Malta

Secondary Education Certificate
Syllabus for **PHYSICS**

Assessment

The examination will consist of two written papers of two hours' duration each and an assessment of practical work

Paper I will consist of a written paper, comprising about 10 compulsory short questions to be answered in the spaces provided in the examination booklet, and a practical component. This paper is be taken by ALL candidates registered by the examination.

There will be two versions of Paper II; **Paper IIA** or **Paper IIB**. Questions in Paper IIA will be more difficult than those in Paper I. Questions in Paper IIB will be less difficult than those in Paper I.

Paper IIA or **Paper IIB** will consist of five compulsory questions, two of which will test experimental skills.

The right-hand column on the following pages shows the relevant page numbers in **Physics for You**, by Keith Johnson, revised edition 2001.
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SECONDARY EDUCATION CERTIFICATE

SYLLABUS FOR PHYSICS - 2002-2003

	Unit	Content	Page numbers in Physics for You
	Measurements		
			p. 6, 83
1.1	Length	Use and describe the use of rulers and measuring cylinders to determine a length or a volume	
1.2	Time	Use and describe the use of clocks and stopwatches to determine an interval of time	7
1.3	Mass	Use and describe the use of balances, including an electronic balance, to determine the mass of an object	7, 83
1.4	Density	Describe an experiment to determine the density of a liquid and of a regularly or irregularly shaped solid and make the necessary calculations	82-83
	Forces		
			75
2.1	Stretching Materials	Use a newton balance to measure forces	
		Describe how extension varies with applied force for a range of materials Understand the meaning of elastic limit Describe the behavior of a helical spring and a rubber band when subjected to an increasing force, including Hooke's Law	74, 379-380
2.2	Pressure	Use of the equation, $\text{Pressure} = \frac{Normal\ Force}{Area}$ Describe situations where a force applied on a small area produces a large pressure Describe situations where a force applied on a large area produces a small pressure	85
2.3	Pressure in Liquids	Understand that liquids transmit pressure in all directions enabling force to be multiplied	86-88
		Describe one everyday application of hydraulics	e.g. car brakes
		Apply $\text{Pressure} = \frac{Force}{Area}$ to simple hydraulic machines	
		Relate the pressure beneath a liquid surface to depth and to density Use of the equation **P = ρ.g.h** is required	86

2.4	Atmospheric Pressure	Understand that the atmosphere exerts a pressure Know that atmospheric pressure may be measured by a barometer Details of construction are not required Understand that atmospheric pressure decreases to zero with increase in height above the Earth's surface Appreciate that changes in atmospheric pressure may indicate a change in the weather	p. 89-90
2.5	Pressure in Gases	Describe qualitatively how the pressure of a fixed mass of gas is affected by changes in its temperature and volume	36
	Turning Effect of Forces		
			100
3.1	Moment of a Force	State that the turning effect of a force depends on the size of the force and the perpendicular distance from the pivot to the line of action of the force Use the equation **Moment = Force x Perpendicular distance from pivot to line of action of force**	
3.2	Principle of Moments	Describe an experiment, involving vertical forces, to verify that there is no net moment on a body in equilibrium	101
		Understand that the weight of an object acts at its centre of mass Be familiar with the two conditions for equilibrium of a body Solve problems on simple balanced systems	102-105
	Motion		
4.1	Linear Motion	Use $Velocity = \frac{change\ in\ displacement}{change\ in\ time}$ Interpret displacement-time graphs and calculate velocity from such graphs	130, 134
		Use $Acceleration = \frac{change\ in\ velocity}{change\ in\ time}$ Interpret velocity-time graphs and calculate displacement and acceleration from such graphs	130, 132-133
		State the factors which affect braking distance and thinking distance Understand that **Stopping distance = Thinking distance + Breaking distance**	98
		Appreciate that bodies falling freely have the same acceleration	136-137
		Use the equations: **v = u +a.t** **s = {(u + v)/2}.t** **$s = a.t^2/2$**	135
		Describe how to find the acceleration of free fall by timing a falling object	137

	Forces and Motion		
			p. 76-77, 96, 99
5.1	Kinematics	Understand that objects continue moving with constant velocity or remain at rest when all the forces acting on them balance	
		Understand that an unbalanced force acting on an object gives the object an acceleration in the direction of the force	
		Use the equations: **F = m.a** and **W = m.g**	138-139
		Appreciate that when an object A exerts a force on object B, object B exerts an equal force in the opposite direction	94-95
		Understand that for a body moving through a medium, resistive forces depend on body shape and speed	93, 99
		Understand that forces acting on a body which has reached terminal speed are balanced	
	Momentum		
6.1	Law of conservation of momentum	Understand that when two objects moving in one direction interact, their total momentum is conserved if there are no external forces acting on them	144-146
		Use the principle of conservation of momentum in the collision of two objects and the explosion of an object	
		Use and apply the equation: **Force = (Change in momentum) / (Change in time)**	
		Apply equation to practical situations like the packaging of fragile objects, the action of crumple zones and seat belts	
	Energy, Work and Power		
			8-9, 108-111
7.1	Energy	Give examples of energy in different forms, its conversion and conservation and apply the principle of conservation of energy to simple examples	
	Work	Use: **Work = force x distance moved in the direction of the force**	107
		Use: **Work done in raising a mass against its weight = m.g.h.,** and **kinetic energy = $m.v^2/2$**	116-117
	Power	Use: **Power = work done (converted energy) / time taken**	118-119

	Heat Energy		
			p. 38-40
8.1	Heat and Temperature	Know that a change in temperature may be caused by energy transfer and that a temperature difference may cause energy transfer called heat	
		Use the equation: **Energy transfer = mass x specific heat capacity x temperature change**	
		Describe experiments by which the specific heat capacity of a solid and a liquid may be determined, using an electrical heater of known power	
		Describe one everyday effect due to the relatively large specific heat of water	
8.2	Heat Transfer	Give examples of good and bad conductors of heat and describe their uses	42-45
		Appreciate that convection currents in gases and liquids involve movement of the fluid due to differences in density	46-47
		Describe the role of convection in space heating	
		Understand that insulation reduces energy transfer by conduction and convection	44, 53
		Understand that everyday objects radiate energy in the form of waves (infra-red) which form part of the electromagnetic spectrum	48-53, 219
		Appreciate that the power radiated increases with increase in temperature	
		Describe experiments to show the properties of good and bad emitters and good and bad absorbers of infra-red radiation	48-49
		Identify and explain some of the everyday applications and consequences of heat radiation, including the 'greenhouse effect'	49-53
	Energy Sources		
9.1		Classify energy sources as renewable and non-renewable	11-13, 111, 113-115
		Give examples of each class	
		State the advantages and disadvantages of fossil fuel, nuclear, wind, hydroelectric, solar and biomass sources of energy	
		Draw and explain energy flow diagrams through steady state systems such as a filament lamp, a power station, a vehicle travelling at constant speed on a level road	112, 113, 122
	Energy Efficiency		
10.1		Understand the efficient use of energy in the context of the home, heating and cooling of buildings, and of the internal combustion engine	10, 44-45, 64
		Understand the effect on energy resources of the efficient use of these resources, considering pollution and running costs	113-115
		Contrast the efficiencies of energy conversion devices by comparing energy input and useful energy output	(worksheet in Teacher Support Pack)
		Use the equation: **Efficiency = useful energy output/ total energy input**	112

	Waves		
11.1		Describe what is meant by wave motion as illustrated by vibration in ropes, springs and by experiments with water waves	p. 174-177
		Understand that waves are a means of energy transfer without transfer of matter	
		Understand the meaning of the term wavefront	
		Distinguish between transverse and longitudinal waves and give examples	175
		Interpret displacement-distance graphs for transverse waves	
		State the meaning of the terms frequency, wavelength, wave velocity, amplitude	
		Understand that the wave frequency is determined by the source	
		Identify wavelength and amplitude in transverse and longitudinal waves	175, 229
		Use: **Wave speed = frequency x wavelength**	175
		Describe the effect on wavelength of change in frequency of the vibrator in a ripple tank	
	Sound		
12.1		Appreciate that sound waves require a medium	229
		State approximate values for the speed of light and sound	179
		Describe the production of sound by vibrating sources	228-229
		Describe the longitudinal nature of sound waves as a series of compressions and rarefactions	
		State the approximate range of audible frequencies	232
		Describe how reflection of sound may produce echoes	230
		Describe how a signal generator and loudspeaker may be used to produce sounds of varying frequency and loudness	232, 234-5
		Describe how an oscilloscope and a microphone may be used to obtain a signal trace on the oscilloscope screen	234-5
		Describe the effect on loudness of change in amplitude and the effect on pitch of change in frequency	
12.2	Reflection	Describe the use of a ripple tank to demonstrate reflection of waves	176
		Describe the formation, and give the characteristics, of an optical image by a plane mirror	184-187
		Use the law: **Angle of incidence = Angle of reflection**	

12.3	Refraction	Describe the use of a ripple tank to show that refraction involves a change in wave velocity and wave length which may cause a change in wave direction	p. 176
		Describe an experimental demonstration of the refraction of light	192-193
		Use the terms angle of incidence and angle of refraction to describe the passage of light through parallel sided transparent material	
		Describe how an image of a submerged object is formed when light rays are refracted at a water-air plane boundary	194, 198
12.4	Total Internal Reflection	Describe partial reflection and total internal reflection	195
		Describe the action and use of optical fibres	197, 200
12.5	Converging Lenses	Describe the action of a thin converging lens on a beam of light	202-203
		Use the term focal length	
		Draw ray diagrams to illustrate the formation of real and virtual images by a converging lens	204
		Describe and explain the use of a converging lens in a simple camera, a projector, and as a magnifying glass	206, 214, 204
12.6	Dispersion	Give a qualitative account of the dispersion of white light by a prism	216-217
12.7	Diffraction	Describe the use of water waves to show diffraction by wide and narrow gaps	177
		Describe a simple experiment which shows that light can be diffracted but needs a very small gap because the wavelength of light is small	
		Appreciate that diffraction of light is evidence that light behaves like waves	177
	Resonance		
13.1		Know that all objects vibrate with a characteristic or natural frequency	233
		Know that the natural frequency of vibration depends on the dimensions and mass of an object	
		Know that when resonance occurs an object is made to vibrate with its natural frequency of vibration	
		Describe examples of resonance in everyday life	
	Stretched Strings		
14.1		Know the qualitative relationship between the frequency of vibration of a stretched string, its length, tension, and thickness	237
		Apply knowledge of stretched strings to string instruments	
	Ultrasound		
15.1		Know that ultrasound is a high frequency longitudinal wave	240-241
		Describe the use of ultrasound in echo sounding	
		Understand that reflection of ultrasound by body tissue enables organs to be scanned	

	Electromagnetic Waves		
16.1	The Spectrum	Appreciate that light is part of a continuous spectrum of electromagnetic waves all of which travel in vacuum with the same speed State that in order of increasing wavelength (decreasing frequency) this spectrum consists of gamma rays, X-rays, ultra-violet light, infra-red, microwaves, and radio waves State the approximate values for the wavelength of each of these ranges of electromagnetic waves	p. 217-221
16.2	Radio waves	Appreciate that information can be transmitted by radio waves Appreciate that in a radio station, the information contained in sound waves is encoded in a radio wave, and that the radio receiver decodes the information carried by the radio waves to give the information as a sound wave	219, 221, 335
16.3	Microwaves	Appreciate that microwaves of a certain frequency cause heating when absorbed by water and cause burns when absorbed by body tissue	219, 227
16.4	Infra-red waves	Understand that infra-red waves cause heating when absorbed by any object and are used in radiant heaters, optical fibre communication, and for the remote control of TV sets and VCR's	219, 221, 227
16.5	Ultraviolet radiation	Understand that uv radiation can be produced by special lamps and that prolonged exposure to the sun may cause skin cancer from uv radiation	219, 220, 226
16.6	X-rays	Understand that X-rays pass through body tissue but are absorbed by the bones Describe the safety precautions that should be taken when using X-rays and gamma rays	219, 220, 226
16.7	Gamma rays	Describe the use of gamma rays to kill harmful bacteria in food, sterilise surgical instruments, and kill cancer cells	219, 220, 351, 357

	Magnetism		
17.1	Magnets	State the properties of magnets Give an account of induced magnetism Distinguish between magnetic and non-magnetic materials Describe an experiment to identify the pattern of field lines around a bar magnet Distinguish between the magnetic properties of iron and steel Distinguish between the design and the use of permanent magnets and electromagnets	p. 284-249
	Electrostatics		
18.1	Electric charge	Describe simple experiments to show the production and detection of electric charges State that there are positive and negative charges State that like charges repel and unlike charges attract	247
		Know that charge is measured in coulombs	251
18.2	Conductors and insulators	Distinguish between electrical conductors and insulators and give examples of each Appreciate that conductors contain free electrons while insulators contain only bound electrons	249, 254-255
	Induced charges	Give an account of charging by induction, including the role of electrons in the process Describe examples of how electrostatic charges are used in everyday life Describe one situation in which static electricity is dangerous and the precautions taken to ensure that static electricity is discharged safely	248, 252
	Current Electricity		
19.1	Electric currents	Show understanding that an electric current (measured in amperes) is the rate of flow of charge Use the equation **Q = I.t**	256, 266
19.2	Voltage	Know that a cell connected to a closed circuit uses up its chemical energy to push charge through the circuit, and that this chemical energy appears finally as heat Know that if a cell uses V joules of energy to drive 1 coulomb through a conductor, than the voltage (p.d.) across the conductor is V volts Show understanding that e.m.f. is defined as the energy supplied by a source in driving 1C round a complete circuit Use the equations: **Energy, W = Q.V = I.V.t**	266-267
19.3	Resistance	Use and describe the use of an ammeter and voltmeter Use and describe the use of a digital meter to measure current, voltage and resistance	256, 258
		State that **Resistance = Voltage/Current** and use the equation **V = I.R**	259
		Use a variable resistance to control current Describe an experiment to determine the resistance using a voltmeter and ammeter Relate the resistance of a wire to its length and to its diameter. No calculations are required	260-261

19.4	Electric circuits	Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), lamps, ammeters, voltmeters, diodes, LDR's, led's, and thermistors	p. 254-8, 322, 324-5
19.5	Series circuits	Understand that the current at every point in a series circuit is the same Understand that the sum of the p.d.'s across the components in a series circuit is equal to the total p.d. across the supply Give the combined resistance of two or more resistors in series	256, 262
19.6	Parallel circuits	Understand that the current from the source is the sum of the currents in the separate branches of a parallel circuits Understand that the voltage is the same across components in parallel	257
19.7	V-I characteristic graphs	Describe experiments by which V-I graphs for a metallic conductor kept at constant temperature and a filament lamp can be drawn Interpret V-I graphs for a metallic conductor, filament lamp, diode, and thermistor	265
		State how the resistance of an LDR changes with light level and how the resistance of a thermistor changes with temperature	325
19.8	Alternating current	Appreciate that an alternating current, unlike a direct current, changes direction	274, (305)
		Describe how a diode may be used to rectify an alternating current and how an oscilloscope may be used to demonstrate this action of a diode	323
19.9	Domestic supplies	Understand the function of the live, neutral and earth wires in the domestic mains supply Understand that the live wire has to be insulated from the earth and neutral wires Know why domestic supplies are connected in parallel	274
19.10	Earthing	Know that appliances with metal cases need to be earthed	275
19.11	Fuses	Understand how fuses and circuit breakers prevent fire due to electrical faults Understand why fuses have various ratings Understand why double insulated appliances do not need an earth wire Describe how an appliance may be connected correctly to a 3-pin plug Recognize dangerous practice in the use of mains electricity	275
19.12	Electrical power	Use the equation: Power**, P = I.V** Know that the amount of energy transferred from the mains is measured in kilowatt-hours Calculate the energy (in J and in kWh) expended when given the power of the appliance and the time for which the appliance is switched on Calculate the cost of energy when given the cost per kWh	272-273

	Electromagnetism		
20.1	Magnetic effect of a current	Describe the pattern of the magnetic field due to currents in straight wires and in solenoids State the variation of the strength of the field over salient parts of the pattern (Qualitative treatment only) Describe the effect of change of current, change in the number of turns, and of the introduction of an iron core on the strength of the field of a solenoid	p. 292-3
		Given appropriate diagrams, describe and explain the action of simple appliances which use the magnetic effect of electric current	294-297
20.2	Force on a current carrying conductor in a magnetic field	Describe an experiment to show that a force acts on a conductor carrying a current across a magnetic field, including the effect of reversing the current and the direction of the field Give the relative directions of force, field, and current Appreciate that a current-carrying conductor placed parallel to a magnetic field has no force acting on it State that a current-carrying coil in a magnetic field experiences a turning effect and this turning effect is increased by increasing the number of turns on the coil	296
		Relate this turning effect to the action of an electric motor Details of construction are not required	297-9
20.3	Electromagnetic induction	Describe an experiment to show that a changing magnetic field can induce an e.m.f. in a circuit State the factors affecting the magnitude of an induced e.m.f. Show understanding that the direction of the induced e.m.f. opposes the change causing it and relate this phenomena to conservation of energy	302-3
20.4	Simple transformer	Describe the construction and the principle of operation of a basic iron-cored transformer Use the equations: $(V_p/V_s) = (N_p/N_s)$ and $(V_p.I_p = V_s.I_s)$ for an ideal transformer	307-9

	Radioactivity		
21.1	The atom	Describe the atom as an entity made up of a positively charged nucleus and surrounding negatively charged electrons State the approximate diameters of the nucleus and the atom State the charge and relative masses of the proton, neutron and electron	p. 352-3
21.2	The nucleus	Appreciate that the number of protons in a nucleus distinguishes one element from another State the meaning of proton number, nucleon number and their representation in the form $^{4}_{2}He$	353
21.3	Isotopes	State the meaning of the term isotopes	353
21.4	Stability of nuclei	Appreciate that some nuclei are unstable, give out radiation to get rid of excess energy, and are said to be radioactive Appreciate that an element may change into another element when radioactivity occurs	353
21.5	Radioactive radiation	Understand that the three main types of radiation are α, β and γ and describe the nature of these types of radiation Give the relative penetration of these emissions so that each emission is suited to a particular purpose Describe the different abilities of these emissions to produce ionisation and describe their deflections in electric and magnetic fields	350-1
21.6	Nuclear equations	Use symbolic equations to describe the changes in proton and nucleon number which occur when alpha or beta particles are emitted	355
21.7	Background radiation	Show awareness of the existence of background radioactivity State the sources of background radioactivity	350, 360
21.8	Half-life	State the meaning of half-life Use the term half-life in simple calculations which might involve information in tables or decay curves	354, (362)
21.9	Applications	Give and explain examples of practical application involving the use of isotopes	356-7, (362)
21.10	Safety	Describe how radioactive materials are handled, used and stored in a safe way	360

	The Earth and the Universe		
22.1	Solar system	Appreciate that the Earth spins once a day and that half of the Earth which faces the sun is in daylight	p. 158
		Appreciate that the Earth orbits the sun once in 365 days	
		Appreciate that while the stars stay fixed in position, the planets orbit the sun, moving slowly across the sky	161
		Appreciate that the planets reflect light from the sun	
22.2	Gravitational Forces	Know that objects which have a mass attract each other	162
		Know that attraction increases with mass and decreases with distance	
		Understand that the moon orbits the Earth, and the planets orbit the sun because of gravitational force	159, 160
22.3	Satellites	Understand that satellites can be put into orbit round the Earth because of the gravitational force between the Earth and the satellite	162
		Understand that satellites can be used to send information between places on the Earth which are far apart, to monitor conditions on Earth, including the weather, and to observe the Universe without the atmosphere getting in the way	168-9
		Understand that communications satellites are usually put into orbit high above the equator and that they orbit the Earth once a day so that they appear stationary when viewed from Earth	162, 168
		Understand that monitoring satellites are usually put in low polar orbit so that the Earth spins beneath them and they can scan the whole Earth each day	168
22.4	The Universe	Appreciate that our sun is just one of many millions of stars in the Milky Way galaxy, and that the Universe is made up of more than a thousand million such galaxies	164, 165
		Appreciate that galaxies are often millions of times further apart than the stars within the galaxy	167
22.5	Formation of stars	Appreciate that stars are formed when enough gas and dust from space is pulled together by gravitational attraction, that smaller masses may also form and be attracted by a larger mass to become planets	165
22.6	Origin of Universe	Appreciate that present theories of the origin of the Universe must take into account that light from other galaxies is shifted towards the red end of the spectrum, and that the further away galaxies are, the bigger this 'red-shift'	166
		Understand that the current way of explaining these observations is that other galaxies are moving away from us very quickly, and that the further away from us a galaxy is, the faster it is moving away from us	
		Understand that this theory holds that the Universe is supposed to be expanding and that it might have started, billions of years ago, from a huge explosion or 'big-bang'	

End of subject content