma
Radiotherapy	A few years	High	Med/Low	Gamma (or Beta)

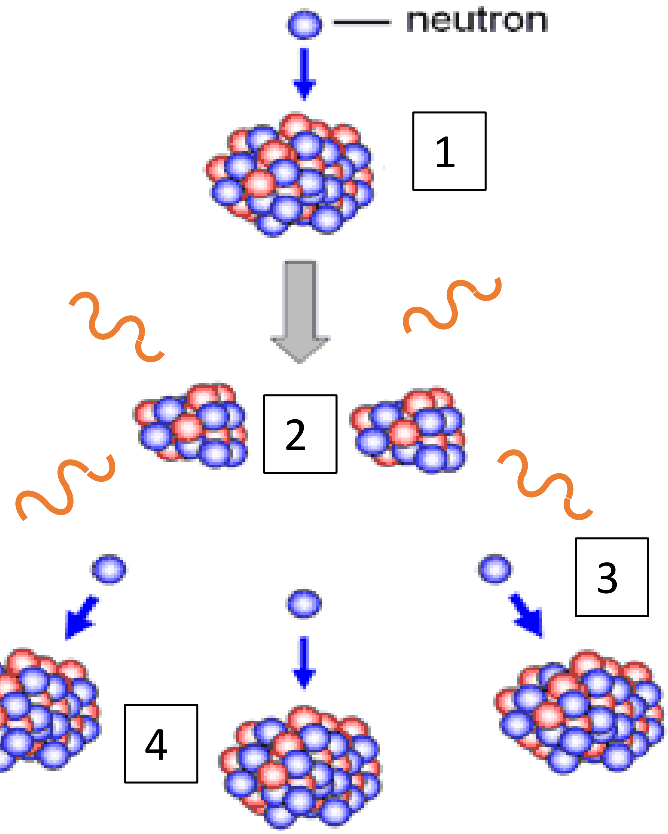
9. Nuclear Fission vs Fusion (TRIPLE ONLY)

Nuclear fission	When a large nuclei breaks into smaller nuclei releasing energy	E.g: • Nuclear power stations • Atomic bombs • The core of the Earth
Nuclear fusion	When small nuclei join together to form larger nuclei. Some mass in converted into energy	E.g: • The Sun • Hydrogen bombs



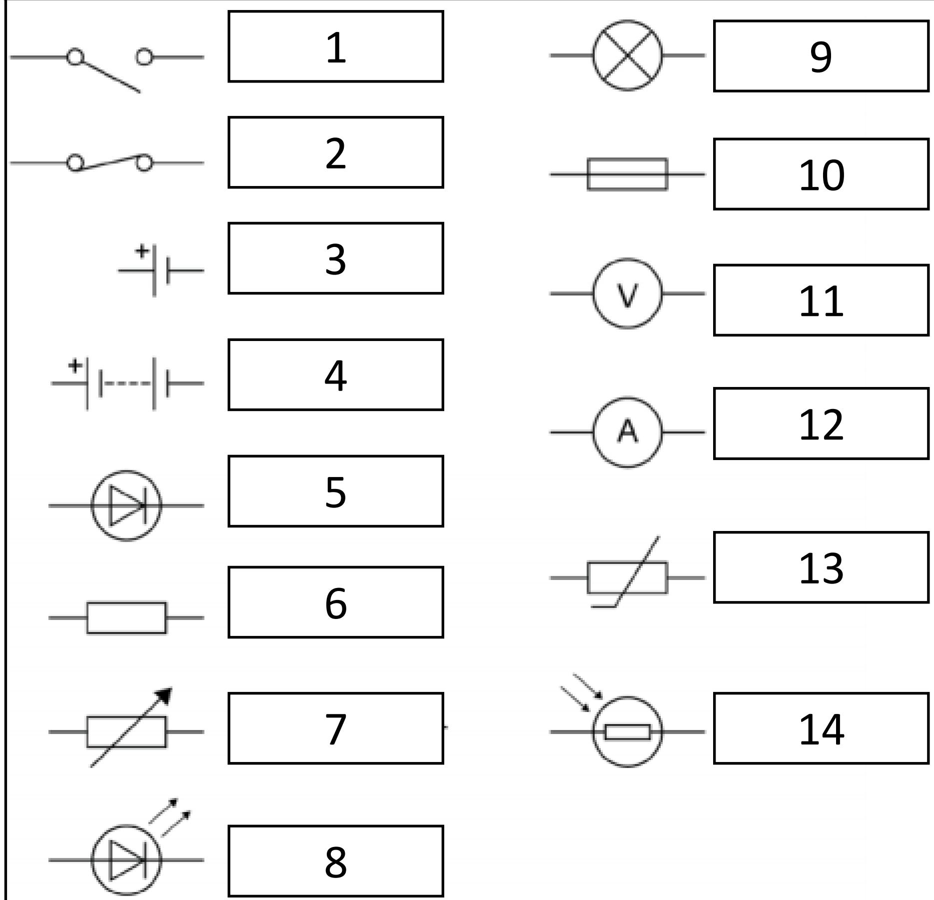
10. Nuclear fission (TRIPLE ONLY)

1	A slow neutron hits the nucleus
2	The nucleus becomes unstable and splits roughly in half
3	3 neutrons and gamma rays are released
4	These neutrons hit other nuclei causing a chain reaction
5	If this is uncontrolled then it will result in an explosion



Physics topic 3: Electricity

1. Standard circuit diagram symbols



1	Switch (open)	8	LED (light emitting diode)
2	Switch (closed)	9	Lamp (bulb)
3	Cell	10	Fuse
4	Battery	11	Voltmeter
5	Diode	12	Ammeter
6	Resistor	13	Thermistor
7	Variable resistor	14	LDR (light-dependent resistor)

2. Electrical charge and current

Charge flow = current x time

$Q = I \times t$

Q = Charge (in coulombs C)
I = Current (in amps A)
t = Time (in seconds s)

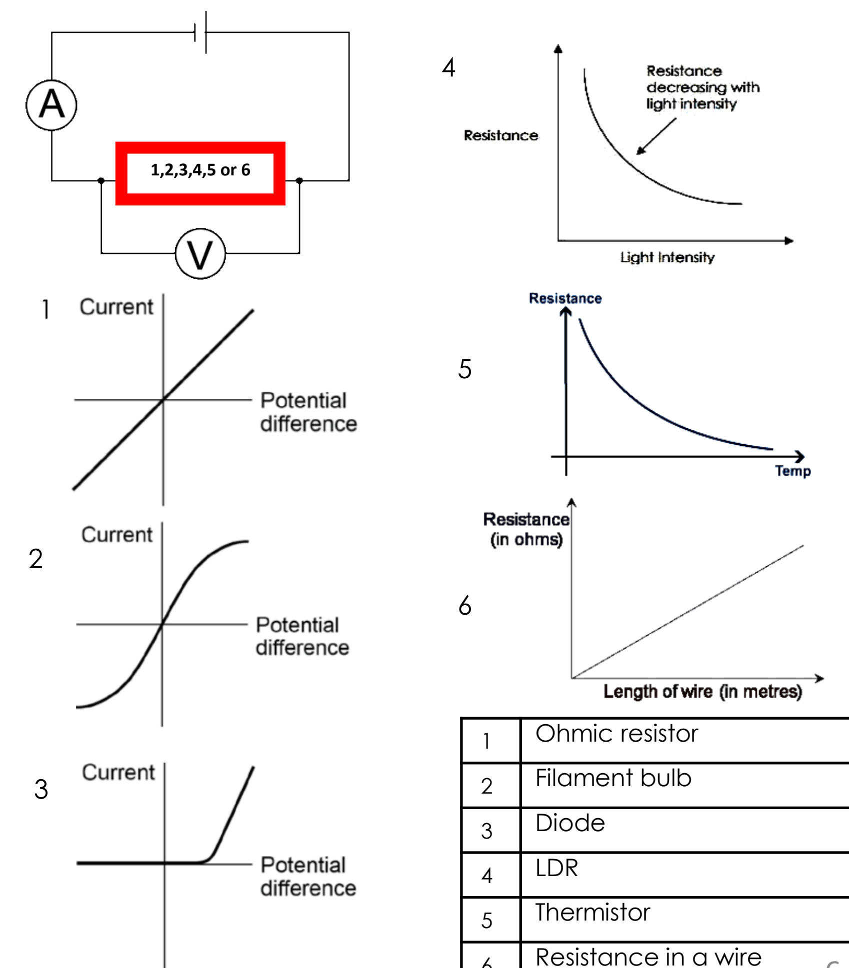
3. Resistance

Potential difference = current x resistance

$V = I \times R$

V = Potential difference/voltage (in volts V)
I = Current (in amps A)
R = Resistance (in ohms Ω)

4. IV characteristics and required practical

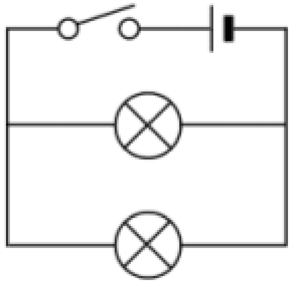


1	Ohmic resistor
2	Filament bulb
3	Diode
4	LDR
5	Thermistor
6	Resistance in a wire

5. Series and parallel circuits

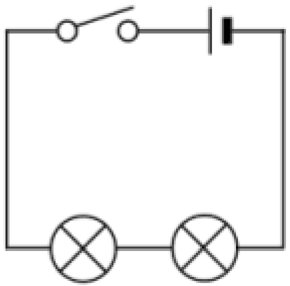
<u>Parallel Circuits</u>

- The current splits at the junction.
- The voltage is the not shared.



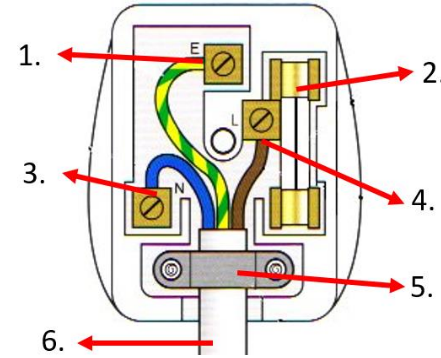
<u>Series Circuits</u>

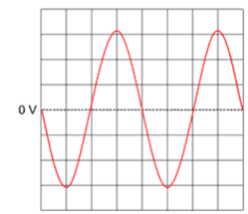
- The current does not split and is the same everywhere
- The voltage is shared
- $R_{TOTAL} = R_1 + R_2 + R_3 \ldots$



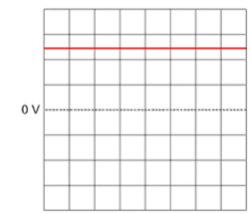
6. Mains electricity keywords

1. Earth wire	Prevents danger from short circuits
2. Fuse	Melts if current gets too high
3. Neutral wire	Carries the current away from plug
4. Live wire (230v)	Carries current to plug
5. Cable grip	Prevents a loose wire if cable is pulled
6. Double insulated cable	Prevents electric shock
7. Alternating current (AC)	Current which changes direction 50 times a second (50 Hz). Found in the mains.
8. Direct current (DC)	Current that only travel in one direction. Found in batteries.





7.



8.

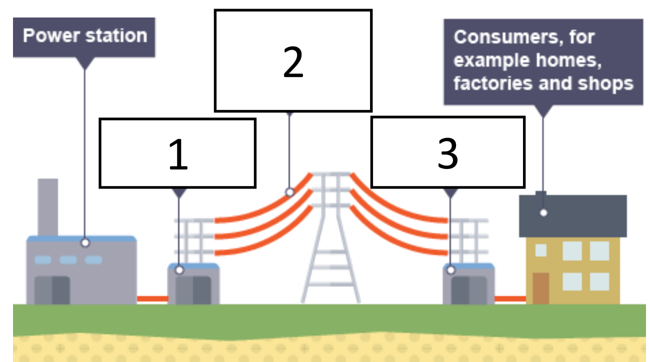
7. Electrical power

power = current^2 x resistance	$P = I^2R$
power = current x potential difference	$P = IV$
energy transferred = charge flow x potential difference	$E = QV$

Symbols and their units

Symbol	Meaning	Unit	Meaning
V	Potential difference	V	Volts
I	Current	A	Amps
R	Resistance	Ω	Ohms
Q	Charge	C	Coulombs
P	Power	W	Watts
E	Energy	J	Joules

8. The National grid

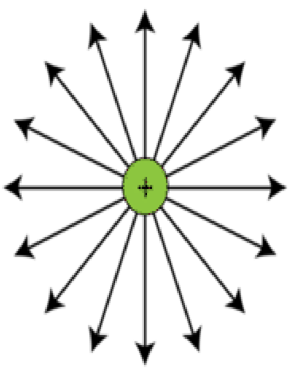


1.Step up transformer	Increase the voltage of the AC
2.High voltage transmission cables	High voltage reduces energy loss
3.Step down transformer	Decreases the voltage of the AC

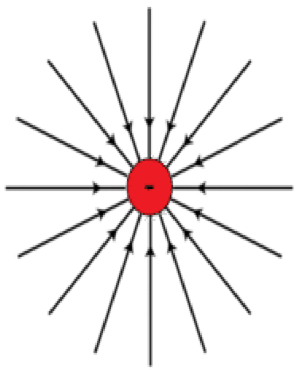
9. Static electricity keywords (TRIPLE ONLY)	
Insulator	Material which holds electrical charge and does not conduct it
Friction	Force which transfers electrons from one insulator to the other
Electrons	Negatively charged particles in atoms. They are the only charges that can move
Electrostatic force	The force between two charges
Van der Graaff generator	Machine used to generate static electricity

Electrostatic force rules (TRIPLE ONLY)		
Charges	Force	Diagram
- and -	repel	(a)
+ and -	attract	(b)
+ and +	repel	(a) But with positive charges and field lines in opposite direction

Electrostatic Field Lines (TRIPLE ONLY)	
Charge	Direction
Positive +	Away from point
Negative -	Towards point

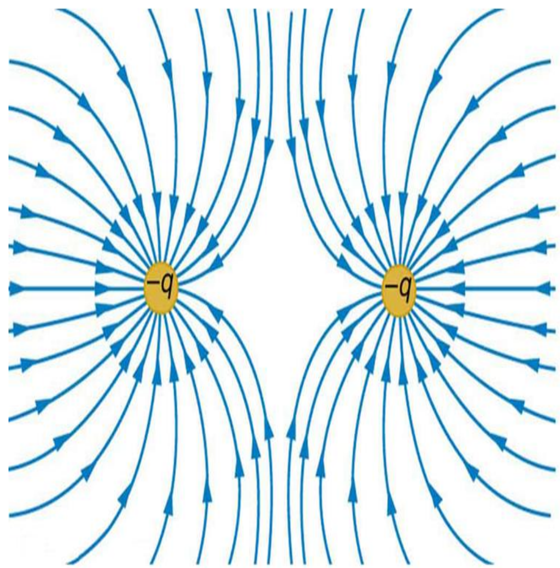


Electric field lines of a positive point charge

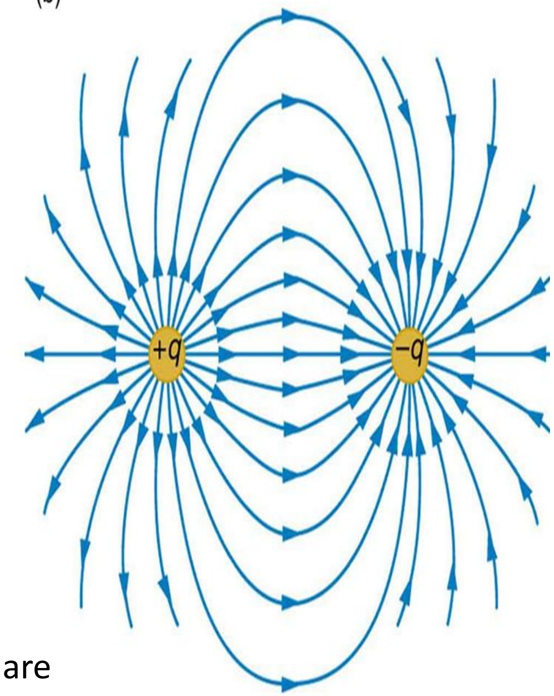


Electric field lines of a negative point charge

(a)



(b)

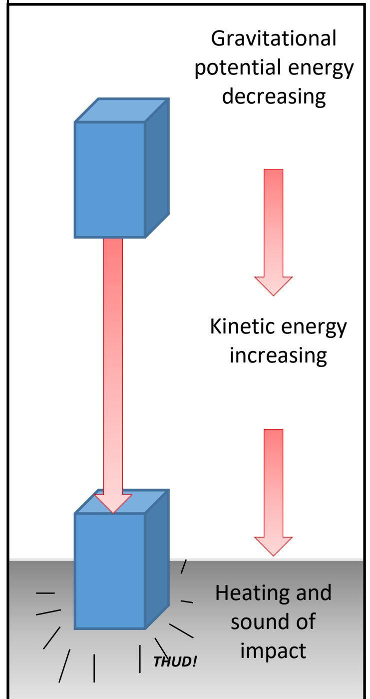


The larger the charge the more field lines are drawn. However, they remain equally spaced about the charge.

Physics topic 4: Energy

1. Key Term	Definition
Kinetic energy (KE)	The energy an object has because it is moving
Gravitational potential energy (GPE)	The energy an object has because of its position above the surface of the Earth or other planet
Elastic potential energy	The energy stored in a springy object when you stretch or squash it
Thermal energy	The energy a substance has because of its temperature
Chemical energy	The energy stored in fuels, food, and batteries
Conservation of energy	Energy cannot be created or destroyed only transferred.
Work done	The energy transferred by a force or electric current
Dissipation	The process of energy being transferred or lost to the surroundings
Friction	A force that opposes movement
System	An object or group of objects
Closed system	An isolated system where no energy transfers take place into or out of the energy stores in the system.
Useful energy	Energy in the place it is wanted in the form that it is needed in
Wasted energy	Energy that is not usefully transferred, usually as thermal.
Energy Store	A term used to describe how an object contains energy. They can be filled or emptied.
Pathway	The method by which energy is transferred from one store to another.

2. Conservation of energy in action



A falling object:

1. Work is done by the force of gravity pulling the object down.
2. The amount of energy in the gravitational store decreases.
3. The amount of energy in the kinetic store increases.
4. Some energy is transferred to the thermal store of the object and the surrounding air as a result of air resistance.
5. When the object hits the floor and stops moving the gravitational and kinetic stores are both empty.
6. The energy has been transferred to the thermal store of the surroundings by heating and by a sound wave.
7. The total amount of energy has remained the same it is now in a different store.

3. Pathways for Energy Transfer:

Heating	Energy is always transferred from hot objects to colder ones until they are at the same temperature
Action of Forces	Work is done by forces to make an object move or to prevent it from moving (friction).
Waves	Mechanical waves – sound, water, seismic Electromagnetic waves - light
Electric Current	Transfers energy from the battery or power supply to the components of an electrical circuit

4. Equations to recall and apply

Equation in words	Equation in symbols	Units
Kinetic Energy = ½ x mass x velocity^2	$E_K = \frac{1}{2} mv^2$	Energy – Joules (J) Mass – Kilograms (kg) Velocity – metres per second (m/s)
Gravitational Energy = mass x gravitational field strength x height	$E_G = mgh$	Energy – Joules (J) Mass – Kilograms (kg) Gravitational field strength – Newtons per kilogram (N/kg) Height – metres(m)
Work done = Force Applied x Displacement	$W = Fs$	Work done – Joules (J) Force – Newtons (N) Displacement – metres (m)
Elastic Energy = ½ x spring constant x extension^2	$E_E = \frac{1}{2} ke^2$	Energy – Joules (J) Extension – metres (m) Spring Constant – Newtons per metre (N/m)
Electrical Work = Charge Flow x Potential Difference	$E = QV$	Electrical Work – Joules (J) Charge – Coulombs (C) Potential Difference – Volts (V)

5. Power

1. The more powerful an appliance, the faster the rate at which it transfers energy

2. **Power, P** (watts, W) = **Energy transferred to appliance, E** (joules, J) / **Time taken for energy to be transferred, t** (seconds, s)

3. The power wasted by an appliance = total power input - useful power output

6. Calculating efficiency

1.Efficiency = Useful output energy transferred by the device / Total input energy supplied to the device

2. Efficiency = Useful power out / Total power in

3. The answer from the calculation above must always be between 0 and 1
4.No device can be more than 100% efficient.
5.Machines waste energy because of friction between their moving parts, air resistance, electrical resistance, and noise.

7. Energy Resources			
Energy Resource	Renewable	Advantages	Disadvantages
Fossil Fuels	No	• Low cost. • Easily transportable. • Reliable.	• Produces large amounts of Carbon Dioxide. • Coal produces Sulfur Dioxide.
Nuclear	No	• Generates a lot of electricity. • Reliable. • High energy density	• Expensive to construct and run. • Produces dangerous radioactive waste which will last for thousands of years.
Solar	Yes	• No fuel costs. • No pollution.	• Expensive to set up. • Doesn't work at night.
Wave	Yes	• No fuel costs. • Reliable.	• Can damage marine ecosystems. • Not everywhere is near water.
Tidal	Yes	• No fuel costs. • No pollution. • Reliable.	• Can damage marine ecosystems. • Not everywhere is near water. • Expensive to construct.
Wind	Yes	• No fuel costs. • No pollution.	• Not always reliable. • Noisy. • Some think they are ugly (eyesore).
Geothermal	Yes	• No fuel costs. • No pollution.	• Very few areas where it is accessible.
Biomass	Yes	• Low cost. • Readily available. • Carbon neutral.	• Large scale land use requiring lots of water. • Destruction of habitat to grow crops.
Hydro-electric	Yes	• No fuel costs. • Reliable. • Easily controlled.	• Requires flooding land to build

Carbon neutral: a process by which no extra carbon is released to the atmosphere.

Y11 GCSE Exam Dates

Y11 Mock(s):

Y11 PPE(s):

Final GCSE(s):

Success Programme Sessions:

Revision Guide (if applicable):

Notes