GCSE Specification : CCEA **Physics**

Please check that you have chosen the correct specification.

The subject content is organised into 6 teaching and learning sections.
The content of these is set out below and for each section the major topics to be covered are listed, together with further detail of the content required.

The content should be read in conjunction with the relevant aims and assessment objectives set out in Section 1 of the full specification.

Subject content for the Foundation Tier is laid out in normal type.

Subject content for the ***Higher Tier only*** is laid out in ***bold italics.***

Questions in Foundation Tier papers will be set only in the content for Foundation Tier.

Questions in Higher Tier papers may be set on any of the content in the specification.

The page numbers refer to the latest (2001) edition of GCSE **Physics for You** (ISBN 0-7487-6236-1)

page numbers in **Physics for You**

3.1 **ENERGY**		
Forms of energy		**page numbers**
3.1.1	Describe energy transfers involving the following forms of energy; chemical, heat, electrical, sound, light, magnetic, nuclear, kinetic and potential (gravitational and strain).	pages 8-9, 108-112, worksheet
Energy resources		
3.1.2	Recall that there is a variety of energy resources, to include: oil, gas, coal, nuclear, biomass, wind, wave, solar, geothermal, tidal and hydroelectric, and distinguish between renewable and non-renewable resources.	p. 11-13, 111-113, worksheet
3.1.3	Explain how energy sources, such as wind and fossil fuels, are ultimately dependent on the Sun's energy.	p. 111
3.1.4	Describe the environmental implications of the use of energy resources, limited to generation of electricity by fossil fuels, nuclear fuels, hydroelectric power, wind farms, waves and tides. Appreciate the effect on the environment of the use of these energy resources limited to the contribution of burning fossil fuels to the greenhouse effect (brief outline only), land/sea use and nuclear waste.	p. 113-5, worksheet
3.1.5	***Evaluate the advantages and disadvantages of using various energy resources to generate electricity. This should take into consideration: reliability, how quickly the different types of power station can respond to changes in demand, the costs of building, operating and decommissioning power stations and any additional information, including quantitative information with which they are provided.***	p. 114-5, worksheet
Work and power		
3.1.6	Recall and use the relationship; work = force x distance moved in the same direction as the force, and know that work is measured in joules.	p. 107 worksheet
3.1.7	Recall and use the formula; power = work done/time taken.	p. 118-9, worksheet
3.1.8	recall that power is measured in watts	p. 118
3.1.9	describe simple experiments to measure personal power and the power of an electric motor.	p. 119, 112, worksheet
3.1.10	***use the relationship between force, distance, time, work and power to describe and explain the function of everyday machines***	p. 122-7
Conservation of energy		
3.1.11	Understand that energy is conserved and describe energy changes in terms of the principle of conservation of energy.	p. 108-9, 112
3.1.12	Understand that energy may be dissipated and become less useful.	p. 112-3, 92-3
3.1.13	***Recall and use the quantitative relationships for work done, kinetic energy (½ mv^2), gravitational potential energy (mgh) and power, in the context of the conservation of energy.***	p. 107, 116-9, worksheets

Efficiency		
3.1.14	Recall that efficiency is a measure of how much energy is transferred in an intended way and recall and use the relationships between efficiency, input energy and output energy.	p. 112-3, 122, 124, 127, worksheet
3.1.15	apply the concept of efficiency to machines.	p. 122, 124, 127
Heat transfer		
3.1.16	describe experiments to show the difference between good thermal conductors and good thermal insulators	p. 42-3
3.1.17	Describe the thermal conduction in good conductors and in insulators in terms of the movement of electrons and vibrational movement of atoms/molecules.	p. 43
3.1.18	Describe convection in liquids and gases in terms of current and the movement of the particles of the liquid or gas.	p. 46-7
3.1.19	describe experiments to show convection in liquids and gases	p. 46-7
3.1.20	Describe the effect that the nature of a surface has on the emission and absorption of radiant heat, including some applications.	p. 48-53
3.1.21	describe experiments to show the effect the nature of a surface has on the emission and absorption of radiant heat	p. 49-9
3.1.22	Describe methods of reducing heat loss from the home.	p. 44-5
Expansion		
3.1.23	recall that most solids, liquids and gases expand when heated and that the expansion of gases is very much greater than the expansion of liquids which is greater than the expansion of solids.	p. 21-7
3.1.24	recall and understand that expansion and contraction produces large forces and how allowance for this is made.	p. 22-3
3.1.25	explain and describe uses made of the expansion in solids and liquids in everyday life.	p. 24, 27, 29
3.1.26	explain and describe the use of the bimetal strip in a range of devices such as thermostats and fire alarms.	p. 24, 27, 270

3.2 **FORCES**		page numbers
Effects of a force, Newton's 1st Law of Motion		
3.2.1	Understand Newton's 1st Law of Motion, i.e. that a change in movement or direction results from unbalanced forces and that balanced forces produce no change.	p. 77-8
3.2.2	Appreciate that friction is a force that opposes motion.	p. 92-3, 98-9
3.2.3	***Calculate the resultant of 2 forces, restricted to forces that are parallel or anti-parallel.***	p. 96
Mass and weight		
3.2.4	Distinguish between mass and weight, in that, mass is an unchanging property of an object whereas weight is a force that depends on how strong gravity is.	p. 75, 76, 139
3.2.15	Recall that, on the Earth, gravity exerts a force of 10 N on every kilogram of mass and be able to carry out simple calculations involving mass and weight.	p. 75, 139
Density		
3.2.6	state and use the equation: density = mass/volume, to solve simple problems.	p. 82, worksheet
3.2.7	recall and use the units of density as kg/m^3 and g/cm^3	p. 82
3.2.8	describe experiments to measure the density of liquids, regular and irregular solids.	p. 83
Hooke's Law		
3.2.9	Investigate experimentally the relationship between force and the extension of a helical spring.	p. 74, worksheet
3.2.10	State and use Hooke's Law and use it to solve simple problems.	p. 74
3.2.11	Understand the meaning of elastic limit.	p. 74
Moments		
3.2.12	Calculate the moment of a force as force x perpendicular distance from the pivot.	p. 100
3.2.13	Describe some practical applications of levers.	p. 100, 123
3.2.14	***State the principle of moments and use it to solve simple problems when an object is balanced under the turning effects of two forces (for an object with a pivot at its centre of mass) or the weight of the object and one other force when the pivot is not at the centre of mass.***	p. 101, worksheet
Centre of mass		
3.2.15	Understand the term centre of mass and how the stability of an object depends on the position of the centre of mass and the width of its base.	p. 102-5
3.2.16	describe an experiment to locate the centre of gravity of an irregular lamina	p. 102-3

Pressure		
3.2.17	Recall and use the relationship between pressure, force and area; recall that pressure is measured in pascals. Problems may be set in which N/cm^2 and N/mm^2 are used.	p. 85, worksheet
Hydraulic machines		
3.2.18	describe how the transmission of pressure by liquids is applied in simple hydraulic machines	p. 86-88
3.2.19	***carry out simple calculations on hydraulic machines ($h\rho g$ is not required).***	p. 88
Motion		
3.2.20	Recall and use the quantitative relationships between average speed, distance and time, including values taken from linear distance-time graphs.	p. 130, 134, worksheet
3.2.21	Distinguish between distance and displacement, speed and velocity.	p. 134, 130
Equations of motion		
3.2.22	Recall and use the quantitative relationships between: ***(i) distance, time and average speed;*** ***(i) displacement, time and average velocity;*** ***(ii) initial velocity, final velocity, acceleration.***	p. 130-5
3.2.23	understand the factors affecting stopping distance, limited to speed of vehicle, reaction time of driver, braking force and friction between wheels and road surface.	p. 98, 77
Graphs : Displacement-time Velocity-time		
3.2.24	***Use graphical methods to determine velocity, acceleration and displacement; know that the slope of a displacement-time graph is the velocity and that the slope of a velocity-time graph is the acceleration and that the area under the graph is the displacement.***	p. 132-4, worksheet
Newton's 1st Law		
3.2.25	***know that in the absence of a resultant force an object will remain at rest or continue to move with constant velocity.***	p. 77
Newton's 2nd Law		
3.2.26	***Recall and use the quantitative relationships between force, mass and acceleration in the form F = ma, where F is the resultant force.***	p. 138-9, worksheet
3.2.27	***describe experiments to investigate the relationship between force, mass and acceleration***	P. 138, worksheet
Acceleration of free fall		
3.2.28	***Appreciate that, in the absence of all other forces, objects near the surface of the earth fall with the same acceleration and recall that this acceleration is known as the acceleration of free fall.***	p. 136-7, 99
3.2.29	***Recall and use the equation : weight = mass x acceleration of free fall.***	p. 75, 139
3.2.30	***describe an experiment to measure the acceleration of free fall***	p. 137, worksheet

Momentum		
3.2.31	Recall that momentum is the product of mass and velocity. Conservation of momentum is **not** required.	p. 144
Conservation of momentum		
3.2.32	***recall and use the conservation of momentum to solve simple problems involving one-dimensional inelastic collisions.***	p. 145-6
Circular motion		
3.2.33	recall some examples of circular motion, from everyday life, from atomic physics and from planetary motion.	p. 78, 158-160, 162, 168, 352
3.2.34	understand that an object moving in a circle requires a centripetal force.	p. 78
3.2.35	***know that the centripetal force needed is greater;*** ***the greater the mass of the object;*** ***the greater the speed of the object;*** ***the small the radius of the circle.***	(p. 78)
3.2.36	Recall that if this force is removed the object will fly off at a tangent to the circle.	p. 78
3.2.37	understand the role circular motion plays in satellite communications	p. 162, 168-9

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3.3 **WAVES, SOUND AND LIGHT**		page numbers
Waves		
3.3.1	Understand that waves transfer energy from one point to another.	p. 174
3.3.2	Distinguish between transverse and longitudinal waves in terms of the motion of the particles of the medium.	p. 174
3.3.3	Recall examples of transverse and longitudinal waves.	p. 174, 154
3.3.4	Describe, using simple wavefront diagrams, how plane waves are reflected at a plane barrier, refracted at a plane boundary, and diffracted by a narrow opening.	p. 175-7, worksheets
3.3.5	Recall the meaning of frequency, wavelength and amplitude of a wave.	p. 175
3.3.6	Recall and use the quantitative relationship between frequency, wavelength and speed of a wave.	p. 175
Sound		
3.3.7	Describe experiments to demonstrate that sound can travel through different materials at different speeds but cannot travel through a vacuum.	p. 231. 229
3.3.8	Relate pitch and loudness of sound to its waveform displayed on a CRO.	p. 234
3.3.9	Recall that the range of human hearing is 20 Hz to 20 kHz and that the upper limit decreases with age.	p. 232
3.3.10	Recall that frequencies greater than 20 kHz are called ultrasound.	p. 232, 230
3.3.11	recall that loud sounds damage the ear and cause progressive deafness and understand the need to control noise levels in the environment.	p. 238, 232
3.3.12	Recall that sound is reflected so that the angle of incidence = the angle of reflection.	p. 176, 230
3.3.13	recall some applications of echoes and carry out simple calculations on the echo principle.	p. 230, 240, worksheet
3.3.14	describe a direct method of measuring the speed of sound	p. 231
3.3.15	Describe some applications of ultrasound in industry and medicine.	p. 240-1
Light		
3.3.16	Recall that luminous objects are seen by the light they emit and that all other objects are seen by the light they reflect.	p. 179
3.3.17	recall that light travels in straight lines at a finite speed.	p. 179
3.3.18	Explain with the help of ray diagrams the formation of shadows by point and extended sources of light.	p. 180-1
3.3.19	recall that light is reflected from plane surfaces so that the angle of incidence = the angle of reflection.	p. 184-7, (190), worksheet
3.3.20	describe an experiment to show that, for plane mirrors, light is reflected so that the angle of incidence equals the angle of reflection.	p. 184-5, worksheet

3.3.21	describe an experiment to show that the image in a plane mirror is the same distance behind the mirror as the object is in front.	p. 186, worksheet
3.3.22	recall other properties of the image in a plane mirror.	p. 186-7
3.3.23	draw ray diagrams for plane mirrors and use them to solve simple problems.	p. 186, worksheet
Refraction		
3.3.24	recall that a change of speed causes light to be refracted at air/glass, glass/air, air/water, and water/air boundaries.	p. 192-3, 176
3.3.25	Recall that when light slows it is bent towards the normal, and the converse. A knowledge of Snell's law or total internal reflection is **not** expected.	p. 193, 176
3.3.26	***Use a wave model to explain refraction of light at a plane surface using simple plane wavefront diagrams.***	p. 176
Total internal reflection		
3.3.27	***recall the conditions for total internal reflection, including the ritical angle. Uses of total internal reflection, limited to optical fibres and reflecting prisms.***	p. 195-7, 200
3.3.28	***describe some uses of optical fibre, limited to communications and medicine.***	p.200, 320 (332)
Dispersion		
3.3.29	Describe how light is dispersed by prisms and understand that a spectrum can be produced because different colours of light are refracted by different amounts.	p. 216-7
The electromagnetic spectrum		
3.3.30	Recall that the electromagnetic spectrum includes radio waves, microwaves, infrared, visible light, ultraviolet waves, X-rays and gamma-rays and be able to arrange them in order of wavelength.	p. 218-221, worksheet
3.3.31	recall that electromagnetic waves require no medium for propagation and that all travel at the same speed in a vacuum.	p. 219
3.3.32	Describe some uses and dangers of microwaves, infrared and ultraviolet waves in domestic situations.	p. 218-221, 227, worksheet
3.3.33	describe some uses of radio waves, microwaves, infrared and visible light in communications.	p. 219, 221, 227, 320, (335)
3.3.34	Describe some uses of X-rays and gamma-rays in medicine.	p. 218, 220, 318, 356
Lenses		
3.3.35	distinguish between the action of converging and diverging lenses (qualitative treatment only).	p. 202
3.3.36	define the focal length of a converging lens.	p. 202
3.3.37	describe an experiment to measure the focal length of a converging lens using a distant object.	p. 203
3.3.38	***draw ray diagrams to show how converging lenses form real and virtual images.***	p. 204
3.3.39	***use ray diagrams to explain the principle of the simple camera, the projector and the magnifying glass. (Details of the construction of these are not required.)***	p. 204, 206, 214

3.4 ELECTRICITY AND MAGNETISM		page numbers
Static charge		
3.4.1	know that insulating materials can be charged by friction and explain this in terms of transfer of charge.	p. 247-8
3.4.2	Understand that positively charged objects have a deficiency of electrons and negatively charged objects have a surplus of electrons.	p. 248
3.4.3	Describe the dangers and use of electrostatic charge generated in everyday contexts.	p. 252, 251, 321
Charge flow		
3.4.4	understand the difference between conductors and insulators in terms of free electrons, and recall that an electric current is a flow of electrons and that it is in the opposite direction to that of a conventional current.	p. 254-5, 251, 268
3.4.5	***Recall and use the quantitative relationship between current, charge and time.***	p. 266
3.4.6	***Recall that charge is measured in coulombs.***	p. 251, 266
Electric circuits		
3.4.7	Understand the role of conductors, insulators and switches in simple series and parallel circuits.	p. 254-7
3.4.8	Describe the effects of varying the current on bulb brightness, motor speed and heater output.	p. 260-1
3.4.9	Describe and record diagrammatically simple electric circuits.	p. 254-261
3.4.10	Measure current and voltage in series and parallel circuits.	p. 256, 258
3.4.11	Recall that in a series circuit the current is the same everywhere.	p. 256
3.4.12	Recall that in a series circuit the sum of the voltages is equal to the voltage across the whole circuit.	p. 262
3.4.13	Recall that in a parallel circuit the sum of the currents in the branches is equal to the current entering the parallel section.	p. 257
3.4.14	Recall that voltages across components in parallel are equal.	p. 263
3.4.15	Calculate the total resistance of resistors in series.	p. 262, 267
3.4.16	Calculate the resistance of two equal resistors in parallel.	p. 263, 267
3.4.17	***calculate the combined resistance of any number of resistors in parallel.***	(p. 263, 267)
3.4.18	***calculate the combined resistance of circuits with series and parallel sections.***	p. 262-3, 267, worksheet

Ohm's Law		
3.4.19	describe an experiment to obtain voltage and current measurements for a metallic conductor at constant temperature.	p. 261, worksheet
3.4.20	Plot and interpret voltage – current graphs for metallic conductors at constant temperature.	p. 265, worksheet
3.4.21	State and use Ohm's Law in the form V/I = R, where R is the resistance, measured in ohms.	p. 259
3.4.22	recall, in qualitative terms, how the resistance of a metallic conductor at constant temperature depends on length and area of cross-section.	p. 260, 265
3.4.23	***describe experiments to obtain voltage-current characteristics for the filament bulb, and diode.***	p. 265, 322
3.4.24	Plot and interpret voltage-current graphs for the filament bulb, ***and diode.***	p. 265, 322, worksheet
3.4.25	***Understand that voltage is the energy transferred per unit charge.***	p. 267
3.4.26	***Recall and use the quantitative relationships between power, energy, current, voltage and time.***	p. 267, 272-3
3.4.21	Recall how the resistance of a thermistor (n.t.c.) varies with temperature.	p. 265, 325, worksheet
3.4.28	***recall how the resistance of a light-dependent resistor (LDR) varies with light level.***	p. 325
Electricity in the home		
3.4.29	Understand one-way and two-way switching.	p. 254, 271
3.3.30	recall that fuses and earth wires protect the user	p. 274
3.4.31	Describe how to wire a fused three-pin plug.	p. 275, worksheet
3.4.32	Understand the functions of live and neutral wires and how the earth wire and fuse protect the user from electric shock.	p. 274-5, worksheet
3.4.33	Describe how double insulation protects the user.	p. 275
3.4.34	Describe how residual current circuit breakers protect the user.	p. 345 (270, 301, 312, worksheets
3.4.35	Understand the positioning of switches and fuses on the live side of appliances.	p. 271, 275, worksheet
3.4.36	Calculate the costs of using electricity from meter readings.	p. 273, worksheet
3.4.37	Understand the meaning of the kilowatt-hour and calculate the cost of using electrical appliances using their power rating.	p. 273
3.4.38	***solve problems involving the rating of a fuse to be selected for a given set of conditions.***	p. 275

Electromagnetism		
3.4.39	describe how to make a simple electromagnet and recall, qualitatively, how the strength of the electromagnet is affected by; (i) the number of turns, (ii) the current, (iii) the material used for the core.	p. 292-3, worksheet
3.4.40	***describe the shape and direction of the magnetic field pattern produced by the current in a solenoid and relate the current direction to the polarity.***	p. 293
3.4.41	describe the structure of the simple make-and-break electric doorbell and be able to describe how it works.	p. 294, worksheet
3.4.42	describe how electromagnetic relay works and recall some of its uses	p. 295, 326-7, worksheet
3.4.43	recall that a current-carrying conductor in a magnetic field experiences a force perpendicular to both the current and magnetic field directions, and that reversing the current direction reverses the direction of the force. Fleming's left-hand rule is not required.	p. 296
3.4.44	describe how the simple electric motor works. (Questions will not be set on the operation of the split-ring commutator.)	p. 298-9
Electromagnetic induction		
3.4.45	***Understand that current may be induced in a conductor by its motion relative to a magnet, and by changing the current in a neighbouring conductor and that these effects form the basis for a.c. generators and transformers.***	p. 302-3, 307-8
3.4.46	Know the difference between a.c. and d.c.	p. 254, 274, 304-5
Generation and transmission of electricity		
3.4.47	***Recall that a.c. generators are used in the generation of electricity.*** (Construction details **not** required).	p. 113, 306
3.4.48	***Describe how step-up and step-down transformers are used in the transmission of electricity.***	p. 308-9, worksheet
3.4.49	***recall and understand how stepping up the voltage reduces energy losses in the grid.***	p. 309
Transformers		
3.4.50	***describe the construction of a transformer, including the primary coil, secondary coil and core.***	p. 308
3.4.51	***state and use the turns-ratio equation, Ns/Np = Vs/Vp***	p. 308, worksheet

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3.5 **RADIOACTIVITY**		page numbers
Structure of the atom		
3.5.1	describe the structure of atoms in terms of protons, neutrons and electrons.	p. 352-3
3.5.2	***recall evidence for the present model of the structure of the atom and how this evidence was in conflict with previous models.***	p. 352, 368, worksheet
Structure of the nucleus		
3.5.3	describe a nucleus in terms of atomic number Z, mass number A, using the notation ${}^{A}_{Z}X$.	p. 353
3.5.4	recall what an isotope is.	p. 353
Radioactivity		
3.5.5	recall that some combinations of neutrons and protons are unstable and disintegrate, such nuclei being described as radioactive.	p. 355, worksheet
3.5.6	recall that radioactive nuclei emit alpha, beta and gamma radiation and state the nature of each.	p. 350-1
3.5.7	***describe these disintegrations in terms of equations involving mass numbers and atomic numbers.***	p. 355, worksheet
3.5.8	describe simple experiments to measure the range of each of these radiations in air, paper, aluminium and lead.	p. 350-1
3.5.9	recall that alpha radiation is stopped by a few centimetres of air or a sheet of paper, that beta radiation is stopped by several metres of air or a thin sheet of aluminium and that gamma radiation easily passes through all of these but that lead is an effective shield.	p. 350-1
3.5.10	understand what background activity is, its source and how it is taken into account when measurements of activity are taken.	p. 350, 360
3.5.11	recall the dangers of radioactivity and steps taken to minimise the risk to those who use it.	p. 360, worksheet
Half-life		
3.5.12	recall the meaning of half-life.	p. 354
3.5.13	***be able to carry out simple calculations involving half-life.***	p. 354, 362, worksheet
3.5.14	recall some uses of radioactivity in industry, medicine and agriculture.	p. 356-7, 220
Fission and fusion		
3.5.15	***describe nuclear fission in simple terms and be aware that it is a form of energy used in the generation of electricity.***	p. 358-9
3.5.16	***describe nuclear fusion in simple terms and be aware that it is the source of a star's energy.***	p. 164

3.6 **EARTH IN SPACE**		page numbers
Seasons		
3.6.1	Explain changes in day length, seasonal changes and changes in the elevation of the Sun in terms of the tilt of the Earth's axis and its movement around the Sun.	p. 158
Solar system		
3.6.2	Recall the solar system as the Sun, the planets, moons, asteroids and comets. Recall how the various parts move relative to each other. Candidates will be expected to recall the order of the planets from the Sun outwards	p. 160-1, 159, 163
3.6.3	recall, evaluate and discuss the historical evidence for the heliocentric solar system as opposed to the geocentric. Be aware how acceptance, or rejection, of the two ideas depended on the social and historical context in which it was developed and proposed.	p. 369, 372, worksheet
Gravitation		
3.6.4	***recall that gravitational force acts towards the centre of every astronomical object and that this force determines the motion of the planets and comets round the Sun, and satellites round the planets.***	p. 162-3, 168
3.6.5	recall uses of artificial satellites, limited to observation of the Earth, weather monitoring, astronomy and communications.	p. 168-9, 221, 320
3.6.6	***recall that gravitational forces act between all masses and know that the magnitude diminishes with distance and increases with mass.***	p. 162
Galaxy		
3.6.7	Recall that the Universe is made up of innumerable galaxies. A galaxy is a vast number of star systems held by gravitational forces. The Milky Way is the galaxy which contains our solar systems.	p. 165-6
Light year		
3.6.8	recall that a light year is the distance travelled by light in one Earth year. Use of the light year as a unit of distance.	p. 179, 165
Nebular model		
3.6.9	***Describe the nebular (gas cloud) model for the formation of the solar system.***	p. 163
Big Bang		
3.6.10	Describe the Big Bang model for the formation of the universe.	p. 166, 369
3.6.11	***recall that evidence for the Big Bang includes that light from other galaxies is shifted to the red end of the spectrum and that this can be explained by these galaxies moving away from us.***	p. 166
Stars		
3.6.12	Describe how stars are formed. (The life cycle of stars is not required).	p. 163, 165
3.6.13	Recall that stars are powered by nuclear fusion processes.	p. 164

Space travel		
3.6.14	Consider the possibilities and limitations of space exploration in terms of distances and speed of travel.	(p. 167)
Life on other planets		
3.6.15	Recall, evaluate and discuss evidence for life and planets outside our solar system.	p. 167

end of subject content