Additional Science Physics

P2

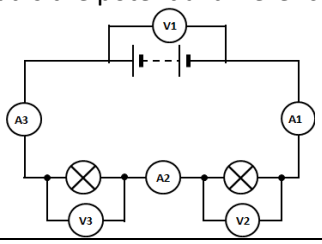
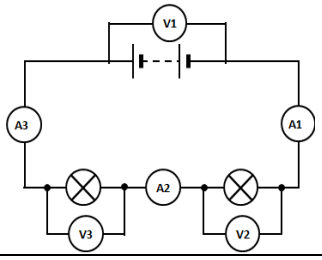
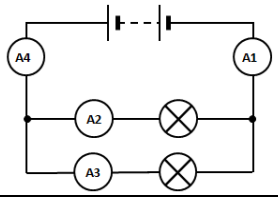
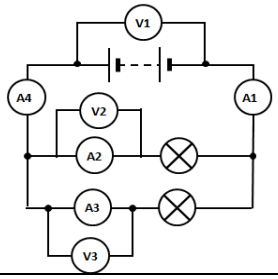
Core Questions and Keywords and Definitions

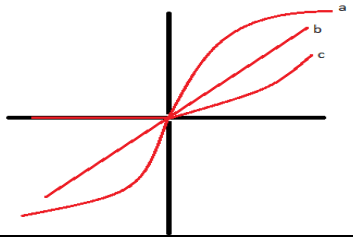
Core Questions

Topic 1

Name 3 sub atomic particles	Protons, neutrons and electrons,
Name the mass and charge of a proton	Mass 1, charge positive
Name the mass and charge of an electron	Mass 0, charge negative
Name the mass and charge of a neutron	Mass 1, charge neutral
What sub-atomic particles are found in the nucleus?	Protons and neutrons
What sub-atomic particles are found in orbits outside the nucleus?	Electrons
Opposite/unlike charges...	Attract
Same/like charges...	Repel
Describe how static electricity is formed	Friction between 2 insulators causes electrons to move from one material to another.
What charge does an object which has gained electrons have?	Negative
What charge does the object which has lost electrons have?	Positive
Explain how static electricity induces a charge	A negative object is brought near a neutral object; it repels the negative electrons leaving a positive charge on the neutral object. The negative object is attracted to the now positive object.
Name 3 uses of static electricity	Spray painting cars, chimney precipitators, spraying insecticide
Describe how static electricity is used to spray paint	(charges can be the other way around) Paint is given a negative charge; they repel each other and form a mist of paint. The car is given a positive charge; the negative paint attracts to the positive car and coats it.
Suggest benefits to using static electricity for spray-painting or insecticides	Less waste of paint Saves money
Explain how static electricity builds up in aircraft	Friction, caused by the plane colliding with particles in the atmosphere, causes electrons to build up in the body of the aircraft as it is insulated and these electrons cannot be earthed.
What are some of the potential dangers of electrostatic charges?	-Fuelling aircraft- static builds up in the nozzle and could spark and ignite the fuel causing an explosion -Lightning -Flying aircraft
How are aeroplanes refuelled safely	The aeroplane and the tanker are earthed using a metal wire to discharge any build up of electrons
Describe the movement of electrons when you get a static electric shock	Electrons are built up in you as your shoes/jumper rub against something, when you touch a conductor you get an electric shock as electrons flow from you through the conductor and to the Earth.
Why are metals good conductors?	They contain a sea of delocalised/free electrons, which are free to move
What is current?	The flow of electrons
What is electric current?	The rate of flow of electrons
Describe a direct current	The flow of electrons in one direction
State objects that would produce a direct current	A battery, a cell, a dynamo
Describe an alternating current	Electrons moving back and forth millions of times a second
How do you calculate charge?	Charge = current x time
What unit do we measure charge in?	Coulombs (C)

Topic 2

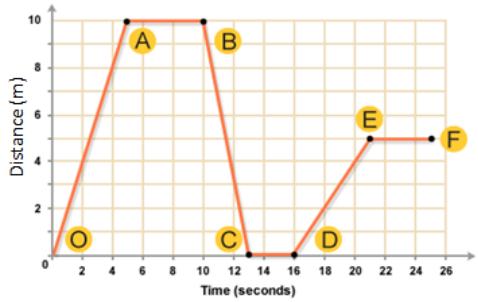
What is the unit for current, how do you measure it and how do you place it in a circuit?	Measured in Amps (A), using an ammeter which is placed in series in a circuit
What is the unit for potential difference, what equipment do you use to measure it and how do you place it in a circuit?	Measured in Volts (V), using a voltmeter which is placed across a component (parallel to a component)
What happens to current in a series circuit?	The current is always the same throughout a series circuit
What happens to the voltage in a series circuit?	The voltage provided by the power pack/battery is shared between the components in the series circuit
If the potential difference across V2 is 2.5V and across V3 is 2.5V, what is the potential difference across V1? 	5V V1 = V2 + V3
If A1 read 3A, what would the current at A2 and A3 be? 	3A
What happens to the current in a parallel circuit?	The current splits/divides at a junction and recombines at a later junction
What happens to the voltage in a parallel circuit?	The voltage across the powerpack/battery is the same across all components in a parallel circuit
If A1 = 3 A and A2 = 1A, what is the current measured at A3 and A4? 	A3 = 2A A4 = 3A (because the current after the junction must always equal the current before the junction)
If V2 has the potential difference of 5V, what is the potential difference of V1 and V3? 	They are both 5V
What happens to the current if you increase the potential difference (voltage) of a power pack/battery	The current increases
If you increase the resistance in a circuit, what happens to the current?	It decreases.
How do you calculate resistance?	Resistance = voltage / current R = V/ I
What is the unit for resistance?	Ohms (Ω)
Determine the resistance of this circuit if the current is 2.5A and the voltage is 3V	Equation: R = V/ I Substitute: R = 3V / 2.5A Calculate: 3 / 2.5 = 1.2

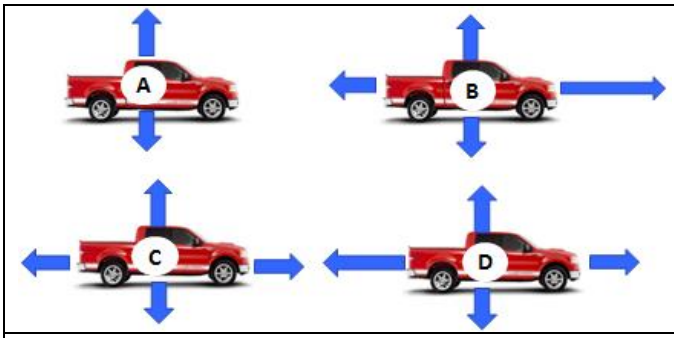
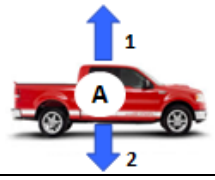
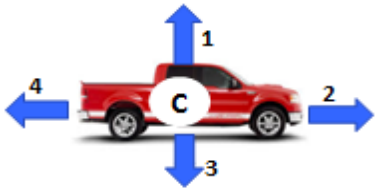
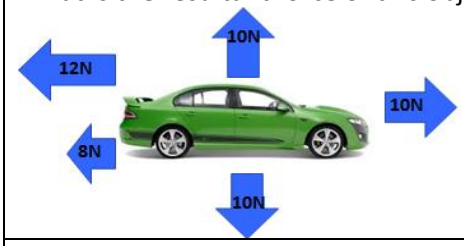
	Units: R = 1.2 Ω
If the current in a circuit is 1.4A, and the resistance is 3Ω, what is the potential difference in the circuit?	Equation: V = I x R Substitute: V = 1.4A x 3Ω Calculate: 1.4 x 3 = 4.2 Units: V = 4.2V
Figure out the current when the resistance is 2.5Ω and the voltage is 13V.	Equation: I = V / R Substitute: I = 13V / 2.5Ω Calculate: 13 / 2.5 = 5.2 Units: I = 5.2A
Explain why the resistance of a filament lamp changes as it gets hot?	The resistance of a filament lamp increases as it gets hot because the metal ions in the filament vibrate faster causing more collisions with the moving electrons, decreasing current.
How does a diode work?	It only allows current to pass through it in one direction.
How does the current vary with voltage for a diode?	When the current is flowing in the right direction, the current increases voltage increases but it is not directly proportional (not a straight line on the graph). The gradient of the graph increases as current increases, because as the diode gets hotter (from the greater current) its resistance increases.
What is an LDR?	Light dependent resistor.
How does the resistance of a light dependant resistor change with light intensity?	As light intensity increases, the resistance decreases.
What happens to the resistance and current in a thermistor as you increase temperature?	As the temperature increases, the resistance decreases, which increases the current (flow of electrons)
How does the current vary with voltage for a filament lamp as it warms up?	As a bulb heats up the resistance increases and so, as current increases voltage increases but it is not directly proportional (not a straight line on the graph). The gradient of the graph increases as current increases. This is because as the bulb gets hotter its resistance increases, until it reaches its maximum temperature.
Which of the following graphs shows how current varies with potential difference for: 1) Filament lamp 2) Diode 3) Fixed resistor 	1) Filament lamp – graph a 2) Diode – graph c 3) Fixed resistor – graph b
What does resistance transfer electrical energy into?	Thermal energy (heat)
Name a device where the heating effect of an electric current is useful.	Toaster, kettle, oven...
Name a device where the heating effect of an electric current is not useful.	Light bulb
What is the unit for electrical power?	Watt
What is the unit for energy transferred?	Joule
What is power?	The rate of energy transferred from one form to another/others.
What unit do we measure power in?	Watts (W)
How can you calculate power using the energy transferred in an object and the time it is used for?	Power = Energy transferred/time taken P = E / t
What is the power of a device if it transfers 18,000J of energy in 10 minutes?	Equation: P = E / t

	Convert: time needs to be in seconds, 10 minutes x 60 = 600s Substitute: P = 18,000J / 600s Calculate: 18,000 / 600 Units: P = 30W
How long is a 50W device used for if it transfers 1.5kJ?	Equation: t = E / P Convert: Energy needs to be in J: 1.5kJ x 1000 = 1500J Substitute: t = 1500J / 50W Calculate: 1500 / 50 = 30 Units: t = 30s
How much energy is transferred when a 500W device is used for half an hour?	Equation: E = P x t Convert: Time needs to be in seconds: 0.5 hours x 60 = 30 minutes x 60 = 1800s Substitute: E = 500W x 1800s Calculate: 500 x 1800 = 900,000 Units: E = 900,000J
How can you calculate power using current and voltage?	Power = Current x voltage P = I x V
A kettle uses the mains electricity at 230V. The current is 13A. What is the power of the kettle?	Equation: P = I x V Substitute: P = 13A x 230V Calculate: 13 x 230= 2990 Units: P = 2990W
What is the current flowing through a 36W device using a 12V power supply?	Equation: I = P / V Substitute: I = 36W / 12V Calculate: 36 / 12 =3A Units: I = 3A
What is the voltage of the power supply for a 144W device which has current of 16A flowing through it?	Equation: V = P / I Substitute: V = 144W / 16A Calculate: 144 / 16 = 9 Units: V = 9V
How is energy calculated using an equation? (hint: combine the power calculations together!)	Energy = Current x Voltage x time E = I x V x t
What is the energy transferred when a radio uses a 12V supply for 15 minutes, and has a current of 3A?	Equation: E = I x V x t Convert: 15 minutes into seconds: 15 x 60 = 900s Substitute: E = 3A x 12V x 900s Calculate: 3 x 12 x 900 = 32400 Units: E = 32400J

Topic 3

What is the unit for velocity?	m/s
What is a vector quantity?	It has both a size (magnitude) and direction.
Give 5 examples of a vector quantity?	Displacement, velocity, acceleration, force and momentum.
How is speed calculated?	Speed = distance / time
A cyclist travels a distance of 1800m in 2 minutes. What is their speed?	Equation: S = D / t Convert: Time needs to be in seconds: 2 x 60 = 120s Substitute: S = 1800m / 120s Calculate: S = 1800 / 120 = 15 Units: S = 15 m/s
How long did it take for a car to travel 30 metres when travelling at 0.6m/s?	Equation: t = D / S Substitute: t = 30m / 0.6m/s Calculate: t = 30 / 0.6 Units: t = 50s

A peregrine falcon can fly at speeds of 50m/s, at this speed how far can it travel in 7 seconds?	Equation: D = S x t Substitute: D = S x t Calculate: 50 x 7 = 350 Units: 350m
Using a distance time graph, describe what is happening to the object between O and A, A and B and B and C? 	O and A: The object is accelerating forwards A and B: The object is stationary B and C: The object is moving backwards
What is acceleration and its unit?	Acceleration is the rate of change of speed, its unit is m/s^2
How do you calculate acceleration?	Acceleration = change in velocity / time
How do you calculate change in velocity?	Change in velocity = final velocity – initial velocity v – u
A car starts from 0m/s and reaches a velocity of 50m/s in 5 seconds, what is its acceleration?	Equation: A = (v – u) / t Substitute: A = (50m/s – 0m/s) / 5 Calculate: A = 50 / 5 Units: 10 m/s^2
What is the change in velocity if an object accelerates at a rate of $2m/s^2$ in 600 seconds	Equation: (v – u) = A x t Substitute: (v – u) = $2m/s^2$ x 600s Calculate: 2 x 600 = 1200 Units: (v – u) = 1200m/s
How long did it take for a car accelerating by $-2.5m/s^2$ when its initial velocity was 70m/s and its final velocity was 20m/s.	Equation: t = (v – u) / A Substitute: t = (20m/s – 70m/s) / $-2.5m/s^2$ Calculate: -50 / -2.5 = 20 Units: t = 20s
Give 2 examples of how an object can accelerate.	1) If it's speeding up or slowing down. 2) If it's changing direction.
Describe the motion of each objects on these velocity-time graphs 	1) The object is accelerating quickly 2) The object is moving at a constant speed 3) The object is decelerating 4) The object is stationary
Describe how to calculate the distance an object has travelled using a velocity-time graph	By measuring the area under the graph
Name a force	Friction/drag/air resistance/water resistance Weight/gravity Thrust/upthrust/ Reaction Lift
When 2 forces (action and reaction forces) interact with each other, what effect do they have?	When action and reaction forces interact they exert a force that is equal in size and opposite in direction to each other
Describe the motion of each 4 objects	A: Stationary B: Accelerating C: Constant speed D: Decelerating

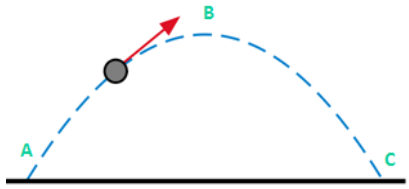
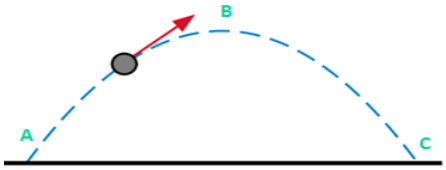
	
What are the forces in this free-body diagram? 	1= reaction 2= gravity
What are the forces in this free-body diagram? 	1= reaction 2= thrust 3= gravity 4= friction/air resistance/ drag
If the forces acting on an object are balanced and the resultant force is zero, what is the motion of the object?	Stationary or constant speed
If the forces on an object are unbalanced, how will it behave?	It will accelerate in the direction of the resultant force.
What is resultant force?	The total force that results from 2 or more forces acting on an object
What is the resultant force of this object? What is it's motion? 	10N to the left The object is decelerating
A cyclist applies 100 N of thrust to a bike and is battling against 75 N of wind resistance, how would you describe their motion and what is the resultant force?	They are accelerating with a resultant force of 25N acting in forwards direction.
What 2 factors affect the size of the acceleration of an object?	The mass of the object and the size of the force accelerating the object forwards
F=ma what does it stand for, what are the units for F and m?	Force = mass x acceleration Force unit is Newtons (N) Mass unit is kilograms (Kg)
A 1500kg car has an acceleration of 3.0m/s^2, what is the force provided by the engine?	Equation: F = M x A Substitute: F = 1500kg x 3m/s^2 Calculate: 1500 x 3 = 4500 Units: F = 4500N
A car accelerates at 6m/s^2 as its engine provides a force of 7,800 N. What is the mass of the car?	Equation: M = F / A Substitute: M = 7,800N / 6m/s^2 Calculate: M = 7,800 / 6 Units: M = 1,300kg
A jumbo jet has a mass of 40, 000,000g. If its engines produce a force of 800, 000 N, what will its acceleration be?	Equation: A = F / M Convert: Mass needs to be in kg, 40,000,000 / 1000 = 40,000 Substitute: A = 800,000 / 40,000kg Calculate: 800,000 / 40,000 Units: A = 20m/s^2

What is the difference between mass and weight?	Mass never changes, it is a measure of the amount of matter that makes up an object whereas weight depends on the gravitational field strength of a planet
What is terminal velocity?	The point at which the weight and air resistance are balanced and the object can accelerate no more.
Describe how the forces acting on a ball change as it starts to fall from the sky	At the start of the fall the downward force (weight) is greater than the upward force (air resistance). The weight remains constant but the air resistance increases as the ball accelerates until the weight is balanced out by the air resistance. At this point the ball is moving at a constant speed, this is known as the terminal velocity.
How do you calculate the weight of an object?	Weight (N) = mass (kg) x gravitational field strength (N/kg)
What is the weight of a 300kg planetary landing craft on the surface of the Earth?	Equation: W = M x GFS Substitute: W = 300kg x 10N Calculate: 300 x 10 = 3000 Units: W = 3000N
What is the mass of an object if the weight is 120N on Jupiter whose GFS is 25N/kg?	Equation: M = W / GFS Substitute: M = 120N / 25N/kg Calculate: M = 120 / 25 = 0.48 Units: M = 4.8kg
What is the GFS of Mars if a 150kg object has a weight of 570N?	Equation: GFS = W / M Substitute: GFS = 570N / 150kg Calculate: 570 / 150 = 3.8 Units: GFS = 3.8N/kg

Topic 4

How do you calculate the stopping distance of a car?	Stopping Distance = Thinking distance + Braking distance
List four factors that affect the thinking distance of a driver	alcohol/other drugs, tiredness, distractions, age,
List 5 factors that affect the braking distance of a car	Quality of brakes, mass of vehicle, speed of vehicle, state of the road, the amount of friction between the tyre and road surface (affected by weather and tyre condition).
What is momentum?	Momentum is a measurement of the velocity and mass of a moving object.
Name 3 ways we can change the momentum of an object	1. Changing the size of an object 2. Changing the speed of an object 3. Changing the direction of an object
What is the unit for momentum?	Kg m/s
How do you calculate momentum?	Momentum = mass x velocity
A 1200kg car travels along at 12 m/s, calculate its momentum.	Equation: Mo = Ma x V Substitute: Mo = 1200kg x 12m/s Calculate: Mo = 1200 x 12 = 14400 Units: Mo = 14,400 kg m/s
Calculate the velocity of a 250kg object if it's momentum is 5000 kg m/s.	Equation: V = Mo / Ma Substitute: V = 5000 kg m/s / 250kg Calculate: V = 5000 / 250 = 20 Units: V = 20 m/s

Calculate the mass of an object which has the momentum of 54, 000 kg m/s and travels at a velocity of 12m/s.	Equation: Ma = Mo / V Substitute: Ma = 54,000kg m/s /12m/s Calculate: Ma = 54,000 / 12 = 4500 Units: Ma = 4500 kg
What features do cars have to reduce the rate of change of momentum of passengers when the car brakes sharply or has a collision?	Seatbelts, crumple zones, air bags.
Why do seat belts, crumple zones and air bags make collisions safer?	They increase the time taken for the person in the vehicle to stop; this reduces the size of the force acting on a person.
What is the law of conservation of momentum?	The total momentum before a collision is the same as the total momentum after a collision
A ball with momentum of 10kg m/s hits a stationary object, what is the total momentum of the balls after the collision?	10kg m/s
HIGHER) How can you calculate the force of an object during a collision?	Force = Change in momentum / time
HIGHER) What force is needed to get a 25 kg stationary bicycle moving from 0m/s to 12 m/s in 5s?	Momentum at start = 0 × 12 = 0 kg m/s Momentum at end = 25 × 12 = 300 kg m/s Change in momentum = 300 – 0 = 300 kg m/s Equation: Force = change in momentum ÷ time Substitution: Force = 300kg m/s ÷ 5s Calculation: Force = 300 ÷ 5 = 60 Units: Force = 60N
How can you increase an objects gravitational potential energy?	Increase the objects height
How do you calculate work done?	Work done (J) = Force (N) x Distance (m)
What is work done?	It is the amount of energy transferred
What is the unit for work done?	Joules
Sharon lifts a 5N weight 50cm, how much work is done?	Equation: WD = F x D Convert: distance needs to be in metres= 50cm becomes 0.5M Substitute: WD = 5N x 0.5 Calculate: 5 x 0.5 = 2.5 Units: WD = 2.5J
What is the force if the work done is 30J when an object is moved 4m?	Equation: F = WD / D Substitute: F = 30J / 4m Calculate: 30 / 4 = 7.5 Units: F = 7.5N
Calculate the distance an object when it is moved with a force of 30N, if the work done is 900J.	Equation: D = WD / F Substitute: D = 900J / 30N Calculate: 900 / 30 = 30 Units: D = 30m
What is a definition of power?	The amount of energy transferred every second (Joule per second (J/S))
What is the unit for power?	Watt (W)
How do you calculate power?	Power = work done / time
What can be measured in joules per second?	Power
The rate of doing work is called...	Power
Calculate the power of an object if the work done is 800J in 400s	Equation: P = WD / t Substitute: P = 800J / 400s Calculate: 800 / 400 = 2 Units: P = 2W
What is the work done if a 500W crane moves a box in 1,800s?	Equation: WD = P x t Substitute: WD = 500W x 1,800s Calculate: 500 x 1,800 = 900,000 Units: WD = 900,000s

How fast can a 1,600W machine move an object which would require 32,000J?	Equation: t = WD / P Substitute: t = 32,000J / 1,600W Calculate: 32,000 / 1,600 = 20 Units: t = 20s
How can you combine work done = force x distance and power = work done / time	Power = $\frac{\text{(force x distance)}}{\text{time}}$
A motorbike accelerates over 40m, it uses a force of 6000N and takes 5 seconds to travel the 40m. What power did the engine produce?	Equation 1: Work done = F x d Substitute: Work done = 6000N x 40m Calculate: Work done = 240,000 J Equation 2: Power = work done / time taken Substitute: Power = 240,000J / 5 Calculate: Power = 240,000 / 5 = 48,000 Units: Power = 48,000W or 48kW Or Equation: P = (F x D) / t Substitute: P = (6000 x 40) / 5 Calculate: 240,000 / 5 = 48,000 Units: 48,000W
A cart on a rollercoaster sits stationary at the top of a steep drop. Which type of energy does it have a lot of?	Gravitational Potential Energy (GPE)
What is the value of this energy equal to?	The work done moving the cart to the top of the ride.
As the cart rolls down the track, what is this energy converted to?	Kinetic, thermal (heat) and sound energy
Name 9 different types of energy.	Kinetic, gravitational potential, electrical, chemical, nuclear, sound, light, heat, elastic
Energy transfers are never totally efficient, which type of energy is most often lost to the surroundings in an energy transfer?	Heat
At which point will the ball have the maximum/greatest gravitational potential energy? 	B has the greatest gravitational potential energy
What energy changes are occurring between B and C? 	Gravitational potential energy is decreasing as it transfers into an increasing amount of kinetic energy, thermal energy and sound energy
How do you calculate gravitational potential energy?	GPE (J) = mass (kg) x gravitational field strength (N/kg) x height (m)
What is the gravitational potential energy gained by a 500kg car is lifted 15m on Earth (GFS=10N/kg)?	Equation: GPE = m x gfs x h Substitute: GPE = 500 x 10 x 15 Calculate: 500 x 10 x 15 = 75000 Units: GPE = 75,000 J
How do you calculate kinetic energy?	Kinetic energy = ½ x mass x velocity^2
What is the kinetic energy transferred by a 2kg dog walking 2m/s?	Equation: KE = ½ x m x v^2 Conversions: 2m/s x 2m/s = 4m/s^2 Substitute: KE = ½ x 2kg x 4m/s^2 Calculate: KE = 0.5 x 2 x 4 Units: KE = 4J

Topic 5

What is alpha radiation?	A Helium nuclei (two protons and two neutrons)
What is beta radiation?	An electron
What is gamma radiation?	An electromagnetic wave
What is an ion?	A charged atom or group of atoms.
How do atoms form ions?	By gaining or losing electrons.
When an unstable nucleus emits ionising radiation is it a random or predictable event?	random
Which is most highly ionising type of radiation?	Alpha
Which is more penetrating type of radiation?	Gamma
For each type of radiation, state what can stop it	Alpha: a sheet of paper, skin, a few cms of air Beta: 3mm aluminium, metres of air Gamma: Thick lead or concrete; kilometres of air
What is the atomic number?	The number of protons present.
What is the mass number?	The relative mass of an atom which is equal to the number of protons and neutrons present.
What is an isotope?	Two or more atoms of the same element (the same number of protons) but with a different number of neutrons.
Do radioactive sources stay radioactive forever?	No- the activity of a radioactive source decreases over time
Describe how nuclear fission produces thermal energy	1) Uranium 235 nucleus absorbs a neutron 2) Nucleus becomes unstable 3) Nucleus splits (known as fission) 4) Into 2 daughter nuclei (of similar size) (Kr & Ba) 5) 2 or more neutrons released 6) Energy is released
What is a nuclear chain reaction?	Where the neutrons produced by a fission reaction trigger further nuclear fission reactions. This increases in number of fission reactions as more neutrons are produced.
What does the fission of U-235 produce?	Two daughter nuclei and two or more neutrons and a large amount of energy.
How are chain reactions controlled?	Control rods are lowered to absorb excess neutrons
How can you increase the amount of electricity being generated using the control rods in a nuclear reactor?	By moving the control rods out of the reactor, fewer neutrons are absorbed and so more fission reactions occur. This produces more thermal energy which enables more electricity to be generated
How can you stop a nuclear reactor fully?	By lowering the control rods all the way to the bottom of the nuclear reactor, all neutrons produced by fission reactions will be absorbed and so no further reactions will occur, stopping the nuclear reactor from producing energy.
What does the moderator do in a nuclear reactor	It slows neutrons down so they can be absorbed by a uranium nucleus and result in another fission reaction.
What material is used for a control rod?	Boron
What material is used for a moderator?	Graphite
What is the key benefits and disadvantages of using nuclear power to generate electricity?	Benefits: no direct CO_2 emissions Disadvantages: public perception, risk, safety issues and radioactive waste disposal, use of nuclear materials in terrorism.
How is thermal energy from a nuclear reactor used to generate electrical energy in a power station?	Thermal energy from the nuclear reactor turns the water into steam. This turns a turbine which in turn turns a generator (a coil of wire inside a magnetic field), generating electricity.

What is nuclear fusion?	Reaction caused when the nuclei of light atoms like Hydrogen join together to make the nucleus of a heavier atom like helium.
Describe what happens during nuclear fusion	2 hydrogen nuclei join/fuse together to form helium nuclei which releases thermal energy
Where is fusion found naturally?	In stars
What are the conditions required for fusion and where does it normally occur?	At very high temperatures, very high pressures and densities, the hydrogen nuclei need to collide at very high speeds so they have lots of kinetic energy.
Why is it extremely difficult to initiate nuclear fusion?	Both helium nuclei have positive charges This means they repel each other This reduces possibility of successful collisions to form helium, a neutron and also the energy The rate of fusion is too small to be useful for generating electricity.
Why can we not make a nuclear fusion power station?	It is impossible to raise the temperature to the required level for enough reactant to make the reaction self-sustaining.
When is a new idea accepted by the scientific community (e.g. cold fusion)	When it can be validated
Explain the phrase validated by the scientific community.	The procedure has been checked to confirm consistent results by other reputable scientists /organisations / peers.

Topic 6

What is the unit of activity of a radioactive isotope?	The Bequerel (Bq) is the number of emissions every second.
Why is ionising radiation dangerous?	It can lead to tissue damage, burns, DNA mutations and cancer.
What precautions should be taken when handling radioactive substances?	Handle with tongs, protective clothing, never point a source at yourself or others. The risk is reduced with increased distance.
The nuclear power industry creates a lot of radioactive waste, what are the options for disposal?	Bury - probably best. Dump at sea - not preferable because over time the containers will corrode and leak radiation into the sea which could then get into the food chain. Launch into space - expensive and not preferable because if the launch goes wrong it will scatter radioactive material over a large area of earth.
The products of nuclear fission are radioactive. Why is this problem?	Some remain radioactive for a many years. Long term storage and disposal is problematic.
What are some of the risks of using nuclear power?	Rods are radioactive which can cause cancer Danger of accident during transport Workers could be exposed to radiation Can damage environment if not properly contained Materials being disposed of are radioactive for long periods of time Water causing corrosion / leaks of radioactive waste Security from terrorist activity Leakage of radioactivity Contamination of ground, sea water, lakes, rivers, crops, fish, animals, drinking water
What are some precautions we can take to reduce the risk of using nuclear energy to generate electricity?	Long term storage, underground /under the sea Radiation shielding, lead/steel/concrete/ containers, sealed in glass. Shielding to protect people from radiation Security can be used to prevent public access to nuclear power stations

	Vehicle transporting radioactive materials need to be protected against damage Special disposal facilities needed, not landfill sites Need to be kept secure while decaying to safe levels Some materials have a shorter half-life, so long term storage is not necessary
What are some of the advantages and disadvantages of nuclear power?	**Advantages:** +Nuclear power plants do not produce carbon dioxide **Disadvantages:** -Processes used to make fuel rods require energy and generating this energy may cause carbon dioxide to be produced -Nuclear waste has to be stored for tens of thousands of years, nothing can be leaked during this time -Nuclear power is considered unsafe as radioactive material can be spread over cities and towns thousands of miles away
What is half life?	The time it takes for half the atoms in a radioactive sample to decay.
How can we calculate half life on a graph?	1) Identify the initial count rate (let's say it is 80) 2) Divide this by 2 (80/2 = 40) 3) Draw a line on the graph from this value (40) 4) When you meet the line of best fit, draw a line to the x-axis 5) This is the half-life
A sample of air contains 6 mg of radon. Radon has a half-life of 4 days. Calculate the mass of the radon remaining after 8 days.	Calculation of number of half-lives: 8 ÷ 4 = 2 (half lives) Evaluation of mass: 6 ÷ 2 = 3 ÷ 2 = 1.5 (mg)
Where does background radiation come from?	Radioactive rocks (earth), cosmic radiation (space), hospitals and industrial uses.
Why is radon gas a problem?	Released from some rocks and increases background radiation in some regions of the UK
How do you measure the radioactivity of a sample?	Take a reading of the background radiation (b) Measure the radioactivity of the sample (s) Subtract the background from the sample to get it's radioactivity (r) R = b - s
The scientist takes several readings of background radiation. Explain why this is necessary to improve the accuracy of the investigation	More accurate Hard to measure a small activity Background radiation affects readings Need to find difference of two small quantities Can test smaller samples
Give 5 uses of radioactivity and say which type of ionising radiation is used in each.	1) Smoke alarms – alpha 2) Irradiating food – gamma 3) Sterilisation of equipment – gamma 4) Tracing and gauging thickness – beta 5) Diagnosis and treatment of cancer – gamma.
Explain why gamma radiation is used for sterilising equipment and irradiating food	Gamma radiation kills microbes/bacteria/viruses on equipment and food. This prevents diseases being spread in hospitals and keeps food fresher for longer
Describe how smoke alarms work	Alpha particles ionise air particles which completes the circuit in the smoke alarm. When smoke particles are produced, they absorb the alpha radiation which prevents the circuit from working and sets off the smoke alarm.
Explain how beta radiation is used to gauge thickness in materials	Beta radiation is passed between paper, if the paper is too thick it will absorb more beta radiation and the count rate being detected will decrease. This increases the pressure of the rollers

	which makes the paper thinner, allowing beta radiation to pass through it again. The opposite occurs if the paper is too thin.
Describe how gamma radiation is used to detect cancer.	Detect cancer: A tracer is taken by a person and is observed by a gamma camera. The gamma radiation shows areas of concerns and as it is very penetrating, the gamma radiation passes straight out of the body- it doesn't stay inside the person which prevents damage to their body.
Describe how gamma radiation is used to treat cancers	Gamma radiation beams are targeted at cancerous cells from many angles to reduce radiating surrounding healthy cells. The radiation kills the cancer cells.

Keywords and Definitions

Keyword	Definition
Discharged	To release a charge by a flow of electrons to earth (or neutral).
Earthing	Many electrical appliances have metal cases, including cookers, washing machines and refrigerators. The earth wire creates a safe route for the current to flow through, if the live wire touches the casing.
Electrostatic charge	The electric charge at rest on the surface of an insulated body (which establishes and adjacent electrostatic field).
Induced charge	To make an object to become charged.
Induction	The action by which a body possessing a charge of static electricity develops a charge of static electricity of the opposite character in a neighbouring body.
Neutrons	A neutron is a subatomic particle contained in the atomic nucleus. It has no net electric charge, unlike the proton's positive electric charge.
Neutrons	Particles in the nucleus with a mass of 1 and no charge,
Nucleus	The central and most important part of an object, movement, or group, forming the basis for its activity and growth.
Protons	A stable subatomic particle occurring in all atomic nuclei, with a positive electric charge equal in magnitude to that of an electron.
Static electricity	A stationary electric charge, typically produced by friction that causes sparks or crackling or the attraction of dust or hair.
Alternating current	In alternating current, the electrons don't move steadily forward. Instead, they just move back and forth.
Ammeter	An instrument for measuring electric current
Amperes (A)	Equivalent to one coulomb per second, formally defined to be the constant current
Coulombs (C)	The unit of electrical charge equal to the quantity of charge transferred in one second by a steady current
Current	An electric current is a flow of electric charge through an electrical conductor.
Diodes	Current will only flow through a diode in one direction only
Direct current	An electric current that flows continuously in a single direction
Filament lamps	As the temperature of the filament increases, the resistance increases making a curve.
In parallel	When the components of a circuit are parallel to each other
In series	when the components of a circuit are next to each other
Ions	An atom or molecule with a net electric charge due to the loss or gain of one or more electrons.
Light-dependent resistor (LDR)	An LDR is a special type of resistor that changes its resistance depending on how much light there is
Ohms (Ω)	Resistance unit

Parallel circuit	A closed circuit in which the current divides into different paths before recombining to complete the circuit
Potential difference	The difference of electrical potential between two points, measured in volts.
Power	The rate at which work is performed, or energy converted.
Resistance	Anything in the circuit which slows the flow down.
Series circuit	A circuit that has its parts connected serially
Thermistors	Similar to an LDR but its resistance depends on temperature, high temp low resistance and vice versa.
Variable resistor	Controls the magnitude of resistance passing through the resistor
Voltage	An electromotive force or potential difference (unit).
Voltmeter	An instrument for measuring electric potential in volts.
Watts (W)	The unit that measures power. Equal to one joule per second. A watt is equal to current x voltage.
Acceleration	The rate of change of speed.
Action force	A force that exerts a force on another object. It often comes in pairs with the Reaction Force, forming an action-reaction pairs.
Air resistance	A force caused by air when an object is moving.
Displacement	How far something has moved in a straight line.
Distance-time graphs	A graph recording distance travelled over a particular time.
Drag	A resistance to motion when an object moves through a medium. E.g. a boat moving through water.
Force	Strength or energy as an attribute of physical action or movement
Free-body diagram	A pictorial device, often a rough working sketch, used by engineers and physicists to analyse the forces and moments acting on a body.
Gradient	How steep a line is.
Gravitational field strength	Gravitational field strength at a point is defined as the gravitational force per unit mass at that point.
Interact	Act in such a way as to have an effect on another
Mass	The amount of an object there is.
Reaction force	A force that acts in the opposite direction to an action force.
Resultant	The result of two or more forces acting conjointly.
Speed	How fast something is moving without a concern for the direction.
Terminal velocity	Where the downward force of gravity equals the force of drag.
Vector	A quantity that has a direction and size.
Velocity	How fast something is moving in a particular direction.
Weight	The force with which an object near the Earth or another celestial body is attracted toward the centre of the body by gravity
Air bags	A safety device in a car, consisting of a bag that inflates automatically in an accident in order to increase the time it takes the person to slow down and reduce the force on their body.
Braking distance	The braking distance is the distance taken to stop once the brakes are applied.
Crumple zones	A part of a motor vehicle, esp. the extreme front and rear, designed to crumple easily in a crash and absorb the main force of an impact.
Crumple zones	A part of a motor vehicle, esp. the extreme front and rear, designed to crumple easily in a crash and absorb the main force of an impact (by increasing the time it takes the vehicle to stop).
Energy transferred	The amount of energy being transferred from one place to another.
Friction	The resistance that one surface or object encounters when moving over another.
Gravitational potential energy	The energy that must be used against gravitational forces to move a particle of mass.

Joules (J)	The measurement of work done and energy transferred.
Kinetic energy	This is the energy something has when moving.
Kinetic energy	This is the energy something has when moving.
Momentum	The tendency of the object to keep moving in the same direction
Power	How quickly work is being done and therefore how quickly energy is being transferred.
Reaction time	The time that goes by between a stimulus and the response to it.
Seat belt	A safety device used in a car or plane to cause you to slow down over a longer period of time, thus reducing the force on the body in an accident.
Stopping distance	Stopping distance is the distance it takes for a car to stop from a specific speed.
Thinking distance	The thinking distance is the distance travelled in between the driver realising he needs to brake
Vector quantity	An amount or measurement that is related to a direction. Velocity, acceleration, and weight are vector quantities
Watts (W)	The measurement of power, it is equal to one joule per second.
Work	The amount of energy transferred doing something.
Alpha particles	Ionising radiation containing 2 neutrons and 2 protons (helium nucleus).
Atomic number	The amount of protons that an element has.
Beta particles	High-speed electrons that are emitted from an unstable nucleus
Chain reaction	A reaction which causes many others one after the other.
Control rods	Structures which absorb the neutrons, these are placed between the fuel rods in the core
Core	Where the fuel and control rods are placed and the reaction is occurring.
Daughter nuclei	The remaining nuclide left over from radioactive decay.
Decays	When the nucleus of an atom breaks down causing it to emit radiation
Gamma rays	High frequency electromagnetic waves emitted by some unstable nuclei and so travel at the speed of light
Ion	An atom which has gained or lost electrons.
Ionising radiation	Radiation that causes atoms to lose electrons and become ions
Isotopes	A different atomic form of the same element with the same number of protons but a different number of neutrons.
Mass number	The number of protons and neutrons in the nucleus of an atom.
Moderator	Something that slows down a nuclear reaction by slowing/absorbing neutrons.
Nuclear fission	A nuclear reaction in which a heavy nucleus splits spontaneously or on impact with another particle, with the release of energy
Nuclear fusion	A nuclear reaction in which atomic nuclei of low atomic number fuse to form a heavier nucleus with the release of energy
Nuclear reactors	This transforms the energy contained in the nuclei of uranium and plutonium atom, into thermal energy using nuclear fission
Nucleon number	The number of protons and neutrons found in the nucleus of an atom. An alternative name for mass number.
Nucleons	The particles found in the nucleus are called this.
Penetration distance	How far ionising radiation can travel through a substance.
Proton number	The number of protons that an element has.
Radioactive	When a substance has an unstable nucleus, resulting in release or nuclear radiation.
Random	Without a fixed time or pattern.
Sub-atomic particles	The smaller particles that make up an atom.
Unstable	An atom which has too many neutrons could be said to be this.
Activity	How much radiation is produced.

Background count	The amount of background radiation.
Background radiation	Small amounts of radiation in the atmosphere
Becquerel (Bq)	A unit of measurement, number of nuclear decays per second.
Cosmic rays	The radiation emitted from space.
Count rate	Number of clicks per second or minute of ionising radiation
Electrostatic repulsion	When two of the same charges repel each other
Geiger-Müller (GM) tube	Measures intensity of radiation.
Half-life	The time taken for half the undecayed nuclei to decay.
Hazards	Dangers to a person or object
High level waste (HLW)	Sealed in glass canisters and concreted over until the radiation becomes low level.
Intermediate level waste (ILW)	Contained in metal cylinders because they become radioactive.
Irradiated	To expose to radiation. For example to when you expose food to gamma rays to kill microorganisms you are irradiating the food.
Low level waste (LLW)	Not as radioactive, buried and compacted in special sites.
Mutation	The changing of a structure, resulting in a variant
Peer-reviewed	Reviewed by someone with knowledge on the subject
Radioactive	Something that emits ionising radiation
Radioactive decay	When an unstable radioactive nuclei decays and emits ionising radiation.
Radioactive waste	Made up of radioactive daughter nuclei and radioactive isotopes formed when the materials in the core absorb neutrons
Radiotherapy	The controlled use of high energy X-rays to treat many different types of cancer. In some cases, radiotherapy can also be used to treat non-cancerous tumours.
Radon	A gas emitted produced by the natural decay of radioactive sources. E.g. Uranium.
Risk	A situation involving exposure to danger
Sterilised	To make something free from bacteria or other living microorganisms using Radiation
Tracer	These are used for tracking substances such as: -Find leaks or blockages in underground pipes -Find the route of underground pipes -Track the dispersal of waste
Validated	To check or prove the accuracy of something