Revision Checklist for O-Level Physics 5054

Guide for Students

UNIVERSITY of CAMBRIDGE
International Examinations

REVISION CHECKLIST for O Level Physics 5054

A guide for students

How to use this guide
The guide describes what you need to know about your O level Physics examination.

It will help you to plan your revision programme for the written examinations and will explain what the examiners are looking for in the answers you write. It can also be used to help you to revise by using the tick boxes in Section 3, 'What you need to know', to check what you know and which topic areas of Physics you have covered.

The guide contains the following sections:

Section 1 - **How will you be tested?**
This section will give you information about the different theory and practical examination papers that are available.

Section 2 - What will be tested?
This section describes the areas of knowledge, understanding and skills that the Examiners will test you on. It is particularly important to realise that most marks are awarded for understanding and skills and only 30% of the total mark is for simple recall.

Section 3 - What you need to know
This shows the syllabus in a simple way so that you can check

- the topics you need to know about
- details about each topic in the syllabus
- how much of the syllabus you have covered

Appendices
This section covers other things you need to know such as:

- symbols, units and definitions of physical quantities
- the importance of the command words the Examiners use in examination Papers
- some useful websites that you might use

Not all the information will be relevant to you. For example, you will need to select what you need to know in Sections 1 and 3 by finding out from your teacher which practical examination paper you will be taking.

Section 1 - How will you be tested?

1.1 The examination Papers you will take

You will be entered for **three** examination Papers, **two** theory Papers and **one** practical Paper. You will need to ask your teacher which practical Paper you are taking. You will take Paper 1 (theory), Paper 2 (theory) and either Paper 3 (the Practical Paper) or Paper 4 (the Alternative to Practical Paper). You should check with your teacher which of these two papers you will take.

1.2 About the theory Papers

The table gives you information about the theory Papers

Paper number	How long and how many marks?	What's in the Paper?	What's the % of the total examination?
Paper 1	1 hour (40 marks)	40 multiple choice questions.	27.6%
Paper 2	1 ¾ hours (75 marks)	Short answer and structured questions	51.7%
Practical Paper	see next table (30 marks)	see next table	20.7%

Here is some more information about each Paper.

Paper 1

The multiple choice questions cover the entire syllabus, apart from section 25 on Electronic Systems. You have to choose one of the four possible answers in each question.

Paper 2

There are two sections. Section A contains short structured questions where you may have to write a few words or sentences or make a calculation. Your answers are written in the spaces provided on the actual question paper. In Section B you have to answer two of the three questions available; so take your time to choose your questions carefully at the start of the examination. Until 2010 you answer section B on the ruled lines at the end of the question paper or you use additional paper. From 2010 you will answer the two questions that you choose in spaces provided on the question paper.

1.3 About the practical Papers

Just over twenty percent of the marks for O level Physics are for practical work.

You will do **one** of the practical Papers shown in the table, either Paper 3 or Paper 4. Your teacher will tell you which practical paper you will do.

Paper number and type	How long and how many marks?	What's involved?
Paper 3 (practical test)	2 hours (30 marks)	You do a practical exam which is supervised by a teacher.
Paper 4 (alternative to practical)	1 ½ hours (30 marks)	You answer a written paper about practical work.

Here is some more detail about the Practical Papers. If you are unsure of anything, ask your teacher.

Paper 3 (Practical test)
You do a practical exam, which is supervised by a teacher. You will carry out four short experiments.

Section A contains three short questions and lasts 1 hour. Section B contains one question that takes 1 hour.

You are given an instruction sheet, which enables you carry out the experiments. You will take readings and record them in a table using a sensible number of figures and give the unit. You will usually draw a graph and make some conclusions, commenting upon accuracy and on how to improve the experiment.

You may be asked to use the following techniques, amongst others:

- recording current and potential difference and drawing circuit diagrams
- ray tracing and drawing ray diagrams
- measuring temperature
- balancing (centre of mass and moments)
- stretching of springs
- timing of oscillations

Your experience of practical work during the course should enable you to handle the experimental techniques. Your teacher will be able to give you more examples and explain how to take readings and analyse the data.

Paper 4 (Alternative to Practical)
This is a written paper, testing the same skills as Paper 3. There are usually four questions which test practical procedures in the Physics laboratory.

You may be asked to:

- record readings from diagrams of apparatus e.g. current readings
- answer questions on the arrangement of apparatus
- complete tables of data
- draw conclusions from information
- answer questions about experimental data
- plot a graph from a table of readings
- interpret information from graphs
- draw ray diagrams
- identify sources of error and suggest improvements in the experiment
- suggest suitable apparatus for investigations

You will need to do plenty of practical work during the course in order to score a good mark on this Paper in the examination.

Section 2 - What will be tested?

The Examiners take account of the following areas in your examination Papers:

- your knowledge (what you remember) and understanding (how you use what you know and apply it to unfamiliar situations)
- how you handle information and solve problems
- your experimental skills

These areas of knowledge and skills are called Assessment Objectives. The theory Papers test mainly Objective A (knowledge with understanding) and Assessment Objective B (handling information and problem solving). You should note that 65% of the marks available are for Assessment Objective A and of these only 30% are for simple recall. The purpose of the practical Paper is to test Assessment Objective C (experimental skills). Your teacher will be able to give you more information about how each of these is used in examination Papers. The table shows you the range of skills you should try to develop.

Skill	***What the skill means***	***What you need to be able to do***
A: Knowledge with understanding	remembering facts and applying these facts to new situations	Use scientific ideas, facts and laws Know the meaning of scientific terms e.g. centre of mass Know equations and definitions Use simple equations, e.g. speed = distance/time Know about apparatus and how it works Know about symbols, quantities (e.g. mass and weight) and units (e.g. kg and N)
B: Handling information and solving problems	how you extract information and rearrange it in a sensible pattern and how you carry out calculations and make predictions	Select and organize information from graphs, tables and written text Change information from one form to another e.g. draw graphs. Arrange data and carry out calculations Identify patterns from information given and draw conclusions Explain scientific relationships, e.g. use the moving (kinetic) particle theory to explain ideas about solids, liquids and gases. Make predictions and develop scientific ideas Solve problems
C: Experimental skills and investigations	planning and carrying out experiments and recording and analysing information	Follow instructions to set up and use apparatus safely Make observations and measurements and record them with regard to accuracy Analyse experimental results Plan and carry out an experiment describing any problems and suggesting improvements

Section 3 - What you need to know

This is a table, which describes the things you may be tested on in the examination. When it uses the word "*qualitatively"* you are expected to be able to answer in words or give a diagram without having to do a calculation.

How to use the table
You can use the table throughout your course to check the topic areas you have covered.
There is no need to start at the beginning. Use it when you finish a section of your course to make sure that you understand what you should be able to do.

When you think you have a good knowledge of a topic, you can tick the appropriate box in the checklist column. The main headings in the topic areas are usually followed by the details of what you should know.

Test yourself as follows:

- cover up the details with a piece of paper
- try to remember the details
- when you have remembered the details correctly, put a tick in the appropriate box

You can also use it as a revision aid at the end of the course to find out any weaknesses or areas you need to do some work on or ask your teacher about.

If you use a pencil to tick the boxes, you can retest yourself whenever you want by simply rubbing out the ticks. If you are using the table to check which topics you have covered, you can put a tick in the topic column, next to the appropriate bullet point.

The column headed 'Comments' can be used:

- to add further information about the details for each bullet point
- to add learning aids, e.g. simple equations set out in a triangle to help in rearranging the equation
- to highlight areas of difficulty/ things you need to ask your teacher about

There are six major themes in the table, General Physics, Mechanics and Properties of Matter, Energy and Thermal Physics, Waves, Electricity and Magnetism and Atomic Physics. Each theme contains a number of sections. The 27 sections cover the whole syllabus. Each section contains a number of topics and the table lists what you should be able to do in each topic.

You should note that questions in section 25, Electronic Systems, only appear in Paper 2 and are always set as an alternative within a question. This means that your teacher may have chosen not to cover this section in your course. In that case you may choose not to learn that topic. Do, however, make sure that you understand topic 24, Introductory Electronics.

Topic	*You should be able to:*	*Checklist*	*Comments*
THEME 1 GENERAL PHYSICS			
1. Physical Quantities, Units and Measurement			
Scalars and vectors	• define the terms scalar and vector. • find the resultant of two vectors by a graphical method • list the vectors and scalars from distance, displacement, length, speed, velocity, time, acceleration, mass and force.	☐ ☐ ☐	
Measurement techniques	• describe how to measure a variety of lengths with appropriate accuracy using tapes, rules, micrometers, and calipers using a vernier as necessary. • describe how to measure a variety of time intervals using clocks and stopwatches.	☐ ☐	
Units and symbols	• recognise and use the SI system of units – your teacher will have more information	☐	
THEME 2 MECHANICS AND PROPERTIES OF MATTER			
2. Kinematics			
Speed, velocity and acceleration	• state what is meant by speed and velocity. • calculate average speed using *distance travelled/time taken*. • state what is meant by uniform acceleration and calculate the value of an acceleration using *change in velocity/time taken*. • discuss non-uniform acceleration	☐ ☐ ☐ ☐	
Graphical analysis of motion	• plot and interpret speed-time and distance-time graphs. • recognise from the shape of a speed-time graph when a body is at rest, moving with uniform speed, moving with uniform acceleration, or moving with non-uniform acceleration. • calculate the area under a speed-time graph to find the distance travelled for a motion with constant speed or constant acceleration	☐ ☐ ☐ ☐	
Free-fall	• state that the acceleration of free-fall for a body near to the Earth is constant and is about 10 m/s^2 • describe in words the motion of bodies with constant weight falling with and without air resistance (including reference to terminal velocity).	☐ ☐	

3. Dynamics			
Balanced and unbalanced forces	• state Newton's third law. • describe the effect of balanced and unbalanced forces on a body. • describe the ways in which a force may change the motion of a body. • do calculations using the equation *force = mass x acceleration.*	☐ ☐ ☐ ☐	
Friction	• explain the effects of friction on the motion of a body. • discuss the effect of friction on the motion of a vehicle in the context of tyre surface, road conditions (including skidding), braking force, braking distance, thinking distance and stopping distance.	☐ ☐	
Circular motion	• describe qualitatively motion in a circular path due to a constant perpendicular force, including electrostatic forces on an electron in an atom and gravitational forces on a satellite. ($F = mv^2/r$ is not required.) • discuss how ideas of circular motion are related to the planets in the solar system.	☐ ☐	
4. Mass, Weight and Density			
Mass and weight	• state that mass is a measure of the amount of substance in a body. • state that mass of a body resists change from its state of rest or motion. • calculate weight from the equation *weight = mass x gravitational field strength*. • explain that weights, and therefore masses, may be compared using a balance. • describe how to measure mass and weight by using appropriate balances.	☐ ☐ ☐ ☐ ☐	
Gravitational fields	• state that a gravitational field is a region in which a mass experiences a force due to gravitational attraction.	☐	
Density	• describe how to use a measuring cylinder to measure the volume of a liquid or solid. • describe how to determine the density of a liquid, of a regularly shaped solid and of an irregularly shaped solid which sinks in water (volume by displacement). • make calculations using the formula *density = mass/volume*	☐ ☐ ☐	

5. Turning Effect of Forces			
Moments	• describe the moment of a force in terms of its turning effect and relate this to everyday examples. • state the principle of moments for a body in equilibrium. • make calculations using *moment of a force = force x perpendicular distance* from the pivot and the principle of moments. • describe how to verify the principle of moments.	☐ ☐ ☐ ☐	
Centre of mass	• describe how to determine the position of the centre of mass of a plane lamina.	☐	
Stability	• describe qualitatively the effect of the position of the centre of mass on the stability of simple objects.	☐	
6. Deformation			
Elastic deformation	• state that a force may produce a change in size and shape of a body. • plot, draw and interpret extension-load graphs for an elastic solid and describe the associated experimental procedure. • recognise the significance of the term "limit of proportionality" for an elastic solid. • calculate extensions for an elastic solid using proportionality.	☐ ☐ ☐ ☐	
7. Pressure			
Pressure	• define the term pressure in terms of force and area, and do calculations using the equation *pressure = force/area*. • explain how pressure varies with force and area in the context of everyday examples.	☐ ☐	
Pressure changes	• describe how the height of a liquid column may be used to measure the atmospheric pressure. • explain quantitatively how the pressure beneath a liquid surface changes with depth and density of the liquid in appropriate examples. • describe the use of a manometer in the measurement of pressure difference. • describe and explain the transmission of pressure in hydraulic systems with particular reference to the hydraulic press and hydraulic brakes on vehicles. • describe how a change in volume of a fixed mass of gas at constant temperature is caused by a change in pressure applied to the gas.	☐ ☐ ☐ ☐ ☐	

	• do calculations using $p_1V_1 = p_2V_2$	☐	
THEME 3 ENERGY AND THERMAL PHYSICS			
8. Energy Sources and Transfer of Energy			
Energy forms	• list the different forms of energy with examples in which each form occurs. • state the principle of the conservation of energy and apply this principle to the conversion of energy from one form to another. • state that kinetic energy $E_k = ½ mv^2$ • state that potential energy $E_P = mgh$ • use these equations in calculations.	☐ ☐ ☐ ☐ ☐	
Major sources of energy	• list renewable and non-renewable energy sources. • describe the processes by which energy is converted from one form to another, including reference to o chemical/fuel energy (re-grouping of atoms), o hydroelectric generation (emphasising the mechanical energies involved), o solar energy (nuclei of atoms in the Sun), o nuclear energy, o geothermal energy, o wind energy. • explain nuclear fusion and fission in terms of energy releasing processes. • do calculations using the mass-energy equation $E = mc^2$. • describe the process of electricity generation and draw a block diagram of the process from fuel input to electricity output. • discuss the environmental issues associated with power generation.	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
Work	• calculate work done from the formula *work = force x distance moved in the line of action of the force*.	☐	
Efficiency	• calculate the efficiency of an energy conversion using the formula *efficiency = energy converted to the required form/total energy input.* • discuss the efficiency of energy conversions in common use, particularly those giving electrical output. • discuss the usefulness of energy output from a number of energy conversions.	☐ ☐ ☐	

Power	• calculate power from the formula *power = work done/time taken*.	☐	
9. Transfer of Thermal Energy			
Conduction	• describe how to distinguish between good and bad conductors of heat. • describe in molecular terms how heat transfer occurs in solids.	☐ ☐	
Convection	• describe convection in fluids in terms of density changes.	☐	
Radiation	• describe the process of heat transfer by radiation. • describe how to distinguish between good and bad emitters and good and bad absorbers of infra-red radiation.	☐ ☐	
Total transfer	• describe how heat is transferred to or from buildings and to or from a room. • state and explain the use of the important practical methods of heat insulation for buildings.	☐ ☐	
10. Temperature Content			
Principles of thermometry	• explain how a physical property which varies with temperature may be used for the measurement of temperature and state examples of such properties. • explain the need for fixed points and state what is meant by the ice point and steam point. • discuss sensitivity, range and linearity of thermometers.	☐ ☐ ☐	
Practical thermometers	• describe the structure and action of liquid-in-glass thermometers (including clinical) and of a thermocouple thermometer, showing an appreciation of its use for measuring high temperatures and those which vary rapidly	☐	
11. Thermal Properties of Matter			
Specific heat capacity	• describe a rise in temperature of a body in terms of an increase in its internal energy (random thermal energy). • define the terms *heat capacity and specific heat capacity.* • calculate heat transferred using the formula *thermal energy = mass x specific heat* • *capacity x change in temperature*.	☐ ☐ ☐ ☐	
Melting and boiling	• describe melting/solidification and boiling /condensation in terms of energy transfer without a change in temperature. • state the meaning of melting point and boiling point.	☐ ☐	

	• explain the difference between boiling and evaporation. • define the terms *latent heat* and *specific latent heat.* • explain latent heat in terms of molecular behaviour. • calculate heat transferred in a change of state using the formula *thermal energy = mass x specific latent heat*.	☐ ☐ ☐ ☐	
Thermal expansion of solids, liquids and gases	• describe qualitatively the thermal expansion of solids, liquids and gases. • describe the relative order of magnitude of the expansion of solids, liquids and gases. • list and explain some of the everyday applications and consequences of thermal expansion. • describe qualitatively the effect of a change of temperature on the volume of a gas at constant pressure.	☐ ☐ ☐ ☐	
12. Kinetic Model of Matter			
States of matter	• state the distinguishing properties of solids, liquids and gases.	☐	
Molecular model	• describe qualitatively the molecular structure of solids, liquids and gases, relating their properties to the forces and distances between molecules and to the motion of the molecules. • describe the relationship between the motion of molecules and temperature. • explain the pressure of a gas in terms of the motion of its molecules.	☐ ☐ ☐	
Evaporation	• describe evaporation in terms of the escape of more energetic molecules from the surface of a liquid. • describe how temperature, surface area and draught over a surface influence evaporation. • explain that evaporation causes cooling.	☐ ☐ ☐	
THEME 4 WAVES			
13. General Wave Properties			
Describing wave motion	• describe what is meant by wave motion as illustrated by vibrations in ropes and springs and by experiments using a ripple tank.	☐	
Wave terms	• state what is meant by the term wavefront. • define the terms *speed, frequency, wavelength* and *amplitude* and do calculations using *velocity = frequency x wavelength*.	☐ ☐	

	• describe transverse and longitudinal waves in such a way as to illustrate the differences between them.	☐	
Wave behaviour	• describe the use of a ripple tank to show o reflection at a plane surface, o refraction due to a change of speed at constant frequency. • describe simple experiments to show the reflection and refraction of sound waves.	☐ ☐	
14. Light			
Reflection of light	• define the terms used in reflection including *normal*, *angle of incidence* and *angle of reflection*. • describe an experiment to illustrate the law of reflection. • describe an experiment to find the position and characteristics of an optical image formed by a plane mirror. • state that for reflection, the angle of incidence is equal to the angle of reflection and use this in constructions, measurements and calculations.	☐ ☐ ☐ ☐	
Refraction of light	• define the terms used in refraction including *angle of incidence, angle of refraction* and *refractive index*. • describe experiments to show refraction of light through glass blocks. • do calculations using the equation *sin i / sin r = constant*. • define the terms *critical angle* and *total internal reflection.* • describe experiments to show total internal reflection. • describe the use of optical fibres in telecommunications and state the advantages of their use.	☐ ☐ ☐ ☐ ☐ ☐	
Thin converging and diverging lenses	• describe the action of thin lenses (both converging and diverging) on a beam of light. • define the term *focal length*. • draw ray diagrams to illustrate the formation of real and virtual images of an object by a lens. • define the term *linear magnification* and draw scale diagrams to determine the focal length needed for particular values of magnification (converging lens only). • describe the use of a single lens as a magnifying glass and in a camera, projector and photographic enlarger and draw ray diagrams to show how each forms an image. • draw ray diagrams to show the formation of images in	☐ ☐ ☐ ☐ ☐ ☐	

	the normal eye, a short-sighted eye and a long-sighted eye. • describe the correction of short-sight and long-sight.	☐	
15. Electromagnetic Spectrum			
Dispersion of light	• describe the dispersion of light as illustrated by the action on light of a glass prism. • state the colours of the spectrum and explain how the colours are related to frequency / wavelength.	☐ ☐	
Properties of electromagnetic waves	• state that all electromagnetic waves travel with the same high speed in air and state the magnitude of that speed. • describe the main components of the electromagnetic spectrum.	☐ ☐	
Applications of electromagnetic waves	• discuss the role of the following components in the stated applications: o radiowaves – radio and television communications, o microwaves – satellite television and telephone, o infra-red – household electrical appliances, television controllers and intruder alarms, o light – optical fibres in medical uses and telephone, o ultra-violet – sunbeds, fluorescent tubes and sterilisation, o X-rays, hospital use and engineering applications, o gamma rays and their use in medical treatment.	☐ ☐ ☐ ☐ ☐ ☐ ☐	
16. Sound			
Sound waves	• describe the production of sound by vibrating sources. • describe the longitudinal nature of sound waves and describe compression and rarefaction. • state the approximate range of audible frequencies. • explain why a medium is required in order to transmit sound waves and describe an experiment to demonstrate this. • explain how the loudness and pitch of sound waves relate to amplitude and frequency. • describe how the reflection of sound may produce an echo. • describe the factors which influence the quality (timbre) of sound waves and how these factors may be demonstrated using a CRO.	☐ ☐ ☐ ☐ ☐ ☐ ☐	
Speed of sound	• describe a direct method for the determination of the	☐	

	speed of sound in air and make the necessary calculation. • state the order of magnitude of the speeds of sound in air, liquids and solids.	 ☐	
Ultrasound	• define *ultra sound*. • describe the uses of ultra sound in cleaning, quality control and pre-natal scanning.	☐ ☐	
THEME 5 ELECTRICITY AND MAGNETISM			
17. Magnetism and Electromagnetism			
Laws of magnetism	• state the properties of magnets. • describe induced magnetism. • state the differences between magnetic, non-magnetic and magnetised materials.	☐ ☐ ☐	
Magnetic properties of matter	• describe electrical methods of magnetisation and demagnetisation. • describe the plotting of magnetic field lines with a compass. • state the differences between the properties of temporary magnets (e.g. iron) and permanent magnets (e.g. steel). • describe uses of permanent magnets and electromagnets. • explain the choice of material for, and use of, magnetic screening.	☐ ☐ ☐ ☐ ☐	
Electromagnetism	• describe the use of magnetic materials in audio/video tapes. • describe the pattern of the magnetic field due to currents in straight wires and in solenoids and state the effect on the magnetic field of changing the magnitude and direction of the current. • describe applications of the magnetic effect of a current in relays, circuit-breakers and loudspeakers.	☐ ☐ ☐	
18. Static Electricity			
Laws of electrostatics	• state that unlike charges attract and like charges repel.	☐	
Principles of electrostatics	• describe experiments to show electrostatic charging by friction. • explain that charging of solids involves a movement of electrons. • state that there are positive and negative charges and	☐ ☐ ☐	

	that charge is measured in coulombs. • describe an electric field as a region in which an electric charge experiences a force. • state the direction of lines of force and describe simple field patterns. • describe the separation of charges by induction. • discuss the differences between electrical conductors and insulators and state examples of each. • state what is meant by "earthing" a charged object.	□ □ □ □ □	
Applications of electrostatics	• describe examples where charging could be a problem e.g. lightning • describe examples where charging is helpful e.g. photocopier and electrostatic precipitator.	□ □	
19. Current Electricity			
Current	• state that a current is a flow of charge and that current is measured in amperes. • do calculations using the equation *charge = current x time*. • describe the use of an ammeter with different ranges.	□ □ □	
Electromotive force	• explain that electromotive force (e.m.f.) is measured by the energy dissipated by a source in driving a unit charge around a complete circuit. • state that e.m.f. is work done/charge. • state that the volt is given by J/C. • calculate the total e.m.f. where several sources are arranged in series and discuss how this is used in the design of batteries. • discuss the advantage of making a battery from several equal voltage sources of e.m.f. arranged in parallel.	□ □ □ □ □	
Potential difference	• state that the potential difference (p.d.) across a circuit component is measured in volts. • state that the p.d. across a component in a circuit is given by the work done in the component/charge passed through the component. • describe the use of a voltmeter with different ranges.	□ □ □	

Resistance	• state that *resistance = p.d./current* and use the equation *resistance = voltage/current* in calculations. • describe an experiment to measure the resistance of a metallic conductor using a voltmeter and an ammeter and make the necessary calculations. • discuss the temperature limitation on Ohm's Law. • use quantitatively the proportionality between resistance and the length and the cross-sectional area of a wire. • calculate the net effect of a number of resistors in series and in parallel. • describe the effect of temperature increase on the resistance of a resistor and a filament lamp and draw the respective sketch graphs of current/voltage. • describe the operation of a light-dependent resistor.	☐ ☐ ☐ ☐ ☐ ☐ ☐	
20. D.C. Circuits			
Current and potential difference in circuits	• draw circuit diagrams with power sources (cell, battery or a.c. mains), switches (closed and open), resistors (fixed and variable), light dependent resistors, lamps, ammeters, voltmeters, magnetising coils, bells, fuses, relays, light-emitting diodes and rectifying diodes.	☐	
Series and parallel circuits	• state that the current at every point in a series circuit is the same, and use this in calculations. • state that the sum of the potential differences in a series circuit is equal to the potential difference across the whole circuit and use this in calculations. • state that the current from the source is the sum of the currents in the separate branches of a parallel circuit. • do calculations on the whole circuit, recalling and using formulae including R = V/I and those for potential differences in series, resistors in series and resistors in parallel.	☐ ☐ ☐ ☐	
21. Practical Electricity			
Uses of electricity	• describe the use of electricity in heating, lighting and motors. • do calculations using the equations *power = voltage x current*, and *energy = voltage x current x time*. • Calculate the cost of using electrical appliances where the energy unit is the kW h.	☐ ☐ ☐	

Dangers of electricity	• state the hazards of damaged insulation, overheating of cables and damp conditions.	☐	
Safe use of electricity in the home	• explain the use of fuses and circuit breakers and fuse ratings and circuit breaker settings. • explain the need for earthing metal cases and for double insulation. • state the meaning of the terms live, neutral and earth. • describe how to wire a mains plug. • explain why switches, fuses and circuit breakers are wired into the live conductor.	☐ ☐ ☐ ☐ ☐	
22. Electromagnetism			
Force on a current-carrying conductor	• describe experiments to show the force on a current-carrying conductor, and on a beam of charged particles, in a magnetic field, including the effect of reversing the current, and reversing the direction of the field. • state the relative directions of force, field and current. • describe the field patterns between currents in parallel conductors and relate these to the forces which exist between the conductors (excluding the Earth's field).	☐ ☐ ☐	
The d.c. motor	• explain how a current-carrying coil in a magnetic field experiences a turning effect and that the effect is increased by increasing the number of turns on the coil and increasing the current. • discuss how this turning effect is used in the action of an electric motor. • describe the action of a split-ring commutator in a two-pole, single coil motor and the effect of winding the coil onto a soft-iron cylinder.	☐ ☐ ☐	
23. Electromagnetic Induction			
Principles of electromagnetic induction	• describe an experiment which shows that a changing magnetic field can induce an e.m.f. in a circuit. • state the factors affecting the magnitude of the induced e.m.f. • state that the direction of a current produced by an induced e.m.f. opposes the change producing it (Lenz's Law) and describe how this law may be demonstrated.	☐ ☐ ☐	
The a.c. generator	• describe a simple form of a.c. generator (rotating coil or rotating magnet) and the use of slip rings where needed.	☐	

	• sketch a graph of voltage output against time for a simple a.c. generator.	☐	
The transformer	• describe the structure and principle of operation of a simple iron-cored transformer. • state the advantages of high voltage transmission. • discuss the environmental and cost implications of underground power transmission compared to overhead lines	☐ ☐ ☐	
24. Introductory Electronics			
Thermionic emission	• state that electrons are emitted by a hot metal filament. • explain that to cause a continuous flow of emitted electrons requires high positive potential and very low gas pressure. • describe the deflection of an electron beam by electric fields and magnetic fields. • state that the flow of electrons (electron current) is from negative to positive and is in the opposite direction to conventional current.	☐ ☐ ☐ ☐	
Simple treatment of cathode-ray oscilloscope	• describe in outline the basic structure and action of a cathode-ray oscilloscope (c.r.o.) (detailed circuits are not required). • describe the use of a cathode-ray oscilloscope to display waveforms and to measure p.d.'s and short intervals of time.	☐ ☐	
Action and use of circuit components	• explain how the values of resistors are chosen according to a colour code and why widely different values are needed in different types of circuit. • discuss the need to choose components with suitable power ratings. • describe the action of thermistors and light-dependent resistors and explain their use as input sensors. • describe the action of a variable potential divider (potentiometer). • describe the action of a capacitor as a charge store and explain its use in time delay circuits. • describe the action of a reed switch and reed relay. • explain the use of reed relays in switching circuits. • describe and explain circuits operating as light-sensitive switches and temperature operated alarms (using a reed relay or other circuits). • state the meaning of the terms processor, output device and feedback.	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	

25. Electronic Systems	**Note this topic is optional. Questions are always set as alternatives.**		
Switching and logic circuits	• *describe the action of a bipolar npn transistor as an electrically operated switch and explain its use in switching circuits.* • *state in words and in truth table form, the action of the following logic gates, AND, OR, NAND, NOR and NOT(inverter).* • *state the symbols for the logic gates listed above (American ANSI Y 32.14 symbols will be used).*	☐ ☐ ☐	
Bistable and astable circuits	• *describe the use of a bistable circuit.* • *discuss the fact that bistable circuits exhibit the property of memory.* • *describe the use of an astable circuit (pulse generator).* • *describe how the frequency of an astable circuit is related to the values of the resistive and capacitative components.*	☐ ☐ ☐ ☐	
THEME 6 ATOMIC PHYSICS			
26. Radioactivity			
Detection of radioactivity	• describe the detection of alpha-particles, beta-particles and gamma-rays by appropriate methods. • state and explain the random emission of radioactivity in direction and time.	☐ ☐	
Characteristics of the three types of emission	• state, for radioactive emissions, their nature, relative ionising effects and relative penetrating powers. • describe the deflection of radioactive emissions in electric and magnetic fields.	☐ ☐	
Nuclear reactions	• explain what is meant by radioactive decay. • explain the processes of fusion and fission. • describe with the aid of a block diagram one type of fission reactor for use in a power station. • discuss theories of star formation and their energy production by fusion. • explain what is meant by the term *half-life*.	☐ ☐ ☐ ☐ ☐	
Half-life	• make calculations based on half-life which might involve information in tables or shown by decay curves.	☐	
Uses of radioactive isotopes including safety precautions	• describe how radioactive materials are handled, used and stored in a safe way. • discuss the way in which the type of radiation emitted and the half-life determine the use for the material. • discuss the origins and effect of background radiation. • discuss the dating of objects by the use of ^{14}C.	☐ ☐ ☐ ☐	

27. The Nuclear Atom			
Atomic model	• describe the structure of the atom in terms of nucleus and electrons. • describe how the Geiger-Marsden alpha-particle scattering experiment provides evidence for the nuclear atom.	□ □	
Nucleus	• describe the composition of the nucleus in terms of protons and neutrons. • define the terms *proton number* (atomic number), Z and *nucleon number* (mass number), A. • explain the term nuclide and use the nuclide notation $^{A}_{Z}X$ to construct equations where radioactive decay leads to changes in the composition of the nucleus. • define the term *isotope*. • explain, using nuclide notation, how one element may have a number of isotopes.	□ □ □ □ □	

Symbols, Units and Definitions of Physical Quantities

You should be able to state the symbols for the following physical quantities and, where indicated, state the units in which they are measured. Although the unit of temperature as K appears you will be able to use ºC instead.

You should be able to define those items indicated by an asterisk (*)

Quantity	**Symbol**	**Unit**
length	*l*, h ...	km, m, cm, m
area	A	m^2, cm^2
volume	V	m^3, cm^3
weight	W	N*
mass	m, M	kg, g, mg
time	t	h, min, s, ms
density*	ρ	g/cm^3, kg/m^3
speed*	u, v	km/h, m/s, cm/s
acceleration	a	m/s^2
acceleration of free fall	g	
force*	F, P. . .	N
moment of force*		Nm
work done	W,E	J*, kWh*
energy	E	J
power*	P	W*
pressure*	p, P	Pa*, N/m^2
atmospheric pressure		use of millibar
temperature	θ , t : T	°C: K
heat capacity	C	J/°C J/K
specific heat capacity*	c	J/(g°C), J/(g K)
latent heat	L	J
specific latent heat*	l	J/kg, J/g
frequency*	f	Hz
wavelength*	λ	m, cm
focal length	f	m, cm
angle of incidence	i	degree (°)
angles of reflection, refraction	r	degree (°)
critical angle	c	degree (°)
potential difference */ voltage	V	V* mV
current*	I	A, mA
charge		C, A s
e.m.f.*	E	V
resistance	R	Ω

Command words and phrases used in physics papers

Examiners use command words to help you to write down the answer they are looking for. This table explains what each of these words or phrases means and will help you to understand the kind of answer you should write. The list is in alphabetical order. You should bear in mind that the meaning of a term may vary slightly according to how the question is worded.

Calculate	A numerical answer is needed. Show your working, especially when there are two or more steps in a calculation.
Deduce	This may be used in two ways: • You find the answer by working out the patterns in the information given to you and drawing logical conclusions from them. You may need to use information from tables and graphs and do calculations. *e.g. deduce what will happen to the velocity of the vehicle if ….* • You have to refer to a Law or scientific theory or give a reason for your answer *e.g. use your knowledge of the kinetic theory to deduce what will happen when ……* •
Define	A formal statement of a quantity is required. You can sometimes give a defining equation, e.g. speed = d/t, as long as you state what the symbols are that you use in your equation, in the example given d = distance, t= time.
Describe	Try to set out a logical sequence that allows the reader to follow the main points about something. You may use labelled diagrams if you find it easier; *e.g. describe a rotating-coil generator* You may also be asked to describe • observations; *e.g. describe the ways in which a force may change the motion of a body* • how to do particular experiments; *e.g. describe an experiment to determine resistance using a voltmeter and an ammeter.*
Determine	You are expected to use a formula or method that you know to calculate a quantity; *e.g. Determine graphically the resultant of two vectors.*
Discuss	You must write down points **for** and **against** an argument; *e.g. discuss the supply of energy with a nuclear power station.*
Estimate	Give an approximate value for a quantity based on reasons and data. You may need to make some approximations; *e.g. estimate the volume of a test tube.*
Explain	You must give reasons for your answer **or** refer to a particular theory.
List	Write down a number of separate points. Where the number of points is stated in the question, you should not write more than this number.

Measure	You are expected to find a quantity by using a measuring instrument; e.g. length by using a ruler, or angle by using a protractor.
Outline	State the main points briefly *e.g. outline a method of magnetising an iron bar*

Predict	This can be used in two ways: • You find the answer by working out the patterns in the information provided and drawing logical conclusions from this. You may need to use information from tables and graphs and do calculations; e.*g. predict what will happen to the direction of the resultant force if ….* • It may also mean stating what might happen next *e.g. predict what effect an increase in temperature will have on the resistance.*
Sketch	When drawing graphs, this means that you draw the approximate shape and/ or position of the graph. You need to make sure that important details, such as the line passing through the origin or finishing at a certain point, are drawn accurately. When drawing apparatus or other diagrams, a simple line drawing is all that is needed, but make sure that the proportions are correct and the most important details are shown. Always label diagrams.
State	You should give a short answer without going into any detail or explanation.
Suggest	This may be used in two ways: • There may be more than one correct answer. *e.g. suggest a precaution to improve the accuracy of the experiment* • You are being asked to apply your general knowledge of physics or reasoning skills to a topic area that is not on the syllabus *e.g. applying ideas about moments to the stability of a vehicle*. •
What is meant by/ What do you understand by	You should define something and also make a more detailed comment about it. The amount of detail depends on the number of marks awarded; *e.g. what do you understand by the term total internal reflection*.

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