Science Faculty

Physics: Energy Checklist

Assessment Guidance

You will be assessed on some of the following criteria form your exam board. The assessment will last for 50miutes and be worth 50 marks, it will include a range of questions, including some multiple choice questions, some short answer questions and some questions which require longer answers. To access the highest marks for your test, use as many key scientific words as possible.

Equipment you will need: pen, pencil, calculator, ruler, compass and protractor.

Energy			**check**
foundation	higher	**triple**	
A system is an object or group of objects.			
There are changes in the way energy is stored when a system changes.			
Students should be able to describe all the changes involved in the way energy is stored when a system changes, for common situations. For example: • an object projected upwards • a moving object hitting an obstacle • an object accelerated by a constant force • a vehicle slowing down • bringing water to a boil in an electric kettle.			
Throughout this section on Energy students should be able to calculate the changes in energy involved when a system is changed by: • heating • work done by forces ~~• work done when a current flows~~			
use calculations to show how the overall energy in a system is redistributed when the system is changed.			
Students should be able to calculate the amount of energy associated with a moving object, a stretched spring and an object raised above ground level.			
Students should be able to recall and apply this equation. **kinetic energy = 0.5 × mass × speed^2**			
The amount of elastic potential energy stored in a stretched spring can be calculated using the equation: **elastic potential energy = 0.5 × spring constant × extension^2**			
The amount of gravitational potential energy gained by an object raised above ground level can be calculated using the equation: **g . p . e . = mass × gravitational field strength × height**			
The amount of energy stored in or released from a system as its temperature changes can be calculated using the equation: c**hange in thermal energy = mass × specific heat capacity × temperature change** which is given on the Physics equation sheet.			
The specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius.			
investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store (or work done) to the increase in temperature and subsequent increase in thermal energy stored.			
Power is defined as the rate at which energy is transferred or the rate at which work is done.			

Students should be able to recall and apply both equations. **power = energy transferred/time power = work done/time**	
~~An energy transfer of 1 joule per second is equal to a power of 1 watt.~~	
~~Students should be able to give examples that illustrate the definition of power eg comparing two electric motors that both lift the same weight through the same height but one does it faster than the other.~~	
Energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed.	
Students should be able to describe with examples where there are energy transfers in a closed system, that there is no net change to the total energy.	
Students should be able to describe, with examples, how in all system changes energy is dissipated, so that it is stored in less useful ways. This energy is often described as being 'wasted'.	
Students should be able to explain ways of reducing unwanted energy transfers, for example through lubrication and the use of thermal insulation.	
The higher the thermal conductivity of a material the higher the rate of energy transfer by conduction across the material.	
Students should be able to describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls.	
investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material.	
The energy efficiency for any energy transfer can be calculated using the equation: **efficiency = useful out put energy transfer/total in put energy transfer** Efficiency may also be calculated using the equation: **efficiency = useful power output/total power input** Students should be able to recall and apply both equations.	
Students should be able to describe ways to increase the efficiency of an intended energy transfer.	
The main energy resources available for use on Earth include: fossil fuels (coal, oil and gas), nuclear fuel, bio-fuel, wind, hydroelectricity, geothermal, the tides, the Sun and water waves.	
A renewable energy resource is one that is being (or can be) replenished as it is used.	
The uses of energy resources include: transport, electricity generation and heating.	
describe the main energy sources available	
distinguish between energy resources that are renewable and energy resources that are non-renewable	
compare ways that different energy resources are used, the uses to include transport, electricity generation and heating	
understand why some energy resources are more reliable than others	
describe the environmental impact arising from the use of different energy resources	
explain patterns and trends in the use of energy resources.	
consider the environmental issues that may arise from the use of different energy resources	
show that science has the ability to identify environmental issues arising from the use of energy resources but not always the power to deal with the issues because of political, social, ethical or economic considerations.	

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Physics: Simple Circuits Checklist

Assessment Guidance

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Equipment you will need: pen, pencil, calculator, ruler, compass and protractor.

	Simple circuits			check
	foundation	higher	**triple**	
Standard circuit diagram symbols	Circuit diagrams use standard symbols for a switch, cell, battery, diode, resistor, variable resistor, LED, lamp, fuse, voltmeter, ammeter, thermistor, LDR			
Electrical charge and current	For electrical charge to flow through a closed circuit the circuit must include a source of potential difference.			
	Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge.			
	Students should be able to recall and apply **charge flow = current × time** equation.			
	A current has the same value at any point in a single closed loop.			
Current, resistance and potential difference	The current (I) through a component depends on both the resistance (R) of the component and the potential difference (V) across the component. The greater the resistance of the component the smaller the current for a given potential difference (pd) across the component.			
	Students should be able to recall and apply **potential difference = current × resistance** equation.			
Required practical activity 3	Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include: • the length of a wire at constant temperature • combinations of resistors in series and parallel.			
Resistors	Students should be able to explain that, for some resistors, the value of R remains constant but that in others it can change as the current changes.			
	The current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor. This means that the resistance remains constant as the current changes.			
	The resistance of components such as lamps, diodes, thermistors and LDRs is not constant; it changes with the current through the component.			
	The resistance of a filament lamp increases as the temperature of the filament increases.			
	The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction.			
	The resistance of a thermistor decreases as the temperature increases.			
	The applications of thermistors in circuits eg a thermostat is required.			
	The resistance of an LDR decreases as light intensity increases.			
	The application of LDRs in circuits eg switching lights on when it gets dark is required.			
	explain the design and use of a circuit to measure the resistance of a component by measuring the current through, and potential difference across, the component			

	draw an appropriate circuit diagram using correct circuit symbols.	
	Students should be able to use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties.	
Required practical activity 4	use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements, including a filament lamp, a diode and a resistor at constant temperature.	
Series and parallel circuits	There are two ways of joining electrical components, in series and in parallel. Some circuits include both series and parallel parts.	
	For components connected in series: • there is the same current through each component • the total potential difference of the power supply is shared between the components • the total resistance of two components is the sum of the resistance of each component.	
	For components connected in parallel: • the potential difference across each component is the same • the total current through the whole circuit is the sum of the currents through the separate components • the total resistance of two resistors is less than the resistance of the smallest individual resistor.	
	use circuit diagrams to construct and check series and parallel circuits that include a variety of common circuit components	
	describe the difference between series and parallel circuits	
	explain qualitatively why adding resistors in series increases the total resistance whilst adding resistors in parallel decreases the total resistance	
	explain the design and use of dc series circuits for measurement and testing purposes	
	calculate the currents, potential differences and resistances in dc series circuits	
	solve problems for circuits which include resistors in series using the concept of equivalent resistance.	
Direct and alternating potential difference	Mains electricity is an ac supply. In the United Kingdom the domestic electricity supply has a frequency of 50 Hz and is about 230 V.	
	Students should be able to explain the difference between direct and alternating potential difference.	
	Most electrical appliances are connected to the mains using threecore cable. The insulation covering each wire is colour coded for easy identification: live wire – brown neutral wire – blue earth wire – green and yellow stripes.	
	The live wire carries the alternating potential difference from the supply. The neutral wire completes the circuit. The earth wire is a safety wire to stop the appliance becoming live.	
	The potential difference between the live wire and earth (0 V) is about 230 V. The neutral wire is at, or close to, earth potential (0 V). The earth wire is at 0 V, it only carries a current if there is a fault.	
	Explain that a live wire may be dangerous even when a switch in the mains circuit is open	
	Explain the dangers of providing any connection between the live wire and earth.	
Power	Students should be able to explain how the power transfer in any circuit device is related to the potential difference across it and the current through it, and to the energy changes over time	
	Students should be able to recall and apply both equations. **power = potential difference × current** **power = current^2 × resistance**	
Energy transfers in everyday appliances	Everyday electrical appliances are designed to bring about energy transfers.	
	The amount of energy an appliance transfers depends on how long the appliance is switched on for and the power of the appliance.	
	Students should be able to describe how different domestic appliances transfer energy from batteries or ac mains to the kinetic energy of electric motors or the energy of heating devices.	
	Work is done when charge flows in a circuit.	
	Students should be able to recall and apply both equations.	

	energy transferred = power × time energy trans f erred = charge flow × potential difference	
	explain how the power of a circuit device is related to the potential difference across it and the current through it	
	explain how the power of a circuit device is related to the energy transferred over a given time.	
	Students should be able to describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use.	
The National Grid	The National Grid is a system of cables and transformers linking power stations to consumers.	
	Electrical power is transferred from power stations to consumers using the National Grid.	
	Step-up transformers are used to increase the potential difference from the power station to the transmission cables then step-down transformers are used to decrease, to a much lower value, the potential difference for domestic use.	
	Students should be able to explain why the National Grid system is an efficient way to transfer energy.	
Static charge	**When certain insulating materials are rubbed against each other they become electrically charged. Negatively charged electrons are rubbed off one material and on to the other. The material that gains electrons becomes negatively charged. The material that loses electrons is left with an equal positive charge.**	
	When two electrically charged objects are brought close together they exert a force on each other. Two objects that carry the same type of charge repel. Two objects that carry different types of charge attract. Attraction and repulsion between two charged objects are examples of non-contact force.	
	describe the production of static electricity, and sparking, by rubbing surfaces	
	describe evidence that charged objects exert forces of attraction or repulsion on one another when not in contact	
	explain how the transfer of electrons between objects can explain the phenomena of static electricity.	
Electric fields	**A charged object creates an electric field around itself. The electric field is strongest close to the charged object. The further away from the charged object, the weaker the field.**	
	A second charged object placed in the field experiences a force. The force gets stronger as the distance between the objects decreases.	
	draw the electric field pattern for an isolated charged sphere	
	explain the concept of an electric field	
	explain how the concept of an electric field helps to explain the non-contact force between charged objects as well as other electrostatic phenomena such as sparking.	

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Physics: Particles Checklist

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Equipment you will need: pen, pencil, calculator, ruler, compass and protractor.

	Particles	check

Density of materials	Students should be able to recall and apply the density equation to changes where mass is conserved. **density = mass/volume**	
	Students should be able to recognise/draw simple diagrams to model the difference between solids, liquids and gases.	
	Students should be able to explain the differences in density between the different states of matter in terms of the arrangement of atoms or molecules.	
Required practical activity 5:	Use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids. Volume should be determined from the dimensions of regularly shaped objects, and by a displacement technique for irregularly shaped objects. Dimensions to be measured using appropriate apparatus such as a ruler, micrometer or Vernier callipers.	
Changes of state	Students should be able to describe how, when substances change state (melt, freeze, boil, evaporate, condense or sublimate), mass is conserved.	
	Changes of state are physical changes which differ from chemical changes because the material recovers its original properties if the change is reversed.	
Internal energy	Energy is stored inside a system by the particles (atoms and molecules) that make up the system. This is called internal energy.	
	Internal energy is the total kinetic energy and potential energy of all the particles (atoms and molecules) that make up a system.	
	Heating changes the energy stored within the system by increasing the energy of the particles that make up the system. This either raises the temperature of the system or produces a change of state.	
Temperature changes in a system and specific heat capacity	If the temperature of the system increases, the increase in temperature depends on the mass of the substance heated, the type of material and the energy input to the system.	
	The specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius.	
	Students should be able to apply $\Delta E = m c \Delta \theta$ equation, which is given on the Physics equation sheet, to calculate the energy change involved when the temperature of a material changes.	
Changes of heat and specific latent heat	If a change of state happens: The energy needed for a substance to change state is called latent heat. When a change of state occurs, the energy supplied changes the energy stored (internal energy) but not the temperature.	
	The specific latent heat of a substance is the amount of energy required to change the state of one kilogram of the substance with no change in temperature.	
	Specific latent heat of fusion – change of state from solid to liquid/Specific latent heat of vaporisation – change of state from liquid to vapour	
	Students should be able to apply $E = m L$ equation, which is given on the Physics equation sheet, to calculate the energy change involved in a change of state.	
	Students should be able to interpret heating and cooling graphs that include changes of state.	
	Students should be able to distinguish between specific heat capacity and specific latent heat.	
Particle motion in gases	The molecules of a gas are in constant random motion. The temperature of the gas is related to the average kinetic energy of the molecules.	
	Changing the temperature of a gas, held at constant volume, changes the pressure exerted by the gas.	
	explain how the motion of the molecules in a gas is related to both its temperature and its pressure	
	explain qualitatively the relation between the temperature of a gas and its pressure at constant volume.	
Pressure in gases *Triples only*	**A gas can be compressed or expanded by pressure changes. The pressure produces a net force at right angles to the wall of the gas container (or any surface).**	
	Changing the temperature of a gas, held at constant volume, changes the pressure exerted by the gas.	

	explain how the motion of the molecules in a gas is related to both its temperature and its pressure	
	explain qualitatively the relation between the temperature of a gas and its pressure at constant volume.	
	A gas can be compressed or expanded by pressure changes. The pressure produces a net force at right angles to the wall of the gas container (or any surface).	
	Students should be able to use the particle model to explain how increasing the volume in which a gas is contained, at constant temperature, can lead to a decrease in pressure.	
	Students should be able to apply p V = constant equation which is given on the Physics equation sheet.	
	Students should be able to calculate the change in the pressure of a gas or the volume of a gas (a fixed mass held at constant temperature) when either the pressure or volume is increased or decreased.	
Increasing the pressure of a gas *Triples only*	**Work is the transfer of energy by a force.**	
	Doing work on a gas increases the internal energy of the gas and can cause an increase in the temperature of the gas.	
	Students should be able to explain how, in a given situation eg a bicycle pump, doing work on an enclosed gas leads to an increase in the temperature of the gas.	

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Physics: Atomic Structure Checklist

Assessment Guidance

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	Atomic Structure	check
The structure of an atom	Atoms are very small, having a radius of about 1 × 10-10 metres.	
	The basic structure of an atom is a positively charged nucleus composed of both protons and neutrons surrounded by negatively charged electrons.	
	The radius of a nucleus is less than 1/10 000 of the radius of an atom. Most of the mass of an atom is concentrated in the nucleus.	
	The electrons are arranged at different distances from the nucleus (different energy levels). The electron arrangements may change with the absorption of electromagnetic radiation (move further from the nucleus; a higher energy level) or by the emission of electromagnetic radiation (move closer to the nucleus; a lower energy level).	
	In an atom the number of electrons is equal to the number of protons in the nucleus. Atoms have no overall electrical charge.	
	All atoms of a particular element have the same number of protons. The number of protons in an atom of an element is called its atomic number.	
	The total number of protons and neutrons in an atom is called its mass number.	
	Atoms of the same element can have different numbers of neutrons; these atoms are called isotopes of that element.	

	Atoms turn into positive ions if they lose one or more outer electron(s).	
	Students should be able to relate differences between isotopes to differences in conventional representations of their identities, charges and masses.	
The development of the model of the atom	New experimental evidence may lead to a scientific model being changed or replaced.	
	Before the discovery of the electron, atoms were thought to be tiny spheres that could not be divided.	
	The discovery of the electron led to the plum pudding model of the atom. The model suggested that the atom is a ball of positive charge with negative electrons embedded in it.	
	The results from the alpha particle scattering experiment led to the conclusion that the mass of an atom was concentrated at the centre (nucleus) and that the nucleus was charged. This nuclear model replaced the plum pudding model.	
	Niels Bohr adapted the nuclear model by suggesting that electrons orbit the nucleus at specific distances. The theoretical calculations of Bohr agreed with experimental observations.	
	Later experiments led to the idea that the positive charge of any nucleus could be subdivided into a whole number of smaller particles, each particle having the same amount of positive charge. The name proton was given to these particles.	
	The experimental work of James Chadwick provided the evidence to show the existence of neutrons within the nucleus. This was about 20 years after the nucleus became an accepted scientific idea.	
	why the new evidence from the scattering experiment led to a change in the atomic model	
	the difference between the plum pudding model of the atom and the nuclear model of the atom.	
Radioactive decay and nuclear radiation	Some atomic nuclei are unstable. The nucleus gives out radiation as it changes to become more stable. This is a random process called radioactive decay.	
	Activity is the rate at which a source of unstable nuclei decays	
	Activity is measured in becquerel (Bq)	
	Count-rate is the number of decays recorded each second by a detector (eg Geiger-Muller tube).	
	The nuclear radiation emitted may be: • an alpha particle (α) – this consists of two neutrons and two protons, it is the same as a helium nucleus • a beta particle (β) – a high speed electron ejected from the nucleus as a neutron turns into a proton • a gamma ray (γ) – electromagnetic radiation from the nucleus • a neutron (n).	
	Required knowledge of the properties of alpha particles, beta particles and gamma rays is limited to their penetration through materials, their range in air and ionising power.	
	Students should be able to apply their knowledge to the uses of radiation and evaluate the best sources of radiation to use in a given situation.	
Nuclear equations	Nuclear equations are used to represent radioactive decay.	
	beta decay does not cause the mass of the nucleus to change but does cause the charge of the nucleus to increase.	
	Students should be able to use the names and symbols of common nuclei and particles to write balanced equations that show single alpha (α) and beta (β) decay. This is limited to balancing the atomic numbers and mass numbers.	
	The emission of a gamma ray does not cause the mass or the charge of the nucleus to change.	
Half-lives and the random nature of radioactive decay	Radioactive decay is random.	
	The half-life of a radioactive isotope is the time it takes for the number of nuclei of the isotope in a sample to halve, or the time it takes for the count rate (or activity) from a sample containing the isotope to fall to half its initial level.	
	Explain the concept of half-life and how it is related to the random nature of radioactive decay.	
	determine the half-life of a radioactive isotope from given information.	

Radioactive contamination	Radioactive contamination is the unwanted presence of materials containing radioactive atoms on other materials. The hazard from contamination is due to the decay of the contaminating atoms. The type of radiation emitted affects the level of hazard.	
	Irradiation is the process of exposing an object to nuclear radiation. The irradiated object does not become radioactive.	
	Students should be able to compare the hazards associated with contamination and irradiation.	
	Suitable precautions must be taken to protect against any hazard that the radioactive source used in the process of irradiation may present.	
	Students should understand that it is important for the findings of studies into the effects of radiation on humans to be published and shared with other scientists so that the findings can be checked by peer review.	
Background radiation	Background radiation is around us all of the time. It comes from: • natural sources such as rocks and cosmic rays from space • man-made sources such as the fallout from nuclear weapons testing and nuclear accidents.	
	The level of background radiation and radiation dose may be affected by occupation/location.	
	Radiation dose is measured in sieverts (Sv)	
	1000 millisieverts (mSv) = 1 sievert (Sv)	
Different half-lives of radioactive isotopes	Radioactive isotopes have a very wide range of half-life values.	
	Students should be able to explain why the hazards associated with radioactive material differ according to the half-life involved.	
Uses of nuclear radiation	Nuclear radiations are used in medicine for the: • exploration of internal organs • control or destruction of unwanted tissue.	
	describe and evaluate the uses of nuclear radiations for exploration of internal organs, and for control or destruction of unwanted tissue	
	evaluate the perceived risks of using nuclear radiations in relation to given data and consequences.	
Nuclear fission	Nuclear fission is the splitting of a large and unstable nucleus (eg uranium or plutonium).	
	Spontaneous fission is rare. Usually, for fission to occur the unstable nucleus must first absorb a neutron.	
	The nucleus undergoing fission splits into two smaller nuclei, roughly equal in size, and emits two or three neutrons plus gamma rays. Energy is released by the fission reaction.	
	All of the fission products have kinetic energy.	
	The neutrons may go on to start a chain reaction.	
	The chain reaction is controlled in a nuclear reactor to control the energy released. The explosion caused by a nuclear weapon is caused by an uncontrolled chain reaction.	
	draw/interpret diagrams representing nuclear fission and how a chain reaction may occur.	
Nuclear fusion	Nuclear fusion is the joining of two light nuclei to form a heavier nucleus. In this process some of the mass may be converted into the energy of radiation.	

Science Faculty

Physics: Forces Checklist

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Equipment you will need: pen, pencil, calculator, ruler, compass and protractor.

	Forces foundation / higher / **triple**	**RAG**
Scalar and vector quantities	Scalar quantities have magnitude only.	
	Vector quantities have magnitude and an associated direction.	
	A vector quantity may be represented by an arrow. The length of the arrow represents the magnitude, and the direction of the arrow the direction of the vector quantity.	
Contact and non-contact forces	A force is a push or pull that acts on an object due to the interaction with another object. All forces between objects are either: • contact forces – the objects are physically touching • non-contact forces – the objects are physically separated.	
	Examples of contact forces include friction, air resistance, tension and normal contact force.	
	Examples of non-contact forces are gravitational force, electrostatic force and magnetic force.	
	Force is a vector quantity.	
	Students should be able to describe the interaction between pairs of objects which produce a force on each object. The forces to be represented as vectors.	
Gravity	Weight is the force acting on an object due to gravity. The force of gravity close to the Earth is due to the gravitational field around the Earth.	
	The weight of an object depends on the gravitational field strength at the point where the object is.	
	Recall and apply **weight = mass × gravitational** field strength equation.	
	The weight of an object may be considered to act at a single point referred to as the object's 'centre of mass'.	
	The weight of an object and the mass of an object are directly proportional.	
Resultant forces	A number of forces acting on an object may be replaced by a single force that has the same effect as all the original forces acting together. This single force is called the resultant force.	
	Students should be able to calculate the resultant of two forces that act in a straight line.	
	describe examples of the forces acting on an isolated object or system	
	Use free body diagrams to describe qualitatively examples where several forces lead to a resultant force on an object, including balanced forces when the resultant force is zero.	
	A single force can be resolved into two components acting at right angles to each other. The two component forces together have the same effect as the single force.	
	Students should be able to use vector diagrams to illustrate resolution of forces, equilibrium situations and determine the resultant of two forces, to include both magnitude and direction (scale drawings only).	
Distance and displacement	Distance is how far an object moves and does not involve direction. It is a scalar quantity.	
	Displacement includes both the distance an object moves, measured in a straight line from the start point to the finish point and the direction of that straight line. Displacement is a vector quantity.	
	Express a displacement in terms of both the magnitude and direction.	
Speed	Speed does not involve direction. Speed is a scalar quantity.	
	The speed of a moving object is rarely constant. When people walk, run or travel in a car their speed is constantly changing.	
	The speed at which a person can walk, run or cycle depends on many factors including: age, terrain, fitness and distance travelled. Typical values may be taken as: walking ~ 1.5 m/s; running ~ 3 m/s; cycling ~ 6 m/s.	

	Students should be able to recall typical values of speed for a person walking, running and cycling as well as the typical values of speed for different types of transportation systems	
	It is not only moving objects that have varying speed. The speed of sound and the speed of the wind also vary.	
	A typical value for the speed of sound in air is 330 m/s.	
	Students should be able to make measurements of distance and time and then calculate speeds of objects.	
	Students should be able to recall and apply s = v t equation.	
	Students should be able to calculate average speed for non-uniform motion.	
Velocity	The velocity of an object is its speed in a given direction. Velocity is a vector quantity.	
	Students should be able to explain the vector–scalar distinction as it applies to displacement, distance, velocity and speed.	
	Students should be able to explain qualitatively, with examples, that motion in a circle involves constant speed but changing velocity.	
The distance–time relationship	If an object moves along a straight line, the distance travelled can be represented by a distance–time graph.	
	The speed of an object can be calculated from the gradient of its distance–time graph.	
	Students should be able to draw distance–time graphs from measurements and extract and interpret lines and slopes of distance–time graphs, translating information between graphical and numerical form.	
	Students should be able to determine speed from a distance–time graph.	
	If an object is accelerating, its speed at any particular time can be determined by drawing a tangent and measuring the gradient of the distance–time graph at that time.	
Acceleration	Students should be able to recall and apply **acceleration = change in velocity/time taken** equation.	
	An object that slows down is decelerating.	
	The acceleration of an object can be calculated from the gradient of a velocity–time graph.	
	draw velocity–time graphs from measurements and interpret lines and slopes to determine acceleration	
	Students should be able to apply **final velocity^2-initial velocity^2 = 2 × acceleration × distanc**e equation which is given on the Physics equation sheet.	
	Near the Earth's surface any object falling freely under gravity has an acceleration of about 9.8 m/s2.	
	An object falling through a fluid initially accelerates due to the force of gravity. Eventually the resultant force will be zero and the object will move at its terminal velocity.	
	The distance travelled by an object (or displacement of an object) can be calculated from the area under a velocity–time graph.	
	interpret enclosed areas in velocity–time graphs to determine distance travelled (or displacement)	
	measure, when appropriate, the area under a velocity–time graph by counting squares.	
	draw and interpret velocity–time graphs for objects that reach terminal velocity	
	interpret the changing motion in terms of the forces acting.	
Newton's First Law	If the resultant force acting on an object is zero and: • the object is stationary, the object remains stationary • the object is moving, the object continues to move at the same speed and in the same direction. So the object continues to move at the same velocity.	
	So, when a vehicle travels at a steady speed the resistive forces balance the driving force.	
	So, the velocity (speed and/or direction) of an object will only change if a resultant force is acting on the object.	
	Students should be able to apply Newton's First Law to explain the motion of objects moving with a uniform velocity and objects where the speed and/or direction changes.	
	The tendency of objects to continue in their state of rest or of uniform motion is called inertia.	

Newton's Second Law	The acceleration of an object is proportional to the resultant force acting on the object, and inversely proportional to the mass of the object.	
	Students should be able to recall and apply **F=ma** equation.	
	Students should be able to estimate the speed, accelerations and forces involved in large accelerations for everyday road transport.	
	Students should be able to explain that: • inertial mass is a measure of how difficult it is to change the velocity of an object • inertial mass is defined as the ratio of force over acceleration	
Required practical activity 7	investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force.	
Newton's Third Law	Whenever two objects interact, the forces they exert on each other are equal and opposite.	
	Students should be able to apply Newton's Third Law to examples of equilibrium situations.	
Forces and breaking	The stopping distance of a vehicle is the sum of the distance the vehicle travels during the driver's reaction time (thinking distance) and the distance it travels under the braking force (braking distance). For a given braking force the greater the speed of the vehicle, the greater the stopping distance.	
	Reaction times vary from person to person. Typical values range from 0.2 s to 0.9 s.	
	driver's reaction time can be affected by tiredness, drugs and alcohol. Distractions may also affect a driver's ability to react.	
	explain methods used to measure human reaction times and recall typical results	
	interpret and evaluate measurements from simple methods to measure the different reaction times of students	
	evaluate the effect of various factors on thinking distance based on given data.	
	Students should be able to estimate how the distance for a vehicle to make an emergency stop varies over a range of speeds typical for that vehicle.	
	Students will be required to interpret graphs relating speed to stopping distance for a range of vehicles.	
Factors affecting braking distance	The braking distance of a vehicle can be affected by adverse road and weather conditions and poor condition of the vehicle.	
	Adverse road conditions include wet or icy conditions. Poor condition of the vehicle is limited to the vehicle's brakes or tyres.	
	explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies, and the implications for safety	
	estimate how the distance required for road vehicles to stop in an emergency varies over a range of typical speeds.	
	When a force is applied to the brakes of a vehicle, work done by the friction force between the brakes and the wheel reduces the kinetic energy of the vehicle and the temperature of the brakes increases.	
	The greater the speed of a vehicle the greater the braking force needed to stop the vehicle in a certain distance.	
	The greater the braking force the greater the deceleration of the vehicle. Large decelerations may lead to brakes overheating and/or loss of control.	
	estimate the forces involved in the deceleration of road vehicles in typical situations on a public road.	
	explain the dangers caused by large decelerations	
Momentum is a property of moving objects	Students should be able to recall and apply **momentum = mass × velocity** equation.	
	complete calculations involving an event, such as the collision of two objects.	
	In a closed system, the total momentum before an event is equal to the total momentum after the event.	

Conservation of momentum	describe and explain examples of momentum in an event, such as a collision	
Changes in momentum	**When a force acts on an object that is moving, or able to move, a change in momentum occurs.**	
	Students should be able to apply $F = m \Delta v/\Delta t$ equation which is given on the Physics Equation sheet.	
	The equations $F = m \times a$ and $a = v - u/t$ combine to give the equation $F = m \Delta v/\Delta t$	
	Students should be able to explain safety features such as: air bags, seat belts, gymnasium crash mats, cycle helmets and cushioned surfaces for playgrounds with reference to the concept of rate of change of momentum.	
	Students should be able to apply equations relating force, mass, velocity and acceleration to explain how the changes involved are inter-related.	
	When a force causes an object to move through a distance work is done on the object. So a force does work on an object when the force causes a displacement of the object.	
	Students should be able to recall and apply work done = force × distance equation.	
	One joule of work is done when a force of one newton causes a displacement of one metre. 1 joule = 1 newton-metre	
	Students should be able to describe the energy transfer involved when work is done.	
	Students should be able to convert between newton-metres and joules.	
	Work done against the frictional forces acting on an object causes a rise in the temperature of the object.	
	give examples of the forces involved in stretching, bending or compressing an object	
	explain why, to change the shape of an object (by stretching, bending or compressing), more than one force has to be applied – this is limited to stationary objects only	
	describe the difference between elastic deformation and inelastic deformation caused by stretching forces.	
	The extension of an elastic object, such as a spring, is directly proportional to the force applied, provided that the limit of proportionality is not exceeded.	
	Students should be able to recall and apply force = spring constant × extension equation.	
	This relationship also applies to the compression of an elastic object, where 'extension' would be the compression of the object.	
	A force that stretches (or compresses) a spring does work and elastic potential energy is stored in the spring. Provided the spring is not inelastically deformed, the work done on the spring and the elastic potential energy stored are equal.	
	describe the difference between a linear and non-linear relationship between force and extension	
	calculate a spring constant in linear cases	
	interpret data from an investigation of the relationship between force and extension	
	calculate work done in stretching (or compressing) a spring (up to the limit of proportionality) using the equation which is given on the Physics equation sheet. elastic potential energy = 0.5 × spring constant×extension2	

	Students should be able to calculate relevant values of stored energy and energy transfers.	
	investigate the relationship between force and extension for a spring.	
	A force or a system of forces may cause an object to rotate.	
	Students should be able to describe examples in which forces cause rotation.	
	Students should be able to recall and apply moment o f a force = force × distance equation.	
	If an object is balanced, the total clockwise moment about a pivot equals the total anticlockwise moment about that pivot.	
	Students should be able to calculate the size of a force, or its distance from a pivot, acting on an object that is balanced.	
	A simple lever and a simple gear system can both be used to transmit the rotational effects of forces.	
	Students should be able to explain how levers and gears transmit the rotational effects of forces.	
	A fluid can be either a liquid or a gas.	
	The pressure in fluids causes a force normal (at right angles) to any surface.	
	Students should be able to recall and apply pressure = force normal to a surface/area of that surface equation.	
	Students should be able to apply pressure = height of the column × density of the liquid × gravitational field strength equation which is equation sheet.	
	Students should be able to explain why, in a liquid, pressure at a point increases with the height of the column of liquid above that point and with the density of the liquid.	
	Students should be able to calculate the differences in pressure at different depths in a liquid.	
	A partially (or totally) submerged object experiences a greater pressure on the bottom surface than on the top surface. This creates a resultant force upwards. This force is called the upthrust.	
	Students should be able to describe the factors which influence floating and sinking.	
	The atmosphere is a thin layer (relative to the size of the Earth) of air round the Earth. The atmosphere gets less dense with increasing altitude.	
	Air molecules colliding with a surface create atmospheric pressure. The number of air molecules (and so the weight of air) above a surface decreases as the height of the surface above ground level increases. So as height increases there is always less air above a surface than there is at a lower height. So atmospheric pressure decreases with an increase in height	
	describe a simple model of the Earth's atmosphere and of atmospheric pressure	
	explain why atmospheric pressure varies with height above a surface.	

Science Faculty

Physics: Waves Checklist

Assessment Guidance

You will be assessed on some of the following criteria form your exam board. The assessment will last for 50miutes and be worth 50 marks, it will include a range of questions, including some multiple choice questions, some short answer questions and some questions which require longer answers. To access the highest marks for your test, use as many key scientific words as possible.

Equipment you will need: pen, pencil, calculator, ruler, compass and protractor.

Electromagnetic spectrum			RAG
foundation	higher	**triple**	
Electromagnetic waves are transverse waves that transfer energy from the source of the waves to an absorber.			
Electromagnetic waves form a continuous spectrum and all types of electromagnetic wave travel at the same velocity through a vacuum (space) or air.			
The waves that form the electromagnetic spectrum are grouped in terms of their wavelength and their frequency. Going from long to short wavelength (or from low to high frequency) the groups are: radio, microwave, infrared, visible light (red to violet), ultraviolet, Xrays and gamma rays.			
Students should be able to give examples that illustrate the transfer of energy by electromagnetic waves.			
Different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength.			
Some effects, for example refraction, are due to the difference in velocity of the waves in different substances.			
Students should be able to use wave front diagrams to explain refraction in terms of the change of speed that happens when a wave travels from one medium to a different medium.			
investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.			
Each colour within the visible light spectrum has its own narrow band of wavelength and frequency.			
Reflection from a smooth surface in a single direction is called specular reflection. Reflection from a rough surface causes scattering: this is called diffuse reflection.			
Colour filters work by absorbing certain wavelengths (and colour) and transmitting other wavelengths (and colour).			
The colour of an opaque object is determined by which wavelengths of light are more strongly reflected. Wavelengths that are not reflected are absorbed. If all wavelengths are reflected equally the object appears white. If all wavelengths are absorbed the objects appears black.			
Objects that transmit light are either transparent or translucent.			
how the colour of an object is related to the differential absorption, transmission and reflection of different wavelengths of light by the object			
the effect of viewing objects through filters or the effect on light of passing through filters			
why an opaque object has a particular colour.			

Changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed over a wide frequency range. Gamma rays originate from changes in the nucleus of an atom.	
Radio waves can be produced by oscillations in electrical circuits.	
Ultraviolet waves, X-rays and gamma rays can have hazardous effects on human body tissue. The effects depend on the type of radiation and the size of the dose. Radiation dose (in sieverts) is a measure of the risk of harm resulting from an exposure of the body to the radiation.	
When radio waves are absorbed they may create an alternating current with the same frequency as the radio wave itself, so radio waves can themselves induce oscillations in an electrical circuit.	
1000 millisieverts (mSv) = 1 sievert (Sv)	
Students should be able to draw conclusions from given data about the risks and consequences of exposure to radiation.	
Ultraviolet waves can cause skin to age prematurely and increase the risk of skin cancer. X-rays and gamma rays are ionising radiation that can cause the mutation of genes and cancer.	
Electromagnetic waves have many practical applications. For example: • radio waves – television and radio • microwaves – satellite communications, cooking food • infrared – electrical heaters, cooking food, infrared cameras • visible light – fibre optic communications • ultraviolet – energy efficient lamps, sun tanning • X-rays and gamma rays – medical imaging and treatments.	
Students should be able to give brief explanations why each type of electromagnetic wave is suitable for the practical application.	

Waves			**RAG**
foundation	higher	**triple**	
Waves may be either transverse or longitudinal.			
The ripples on a water surface are an example of a transverse wave.			
Longitudinal waves show areas of compression and rarefaction. Sound waves travelling through air are longitudinal.			
Students should be able to describe the difference between longitudinal and transverse waves.			
Students should be able to describe evidence that, for both ripples on a water surface and sound waves in air, it is the wave and not the water or air itself that travels.			
Students should be able to describe wave motion in terms of their amplitude, wavelength, frequency and period.			
Students should be able to show how changes in velocity, frequency and wavelength, in transmission of sound waves from one medium to another, are inter-related.			
The amplitude of a wave is the maximum displacement of a point on a wave away from its undisturbed position.			
The wavelength of a wave is the distance from a point on one wave to the equivalent point on the adjacent wave.			
The frequency of a wave is the number of waves passing a point each second.			

Students should be able to apply T = 1/f equation which is given on the Physics equation sheet.	
Students should be able to recall and apply v = f λ equation.	
identify amplitude and wavelength from given diagrams	
describe a method to measure the speed of sound waves in air	
describe a method to measure the speed of ripples on a water surface.	
make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid and take appropriate measurements.	
Waves can be reflected at the boundary between two different materials.	
Waves can be absorbed or transmitted at the boundary between two different materials.	
Students should be able to construct ray diagrams to illustrate the reflection of a wave at a surface.	
Students should be able to describe the effects of reflection, transmission and absorption of waves at material interfaces.	
investigate the reflection of light by different types of surface and the refraction of light by different substances.	
Sound waves can travel through solids causing vibrations in the solid.	
Within the ear, sound waves cause the ear drum and other parts to vibrate which causes the sensation of sound. The conversion of sound waves to vibrations of solids works over a limited frequency range. This restricts the limits of human hearing.	
describe, with examples, processes which convert wave disturbances between sound waves and vibrations in solids. Examples may include the effect of sound waves on the ear drum	
explain why such processes only work over a limited frequency range and the relevance of this to human hearing.	
Students should know that the range of normal human hearing is from 20 Hz to 20 kHz.	
Students should be able to explain in qualitative terms, how the differences in velocity, absorption and reflection between different types of wave in solids and liquids can be used both for detection and exploration of structures which are hidden from direct observation.	
Ultrasound waves have a frequency higher than the upper limit of hearing for humans. Ultrasound waves are partially reflected when they meet a boundary between two different media. The time taken for the reflections to reach a detector can be used to determine how far away such a boundary is. This allows ultrasound waves to be used for both medical and industrial imaging.	
Seismic waves are produced by earthquakes. P-waves are longitudinal, seismic waves. P-waves travel at different speeds through solids and liquids. S-waves are transverse, seismic waves. S-waves cannot travel through a liquid. P-waves and S-waves provide evidence for the structure and size of the Earth's core.	
Echo sounding, using high frequency sound waves is used to detect objects in deep water and measure water depth.	
Students should be aware that the study of seismic waves provided new evidence that led to discoveries about parts of the Earth which are not directly observable.	

Science Faculty

Physics: Magnetism Checklist

Assessment Guidance

You will be assessed on some of the following criteria form your exam board. The assessment will last for 50miutes and be worth 50 marks, it will include a range of questions, including some multiple choice questions, some short answer questions and some questions which require longer answers. To access the highest marks for your test, use as many key scientific words as possible.

Equipment you will need: pen, pencil, calculator, ruler, compass and protractor.

	Magnetism			**check**
	foundation	higher	**triple**	
Poles of a magnet	The poles of a magnet are the places where the magnetic forces are strongest. When two magnets are brought close together they exert a force on each other. Two like poles repel each other. Two unlike poles attract each other. Attraction and repulsion between two magnetic poles are examples of non-contact force.			
	A permanent magnet produces its own magnetic field. An induced magnet is a material that becomes a magnet when it is placed in a magnetic field. Induced magnetism always causes a force of attraction. When removed from the magnetic field an induced magnet loses most/all of its magnetism quickly.			
	describe the attraction and repulsion between unlike and like poles for permanent magnets			
	describe the difference between permanent and induced magnets.			
Magnetic fields	The region around a magnet where a force acts on another magnet or on a magnetic material (iron, steel, cobalt and nickel) is called the magnetic field.			
	The force between a magnet and a magnetic material is always one of attraction.			
	The strength of the magnetic field depends on the distance from the magnet. The field is strongest at the poles of the magnet.			
	The direction of the magnetic field at any point is given by the direction of the force that would act on another north pole placed at that point. The direction of a magnetic field line is from the north (seeking) pole of a magnet to the south(seeking) pole of the magnet.			
	magnetic compass contains a small bar magnet. The Earth has a magnetic field. The compass needle points in the direction of the Earth's magnetic field.			
	describe how to plot the magnetic field pattern of a magnet using a compass			
	draw the magnetic field pattern of a bar magnet showing how strength and direction change from one point to another			
	explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic			
Electromagnetism	When a current flows through a conducting wire a magnetic field is produced around the wire. The strength of the magnetic field depends on the current through the wire and the distance from the wire.			
	Shaping a wire to form a solenoid increases the strength of the magnetic field created by a current through the wire. The magnetic field inside a solenoid is strong and uniform.			
	The magnetic field around a solenoid has a similar shape to that of a bar magnet. Adding an iron core increases the strength of the magnetic field of a solenoid. An electromagnet is a solenoid with an iron core.			
	describe how the magnetic effect of a current can be demonstrated			
	draw the magnetic field pattern for a straight wire carrying a current and for a solenoid (showing the direction of the field)			
	explain how a solenoid arrangement can increase the magnetic effect of the current.			

	Students should be able to interpret diagrams of electromagnetic devices in order to explain how they work.	
Fleming's left-hand rule	When a conductor carrying a current is placed in a magnetic field the magnet producing the field and the conductor exert a force on each other. This is called the motor effect.	
	Students should be able to show that Fleming's left-hand rule represents the relative orientation of the force, the current in the conductor and the magnetic field.	
	Students should be able to recall the factors that affect the size of the force on the conductor.	
	Students should be able to apply this equation which is given on the physics equation sheet. **force = magnetic flux density × current × length**	
Electric motors	A coil of wire carrying a current in a magnetic field tends to rotate. This is the basis of an electric motor.	
	Students should be able to explain how the force on a conductor in a magnetic field causes the rotation of the coil in an electric motor.	
Loudspeakers	**Loudspeakers and headphones use the motor effect to convert variations in current in electrical circuits to the pressure variations in sound waves.**	
	Students should be able to explain how a moving-coil loudspeaker and headphones work.	
Induced potential	**If an electrical conductor moves relative to a magnetic field or if there is a change in the magnetic field around a conductor, a potential difference is induced across the ends of the conductor. If the conductor is part of a complete circuit, a current is induced in the conductor. This is called the generator effect.**	
	An induced current generates a magnetic field that opposes the original change, either the movement of the conductor or the change in magnetic field.	
	Students should be able to recall the factors that affect the size of the induced potential difference/induced current.	
	Students should be able to recall the factors that affect the direction of the induced potential difference/induced current.	
	Students should be able to apply the principles of the generator effect in a given context.	
Uses of the generator effect	**The generator effect is used in an alternator to generate ac and in a dynamo to generate dc.**	
	explain how the generator effect is used in an alternator to generate ac and in a dynamo to generate dc	
	draw/interpret graphs of potential difference generated in the coil against time.	
Microphones	**Microphones use the generator effect to convert the pressure variations in sound waves into variations in current in electrical circuits.**	
	Students should be able to explain how a moving-coil microphone works.	
Transformers	**A basic transformer consists of a primary coil and a secondary coil wound on an iron core.**	
	Iron is used as it is easily magnetised.	
	The ratio of the potential differences across the primary and secondary coils of a transformer Vp and Vs depends on the ratio of the number of turns on each coil, np and ns.	
	Students should be able to apply this equation which is given on the Physics equation sheet. Vp/vs= np/ns	
	If transformers were 100% efficient, the electrical power output would equal the electrical power input.	
	Students should be able to apply this equation which is given on the Physics equation sheet. Vs × Is = Vp × Ip	
	explain how the effect of an alternating current in one coil in inducing a current in another is used in transformers	
	explain how the ratio of the potential differences across the two coils depends on the ratio of the number of turns on each	

	calculate the current drawn from the input supply to provide a particular power output	
	apply the equation linking the p.d.s and number of turns in the two coils of a transformer to the currents and the power transfer involved, and relate these to the advantages of power transmission at high potential differences.	

Science Faculty [TRIPLE] Physics: Space Checklist

Assessment Guidance

You will be assessed on some of the following criteria form your exam board. The assessment will last for 50miutes and be worth 50 marks, it will include a range of questions, including some multiple choice questions, some short answer questions and some questions which require longer answers. To access the highest marks for your test, use as many key scientific words as possible.

Equipment you will need: pen, pencil, calculator, ruler, compass and protractor.

	Space	check
Our solar system	Within our solar system there is one star, the Sun, plus the eight planets and the dwarf planets that orbit around the Sun. Natural satellites, the moons that orbit planets, are also part of the solar system.	
	Our solar system is a small part of the Milky Way galaxy.	
	The Sun was formed from a cloud of dust and gas (nebula) pulled together by gravitational attraction	
	how, at the start of a star's life cycle, the dust and gas drawn together by gravity causes fusion reactions	
	that fusion reactions lead to an equilibrium between the gravitational collapse of a star and the expansion of a star due to fusion energy.	
The life cycle of a star	A star goes through a life cycle. The life cycle is determined by the size of the star.	
	Students should be able to describe the life cycle of a star	
	Fusion processes in stars produce all of the naturally occurring elements. Elements heavier than iron are produced in a supernova.	
	The explosion of a massive star (supernova) distributes the elements throughout the universe.	
	Students should be able to explain how fusion processes lead to the formation of new elements.	
Orbital motion, natural and artificial satellites	Gravity provides the force that allows planets and satellites (both natural and artificial) to maintain their circular orbits.	
	Students should be able to describe the similarities and distinctions between the planets, their moons, and artificial satellites.	
	for circular orbits, the force of gravity can lead to changing velocity but unchanged speed	
	for a stable orbit, the radius must change if the speed changes.	
Red-shift	There is an observed increase in the wavelength of light from most distant galaxies. The further away the galaxies, the faster they are moving and the bigger the observed increase in wavelength. This effect is called red-shift.	
	The observed red-shift provides evidence that space itself (the universe) is expanding and supports the Big Bang theory.	
	The Big Bang theory suggests that the universe began from a very small region that was extremely hot and dense.	

	Since 1998 onwards, observations of supernovae suggest that distant galaxies are receding ever faster.	
	qualitatively the red-shift of light from galaxies that are receding	
	that the change of each galaxy's speed with distance is evidence of an expanding universe	
	how red-shift provides evidence for the Big Bang model	
	how scientists are able to use observations to arrive at theories such as the Big Bang theory	
	that there is still much about the universe that is not understood, for example dark mass and dark energy.	
Lenses	A lens forms an image by refracting light. In a convex lens, parallel rays of light are brought to a focus at the principal focus. The distance from the lens to the principal focus is called the focal length. Ray diagrams are used to show the formation of images by convex and concave lenses.	
	The image produced by a convex lens can be either real or virtual. The image produced by a concave lens is always virtual.	
	Students should be able to construct ray diagrams to illustrate the similarities and differences between convex and concave lenses.	
	Students should be able to apply magnification = image height/object height equation which is given on the Physics equation sheet.	
Emission and absorption of infrared radiation	All bodies (objects), no matter what temperature, emit and absorb infrared radiation. The hotter the body, the more infrared radiation it radiates in a given time.	
	A perfect black body is an object that absorbs all of the radiation incident on it. A black body does not reflect or transmit any radiation. Since a good absorber is also a good emitter, a perfect black body would be the best possible emitter.	
Perfect black bodies and radiation	that all bodies (objects) emit radiation	
	that the intensity and wavelength distribution of any emission depends on the temperature of the body.	
	A body at constant temperature is absorbing radiation at the same rate as it is emitting radiation. The temperature of a body increases when the body absorbs radiation faster than it emits radiation.	
	The temperature of the Earth depends on many factors including: the rates of absorption and emission of radiation, reflection of radiation into space.	
	Students should be able to explain how the temperature of a body is related to the balance between incoming radiation absorbed and radiation emitted, using everyday examples to illustrate this balance, and the example of the factors which determine the temperature of the Earth.	
	Students should be able to use information, or draw/interpret diagrams to show how radiation affects the temperature of the Earth's surface and atmosphere.	