Edexcel IGCSE Colour-coded specification

Forces and Motion

(a)	Units
Students should:	
1.1	use the following units: kilogram (kg), metre (m), metre/second (m/s), metre/second^2 (m/s^2), newton (N), second (s) and newton/kilogram (N/kg)
1.2P	**use the following units: newton metre (Nm), kilogram metre/second (kg m/s)**

(b)	Movement and position		
Learning Objective (with Specification Reference No)		Paper 1	Paper 2
1.3 plot and explain distance−time graphs 1.4 know and use the relationship between average speed, distance moved and time taken: $$Average\ Speed = \frac{Distance\ moved}{(time\ taken)}$$			
1.5 *practical: investigate the motion of everyday objects such as toy cars or tennis balls*			
1.6 know and use the relationship between acceleration, change in velocity and time taken: $$acceleration = \frac{change\ in\ velocity}{time\ taken}$$ $$a = \frac{v - u}{t}$$			
1.7 plot and explain velocity-time graphs			
1.8 determine acceleration from the gradient of a velocity−time graph			
1.9 determine the distance travelled from the area between a velocity−time graph and the time axis			
1.10 use the relationship between final speed, initial speed, acceleration and distance moved: (final speed)^2 = (initial speed)^2 + (2 × acceleration × distance moved) $v^2 = u^2 + (2 × a × s)$			

(b)	Forces		
Learning Objective (with Specification Reference No)		Paper 1	Paper 2
1.11 describe the effects of forces between bodies such as changes in speed, shape or direction			
1.12 identify different types of force such as gravitational or electrostatic			
1.13 understand how vector quantities differ from scalar quantities			
1.14 understand that force is a vector quantity			
1.15 calculate the resultant force of forces that act along a line			
1.16 know that friction is a force that opposes motion			
1.17 know and use the relationship between unbalanced force, mass and acceleration: force = mass × acceleration $F = m \times a$			
1.18 know and use the relationship between weight, mass and gravitational field strength: weight = mass × gravitational field strength $W = m \times g$			
1.19 know that the stopping distance of a vehicle is made up of the sum of the thinking distance and the braking distance			
1.20 describe the factors affecting vehicle stopping distance, including speed, mass, road condition and reaction time			
1.21 describe the forces acting on falling objects (and explain why falling objects reach a terminal velocity)			
1.22 *practical: investigate how extension varies with applied force for helical springs, metal wires and rubber bands*			
1.23 know that the initial linear region of a force-extension graph is associated with Hooke's law			
1.24 describe elastic behaviour as the ability of a material to recover its original shape after the forces causing deformation have been removed			
1.25P know and use the relationship between momentum, mass and velocity: momentum = mass × velocity $p = m \times v$			
1.26P use the idea of momentum to explain safety features			
1.27P use the conservation of momentum to calculate the mass, velocity or momentum of objects			
1.28P use the relationship between force, change in momentum and time taken: $$Force = \frac{change\ in\ momentum}{time\ taken}$$ $$F = \frac{mv - mu}{t}$$			
1.29P demonstrate an understanding of Newton's third law			
1.30P know and use the relationship between the moment of			

a force and its perpendicular distance from the pivot: moment = force × perpendicular distance from the pivot		
1.31P know that the weight of a body acts through its centre of gravity		
1.32P use the principle of moments for a simple system of parallel forces acting in one plane		
1.33P understand how the upward forces on a light beam, supported at its ends, vary with the position of a heavy object placed on the beam		

Electricity

(a)	Units
Students should:	
2.1	use the following units: ampere (A), coulomb (C), joule (J), ohm (Ω), second (s), volt (V) and watt (W)

(b)	**Mains electricity**		
Learning Objective (with Specification Reference No)		Paper 1	Paper 2
2.2 understand how the use of insulation, double insulation, earthing, fuses and circuit breakers protects the device or user in a range of domestic appliances			
2.3 understand why a current in a resistor results in the electrical transfer of energy and an increase in temperature, and how this can be used in a variety of domestic contexts			
2.4 know and use the relationship between power, current and voltage: power = current × voltage $P = I \times V$ and apply the relationship to the selection of appropriate fuses			
2.5 use the relationship between energy transferred, current, voltage and time: energy transferred = current × voltage × time $E = I \times V \times t$			
2.6 know the difference between mains electricity being alternating current (a.c.) and direct current (d.c.) being supplied by a cell or battery			

(c)	**Energy and voltage in circuits**		
Learning Objective (with Specification Reference No)		Paper 1	Paper 2
2.7 explain why a series or parallel circuit is more appropriate for particular applications, including domestic lighting		■	
2.8 understand how the current in a series circuit depends on the applied voltage and the number and nature of other components		■	
2.9 describe how current varies with voltage in wires, resistors, metal filament lamps and diodes, and how to investigate this experimentally		■	
2.10 describe the qualitative effect of changing resistance on the current in a circuit		■	

2.11 describe the qualitative variation of resistance of light-dependent resistors (LDRs) with illumination and thermistors with temperature		
2.12 know that lamps and LEDs can be used to indicate the presence of a current in a circuit		
2.13 know and use the relationship between voltage, current and resistance: voltage = current × resistance $V = I \times R$		
2.14 know that current is the rate of flow of charge		
2.15 know and use the relationship between charge, current and time: charge = current × time $Q = I \times t$		
2.16 know that electric current in solid metallic conductors is a flow of negatively charged electrons		
2.17 understand why current is conserved at a junction in a circuit		
2.18 know that the voltage across two components connected in parallel is the same		
2.19 calculate the currents, voltages and resistances of two resistive components connected in a series circuit		
2.20 know that: • voltage is the energy transferred per unit charge passed • tthe volt is a joule per coulomb.		
2.21 know and use the relationship between energy transferred, charge and voltage: energy transferred = charge × voltage $E = Q \times V$		

(d) Electric charge		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
2.22P identify common materials which are electrical conductors or insulators, including metals and plastics		
2.23P *practical: investigate how insulating materials can be charged by friction*		
2.24P explain how positive and negative electrostatic charges are produced on materials by the loss and gain of electrons		
2.25P know that there are forces of attraction between unlike charges and forces of repulsion between like charges		
2.26P explain electrostatic phenomena in terms of the movement of electrons		
2.27P explain the potential dangers of electrostatic charges, e.g. when fuelling aircraft and tankers		
2.28P explain some uses of electrostatic charges, e.g. in photocopiers and inkjet printers		

Waves

(a)	Units
Students should:	
3.1	use the following units: degree (°), hertz (Hz), metre (m), metre/second (m/s) and second (s)

(b) Properties of waves		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
3.2 explain the difference between longitudinal and transverse waves		
3.3 know the definitions of amplitude, wavefront, frequency, wavelength and period of a wave		
3.4 know that waves transfer energy and information without transferring matter		
3.5 know and use the relationship between the speed, frequency and wavelength of a wave: wave speed = frequency × wavelength $v = f \times \lambda$		
3.6 use the relationship between frequency and time period: $frequency = \dfrac{1}{time\ period}$ $f = \dfrac{1}{T}$		
3.7 use the above relationships in different contexts including sound waves and electromagnetic waves		
3.8 explain why there is a change in the observed frequency and wavelength of a wave when its source is moving relative to an observer, and that this is known as the Doppler effect		
3.9 explain that all waves can be reflected and refracted		

(c) The electromagnetic spectrum		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
3.10 know that light is part of a continuous electromagnetic spectrum that includes radio, microwave, infrared, visible, ultraviolet, x-ray and gamma ray radiations and that all these waves travel at the same speed in free space		
3.11 know the order of the electromagnetic spectrum in terms of decreasing wavelength and increasing frequency, including the colours of the visible spectrum		
3.12 explain some of the uses of electromagnetic radiations, including: • radio waves: broadcasting and communications • microwaves: cooking and satellite transmissions • infrared: heaters and night vision equipment • visible light: optical fibres and photography • ultraviolet: fluorescent lamps • x-rays: observing the internal structure of objects and materials, including for medical applications • gamma rays: sterilising food and medical equipment		
3.13 explain the detrimental effects of excessive exposure of the human body to electromagnetic waves, including: • microwaves: internal heating of body tissue • infrared: skin burns • ultraviolet: damage to surface cells and blindness • gamma rays: cancer, mutation and describe simple protective measures against the risks		

(d) Light and sound		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
3.14 know that light waves are transverse waves and that they can be reflected and refracted		
3.15 use the law of reflection (the angle of incidence equals the angle of reflection)		
3.16 draw ray diagrams to illustrate reflection and refraction		
3.17 *practical: investigate the refraction of light, using rectangular blocks, semi-circular blocks and triangular prisms*		
3.18 know and use the relationship between refractive index, angle of incidence and angle of refraction: $$n = \frac{\sin i}{\sin r}$$		
3.19 *practical: investigate the refractive index of glass, using a glass block*		
3.20 describe the role of total internal reflection in transmitting information along optical fibres and in prisms		
3.21 explain the meaning of critical angle *c*		
3.22 know and use the relationship between critical angle and refractive index: $$\sin c = \frac{1}{n}$$		
3.23 know that sound waves are longitudinal waves which can be reflected and refracted		
3.24P know that the frequency range for human hearing is 20–20 000 Hz		
3.25P *practical: investigate the speed of sound in air*		
3.26P understand how an oscilloscope and microphone can be used to display a sound wave		
3.27P *practical: investigate the frequency of a sound wave using an oscilloscope*		***
3.28P understand how the pitch of a sound relates to the frequency of vibration of the source		
3.29P understand how the loudness of a sound relates to the amplitude of vibration of the source		

Energy Resources and Energy Transfers

(a)	Units
Students should:	
4.1	use the following units: kilogram (kg), joule (J), metre (m), metre/second (m/s), metre/second^2 (m/s^2), newton (N), second (s) and watt (W)

(b)	Energy transfers		
Learning Objective (with Specification Reference No)		Paper 1	Paper 2
4.2 describe energy transfers involving energy stores: • energy stores: chemical, kinetic, gravitational, elastic, thermal, magnetic, electrostatic, nuclear • energy transfers: mechanically, electrically, by heating, by radiation (light and sound)			
4.3 use the principle of conservation of energy			
4.4 know and use the relationship between efficiency, useful energy output and total energy output: $$Efficiency = \frac{useful\ energy\ output}{total\ energy\ output}\ x\ 100\%$$			
4.5 describe a variety of everyday and scientific devices and situations, explaining the transfer of the input energy in terms of the above relationship, including their representation by Sankey diagrams			
4.6 describe how thermal energy transfer may take place by conduction, convection and radiation			
4.7 explain the role of convection in everyday phenomena			
4.8 explain how emission and absorption of radiation are related to surface and temperature			
4.9 *practical: investigate thermal energy transfer by conduction, convection and radiation*			
4.10 explain ways of reducing unwanted energy transfer, such as insulation			

(c) Work and power

Learning Objective (with Specification Reference No)	Paper 1	Paper 2
4.11 know and use the relationship between work done, force and distance moved in the direction of the force: work done = force × distance moved $W = F \times d$		
4.12 know that work done is equal to energy transferred		
4.13 know and use the relationship between gravitational potential energy, mass, gravitational field strength and height: gravitational potential energy = mass × gravitational field strength × height $GPE = m \times g \times h$		
4.14 know and use the relationship: $kinetic\ energy = \frac{1}{2} \times mass \times speed^2$ $KE = \frac{1}{2} \times m \times v^2$		
4.15 understand how conservation of energy produces a link between gravitational potential energy, kinetic energy and work		
4.16 describe power as the rate of transfer of energy or the rate of doing work		
4.17 use the relationship between power, work done (energy transferred) and time taken: $$power = \frac{work\ done}{time\ taken}$$ $$P = \frac{W}{t}$$		

(d) Energy resources and electricity generation

Learning Objective (with Specification Reference No)	Paper 1	Paper 2
4.18 P describe the energy transfers involved in generating electricity using: • **wind** • **water** • **geothermal resources** • **solar heating systems** • **solar cells** • **fossil fuels** • **nuclear power**		
4.19P describe the advantages and disadvantages of methods of large-scale electricity production from various renewable and non-renewable resources		

Solids, liquids and gases

(a)	Units
Students should:	
5.1	use the following units: degree Celsius (°C), Kelvin (K), joule (J), kilogram (kg), kilogram/metre^3 (kg/m^3), metre (m), metre^2 (m^2), metre^3 (m^3), metre/second (m/s), metre/second^2 (m/s^2), newton (N) and pascal (Pa)
5.2	use the following unit: joules/kilogram degree Celsius (J/kg °C)

(b)	Density and pressure		
Learning Objective (with Specification Reference No)		**Paper 1**	**Paper 2**
5.3	know and use the relationship between density, mass and volume: $$density = \frac{mass}{volume}$$ $$\rho = \frac{m}{V}$$	■	■
5.4	*practical: investigate density using direct measurements of mass and volume*	■	■
5.5	know and use the relationship between pressure, force and area: $$pressure = \frac{force}{area}$$ $$p = \frac{F}{A}$$	■	■
5.6	understand how the pressure at a point in a gas or liquid at rest acts equally in all directions	■	■
5.7	know and use the relationship for pressure difference: pressure difference = height × density × gravitational field strength $p = h \times \rho \times g$	■	■

(c)	Change of state		
Learning Objective (with Specification Reference No)		**Paper 1**	**Paper 2**
5.8P	**explain why heating a system will change the energy stored within the system and raise its temperature or produce changes of state**	■	■
5.9P	**describe the changes that occur when a solid melts to form a liquid, and when a liquid evaporates or boils to form a gas**	■	■
5.10P	**describe the arrangement and motion of particles in solids, liquids and gases**	■	■
5.11P	***practical: obtain a temperature–time graph to show the constant temperature during a change of state***	■	■ ***

5.12P know that specific heat capacity is the energy required to change the temperature of an object by one degree Celsius per kilogram of mass (J/kg °C)	red	green
5.13P use the equation: **change in thermal energy = mass × specific heat capacity × change in temperature** **ΔQ = m × c × ΔT**	red	green
5.14P *practical: investigate the specific heat capacity of materials including water and some solids*	red	***

(d)	**Ideal gas molecules**		
Learning Objective (with Specification Reference No)		Paper 1	Paper 2
5.15 explain how molecules in a gas have random motion and that they exert a force and hence a pressure on the walls of a container			
5.16 understand why there is an absolute zero of temperature which is −273 C			
5.17 describe the Kelvin scale of temperature and be able to convert between the Kelvin and Celsius scales			
5.18 understand why an increase in temperature results in an increase in the average speed of gas molecules			
5.19 know that the Kelvin temperature of a gas is proportional to the average kinetic energy of its molecules			
5.20 explain, for a fixed amount of gas, the qualitative relationship between: • pressure and volume at constant temperature • pressure and Kelvin temperature at constant volume.			
5.21 use the relationship between the pressure and Kelvin temperature of a fixed mass of gas at constant volume: $$\frac{p_1}{T_1} = \frac{p_2}{T_2}$$			
5.22 use the relationship between the pressure and volume of a fixed mass of gas at constant temperature: $$p_1 V_1 = p_2 V_2$$			

Magnetism and Electromagnetism

(a)	Units
Students should:	
6.1	use the following units: ampere (A), volt (V) and watt (W)

(b) Magnetism		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
6.2 know that magnets repel and attract other magnets and attract magnetic substances		
6.3 describe the properties of magnetically hard and soft materials		
6.4 understand the term magnetic field line		
6.5 know that magnetism is induced in some materials when they are placed in a magnetic field		
6.6 *practical: investigate the magnetic field pattern for a permanent bar magnet and between two bar magnets*		
6.7 describe how to use two permanent magnets to produce a uniform magnetic field pattern		

(c) Electromagnetism		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
6.8 know that an electric current in a conductor produces a magnetic field around it		
6.9P describe the construction of electromagnets		
6.10P draw magnetic field patterns for a straight wire, a flat circular coil and a solenoid when each is carrying a current		
6.11P know that there is a force on a charged particle when it moves in a magnetic field as long as its motion is not parallel to the field		
6.12 understand why a force is exerted on a current-carrying wire in a magnetic field, and how this effect is applied in simple d.c. electric motors and loudspeakers		
6.13 use the left-hand rule to predict the direction of the resulting force when a wire carries a current perpendicular to a magnetic field		
6.14 describe how the force on a current-carrying conductor in a magnetic field changes with the magnitude and direction of the field and current		

(d) Electromagnetic induction		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
6.15 know that a voltage is induced in a conductor or a coil when it moves through a magnetic field or when a magnetic field changes through it and describe the factors that affect the size of the		

induced voltage		
6.16 describe the generation of electricity by the rotation of a magnet within a coil of wire and of a coil of wire within a magnetic field, and describe the factors that affect the size of the induced voltage		
6.17P describe the structure of a transformer, and understand that a transformer changes the size of an alternating voltage by having different numbers of turns on the input and output sides		
6.18P explain the use of step-up and step-down transformers in the large-scale generation and transmission of electrical energy		
6.19P know and use the relationship between input (primary) and output (secondary) voltages and the turns ratio for a transformer: $$\frac{input\ (primary)\ voltage}{output\ (secondary)\ voltage)} = \frac{primary\ turns}{secondary\ turns}$$		
6.20P know and use the relationship: $$input\ power = output\ power$$ $$V_p\ I_p = V_s I_s$$ $$for\ 100\%\ efficiency$$		

Radioactivity and Particles

(a)	Units
Students should:	
7.1	use the following units: becquerel (Bq), centimetre (cm), hour (h), minute (min) and second (s)

(b)	Radioactivity		
Learning Objective (with Specification Reference No)		Paper 1	Paper 2
7.2 describe the structure of an atom in terms of protons, neutrons and electrons and use symbols such as $^{14}_{6}C$ to describe particular nuclei		🟩	
7.3 know the terms atomic (proton) number, mass (nucleon) number and isotope		🟩	
7.4 know that alpha (α) particles, beta (β⁻) particles, and gamma (γ) rays are ionising radiations emitted from unstable nuclei in a random process		🟩	
7.5 describe the nature of alpha (α) particles, beta (β⁻) particles, and gamma (γ) rays, and recall that they may be distinguished in terms of penetrating power and ability to ionize		🟩	
7.6 *practical: investigate the penetration powers of different types of radiation using either radioactive sources or simulations*		🟩	
7.7 describe the effects on the atomic and mass numbers of a nucleus of the emission of each of the four main types of radiation (alpha, beta, gamma and neutron radiation)		🟩	
7.8 understand how to balance nuclear equations in terms of mass and charge		🟩	
7.9 know that photographic film or a Geiger−Müller detector can detect ionising radiations		🟩	
7.10 explain the sources of background (ionising) radiation from Earth and space		🟩	
7.11 know that the activity of a radioactive source decreases over a period of time and is measured in becquerels		🟩	
7.12 know the definition of the term half-life and understand that it is different for different radioactive isotopes		🟩	
7.13 use the concept of the half-life to carry out simple calculations on activity, including graphical methods		🟩	
7.14 describe uses of radioactivity in industry and medicine		🟩	
7.15 describe the difference between contamination and irradiation		🟩	
7.16 describe the dangers of ionising radiations, including: • that radiation can cause mutations in living organisms			

	Paper 1	Paper 2
• that radiation can damage cells and tissue		
• the problems arising from the disposal of radioactive waste and how the associated risks can be reduced.		

(c) Fission and fusion

Learning Objective (with Specification Reference No)	Paper 1	Paper 2
7.17 know that nuclear reactions, including fission, fusion and radioactive decay, can be a source of energy		
7.18 understand how a nucleus of U-235 can be split (the process of fission) by collision with a neutron, and that this process releases energy as kinetic energy of the fission products		
7.19 know that the fission of U-235 produces two radioactive daughter nuclei and a small number of neutrons		
7.20 describe how a chain reaction can be set up if the neutrons produced by one fission strike other U-235 nuclei		
7.21 describe the role played by the control rods and moderator in the fission process		
7.22 understand the role of shielding around a nuclear reactor		
7.23 explain the difference between nuclear fusion and nuclear fission		
7.24 describe nuclear fusion as the creation of larger nuclei resulting in a loss of mass from smaller nuclei, accompanied by a release of energy		
7.25 know that fusion is the energy source for stars		
7.26 explain why nuclear fusion does not happen at low temperatures and pressures, due to electrostatic repulsion of protons		

Astrophysics

(a)	Units
Students should:	
8.1	use the following units: kilogram (kg), metre (m), metre/second (m/s), metre/second^2 (m/s^2), newton (N), second (s), newton/kilogram (N/kg)

(b) Motion in the Universe		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
8.2 know that: • the universe is a large collection of billions of galaxies • a galaxy is a large collection of billions of stars • our solar system is in the Milky Way galaxy.		
8.3 understand why gravitational field strength, *g*, varies and know that it is different on other planets and the Moon from that on the Earth		
8.4 explain that gravitational force: • causes moons to orbit planets • causes the planets to orbit the Sun • causes artificial satellites to orbit the Earth • causes comets to orbit the Sun.		
8.5 describe the differences in the orbits of comets, moons and planets		
8.6 use the relationship between orbital speed, orbital radius and time period: $$orbital\ speed = \frac{2\ x\ \pi\ x\ orbital\ radius}{time\ period}$$ $$v = \frac{2\ x\ \pi\ x\ r}{T}$$		

(c) Stellar evolution		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
8.7 understand how stars can be classified according to their colour		
8.8 know that a star's colour is related to its surface temperature		
8.9 describe the evolution of stars of similar mass to the Sun through the following stages: • nebula • star (main sequence) • red giant • white dwarf.		
8.10 describe the evolution of stars with a mass larger than the Sun		
8.11P understand how the brightness of a star at a standard distance can be represented using absolute magnitude		
8.12P draw the main components of the Hertzsprung–Russell diagram (HR diagram)		

(d) Cosmology		
Learning Objective (with Specification Reference No)	Paper 1	Paper 2
8.13P describe the past evolution of the universe and the main arguments in favour of the Big Bang		
8.14P describe evidence that supports the Big Bang theory (red-shift and cosmic microwave background (CMB) radiation)		
8.15P describe that if a wave source is moving relative to an observer there will be a change in the observed frequency and wavelength		
8.16P use the equation relating change in wavelength, wavelength, velocity of a galaxy and the speed of light: $$\frac{change\ in\ wavelength}{reference\ wavelength} = \frac{velocity\ of\ a\ galaxy}{(speed\ of\ light)}$$ $$\frac{\lambda - \lambda_0}{\lambda_0} = \frac{\Delta\lambda}{\lambda_0} = \frac{v}{c}$$		
8.17P describe the red-shift in light received from galaxies at different distances away from the Earth		
8.18P explain why the red-shift of galaxies provides evidence for the expansion of the universe		