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GCSE

Physics

Session: 1994
Type: Syllabus
Code: 1700

GENERAL CERTIFICATE OF SECONDARY EDUCATION

Midland Examining Group

SCIENCE: PHYSICS

Syllabus Code 1700

1994

Examination Syllabus

GENERAL INFORMATION

Availability: This syllabus will be examined by the Midland Examining Group (MEG) in the Summer of the year shown on the cover.

Details of the provision of Autumn examinations are given in Part 2 of the MEG Handbook for Centres.

Certification: This subject will be shown on the GCSE certificate as

SCIENCE: PHYSICS

Certificates will be issued by the Home Board on behalf of MEG.

Exclusions: In any one examination series, candidates entering for this subject may not in addition enter for any other MEG examination with the same certification title.

Entries: All candidates, including private candidates, must be entered by a Centre registered with MEG.

In order to enter candidates, a Centre must register with one of the MEG Boards (designated its Home Board). The Centre must make its entries for all MEG examinations through that Home Board.

All candidates must meet the full requirements of this syllabus and must therefore have their Course Work/Assessed Practical Work authenticated and assessed by an approved Centre.

Results: Results will be certificated as levels 4 - 10 of the National Curriculum ten level scale.

The relationship between the National Curriculum levels and GCSE grades certificated up to 1993 is shown below:

Grade	Level
A	10 9
B	8
C D E	7 6
F	5
G	4

Enquiries: All enquiries about MEG or its examinations should be made to the Centre's Home Board.

Addresses and telephone numbers of the Boards in MEG are given on the back cover of this syllabus.

Marginal downrules indicate alterations to the previous year's syllabus, where appropriate.

PHYSICS

Syllabus Code: **1700**

AIMS

The aims include references to a number of attributes and qualities which cannot or should not be assessed for examination purposes but which nevertheless form an essential part of any physics course. In this respect the aims differ from the assessment objectives which all refer to qualities and competencies that can be assessed.

1 To stimulate and sustain curiosity and an interest in and an enjoyment of physics and its applications.

2 To promote interest in and an awareness, and as far as possible an understanding, of the social, economic and environmental implications of physics.

3 To show that physics is a coherent framework of knowledge based on fundamental theories of the structure and processes of the physical world.

4 To provide a basic knowledge and understanding of the principles of physics which are desirable in a technologically-based society.

5 To provide an appropriate body of knowledge for those not studying the subject beyond this stage, which will also serve as a foundation course for more advanced studies in physics and provide the essential background for study in subjects for which physics is relevant.

6 To develop the skills of observation, experimentation (including the testing of predictions), the processing and interpretation of data (including evaluation of evidence) and the formulation of generalisations and models.

7 To encourage students to apply, qualitatively and quantitatively, their knowledge and understanding of physical principles to familiar and unfamiliar situations.

8 To ensure students can follow instructions and do comply with safety procedures.

9 To foster relevant communication skills and the ability to work with others.

ASSESSMENT OBJECTIVES

The assessment objectives are set out in three groups:

those involving recall (*a*);
those involving knowledge and understanding (*b*);
and those involving processes (*c*).

By 'recall' is meant the recollection of distinct and basic information. In contrast, 'knowledge and understanding' implies some appreciation of the implications and relationships associated with the particular syllabus item.

Within the framework of the content specified by a syllabus to which these criteria apply, candidates are expected to:

(*a*) recall

facts, vocabulary, conventions, physical quantities and units in which they are measured, requirements for safety, names and uses of common measuring instruments;

(*b*) show knowledge and understanding of

(i) definitions and laws (both including formulae statements),

(ii) standard experimental procedures and, where appropriate, the specification of precautions necessary for accuracy,

(iii) concepts, theories and models,

(iv) information presented in various forms (written, tabulated, graphical, diagrammatic, mathematical),

(v) the uses and applications made of physical facts and principles,

(vi) safety procedures.

(*c*) show that they can

(i) use given formulae (to include the substitution of data into given formulae and the manipulation of quantitative relationships),

(ii) apply laws and principles qualitatively and quantitatively to familiar and unfamiliar situations,

(iii) explain phenomena in terms of theories and models,

(iv) follow instructions accurately for the conduct of experiments,

(v) observe, measure and record accurately for the conduct of experiments,

(vi) design and carry out simple experiments (where appropriate including the selection of instruments and safety), and specification of precautions necessary for accuracy,

(vii) translate information from one form to another,

(viii) extract additional information from that which is given, e.g. using the gradient and area under a graph, etc.,

(ix) present information in a precise and logical form,

(x) recognise mistakes, misconceptions, unreliable data and assumptions,

(xi) evaluate critically the design of experiments, experimental observations and other data, and draw conclusions,

(xii) explain technological applications of physics and evaluate their social, economic and environmental implications.

EXPERIMENTAL SKILLS AND ASSESSMENT OBJECTIVES

For the assessment of experimental skills it is convenient to group the relevant Assessment Objectives under four main headings. **A - D** (see also Pages 28 - 30).

A *Using and organising techniques, apparatus and materials.*

B *Observing, measuring and recording.*

C *Handling experimental observations and data.*

D *Planning, carrying out and evaluating investigations.*

RELATIONSHIP OF AIMS TO ASSESSMENT OBJECTIVES

The following table proposes a pattern of relationships between the Aims and Assessment Objectives in the context of three main aspects of a course in physics based upon this syllabus.

	Aims	Assessment Objectives
Knowledge and understanding of physics, its applications and implications	1, 2, 3 4, 5, 9	(a), (b)(i)-(v) (c)(i),(ii), (x), (xi),(xii)
Handling information and solving physical problems	1, 2, 6 7, 9	(a),(b)(i)-(v) (c)(i),(iii), (vii)-(xii)
Experimental skills and techniques of doing physics	1, 2, 6 7, 8, 9	(a),(b)(i)-(vi), (c)(iv) - (vi), (x)-(xi)

RELATIONSHIPS BETWEEN THE ASSESSMENT OBJECTIVES AND THE COMPONENTS OF THE SCHEME OF ASSESSMENT

Prescribing weightings is never an easy process, as the assignment of assessment ideas to specific assessment objectives is inevitably somewhat subjective. However, the intended percentage weightings of the grouped assessment objectives in the papers are as below.

	Intended Percentage Weightings			
Grouped Objectives	Component 1	Component 2	Component 3	Component 4
Recall: (a)	30 - 40	5 - 15	5 - 15	5 - 10
Knowledge and Understanding: (b)(i) - (vi)	30 - 40	40 - 50	45 - 50	40 - 45
Processes: (c) (i) - (c) (iii), (c) (vi) - (c) (xi)	25 - 35	40 - 50	45 - 50	40 - 45

SCHEME OF ASSESSMENT

Component Number	Component Title	Duration	% weighting
1	Paper 1 Multiple choice (40 items)	45 minutes	40
2	Paper 2 Short answers and structured questions	1h 15 minutes	40
3	Paper 3 Optional structured questions (answered on the question paper) and free response questions	1h 30 minutes	-
4	Internal Assessment of Experimental Skills (Course work)		20

There will be three written papers and an internal assessment of experimental skills (Course Work), of which Papers 1, 2 and the Internal Assessment will be compulsory. Papers 1 and 2 will be easier papers allowing scope for weaker candidates to demonstrate their ability in physics.

Papers 1 and 2 together with the Internal Assessment of Experimental Skills are intended for candidates of middle and low ability. Levels 7 – 4 will be awarded on the performance in this part of the examination.

Paper 3 is optional and is designed to provide discrimination between candidates of higher ability and Levels 10, 9 and 8 may be awarded on this part of the examination. Only candidates for whom there is some expectation of gaining a Level 10, 9 or 8 should be entered for Paper 3.

(*a*) Candidates will be awarded grades up to Level 7 on the basis of their performance on Papers 1 and 2 and the Internal Assessment.

(*b*) Candidates who achieve a Level 6 on the basis of (*a*) above, for whom the Internal Assessment of Experimental Skills makes an appropriate contribution and who achieve a Level 8 or 9 or 10 mark on the optional Paper 3 will be awarded Level 8 or 9 or 10 respectively.

Where a candidate attempts all parts of the examination, the performance on Paper 3 will not decrease the Level awarded on Papers 1, 2 and the Internal Assessment.

The aims and assessment objectives permit questions to be set which involve points, experimental methods and applications not specifically mentioned in the subject content, but enough information will be given in the questions to enable candidates to use principles mentioned in the subject content to answer them.

In component 1 only five-choice multiple choice items will be set. Neither multiple completion nor assertion/reason items will be included.

In components 1 and 2 all questions will be compulsory.

Component 4, Internal Assessment of Experimental Skills, must be taken by all candidates. This component is assessed by the teacher in accordance with the Group's general and subject specific instructions and moderated externally by the Group, by post.

MINIMUM COURSE WORK REQUIREMENTS

The minimum Course Work requirement for this syllabus is as follows. Each candidate should attempt at least one piece of Course Work and this should be assessed for at least one skill according to the criteria in the syllabus. If the piece of work does not satisfy the criteria for the award of one mark, a mark of 0 should be awarded. Candidates who do not attempt any Course Work should be marked A.

Differentiation

The purpose of this differentiated scheme of assessment, by using components that are designed to test particular parts of the ability range, is to examine candidates at levels at which they can demonstrate achievement and provide positive evidence of attainment. This will enable effective discrimination over the whole of the ability range.

It follows that if candidates are to obtain benefit from taking papers designed to meet their particular needs, centres must take care to ensure that each candidate is entered for the combination of papers for which he or she is most suited.

It should be recognised that papers designed primarily for candidates expected to achieve the lower grades will be unlikely to yield sufficient evidence of higher abilities for the highest grades to be awarded. Similarly, but perhaps less obviously, candidates who take a paper with which they cannot cope will have insufficient opportunity to demonstrate their limited levels of knowledge and skills to the best advantage.

Private Candidates

The syllabus is available to private candidates provided they are able to undertake assessed practical work (Component 4).

THE STRUCTURE OF THE SYLLABUS

The recommended national core for the GCSE physics examination, which is to form a minimum content of factual knowledge, has been used as a guide in constructing the syllabus. But in order that the syllabus as a whole shall show the relevance of what is taught to the world beyond the classroom, it is helpful to consider in what ways physics impinges on the lives of us all. The following appeared to be useful guidelines.

(1) ENERGY is the central theme. It is useful to start with ENERGY IN THE HOME, but this must inevitably lead to wider applications.

(2) NUCLEAR ENERGY cannot be neglected and this requires some understanding of NUCLEAR RADIATIONS.

(3) The importance of ELECTRICITY in our homes, in industry and in our lives in general is such that its study is essential in a physics course.

(4) Physics is concerned with WAVES in the processes of hearing, seeing and communication.

(5) Engineering is concerned with STRUCTURES (and this requires some study of FORCES) and with CONTROL, mechanical, electrical and electronic (and this requires some basic electronics, primarily concerned with switching).

LANGUAGE OF PHYSICS

In addition to the topics contained within the syllabus, it is also necessary that candidates should have some understanding of what might be called the LANGUAGE OF PHYSICS. This would include awareness of the role played by each of the following:

Units	Laws
The need for definition	Graphs
Symbolism	Models
The role of experiment	Uncertainties

The use of symbols will be as recommended in *SI Units, Signs, Symbols and Abbreviations* (ASE, 1981).

SKILLS

Candidates will be expected to be able to carry out basic physical measurements, including those of length (use of metric rule), area (areas of rectangles and circles), volume (direct measurement of regular solids by dimensions; measurement by displacement for irregular solids), mass (measurement by appropriate balance), time (use of stop clocks and stop watches), temperature (use of thermometers), and force (use of spring balance).

MATHEMATICAL REQUIREMENTS

Candidates will be assumed to have understanding of the following mathematical concepts. Care will be taken to ensure that the mathematical demands on students will not exceed physics demands. For the compulsory papers the mathematical demands will be related, as far as possible, to the 'foundation list' of the Cockcroft Report.

1 Relationships between length, surface area and volume and their units on metric scales.

2 Decimals, fractions, percentages, ratios, proportionality.

3 The use of an electronic calculator with four functions (+, -, x, ÷) to an appropriate number of digits.

4 The use of usual mathematical instruments (ruler, compasses, protractor, set square).

5 Meaning of angle, curve, circle, radius, diameter, square, parallelogram, rectangle, diagonal.

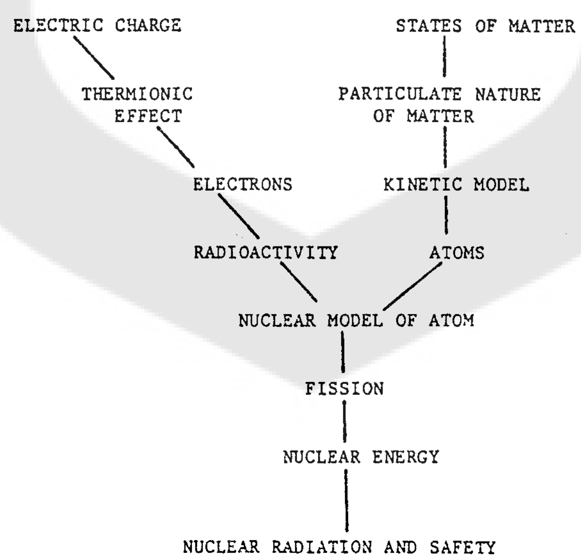
6 The construction of line graphs including curves.

7 Equations of the form $x = yz$ and their solution for any one term when other two are known.

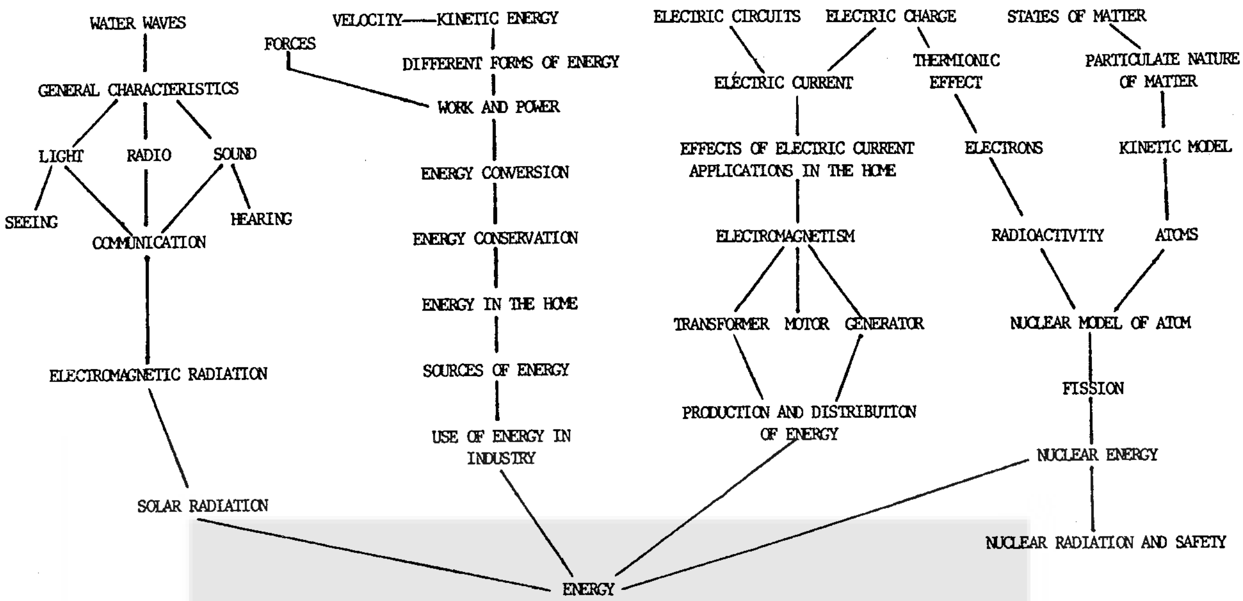
8 Points of the Compass (N, S, E, W).

FLOW DIAGRAM USED IN THE CONSTRUCTION OF THE SYLLABUS

To build a syllabus it is necessary to start from the end-point and work backwards in order to find what topics must previously have been studied in order to promote understanding. To explain this, consider the topics necessary if nuclear energy is to be included. The flow diagram might be as follows:



This technique was used in the construction of the whole of the present syllabus. A structure was built up starting from what were considered the essential themes. The syllabus became a fabric of knowledge, as shown on the next page.



SUBJECT CONTENT

Teachers should also note the sections on the 'Language of Physics' and 'Skills' which appear in preceding pages.

BACKGROUND The following topics would provide a suitable background of scientific **experience** to the examination syllabus. These topics are not part of the examination syllabus unless mentioned in that syllabus.

1 Forces

Forces as pushes or pulls

Effects of forces

Awareness of different types of force:

- gravitational force
- electrostatic force
- magnetic forces
- frictional forces

Appreciation that electrostatic, magnetic and gravitational forces act at a distance and vary with distance

The newton as the unit of force

2 Introduction to Energy in the Home and in Industry

Energy as that which is needed to do useful jobs

Experience of energy conversions

3 Heating

Effects of heating: temperature rise; expansion of solids, liquids and gases

4 Simple phenomena of light

Light travels in straight lines: shadows; eclipses; pinhole camera

Reflection of light (plane surfaces)

5 Simple circuit board work

- Experience of cells and lamps
- Conductors and insulators
- Thick and thin wires
- Heating effect of a current
- Magnetic effect of a current

6 Uses of electricity in the home

- Heating and lighting: electric kettles; fires; irons; etc.
- Appreciation of simple safety factors
- Applications to electric bells, etc.

7 Basic magnetism

- Magnets and their properties
- Magnetic and non-magnetic substances
- Electrical methods of magnetism
- Temporary and permanent magnetism
- Applications to simple compass, magnetic door catches, etc.

8 Introduction to electrostatics

- Electrification by friction
- Positive and negative charges
- Attraction and repulsion
- Applications to electrostatic charge on records, nylon garments, etc.

The content set out on the following pages does not provide a teaching order, it merely gives the topics on which the examination will be set.

The topics are set out in the first column. The second column gives notes on the level of treatment for papers 1 and 2. The third column gives notes on the level of treatment for paper 3, if this differs from column 2. (Paper 3 is only taken by candidates aspiring to GCSE Levels 10 – 8; it is set on the whole syllabus.)

Where equations, whether in words or symbols, are given in the syllabus, quantitative problems may be set. In papers 1 and 2 the relevant equation in the appropriate form will be given in the question. For paper 3 the formulae on page 27 will be given inside the front cover of the paper. In paper 3 rearrangement of the equations may be required.

Simple numerical problems may be set on any part of the syllabus. These may involve the arithmetical skills permitted within the Mathematical Requirements on page 5, together with extracting information from tables, graphs and pie-charts.

Where column 2 says 'Applications' the candidate is not expected to recall in detail the application mentioned; these are examples which teachers may wish to use. The aims and assessment objectives permit questions to be set which involve points, experimental methods and applications not specifically mentioned in the syllabus, but enough information will be given in the questions to enable candidates to use principles mentioned in the syllabus to answer them.

TOPICS IN THE SYLLABUS	NOTES Papers 1 and 2	NOTES Paper 3 (if different from papers 1 and 2)
1 FORCES		
1.1 Gravitational force		
Variation with distance (qualitative treatment only)		Gravitational field strength *g*
Mass and weight		Weight =mass x gravitational field strength W = *mg*
1.2 Force and Extension		
Load-extension graphs; interpretation of these graphs		
Hooke's Law; limit of proportionality	Application: force meter	
1.3 Turning effect of forces		
Factors affecting magnitude	Applications: spanner; crowbar; steering wheel	The moment of a force about a pivot = force x perpendicular distance from force to pivot

1.4 Conditions for equilibrium		
Meaning of equilibrium	Sum of forces equals zero	Resultant force on system is zero
	Clockwise and anti-clockwise turning effects equal	Resultant turning moment is zero
	Problems on balancing a weightless beam with pivot at centre	The principle of moments
		Calculations on simplified representations of real situations e.g. bridges, cranes, and levers
1.5 Pressure		
Force acting on an area	Applications: stilletto heel; drawing pin; knife	Pressure = $\frac{\text{force}}{\text{area}}$; $P = \frac{F}{A}$
Variation of hydrostatic pressure with depth	Applications: water pressure in the home; effect on ear drums when diving	Pressure varies with depth and density of fluid;
Atmospheric pressure and its variation with altitude	Qualitative treatment	
Pressure in gases caused by molecular bombardment (see **3.3, 4.1**)		
Transmission of pressure in liquids; principle of hydraulic machines	Applications: syringe; vehicle brakes	Calculations, assuming uniform pressure and incompressible fluid

2

1.6 Motion		
speed = distance/time		Distinction between speed and velocity
		Average velocity = $\left(\frac{u+v}{2}\right)$
		Distance travelled = $\left(\frac{u+v}{2}\right)t$
Interpretation of distance-time graphs		Calculation of speed from gradient
Acceleration	Formal definition of acceleration not needed	$a = \left(\frac{v-u}{t}\right)$
Interpretation of speed-time graphs		Calculation of acceleration from gradient
1.7 Force and motion		
Forces have direction; resultant of forces acting in opposite directions		
Forces cause acceleration		Force = mass x acceleration; $F = ma$
Mass and inertia		
Free fall; motion under a constant gravitational force		Experimental determination of free-fall acceleration
		Identity of free-fall acceleration with gravitational field strength
Frictional forces	Application: vehicle brakes	
Motion under a balanced force; terminal speed	Application: vehicles in motion	

2	**ENERGY**		
2.1	**Energy**		
	Energy as the ability to do work		
	Different forms of energy		
	Kinetic energy as energy of a moving mass		Kinetic energy $= \frac{1}{2} mv^2$
	Potential energy as energy due to position (gravitational P.E.) or state (strain P.E.)		Gravitational potential energy $= mgh$
2.2	**Work**		
	Work done as energy transformed		
	Work done = force x distance moved along line of action of force		
2.3	**Transformation of energy**		
	Examples of processes and devices for energy transformation		
	Principle of conservation of energy		
2.4	**Power**		
	Power $= \frac{\text{energy transformed}}{\text{time taken}}$		
	Power $= \frac{\text{work done}}{\text{time taken}}$		
	Measurement of personal power	e.g. by running upstairs	
2.5	**Efficiency of energy transformation**		
	Efficiency $= \frac{\text{useful output energy}}{\text{total input energy}}$		Efficiency $= \frac{\text{useful output power}}{\text{total input power}}$

3 STRUCTURE OF MATTER		
3.1 States of Matter		
Solid, liquid and gas; distinguished by density, fluidity, compressibility		
3.2 Density		
Density = mass/volume	Use g/cm^3 or kg/m^3 as appropriate	
Measurement for regular and irregular solids		
Measurement for liquids		
3.3 Molecular model		
Idea of molecules providing explanation of the three states of matter (see 3.1) and of pressure in gases		
Brownian motion and diffusion as supporting evidence	Experimental details not required	

4.	**HEATING**		
4.1	**Effects of heating**		
	Change in temperature, related to change in total molecular energy		
	Celsius temperature scale		
	Change in size, related to molecular model		
	Change in pressure of gas (for constant volume), related to molecular model	Gas laws not required	
	Change of state: melting point; boiling point; cooling curves		
	Factors affecting evaporation: draughts and temperature; molecular explanation		
	Latent heat: molecular explanation		
	Importance of latent heat in the transfer of energy	Applications: ice in drinks; the steam engine; stormy weather; refrigerator; perspiration.	
4.2	**Energy transfers due to heating**		
	Conduction; good and bad conductors, including air	Applications: cooking pan; heat exchanger	
	Convection in liquids and gases	Application: hot water system; space heating	
	Thermal radiation (infra-red): detection by hand or infra-red detector	Applications: space heating; seeing in the dark; the greenhouse effect.	
	Effect of different surfaces on emission and absorption	Application: heat sink	
	Thermal insulation	Applications: double glazing; loft and cavity wall insulation; vacuum flask; wet suit.	

5	**TRANSFER OF ENERGY BY WAVES**		
5.1	**Wave motion**		
	Transfer of energy shown by ropes, springs and water waves		
	Difference between transverse and longitudinal waves; wave speed; frequency; wavelength; amplitude		Speed = frequency x wavelength; $v = f\lambda$
	Reflection of plane waves at plane surfaces, illustrated by water waves		
	Refraction of plane waves due to change of speed, illustrated by water waves		
	Interference from two sources, illustrated by water waves		Interference from two sources, for waves other than water
	Diffraction through narrow openings, illustrated by water waves		Diffraction through narrow openings, for waves other than water
5.2	**Sound waves**		
	Production, due to vibration		
	Transmission as longitudinal waves		Compressions and rarefactions
	Need for a medium		
	Measurement of speed in air by a simple method		
	Reflection of sound; echoes		
	Range of audible frequencies		
	Ultrasonic waves	Applications: testing materials; medical examination; sonar	
	Subjective properties; loudness, pitch and quality related to amplitude, frequency and wave form using microphone and oscilloscope		Measurement of frequency using microphone and oscilloscope

5.3	**Electromagnetic waves**		
	Common properties: means of energy transfer; common speed in vacuum; no need for material medium; transverse nature		
	Electromagnetic spectrum; parts in order of wavelength and frequency	Applications of the parts: radio: communications; microwave: heating; radar infra-red: heating; seeing in the dark (see **4.2**) visible: (see **5.4**) ultra -violet: fluorescence; sunburn X-rays: shadowgraphs of bones gamma rays: examination of welds; radiotherapy (see **8.2, 8.6**)	
5.4	**Light**		
	Light as a wave motion		Qualitative reference to interference and diffraction as evidence for wave nature
	Reflection at a plane surface; angle of incidence = angle of reflection		
	Position and nature of image in a plane mirror		
	Refraction at a plane surface; rays through glass and water	Qualitative treatment	
	Refraction through prisms		
	Formation of a spectrum by triangular prism		
	Total internal reflection	Qualitative treatment Applications: fibre optics; light pipes	
	The action of a converging lens; formation of real image		
	Effect on image size and position of bringing object closer to lens	Qualitative treatment Application: lens camera	

6.	**ELECTRICAL ENERGY**		
6.1	**Sources of electrical energy**		
	Everyday examples: dry cell; car battery; dynamo; transformer	No details of construction and operation, unless mentioned elsewhere in the syllabus (see **7.4** *generator* , **7.5** *transformer*)	
	Direct and alternating current; use of diode to change a.c to d.c.	In calculations all d.c. sources are assumed to give constant voltage output for all currents	
6.2	**Electrical terminology and circuitry**		
	Conductors and insulators; typical examples; simple free electron model to explain difference		
	Current as a flow of charge; measurement with an ammeter in series		
	Potential difference (p.d.) measured with a voltmeter across a circuit component		
	Resistance = $\frac{\text{p.d.}}{\text{current}}$; $R = \frac{V}{I}$		
	Resistance directly proportional to length		Resistance inversely proportional to area of cross-section
	Graphs showing temperature dependence of resistance for a metal and for a thermistor (see **9.1**)	Resistance of thermistor falls with increase in temperature	
	p.d./current graphs; linear and non-linear examples (metals at constant temperature; semi-conductor diode)		
	Drawing and interpreting circuit diagrams containing cells, switches, lamps, fixed resistors, variable resistors, diodes, ammeters, voltmeters, transformers	Symbols for other devices will be given or labelled if necessary	
	Series circuits: current is the same all round the circuit; the combined resistance of two or more resistors in series equals the sum of the resistors		The sum of the potential differences round a circuit equals the potential difference across the power supply

Parallel circuits: the sum of the currents; in the separate branches equals the current in the main circuit

The combined resistance of resistors in parallel is less than any of the separate resistance values.

Potential divider consisting of two resistors in series (see also **9.2**)

Electrical power = p.d x current; $P = VI$

Simple calculations;

$P = \frac{V^2}{R}$ $P = I^2R$

6.3 Electricity in the home

Uses; heating, lighting, motors

Electrical hazards: danger of worn or damaged cables; avoidance of overloading; too great a temperature rise damages insulation leading to fire hazard

Fuses: purpose of fuses; choice of correct fuse knowing current taken by appliance

Electric shock: reasons for earthing metal cases and for double insulation

Hazards in a damp environment

Wiring plugs; colour code for mains wiring to plugs; wiring a 13 A mains plug

House wiring: ring main circuits; domestic fuses; switches and fuses in live leads

Metering: the "unit" of electrical energy = 1 kW h

Electrical energy = power x time
(in kW h) (in kW) (in h)

7	**ELECTROMAGNETISM**		
7.1	**Magnetic effect of a current**		
	Current in a wire produces a magnetic field; factors determining the strength of the effect, including the presence of iron	Application: electromagnets; relays (see **9.3**)	
7.2	**Force on a conductor in a magnetic field**		
	Force perpendicular to current and field directions	Fleming's rule not required	
	Use of this in two-pole d.c. motor; reason for turning effect; need for commutator	Candidates will not be expected to recall diagrams of motors Application: the moving-coil loudspeaker	
7.3	**Electromagnetic induction**		
	Induced voltage when a conductor crosses a field or when a magnetic field through a coil changes		
	Factors affecting induced voltage: field strength, speed and number of turns		Direct proportion between voltage and field strength, speed and number of turns
7.4	**Generators**		
	Generation of a.c. by rotation of a coil in a magnetic field		Voltage/time graph for a rotating coil related to its orientation in the magnetic field
	Simple a.c. generators as practical examples of electromagnetic induction	Candidates will not be asked to recall diagrams of generators	

7.5	**Transformer**		
	Construction		
	Mode of action: changing current in primary coil gives changing magnetic field through secondary coil, which induces voltage in secondary coil		Energy losses in a transformer
	$\frac{\text{secondary voltage}}{\text{primary voltage}} = \frac{\text{secondary turns}}{\text{primary turns}}$		For perfectly efficient transformer: $V_s I_s = V_p I_p$
	Use of transformer to change voltages	Applications: national grid; low voltage power supplies	
7.6	**Transmission of electrical energy**		
	Economic advantage of high voltage transmission, requiring low current for the same power and hence thinner conductors and low energy loss		Simple calculation of current required to transmit a given power at high and at low voltage
	Use of a.c. makes it easy to change voltages for transmission and final use		
	Description of the national grid system; its advantages; safety precautions		

8 ELECTRONS, IONISING RADIATION and NUCLEAR ENERGY		
8.1 Electron beams		
Electric charge emitted by hot filament; production of electron beam		
Deflection of electron beams in electric fields, showing negative nature of charge		
Deflection in magnetic fields	Application: television tube	
The oscilloscope; basic structure of tube including heated cathode, anode, X- and Y- plates, screen		
Use of oscilloscope as a voltmeter, and for examining wave forms		Calculation of voltage, time and frequency from oscilloscope display frequency = $\frac{1}{\text{period}}$
8.2 Radioactivity		
Alpha, beta and gamma radiations: ionising effects		
Absorption of the radiations; ranges in air, paper, aluminium and lead		
Deflection of radiations in electric and magnetic fields		
Identity of the radiations with fast-moving helium nuclei, fast moving electrons and high frequency electromagnetic radiation	Experimental evidence for the identities is not required, apart from deflection in electric and magnetic fields	
Background radiation and its sources		
Detection of ionising radiations by cloud chamber and GM-tube	Details of construction and operation not required	
Random nature of emission process from the nucleus		
Activity-time curve for radioactive decay; half life	Simple calculations	

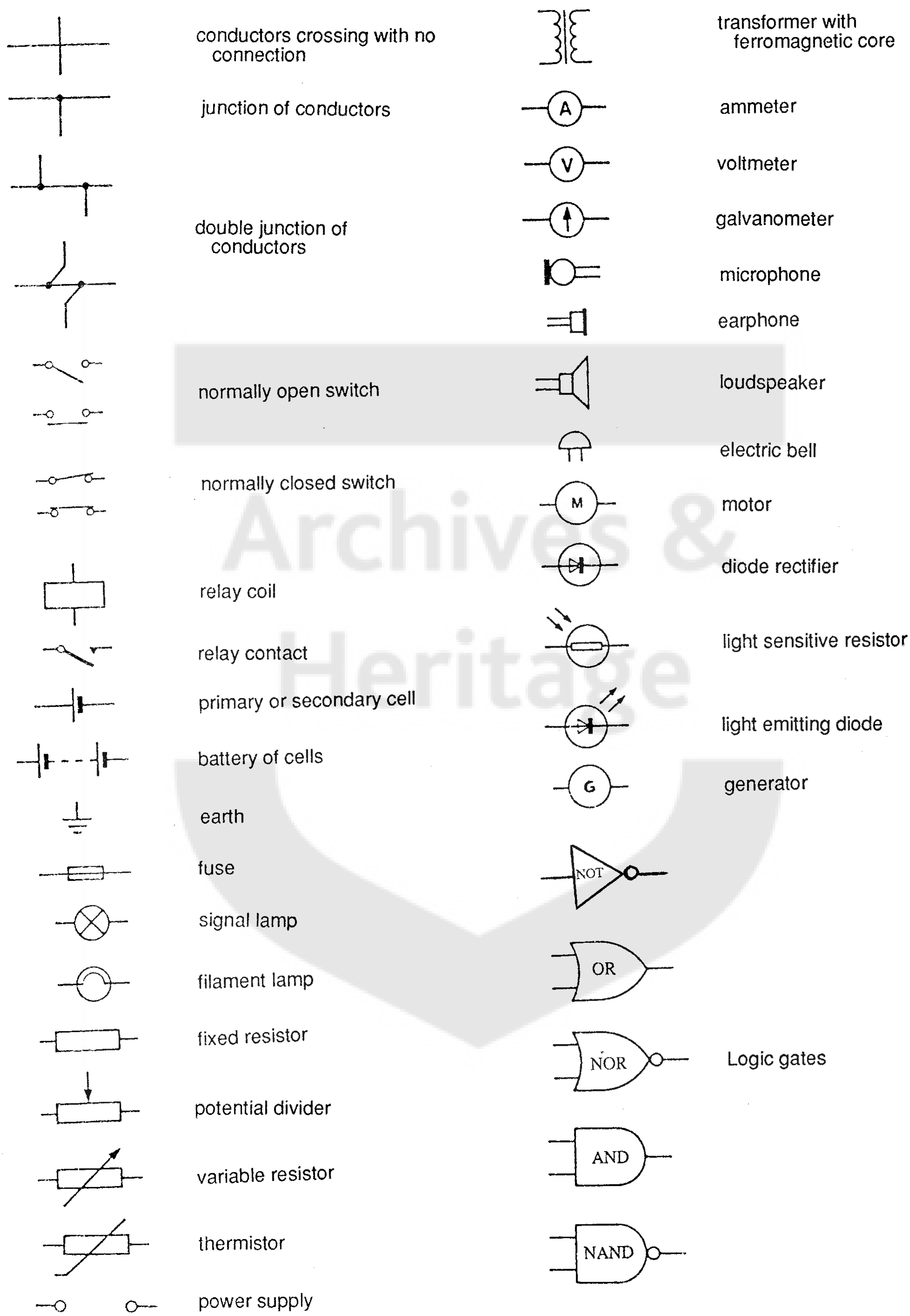
8.3	**Nuclear model of the atom**		
	Alpha-particle scattering as evidence for the nucleus		
	Structure of atoms in terms of protons neutrons and electrons		
	Proton number, Z: nucleon number, A		Nuclear changes in alpha and beta decay, using $^{A}_{Z}X$ notation
	Relative charges and masses of proton, neutron and electron		
	Isotopes		
8.4	**Nuclear energy**		
	Nuclear fission; energy release		
	Chain reaction (controlled and uncontrolled)		
	Outline (flow diagram) of nuclear power station: reactor - heat exchanger - steam turbine - generator	No details of construction required	
8.5	**Safety**		
	Radiation hazards: precautions when using radioactive materials		
	Problem of disposal of radioactive waste		
8.6	**Uses**		
	Use of radioisotopes (and X-rays) in medicine and industry	Applications: tracers; radiotherapy; thickness gauge; testing welds	

9	**ELECTRONICS**		
9.1	**Input devices**		
	The light dependent resistor (LDR); resistance falls with increase in light intensity; sketch graph of resistance against light intensity	Application: light sensor	
	The thermistor; resistance falls with increase in temperature; sketch graph of resistance against temperature	Application: temperature sensor	
	Potential dividers consisting of LDR plus resistor, thermistor plus resistor or switch plus resistor, to provide varying voltages for inputs to logic circuits		Calculations (see **6.2**)
9.2	**Processing devices**		
	NOT gate; two-input AND, OR, NAND, NOR gates; truth tables	It may be assumed that a gate can drive any output device to which it is connected. Knowledge of buffer or driver circuits is not required	Candidates should be able to construct the truth table for simple combinations of gates
	The bistable latch as a device whose output changes when its inputs are put momentarily to logic 1 in turn	Made from two NOR gates, but details of why it works need not be known	
9.3	**Output devices**		
	The light-emitting diode (LED); energy conversion; need for current limiting resistor and correct polarity	Application: logic indicator	Calculation of resistor value
	The buzzer	Application: audible indicator	
	The electromagnetic relay; an electrically operated switch to allow electronic circuits to control a.c. mains or large d.c. currents.	(see **7.1**)	

9.4 The devices put to use

Simple circuits such as light and temperature sensors and alarms, latched alarms, security locks, motor and heater control.	Candidates will not be expected to remember particular circuits, but should show understanding of those presented to them. They may be asked to add one or two components or a few wires to partly drawn circuits.
Draw and interpret circuit diagrams containing components listed in **9.1**, **9.2** and **9.3.** (see also **6.2**).	

ELECTRICAL AND ELECTRONIC SYMBOLS FOR USE IN QUESTION PAPERS



LIST OF FORMULAE TO BE PRINTED IN PAPER 3

The following information may be useful.

1 $\text{Density} = \dfrac{\text{mass}}{\text{volume}}$

2 $\text{Pressure} = \dfrac{\text{force}}{\text{area}} \qquad P = \dfrac{F}{A}$

3 $\text{Force} = \text{mass} \times \text{acceleration} \qquad F = ma$

4 The strength of the gravitational field at Earth's surface (g) can be taken as 10 newtons per kilogram.

$\text{Weight} = \text{mass} \times \text{gravitational field strength} \qquad W = mg$

5 Relationships between initial velocity (u), constant acceleration (a), final velocity (v), and distance travelled (s) after time (t):

$$a = \left(\frac{v-u}{t}\right)$$

$$\text{Average velocity} = \left(\frac{u+v}{2}\right)$$

$$s = \text{average velocity} \times \text{time} = \left(\frac{u+v}{2}\right)t$$

6 For a body of mass m moving with velocity v,

kinetic energy $= {}^{1}/_{2}mv^2$

7 For a body of mass m raised through a height h

gravitational potential energy $= mgh$

8 *Work done = force × distance moved along line of action of force*

9 $\text{Power} = \dfrac{\text{energy transformed}}{\text{time taken}} = \dfrac{\text{work done}}{\text{time taken}}$

10 $\text{The efficiency of a machine or system} = \dfrac{\text{useful output energy}}{\text{total input energy}} = \dfrac{\text{useful output power}}{\text{total input power}}$

11 *The moment of a force about a pivot = force × perpendicular distance from force to pivot*

12 $\text{Wave speed} = \text{frequency} \times \text{wavelength} \qquad v = f\lambda$

13 $\text{Frequency} = \dfrac{1}{\text{period}}$

14 $\text{Resistance} = \dfrac{\text{potential difference}}{\text{current}} \qquad R = \dfrac{V}{I}$

15 $\text{Electric power} = \text{potential difference} \times \text{current} \qquad P = VI = I^2R = \dfrac{V^2}{R}$

16 *Electrical energy (in kW) = power (in kW h) × time (in h)*

17 For a transformer

$$\frac{\text{Secondary voltage}}{\text{Primary voltage}} = \frac{\text{number of turns on secondary coil}}{\text{number of turns on primary coil}} \qquad \frac{V_S}{V_P} = \frac{N_S}{N_P}$$

18 For a transformer with an efficiency of 100%, $V_SI_S = V_PI_P$

NOTES FOR GUIDANCE ON INTERNAL ASSESSMENT OF EXPERIMENTAL SKILLS (Course Work)

The information which follows is provided to assist teachers in making valid and reliable assessment of the experimental skills specified in the assessment objectives of the examination. Attention is drawn to the Group's 'General Course Work Regulations'.

The experimental skills A to D to be assessed are given below.

A Using and organising techniques, apparatus and materials.

B Observing, measuring and recording.

C Handling experimental observations and data.

D Planning, carrying out and evaluating investigations.

The four skills carry equal weighting.

All assessments must be based upon experimental work carried out by the candidates.

It is expected that the teaching and assessment of experimental skills will take place throughout the course.

The assessment scores finally recorded for each skill on the Assessment Sheet (Appendix A) must represent the candidate's best two marks for each skill.

For candidates who miss the assessment of a given skill through no fault of their own, for example because of illness, and who cannot be assessed ON ANOTHER OCCASION, MEG's procedures for special arrangements should be followed as specified in the current Handbook for Centres. However, candidates who for no good reason are absent from an assessment of a given skill, should be given a mark of 0 on that occasion.

Minimum Course Work Requirements

The minimum Course Work requirement for this syllabus is as follows. Each candidate should attempt at least one piece of Course Work and this should be assessed for at least one skill according to the criteria in the syllabus. If the piece of work does not satisfy the criteria for the award of one mark, a mark of 0 should be awarded.

Candidates who do not attempt any Course Work should be marked A.

Teachers must ensure that they can make available to the moderator the evidence for the two assessments of each skill for each candidate. For skills A to D inclusive, information about the tasks set and how the marks were awarded will be required. For skills B, C and D, the candidate's written work will also be required.

CRITERIA FOR ASSESSMENT OF EXPERIMENTAL SKILLS

Each skill must be assessed on a 6 mark scale. Each of the skills is defined in terms of three levels of achievement at marks 2, 4 and 6. A score of 0 marks is available if there is no evidence of positive achievement.

For candidates who do not meet the criteria for a mark of 2, a mark of 1 is available if there is some evidence of positive achievement.

A mark of 3 is available for candidates who go beyond the performance defined for 2 marks, but who do not meet fully the criteria for 4 marks.

Similarly, a mark of 5 is available for those who go beyond the performance defined for 4 marks, but who do not meet fully the criteria for 6 marks.

SKILL A USING AND ORGANISING TECHNIQUES, APPARATUS AND MATERIALS

1

2 - Follows written, diagrammatic or oral instructions to perform a single practical operation.

Uses familiar apparatus and materials adequately, needing reminders on points of safety.

3

4 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of step-by-step practical operations.

Uses familiar apparatus, materials and techniques adequately and safely.

5

6 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of practical operations where there may be a need to modify or adjust one step in the light of the effect of a previous step.

Uses familiar apparatus, materials and techniques safely, correctly and methodically.

SKILL B OBSERVING, MEASURING AND RECORDING

1

2 - Makes observations or readings given detailed instructions.

Records results in an appropriate manner given a detailed format.

3

4 - Makes relevant observations or measurements given an outline format or brief guidelines.

Records results in an appropriate manner given an outline format.

5

6 - Makes relevant observations or measurements to a degree of accuracy appropriate to the instruments or techniques used.

Records results in an appropriate manner given no format.

SKILL C HANDLING EXPERIMENTAL OBSERVATIONS AND DATA

1

2 - Processes results in an appropriate manner given a detailed format.

Draws an obvious qualitative conclusion from the results of an experiment.

3

4 - Processes results in an appropriate manner given an outline format.

Recognises and comments on anomalous results.

Draws qualitative conclusions which are consistent with obtained results, and deduces patterns in data.

5

6 - Processes results in a appropriate manner given no format.

Deals appropriately with anomalous or inconsistent results.

Recognises and comments on possible sources of experimental error.

Expresses conclusions as generalisations or patterns where appropriate.

SKILL D PLANNING, CARRYING OUT AND EVALUATING INVESTIGATIONS

1

2 - Suggests and carries out a simple experimental strategy to investigate a given practical problem.

Attempts 'trial and error' modification in the light of the experimental work carried out.

3

4 - Specifies and carries out a sequence of activities to investigate a given practical problem.

In a situation where there are two variables, recognises the need to keep one of them constant while the other is being changed.

Comments critically on the original plan, and implements appropriate changes in the light of the experimental work carried out.

5

6 - Analyses a practical problem systematically, produces a logical plan and carries out the investigation.

In a given situation, recognises that there is a number of variables, and attempts to control them.

Evaluates chosen procedures, suggests/implements modifications where appropriate and shows a systematic approach in dealing with unexpected results.

NOTES FOR GUIDANCE

The following notes are intended to provide teachers with information to help them to make valid and reliable assessments of the skills of their candidates. Attention is drawn to the booklet 'Course Work 1988'.

The assessments should be based on the principle of positive achievement. Candidates should be given opportunities to demonstrate what they understand and can do.

It is expected that candidates will have had opportunities to acquire a given skill before assessment takes place.

It is not expected that all of the practical work undertaken by a candidate will be assessed.

Assessments can be carried out at any time during the course. However, at whatever stage assessments are done, the standards applied must be those expected at the end of the course as exemplified in the criteria for the skills.

Assessments should normally be made by the person responsible for teaching the candidates.

It is recognised that a given practical task is unlikely to provide opportunities for all aspects of the criteria for a given mark for a particular skill to be satisfied, for example, there may not be any anomalous results (Skill C). However, by using a range of practical work, teachers should ensure that opportunities are provided for all aspects of the criteria to be satisfied during the course.

The educational value of extended experimental investigations is widely recognised. Where such investigations are used for assessment purposes, teachers should make sure that candidates have ample opportunity for displaying the skills required by the scheme of assessment.

It is not necessary for all candidates in a centre, or in a teaching group within a centre, to be assessed on exactly the same practical work, although teachers may well wish to make use of work that is undertaken by all of their candidates.

When an assessment is carried out on group work the teacher must ensure that the individual contribution of each candidate can be assessed.

Skill A may not generate a written product from the candidates. It will often be assessed by watching the candidates carrying out practical work.

Skills B, C and D will usually generate a written product from the candidates. This product will provide evidence for moderation.

Additional information regarding "format" – Skill B

2 Marks – for example, a full results table with labelled columns and units provided would be a suitable "detailed format".

4 Marks – for example, a ruled grid with labelled columns but no units would be a suitable "outline format".

6 Marks – for example, no results table provided, although the instructions to students might well say "record your results in a table", would be suitable for "no format".

Additional information regarding "format" – Skill C

2 Marks – for example, a piece of graph paper labelled and scaled would be a suitable "detailed format".

4 Marks – for example, a blank sheet of graph paper with some instructions such as "plot temperature against time" would be a suitable "outline format".

6 Marks – for example, students told to draw a graph of their results and given a blank sheet of graph paper would be suitable for "no format".

Raw scores for individual practical assessments may be given to candidates as part of the normal feedback from the teacher. The final, internally moderated, total score, which is submitted to MEG, should not be given to the candidates.

MODERATION

(a) *Internal moderation*

When several teachers in a centre are involved in internal assessments, arrangements must be made within the centre for all candidates to be assessed to a common standard.

It is essential that within each centre the marks for each skill assigned within different teaching groups (e.g. different classes) are moderated internally for the whole centre entry. The centre assessments will then be subject to external moderation.

(b) *External moderation*

Assessment sheets (see Appendix A) are to be submitted to MEG no later than the specified date in the year of the examination. For external moderation MEG will require, for a specified sample, evidence which must include for skills A to D inclusive, information about the tasks set and how the marks were awarded. In addition, for skills B, C and D a specified sample of candidates' written work will be required. A further sample may be required. All records and supporting written work should be retained until after publication of results.

Centres may find it convenient to use loose-leaf A4 file paper for assessed written work. This is because examples will be sent through the post for moderation and postage bills are likely to be large if whole exercise books are sent.

The samples sent to the moderator should have the sheets stapled together in the top left hand corner and should be clearly labelled with the centre number and the candidate's name and number. On each piece of work the skill(s) assessed and the mark awarded to each skill must be stated. Authenticated photocopies of the sample required would be acceptable.

Midland Examining Group

MEG MODE 1 SYLLABUSES:
1325, 1327, 1375, 1700, 1701
COURSE WORK ASSESSMENT FORM
GCSE EXAMINATIONS
SUMMER 19

Read the instructions printed overleaf before completing this form.

CENTRE NAME	
CENTRE NUMBER	

SYLLABUS TITLE	
SYLLABUS CODE	

CANDIDATE NAME	CANDI-DATE NUMBER	TEACHING GROUP/ SET	INTERNALLY MODERATED MARKS FOR EACH SKILL								TOTAL MARK (out of 48)	COMMENTS (IF NECESSARY)
			SKILL A (out of 6)	SKILL A (out of 6)	SKILL B (out of 6)	SKILL B (out of 6)	SKILL C (out of 6)	SKILL C (out of 6)	SKILL D (out of 6)	SKILL D (out of 6)		

MODE 1 SCIENCES/CW/A/

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Midland Examining Group

18 June 1993

GCSE EXAMINATION 1994

SCIENCE : PHYSICS (1700)

SYLLABUS AMENDMENT

NOTICE TO TEACHERS

THE MARKING OF SPELLING, PUNCTUATION AND GRAMMAR IN COURSEWORK IN GCSE SCIENCE : PHYSICS (1700) EXAMINATIONS

In October 1992 the Group informed Centres of the SEAC's decision that candidates' coursework must be assessed for accuracy in spelling, punctuation and grammar in the 1994 and subsequent GCSE examinations. Teachers are required to make an overall assessment of the completed 'folio' of work at the end of the course and the instructions for carrying out this assessment in Science : Physics (1700) are given in the supplement to the syllabus printed overleaf.

Any enquiry about this notice should be made in writing to the Secretary of your Home Board.

JP/SLC

GCSE SCIENCE : PHYSICS (1700) – APPENDIX TO THE 1994 SYLLABUS

THE ASSESSMENT OF SPELLING, PUNCTUATION AND GRAMMAR

1994

1 The assessment of spelling, punctuation and grammar is required in the following components of this syllabus:

Component Number	Title
2	Paper 2
3	Paper 3
4	Coursework

2 The marks for each component will be awarded on the basis of the performance in spelling, punctuation and grammar on the component overall, in accordance with the performance criteria given in paragraph 4 below.

3 For the internally assessed component, teachers should first assess each candidate's work against the subject specific criteria given in the syllabus on pages 26 – 28 and award a total mark.

The criteria for spelling, punctuation and grammar should then be applied, and marks added to the total according to the range given below. The Coursework Assessment Forms to be issued by MEG will accommodate the marks awarded for spelling, punctuation and grammar.

4 **Application of Criteria**	**Allocation of Marks** Internally Assessed Components Component 4
Threshold performance Candidates spell, punctuate and use the rules of grammar with reasonable accuracy; they use a limited range of specialist terms appropriately.	1
Intermediate performance Candidates spell, punctuate and use the rules of grammar with considerable accuracy; they use a good range of specialist terms with facility.	2 – 3
High performance Candidates spell, punctuate and use the rules of grammar with almost faultless accuracy, deploying a range of grammatical constructions; they use a wide range of specialist terms adeptly and with precision.	4 – 5