Section C : Specification content

for OCR GCSE PHYSICS (Code 1982)

Please ensure that you have chosen the correct specification

Format

On the following pages, the first 2 columns show the specification content for each section of this syllabus specification.

The third column is provided to give teachers additional information, in abbreviated form, about the way in which the content is linked to other parts of the specification, and the table below summarises this information.

Abbreviation	Explanation and guidance
S (Only in Core Blocks)	This indicates content which also forms part of the associated Single Award A specification (Code 1984)
H	These are Learning Outcomes which are appropriate for candidates working at higher levels. Questions addressing these Learning Outcomes will only appear on the Higher Tier papers, and hence they are only appropriate for candidates likely to achieve A*, A or B.

The fourth column shows the relevant **page numbers** in **Physics for You**
(the revised edition, first published in 2001).

5.4 Content related to Sc4 core

Block 4.1 Electric Circuits

Page Numbers in Physics for You

Chapters 31, 38

	Learning Outcomes	**H/S**	
	Candidates should be able to :		
1	identify cells, batteries and generators as electrical sources, and bulbs, resistors, bells, motors, LEDs, LDRs, thermistors and buzzers as parts of an electrical circuit where electrical energy is dissipated. [The electrical symbols for a cell, battery, power supply, filament bulb, switch, LDR, fixed and variable resistor, LED, motor, heater, thermistor, ammeter and voltmeter should be known.]	**S**	pages 254, 261, 324-5
2	recall that resistors are heated when electric current passes through them.	**S**	p. 270-1
3	describe and explain the effect of a variable resistor in controlling the brightness of a lamp and the speed of a motor.	**S**	p. 261
4	measure resistance by correctly placing a voltmeter and an ammeter in a circuit	**S**	p. 261
5	state and be able to use the equation $V = I R$	**S**	p. 259
6	describe how current varies with voltage in a metal wire at constant temperature, a filament bulb and a silicon diode.	**S**	p. 265
7	describe how the resistance of an LDR varies with light level.		p. 325
8	describe how the resistance of a thermistor (ntc only) varies with temperature.		p. 325

Block 4.2 Forces and Energy transfer

Page Numbers Physics for You

Chapters 15, 16, 18

Learning Outcomes **H/S**

Candidates should be able to:

	Force and Rotation		
1	explain how the turning effect of a force depends on the size of the force and the perpendicular distance from the point of application to the pivot.		page 100
2	state and be able to use the equation moment of a force = force x perpendicular distance to pivot.		p. 100
3	use, for a balanced system, the equation sum of clockwise moments = sum of anticlockwise moments.		p. 101
	Force and Energy		
4	state and be able to use the equation work done = force x distance moved in its own direction.		p. 107
5	use the equation power = work done (or energy transfer) / time taken.		p. 118
6	state and be able to use the equation change in gravitational potential energy = mass x gravitational field strength x height moved.		p. 116
7	state and be able to use the equation kinetic energy = $\frac{1}{2}mv^2$.		p. 117
8	state and be able to use the equation energy transferred = work done.		p. 109
9	use the equation $\text{energy efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$	**S**	p. 112
10	explain the meaning of energy efficiency in the contexts of heating buildings and the performance of machines.	**S**	p. 112, 122

11	describe how domestic insulation reduces energy transfer by conduction, convection and radiation.	**S**	p. 44-51
12	use data on energy efficiency measures to evaluate cost-effectiveness of different approaches.	**S**	p. 45, 112
	Force and Motion		
13	state and be able to use the equation $\text{speed} = \frac{\text{distance}}{\text{time taken}}$		p. 130
14	plot and interpret distance-time graphs.		p. 134
15	calculate speed from a distance-time graph.		p. 134
16	plot and interpret speed-time graphs.		p. 131-3
17	calculate distance travelled from a speed-time graph.		p. 131-3
18	describe how braking distance is affected by the road surface, the mass and speed of the vehicle.		p. 98
19	describe factors that affect the thinking distance.		p. 98
20	recall that stopping distance is the sum of the thinking distance and the braking distance.		p. 98
21	use the equation energy transferred = force x distance = $\frac{1}{2}mv^2$. to discuss stopping distances.		p. 107, 109, 117, 98
22	recall that velocity describes the speed and direction of a moving object.		p. 130
23	calculate velocity from a displacement-time graph.		p. 134
24	state and be able to use the equation $\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$		p. 130, 133
25	calculate acceleration from a velocity-time graph.		p. 132-3
26	describe the relative sizes of the horizontal forces on an object moving in a straight line when it is accelerating, decelerating and moving at constant speed.		p. 77, (139)

27	state and be able use to the equation force = mass × acceleration.	**H**	p. 138-9
28	apply this relationship to the action of seat-belts and crumple zones.	**H**	p. 77, 146
29	describe forces acting between objects.		p. 92-95
30	recognise that when object A pulls or pushes object B then object B pulls or pushes object A with an equal-sized force in the opposite direction.		p. 94-95
	Forces on falling objects		
31	describe the effects of the Earth's pull and resistive forces due to motion in a fluid.	**S**	p. 99
32	state and be able to use the equation weight = mass × gravitational field strength.	**S**	p. 75, 139
33	explain how the size of the resistive force depends on the speed of the object.	**S**	p. 99, 136
34	describe how the forces acting on an object falling at terminal velocity are balanced.	**S**	p. 99, 136

Block 4.3 Wave Properties

Page Numbers in Physics for You

Chapters 28, 21, 25, 29

Learning Outcomes **H/S**

Candidates should be able to :

1	describe the effects of absorbing electromagnetic waves: heating, ionisation and damage to cells and tissue.		pages. 218-221, 226-7, 356
2	explain that wave motion involves an oscillation.		p. 174
3	describe the differences between a transverse and a longitudinal wave and give one example of each.		p. 174
4	recall the meaning of frequency, wavelength and amplitude.	**S**	p. 175
5	identify the wavelength and amplitude of a transverse wave.	**S**	p. 175
6	describe the effect on the loudness of a sound when the amplitude is changed.	**S**	p. 234
7	describe the effect on the pitch of a sound when the frequency is changed.	**S**	p. 234
8	state and be able to use the equation wave speed = frequency x wavelength.		p. 175
9	describe how echoes are caused by the reflection of sound.	**S**	p. 230
10	recall that refraction involves the change in speed of a wave.	**S**	p. 193
11	explain how changing the speed of a wave causes a change in wavelength and this may cause a change in direction.	**S**	p. 176, 193
12	explain and illustrate how virtual images are caused by the refraction of light.	**S**	p. 202, 204
13	recall that waves can be reflected at a plane barrier and that the angle of incidence equals the angle of reflection.	**S**	p. 176, 185
14	explain and illustrate how plane waves are reflected at a concave barrier, and how circular ripples are reflected at a plane barrier.	**S**	p. 176, 178
15	recall that water waves can be refracted if they are slowed down.	**S**	p. 176
16	recall that water waves can spread out at a narrow gap and that this is known as diffraction.		p. 177

17	describe how the amount of spreading depends on the size of the gap compared to the wavelength of the wave.		p. 177
18	recall that light can be diffracted but needs a very small gap as the wavelength of light is very small.		p. 177
19	appreciate that the diffraction of light is evidence for the wave nature of light.		p. 177
20	explain that sound can be diffracted.		p. 177
21	describe how the amount of diffraction of sound depends on the size of the sound source and the wavelength of the sound.		p. 177

Block 4.4 Using Waves

Page Numbers Physics for You

Chapters 28, 25, 29, 20

Learning Outcomes **H/S**

Candidates should be able to :

	The Electromagnetic Spectrum		
1	recall that the different types of electromagnetic waves form a continuous spectrum with a range of wavelength and frequency and that they transfer energy at the same speed in free space.	**S**	p. 218-9
2	list the parts of the spectrum in order of wavelength and frequency (gamma rays; X-rays; ultraviolet; light; infra-red; microwaves; radio waves).	**S**	p. 218-9
3	recall that microwaves cause heating when absorbed by water and cause burns when absorbed by body tissue.	**S**	p. 227
4	recall that infra-red radiation causes heating when absorbed by any object, and its use in radiant heaters.	**S**	p. 227, 270
5	recall that ultra-violet radiation is produced in fluorescent lights.	**S**	p. 226
6	recall that being out in the Sun for too long can cause sunburn and skin cancer from the ultra-violet radiation.	**S**	p. 220
7	explain that the darker the skin, the more ultra-violet radiation is absorbed by the skin and the less reaches the deeper body tissues to cause these cells to become cancerous.	**S**	p. 220
8	describe how information can be transmitted using electromagnetic radiation, including the use of satellites for global communication.	**S**	p. 221, 168-9, 320
9	explain that radio waves are readily diffracted and are therefore suitable for broadcasting.	**S**	p. 177
10	explain how information in narrow beams can be transmitted using microwaves.	**S**	p. 221, 320
11	describe the use of infra-red radiation in night photography.	**S**	p. 53, 221, 227
12	describe what happens to light incident on a perspex/glass-air surface both above and below the critical angle of incidence.	**S**	p. 195-7
13	describe how light is reflected at the inner face of a right-angled prism.	**S**	p. 196
14	explain how optical fibres are used in endoscopy.	**S**	p. 197, 200

15	explain how optical fibres allow the rapid transmission of data using digital signals.	**S**	p. 200, 320, 332
16	describe the transmission of data pulses using light in optical fibres.	**S**	p. 332
17	describe the difference between analogue and digital signals.	**S**	p. 332
18	describe the advantage of using digital signals to allow more information to be transmitted.	**H S**	p. 332-3
19	explain that X-rays pass through flesh but are absorbed by bone.	**S**	p. 218, 318
20	list the safety precautions that should be taken when using X-rays and gamma-rays.	**S**	p. 360, 318
21	interpret given information about the development of ideas concerning the dangers involved with using X-rays and/or radioactive substances.		p. 360, 318
22	describe the use of gamma-rays as tracers to detect malfunction of organs and as treatment for killing body tissue.	**S**	p. 356-7, 220
23	recall that ultrasound is a high-frequency longitudinal wave.	**S**	p. 230, 240-1
24	explain how distances can be measured using echo-sounding.	**S**	p. 230, 240
25	explain how the reflection of ultrasound by body tissue enables organs to be scanned.	**S**	p. 241
26	describe how ultrasound is used for pre-natal scanning.	**S**	p. 241
27	describe one non-medical use of ultrasound.	**S**	p. 240-1
	Seismic Waves		
28	recall that earthquakes produce shock waves, which affect the surface of the Earth and travel inside the Earth, and which can be detected by instruments (seismometers) located on the Earth's surface.	**H**	p. 154-5
29	recall that during earthquakes there are several types of wave produced including: P-waves (primary waves) which are longitudinal waves which travel through both solids and liquids and travel faster than S-waves S-waves (secondary waves) which are transverse waves which travel through solids but not through liquids.	**H**	p. 154-5
30	explain how the differences in behaviour of P-waves and S-waves inside the Earth can be interpreted in terms of a simple mantle/core structure for the inner Earth.	**H**	p. 154-5
31	explain how the seismographic record can be used to find the speed of seismic waves, which give evidence for the structure of the Earth.	**H**	p. 154-5

32	describe the composition of the Earth's outermost layer in terms of plates in relative motion: the upper part of the lithosphere is the crust which is thinner under oceans and thicker under continents the lithosphere is broken into large plates which move because of the massive convection currents which occur below the lithosphere in the deep interior.		p. 165-7
33	relate plate tectonic processes to the formation, deformation and recycling of rocks: plates collide at subduction zones where the oceanic lithosphere descends below the continental lithosphere, forming off-shore trenches and parallel mountain chains with volcanoes. This process can cause earthquakes the forces at the plate boundaries contribute to the rock cycle sea floor spreading causes fractures (cracks) which are filled with molten material from below the lithosphere, producing new rock at subduction zones, increased temperature and pressure can cause metamorphism producing new rocks by recrystallisation, without melting the descending lithosphere enters the hot mantle and partially melts to form magma rising magma can crystallise deep below the surface to form coarse-grained rocks (e.g. granite) or rise to the surface in volcanoes to form fine-grained rocks (e.g. basalt lava or volcanic ash).		p. 156-7
34	interpret given information about developments in ideas of plate tectonics. [No recall is expected.]		p. 369, 156-7

Block 4.5 Radioactivity

Page Numbers Physics for You

Chapter 39

Learning Outcomes **H/S**

Candidates should be able to :

1	describe how the breakdown of an unstable nucleus results in radioactive emission and the formation of a new element.	**S**	p. 355, 358
2	recognise that a stable nucleus can become unstable by the absorption of neutrons.	**S**	p. 358
3	explain that the level of background radiation, from a variety of sources, is higher in some places than in others.	**S**	p. 360
4	describe how to take background radioactivity into account when performing experiments.	**S**	p. 350, 360, worksheet
5	recall the relative penetration of alpha, beta and gamma emissions.	**S**	p. 350-1
6	apply this knowledge to explain why different emissions are suited to particular purposes including sterilisation, thickness measurement, treatment of cancer and tracer techniques.	**S**	p. 356-7
7	describe alpha, beta and gamma emissions in terms of atomic particles and electromagnetic waves.	**S**	p. 350-1
8	explain that the activity of a radioactive sample decreases with time.		p. 354
9	attribute this decrease in activity to a corresponding decrease in the number of unstable nuclei.		p. 354
10	explain half-life as the average time for the number of undecayed nuclei in a sample to halve.		p. 354
11	explain that different radioactive materials decay at different rates.		p. 354
12	use an activity-time graph to determine the half-life of a material.		p. 354, worksheet
13	describe how the half-life of a material can be measured.		p. 354, worksheet
14	apply an understanding of half-life to explain why different sources are suited to particular purposes.		p. 356-7
15	explain how measurements of the amounts of radioactive elements and their decay products in rocks can be used to calculate the age of a rock.		p. 357, 360

16	interpret given information about developments in ideas of radioactivity. [No recall is expected.]	**S**	p. 368
17	recall that exposure to ionising radiation can be harmful.	**S**	p. 360
18	describe the precautions that should be taken when handling radioactive materials.	**S**	p. 360
19	describe some effects of radiation on the human body.	**S**	p. 356, 360
20	explain how the effects of radiation depend on the energy and penetration of the emission as well as the amount of exposure.	**S**	p. 356, 360

Block 4.6 The Earth and Universe

Page Numbers Physics for You

Chapter 20 **H/S**

Learning Outcomes Candidates should be able to :

1	recall the names and properties of bodies in the Universe, to include: the planets in the Solar System, comets, meteors, stars, galaxies and natural satellites.	**S**	p. 160-1, 163, 165
2	explain that the orbit time of a planet depends on its distance from the Sun.	**S**	p. 160-1
3	explain that the Moon remains in orbit around the Earth, and the planets orbit the Sun, because of the gravitational attractive forces between them.	**S**	p. 158-9, 162
4	interpret given information about developments in ideas about models of the Solar System.	**S**	p. 369, 163, worksheet
5	explain that the orbit period of an artificial satellite increases with increasing height above the Earth's surface.	**S**	p. 162, 168
6	describe the variation in gravitational force with distance.	**S**	p. 162
7	explain the variation in speed of a comet during its orbit around the Sun.	**S**	p. 163
8	describe how stars evolve over a long time scale from formation to final state. [Candidates should be familiar with the following terms: fusion, red giant, white dwarf, supernova, neutron star, black hole.]	**S**	p. 165
9	explain that theories for the origin of the Universe must take into account that: --light from other galaxies is shifted to the red end of the spectrum --the further away galaxies are, the greater the red shift.	**S**	p. 166
10	recognise that one way of explaining this is that: --other galaxies are moving away from us very quickly --galaxies furthest from us are moving fastest.	**S**	p. 166
11	explain how knowledge of the rate of expansion of the Universe enables its age to be estimated.	**S**	p. 166
12	explain that there are possible futures for the Universe depending on the amount of mass in the Universe and the speed at which the galaxies are moving apart.	**S**	p. 166
13	interpret given information about developments in ideas on the origin of the Universe. [No recall is expected.]	**S**	p. 369
14	discuss how scientists are trying to find evidence for life on other planets in the Solar System and elsewhere in the Universe.	**S**	p. 167

Block 4.7 Using Electricity

Page Numbers Physics for You

Chapters 30, 31, 32

Learning Outcomes **H/S**

Candidates should be able to :

	Electrostatic Phenomena		
1	explain that when two objects rub together and become charged, electrons are transferred from one object to the other.		p. 247-8
2	explain how charging by contact and charging by induction occur in terms of the movement of electrons.		p. 248, (249)
3	recall that there are repulsive forces between objects with similar charges, and attractive forces between objects with opposite charges.		p. 247
	Uses of Electrostatics		
4	describe some everyday beneficial uses of electrostatic charge and examples where the build-up of static charge should be avoided, to include photocopying, ink-jet printers, the removal of ash from the waste gases in a coal-burning power station and refueling of aircraft.		p. 252, 321
	Electrostatics and Current		
5	recall that current is a flow of charge.		p. 255
6	state and be able to use the equation charge = current x time.	**H**	p. 266
7	explain that the current in a metal is due to a flow of electrons from negative to positive and explain that a current in an electrolytic solution is due to a flow of both positively and negatively charged particles.		p. 255, 278
8	recall that the voltage between two points is the number of joules of energy transferred for each coulomb of charge that passes between the points.	**H**	p. 267
	Electricity in the Home		
9	state and be able to use the equation power = voltage x current.		p. 272
10	explain that a direct current is always in the same direction but an alternating current changes direction.	**S**	p. 254, 274

11	recall that energy is supplied to houses via the live and neutral wires.	**S**	p. 274
12	recall that in normal use no current passes in the earth wire.	**S**	p. 275
13	explain that the live wire has to be insulated from the earth and neutral wires.	**S**	p. 274-5
14	explain how fuses and circuit breakers prevent fire due to electrical faults.	**S**	p. 275, 270, 312
15	explain how the earth wire, together with the fuse or circuit breaker, prevents electrocution.	**S**	p. 275
16	explain why double-insulated appliances do not need an earth wire.	**S**	p. 275
17	explain that energy can be transferred from the electricity supply by means of convection currents and also as electromagnetic waves, including infra-red and microwaves.	**S**	p. 270-1, 227
18	use the equation energy = power x time to calculate energy transfer in joules and kilowatt-hours.	**S**	p. 272-3
19	recall that a domestic electricity meter measures the energy transfer in kilowatt-hours.	**S**	p. 273
20	calculate the cost of electrical energy from a knowledge of the power, the time and the unit cost.	**S**	p. 273

Block 4.8 Electromagnetism

Page Numbers Physics for You

Chapters 35, 36

Learning Outcomes **H/S**

Candidates should be able to :

1	recall that a current-carrying conductor at right angles to a magnetic field experiences a force.		p. 296
2	describe the effect of reversing the current and the direction of the magnetic field.		p. 296
3	explain how this effect is used in a simple electric motor.		p. 298-9
4	describe the effect of changing the size of the current and the strength of the magnetic field.		p. 296
5	explain how the forces on a current-carrying coil in a magnetic field produce a turning effect on the coil.		p. 297
6	describe the use of a split-ring commutator in a simple d.c. motor.		p. 298
7	recall that a voltage is induced in a conductor when it moves across a magnetic field.		p. 302-3
8	recall that a voltage is induced in a conductor when the magnetic field through it changes.	**S**	p. 303
9	describe how the size of the induced voltage depends on the rate at which the change occurs.	**S**	p. 303
10	recall the effect of reversing the change.	**S**	p. 302-3
11	explain that an alternating current is generated when a magnet rotates within a coil of wire.	**S**	p. 304
12	explain that a changing magnetic field in one coil of wire can induce a voltage in a neighbouring coil.	**S**	p. 307
13	explain that a transformer changes the size of an alternating voltage.	**S**	p. 308-9
14	describe the construction of a transformer as two coils of wire wound on an iron core.	**S**	p. 308
15	describe the difference in action and in construction of a step-up and a step-down transformer.	**S**	p. 308-9

16	state and be able to use the equation $V_p / V_s = N_p / N_s$	**H**	page 308
17	state and be able to use the equation $V_p I_p = V_s I_s$	**H**	p. 308
18	describe the energy flow through a coal-burning power station.	**S**	p. 113
19	discuss the social and environmental issues associated with different methods of generating electricity.	**S**	p. 113-5
20	explain that electricity is generated by rotating an electromagnet within coils of wire.	**S**	p. 304, 306
21	describe power losses in transmission.	**S**	p. 309
22	explain why power is transmitted at high voltage.	**H**	p. 309
23	describe the use of transformers in power transmission.	**S**	p. 309
24	explain why the use of transformers dictates the use of alternating current.	**S**	p. 309

5.5 Content related to Extension option A

Extension Block A.1 **Electronics and Control**		Page Numbers in Physics for You
Chapter 38		
Learning Outcomes	**H**	
Candidates should be able to :		
1 know that the input signal for a logic gate is either a high voltage (about 5 V) or a low voltage (about 0V).		page 339
2 appreciate that the output of a logic gate is high or low depending on its input signals.		p. 336-7
3 know the truth tables of AND, OR, and NOT gates in terms of high and low signals.		p. 336-7
4 know how to use switches, LDRs and thermistors in series with resistors to provide input signals for logic gates.		p. 339
5 explain how an LED and series resistor can be used to indicate the output of a logic gate.	**H**	p. 339
6 recall that a relay is needed for a logic gate to switch a current in a mains circuit because: a logic gate output cannot supply much power the relay isolates the low voltage gate from the high voltage mains.	**H**	p. 339, 326-7
7 know that relays controlled by logic gates can be used to switch currents in circuits containing heaters, motors, lights and locks.		p. 326-7, 295
8 explain how logic gates are used as part of an electronic system consisting of input, processor and output device.		p. 327
9 identify input, processor and output stages of an electronic system from a circuit diagram employing logic gates.		p. 338-9
10 know how to work out the truth table of a logic system with up to three inputs made from logic gates.	**H**	p. 338
11 know how to assemble a circuit of logic gates which obeys a given truth table of up to eight rows.	**H**	p. 338
12 know the truth tables of NAND and NOR gates.	**H**	p. 337

13	know how to connect NOR and NAND gates to make a latch (bistable) circuit.		p. 340
14	explain how, for a NOR and NAND gate latch: a brief high signal at one input results in a permanent high signal at the latch output a brief high signal at the other input causes a low signal at the latch output a low signal at both inputs leaves the latch output signal unchanged.	**H**	p. 340
15	explain how two resistors can be used as a potential divider.		p. 264
16	explain how one fixed resistor and one variable resistor in a potential divider allows variation of the output voltage.		p. 264, 339
17	know how to calculate the output signal of a potential divider from the values of its resistors.	**H**	p. 264
18	explain how a thermistor and an LDR can be used with a fixed resistor to generate a signal for a logic gate which depends on environmental conditions.	**H**	p. 339
19	explain how a thermistor and an LDR can be used with a variable resistor to provide a signal with an adjustable threshold for a logic gate.	**H**	p. 339

Extension Block A.2 Processing Waves

Page Numbers in Physics for You

Chapters 25, 26, 27, 29

Learning Outcomes **H**

Candidates should be able to :

1	use the equation: refractive index = $\frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$		p. 193
2	recall that dispersion occurs because waves of different wavelength travel at different speeds in transparent materials.		p. 193, 217
3	explain dispersion in terms of refractive index.		p. 193, 217
4	describe the effect of a convex lens on: a diverging beam of light a parallel beam of light.		p. 202-3
5	know that light incident on a convex lens parallel to the axis passes through the focal point after passing through the lens.		p. 202
6	know how to find the position and size of the real image formed by a convex lens by drawing rays from the object which: pass through the centre of the lens move parallel to the axis before the lens and pass through the focal point after passing through the lens.	**H**	p. 204
7	describe the use of a convex lens as a magnifying glass, in a camera and in a projector.	**H**	p. 204, 206, 214
8	explain how a camera and a projector are focused.		p. 206-7, 214
9	recall that all objects vibrate with a characteristic, or natural frequency.		p. 233
10	know that the natural frequency of an object increases with decreasing mass.	**H**	p. 233
11	know that resonance occurs when an object is subjected to a vibration at its natural frequency.		p. 233
12	describe the effects of resonance in: a pendulum a mass on a spring a vibrating string a column of air in a musical instrument.		p. 233, 236-7

13	recall that a musical instrument produces a sound when: a column of air vibrates at its natural frequency a string vibrates at its natural frequency.		p. 236-7
14	know that the natural frequency of a column of air decreases with increasing length of the column.	**H**	p. 236
15	describe qualitatively how the natural frequency of a vibrating string depends on its length, mass and tension.	**H**	p. 237
16	know that a string can vibrate in different modes, each with a different number of nodes.		(p. 237)
17	know that the frequency of a vibrating string increases with increasing number of nodes.		(p. 237)
18	appreciate that the quality of the note from a stringed instrument depends on the relative intensity of the modes of vibration.		(p. 235)
19	use the displacement-time graph of a sound wave to determine its: frequency amplitude quality.	**H**	p. 234-5
20	know that interference effects can be observed in: sound waves surface water waves electromagnetic waves.		worksheet
21	know that interference of two waves results in a pattern of reinforcement and cancellation of the waves.		worksheet
22	describe a demonstration of interference using sound, water waves or microwaves.		worksheet
23	explain interference effects in terms of constructive and destructive interference.	**H**	worksheet
24	know that the number of half wavelengths in the path difference for two waves from the same source is: an odd number for destructive interference an even number for constructive interference.	**H**	(worksheet)
25	interpret given information about the developments in ideas about the nature of light.		p. 370

Extension Block A.3 Energy and Forces

Page Numbers in Physics for You

Chapters 18, 19, 7

Learning Outcomes **H**

Candidates should be able to :

1	recall that an acceleration preceded by a minus sign represents a deceleration.		p. 130
2	calculate acceleration and displacement from a velocity-time graph.	**H**	p. 133
3	recall and use the equations: $v = u + at$ $v^2 = u^2 + 2as$ $s = ut + \frac{1}{2}at^2$	**H**	p. 135, 137
4	know that an object projected horizontally in the Earth's gravitational field, in the absence of friction, has: a constant horizontal velocity a steadily increasing vertical velocity.	**H**	p. 137
5	describe the path of an object projected horizontally in the Earth's gravitational field.		p. 142
6	recall and use: momentum = mass × velocity	**H**	p. 144
7	know that momentum is conserved.	**H**	p. 145
8	apply the principle of momentum conservation to the interaction of two objects moving in one dimension.	**H**	p. 145-6
9	explain that there is a force on a rocket from its exhaust gases.	**H**	p. 95, 146
10	know that rockets carry their own supply of fuel and oxygen.		p. 67
11	know that injuries in vehicle collisions are due to very rapid accelerations of parts of the body.		p. 77, 146
12	explain that spreading acceleration over a longer time reduces the forces which act.		p. 146, (144)
13	know the use of crumple zones, air-bags and safety straps in cars.		p. 77, 146, worksheet
14	recall and use: energy transfer = mass × specific heat capacity × temperature change appreciate some of the effects of materials having different specific heat capacities.		p. 38-40, worksheet

15	describe ways in which energy transfer from a house is reduced.		p. 45
16	appreciate that in many processes energy is ultimately dissipated as heat in the surroundings.		p. 110-113
17	classify energy sources as renewable or non-renewable.		p. 11-13
18	evaluate the advantages and disadvantages of geothermal, wind, fossil fuel, nuclear and biomass as sources of energy.		p. 12-13, 114-5
19	describe how energy from renewable and non-renewable sources can be transferred to a useful output.		p. 113
20	evaluate the efficiencies of energy transfer devices by comparing energy input and useful energy output.		p. 112, 122
21	recall and use: $\text{efficiency} = \frac{\text{useful work or energy output}}{\text{total energy input}}$		p. 112, 122, worksheet

5.6 Content related to Extension option B

Extension Block B.1 Computational Physics

Page Numbers in Physics for You

Chapters 12, 11, 18, 19, 6

Learning Outcomes **H**

Candidates should be able to :

1	use the equation: density = mass/volume.		p. 82-3
2	know how extension varies with applied force for a range of familiar materials: describe the behaviour of a steel spring, copper wire and a rubber band when subjected to an increasing stretching force understand the difference between elastic and inelastic behaviour and be able to interpret data relating to contemporary applications.		p. 74
3	use the equation: force = spring constant x extension use the gradient of a force/extension graph to determine the spring constant.		**(**p. 74)
4	calculate the energy stored in a spring from the equation: energy = $\frac{1}{2}$ force x displacement for a linear extension and from the area under a force/extension graph.	**H**	p. 116
5	use the gradient of a force/acceleration graphs to determine mass.		p. 138
6	know the difference between vector and scalar quantities. know that for some quantities, e.g. force, direction is important whereas for other quantities, e.g. mass, direction is not important.		p. 96
7	interpret and use vector diagrams to add forces, velocities and displacements: addition of parallel vectors vectors at right angles only.	**H**	p. 96
8	manipulate and be able to use the equations: $v = u + at$ $v^2 = u^2 + 2as$ $s = ut + \frac{1}{2} at^2$	**H**	p. 135-7

9	describe the path of an object projected horizontally in the Earth's gravitational field, including projectiles in sport.		p. 142
10	explain the motion of an object projected horizontally in the Earth's gravitational field. apply the equations of motion to the vertical and horizontal movement of an object projected horizontally in the Earth's gravitational field.	**H** **H**	p. 137
11	use ideas about momentum to: identify situations where the momentum of an object changes describe simple situations involving recoil.		p. 146
12	use the equation: momentum (kg m/s) = mass (kg) x velocity (m/s)	**H**	p. 144
13	explain the idea of conservation of momentum and apply it to describe systems such as: space rockets and artificial satellites collisions, e.g. between vehicles including aspects of road safety collisions between atomic particles.	**H**	p. 145-6
14	recall that when the volume of a gas is reduced its pressure increases and be able to explain this using a molecular model.		p. 36, 16
15	use the equation: PV = constant	**H**	p. 31-35
16	use concepts of proportionality to understand the relationship between volume and temperature, pressure and temperature for a gas and to find the absolute zero; explain why pressure or volume varies with temperature and interpret absolute zero using a molecular model.		p. 32-6, 390-1
17	use the concept of inverse proportion to understand the relationships between pressure and volume for a gas and mass and acceleration for particles.	**H**	p. 390-1, 31, 138
18	use the equation: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	**H**	p. 35
19	use temperature-time graphs to determine rates of cooling.	**H**	**(**p. 56)
20	model random phenomena: to explain why a gas exerts a pressure and why the pressure increases with temperature. to use simple probabilistic models to explain diffusion, radioactive half-life in carbon dating and energy transfer in heat exchangers.	 **H**	p. 16-17, 36, 354, 362, 43

Extension Block B.2 Communication

Page Numbers Physics for You

Chapters 38, 37 **H**

Learning Outcomes Candidates should be able to :

1	appreciate how, historically, the use of light greatly increased the speed of communication but that it requires the use of a code.		p. 370, 335
2	appreciate how the use of electrical signals has improved the speed and distance of communication.		p. 221, 168-9, worksheet
3	know that radio, telephone, television, fax, e-mail and the internet can be used to transmit information rapidly across long distances.		p. 221, 320, 335, 313
4	explain the relative merits of light and radio waves for communication.		p. 200, 335
5	recall what loudspeakers, earphones, microphones and tape heads do and explain how: --loudspeakers and earphones work --microphones (moving coil type) and tape heads work.	**H**	p. 297, 295, p. 334, 313
6	recall the difference between analogue and digital signals and recognise that the latter requires an extension of the idea of a code for transmitting information.		p. 332
7	describe some of the benefits of digital coding of information, and: --how it is used to record on compact discs and transmit information through optical fibres --the advantages of using digital recording and playback using compact discs compared with magnetic tape and vinyl disc.		p. 312, 200, 332-3
8	describe the operation of an amplitude modulated radio system, including the processes of: carrier wave production and modulation, transmission of the signal, reception, diode detection and amplification.	**H**	p. 335
9	appreciate that the behaviour of electron guns in cathode ray tubes can be explained in terms of negatively charged particles given off from a heated wire and then accelerated.		p. 314-5
10	recall the principles of the cathode ray tube and apply this knowledge to the: oscilloscope (to include X and Y plates, volts/cm controls, time-base control, intensity control) television (to cover scan pattern and brightness control via the modulator).	**H**	p. 314-7
11	interpret given information about developments in ideas about the potential health hazards of mobile phones.		worksheet

Extension Block B.3 Energy Transfers

Page Numbers Physics for You

Chapters 16, 38, 7, 29 **H**

Learning Outcomes Candidates should be able to :

1	calculate the net energy transfer from a number of different transfers.		p. 112-113
2	evaluate the efficiencies of energy transfer devices by comparing energy input and useful energy output.		p. 112, 122
3	use the equation: $\text{efficiency} = \frac{\text{energy output}}{\text{energy input}}$		p. 112, 122, worksheet
4	appreciate how LDRs and thermistors can be used with electrical circuits to monitor light levels and temperature in a building: circuits to include the sensor and a resistor in series light and temperature levels monitored via the voltage across the resistor how changing the resistor value can affect the voltage across it. [No details of any switching circuits are required.]	**H**	p. 324-5, 329-330, 339
5	appreciate that raising the temperature of one kilogram of different materials requires the supply of different quantities of energy.		p. 38-40
6	appreciate some of the effects of materials having different specific heat capacities.		p. 40
7	use the equation: change in internal energy (J) = mass (kg) x specific heat capacity (J/kg^{o}C or K) x temperature rise (^{o}C or K)		p. 39, worksheet
8	appreciate and use the relationship between the change in kinetic or potential energy and change in internal energy.	**H**	p. 116-117, 39
9	identify situations where resonance is happening: recall that all objects vibrate with a characteristic or natural frequency describe how to measure the natural frequency of the oscillator.		p. 233, 236-7
10	know that resonance occurs when an object is subjected to a vibration at its natural frequency. describe the conditions for resonance in terms of a large amplitude resulting from the driver frequency being equal to the natural frequency of the oscillator.	**H**	p. 233
11	appreciate some situations in which resonance is desirable and some in which it is not.		p. 233, 236-7

end of specification content