WELSH JOINT EDUCATION COMMITTEE
Y CYD-BWYLLGOR ADDYSG CYMREIG

GENERAL CERTIFICATE OF EDUCATION 1966

REGULATIONS & SCHEDULES

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GENERAL CERTIFICATE OF EDUCATION

REGULATIONS

Note. The term Joint Committee where it occurs in these regulations refers to the Welsh Joint Education Committee.

I. *Dates of the examinations*

Summer examination

The written examination in all subjects at the Ordinary and Advanced levels will begin on or about June 13, 1966. The Practical and Oral examinations required in certain subjects will be held during the summer term, 1966.

Autumn examination

The written examination, which will be held in certain subjects and at the Ordinary level only, will begin on or about November 14, 1966. Further information about the autumn examination, including the conditions for entry, is given in Regulations XI and XII.

II. *Age limit*

No candidate will, in general, be admitted to the 1966 examinations unless he attains the age of 16 on or before September 1, 1966.

The Head of a school is, however, given full discretion to enter pupils who have not attained the age of 16 on or before September 1 in the year of examination if he certifies—

(*a*) that it is educationally desirable for these pupils to take the examination in the particular subjects offered at the time proposed.

(*b*) that these pupils have pursued a course of study with such a degree of competence as to make it very probable that they will pass in the subjects offered.

III. *Admission of candidates*

(*a*) Pupils of any school approved by the Joint Committee may be presented for the examination by the Head of the school, to whom the requisite entry forms will be sent. The Head of a school presenting candidates shall be responsible to the Joint Committee for the provision of suitable and adequate accommodation for the examination of the candidates presented and for the proper conduct of the examination in accordance with the regulations and instructions issued from time to time by the Joint Committee.

(*b*) The Joint Committee may make, or authorize to be made, arrangements for the examination of candidates who are not pupils of any of the schools referred to in the preceding paragraph.

(*c*) Instructions about the entry of candidates are contained in Regulation XII.

IV. *Levels of examination*

The summer examination will be conducted at two levels, (*a*) Ordinary and (*b*) Advanced.

Subjects offered at the Advanced level need not have been previously offered at the Ordinary level. In some subjects at the Advanced level (see Regulation V) a special paper will be set in addition to the main or basic papers. The syllabus for the special paper will be the same as the syllabus for the basic papers at the Advanced level. The special paper will consist of questions of a more searching type designed specially to test the candidate's intellectual grasp and capacity to think about his subject. Candidates may not take a special paper in more than **one** subject.

V. *Subjects of the examination*

The subjects of the examination and the levels at which they may be offered are given below. An asterisk indicates that a Special Paper may be offered at the Advanced level.

		Ordinary	*Advanced*	*See page*
1.	English Language	O		9
†2.	English	O	A*	9
3.	Welsh Language	O		13
‡4.	Welsh	O	A*	13
5.	Greek	O	A*	18
6.	Latin	O	A*	20
7.	French	O	A*	22
8.	German	O	A*	24
9.	Spanish	O	A*	26
10.	Other approved languages	O	A	27
11.	Scripture Knowledge	O	A*	27
12.	History	O	A*	30
13.	Greek and Roman History	O	A*	32
14.	Geography	O	A*	32
15.	Economics	O	A*	34
16.	Mathematics	O		36
17.	Additional Mathematics	O		46
18.	Pure and Applied Mathematics		A*	47
19.	Pure Mathematics		A*	51
20.	Applied Mathematics		A*	53
21.	Physics	O	A*	55
22.	Chemistry	O	A*	62
23.	Botany	O	A*	72
24.	Biology	O	A*	79
25.	Human Biology	O		88
26.	Zoology		A*	91
27.	Geology	O	A*	97
28.	General Science	O		101
29.	Additional General Science	O		101
30.	Engineering Science	O		106
31.	Agricultural Science	O		108
32.	Horticultural Science	O		110
33.	Music	O	A*	110
34.	Art	O	A*	115
35.	Crafts	O		118
36.	Woodwork	O	A	122
37.	Metalwork	O	A	125
38.	Engineering Workshop Theory and Practice	O		129
39.	Geometrical and Engineering Drawing	O	A	131
40.	Geometrical and Building Drawing			132
41.	Practical Plane and Solid Geometry	O		133
42.	Cookery	O		134
43.	Dressmaking	O		135
44.	Homecraft	O		136
45.	Domestic subjects		A	138
46.	Commerce	O		140
47.	Accounts	O		143

† This subject at the Ordinary level connotes English Literature and will be so recorded on the certificate.

‡ Candidates who wish to offer Welsh at the Ordinary level in addition to Welsh Language must take Welsh **0 1** (Welsh Literature).

VI. *Combinations of subjects*

Any number or combination of subjects may be offered for the summer examination except that—

(*a*) The same subject may not be offered at the same examination at both the Ordinary and Advanced levels. A candidate who fails to pass in a subject offered at the Advanced level may however be deemed, at the discretion of the Joint Committee, to have passed in that subject at the Ordinary level.

(*b*) Candidates may **not** offer at the same examination :—

(i) Pure and Applied Mathematics with either Pure Mathematics or Applied Mathematics.

(ii) Mathematics **O** or Additional Mathematics with any **one** of the following : Pure and Applied Mathematics, Pure Mathematics, Applied Mathematics.

(iii) Physics and Engineering Science.

(iv) Biology with either Botany or Zoology at the same level.

(v) More than **one** of the following : Geometrical and Engineering Drawing, Geometrical and Building Drawing, Practical Plane and Solid Geometry.

(vi) General Science with more than **one** of the following : Physics, Chemistry, Biology, Engineering Science, Additional General Science.

(vii) Homecraft **O** with Domestic Subjects **A**; Cookery **O** with Domestic Subjects (paper **A 2**) ; Dressmaking **O** with Domestic Subjects (paper **A 3**).

(viii) The same craft for Art as for Crafts.

(*c*) Additional General Science may be offered only in conjunction with General Science.

VII. *Additional schemes of examination and alternative syllabuses*

The Head of a school may submit for the approval of the Joint Committee :—

(*a*) A scheme for examination in a subject other than those named in Regulation V.

(*b*) A syllabus alternative to that already approved for any of the subjects named in Regulation V. The proposed alternative syllabus should be at least equal in range and character to that approved by the Joint Committee in the same or in a similar subject.

Applications for the approval of additional schemes, or alternative syllabuses, shall be made before March 1, and at least one year in the case of a subject at Ordinary level, and two years in the case of a subject at Advanced level, before the examination for which the proposed additional schemes or alternative syllabuses are intended.

Application for the continued approval of an additional scheme of examination or of an alternative syllabus must be made *each year* not later than March 1 preceding the beginning of the school year for which the continued approval is sought.

The Joint Committee may require that any expense incurred in considering and approving an additional scheme of examination or alternative syllabus and in the conduct of the examination on it shall be borne by those applying for these special services.

VIII. *Examination papers in the Welsh Language*

The Committee is prepared to consider applications from the Head of a school for examination papers in Welsh, to meet the requirements of pupils whose instruction in these subjects has been through the medium of Welsh.

Applications for such papers must be received not later than two years before the date of the examination.

IX. *Certificates*

A General Certificate of Education will be awarded to every candidate who satisfies the examiners in at least one subject at the Ordinary or the Advanced level. At the Advanced level the certificate will indicate :—

(i) the grade (A, B, C, D, E, in order of merit) which the candidate has been awarded on his main or basic papers ;

(ii) the grade ("Distinction" or "Merit") which the candidate has been awarded on a special paper.

X. *Local Authority awards*

At the request of a Local Education Authority, the Joint Committee is prepared to supply information about the performance of applicants for local authority awards.

XI. *Autumn examination*

(*a*) Candidates may offer at the autumn examination only those subjects listed in (*b*) below in which they have previously failed. No candidate may offer more than three subjects, unless otherwise determined by the Committee in a particular case.

A candidate who was entered for the previous summer examination, and who produces medical or other evidence acceptable to the Committee of inability to attend, may be permitted to sit.

(*b*) The subjects that may be offered by a candidate at the autumn examination are as follows :—

English Language, Welsh Language, Welsh (**O2** *or* **O3**), Latin, French, German, Spanish, *either* History *or* Economics, Geography, Mathematics (excluding **Od** and **Oe**), Physics, Chemistry, *either* Biology *or* Human Biology General Science, and Engineering Science.

(*c*) The question papers in the autumn examination will be based on the same syllabuses as those for the previous summer examination. Question papers will also be provided on special schemes approved for the summer examination in the above subjects.

In Modern Languages, the results of the previous oral examination will be used.

(*d*) Heads of schools presenting candidates for the autumn examination may, where circumstances make this course desirable, arrange for the attendance of their candidates at a neighbouring centre.

XII. *Entry forms*

(1) *Internal candidates*

Candidates who are in full- or part-time attendance at a school or college which is an approved centre for the examinations are designated "internal" candidates. Entry forms for internal candidates will be sent to the schools and colleges early in February for the summer examination, and early in September for the autumn examination.

The completed forms must reach this office by the following dates :—

Summer examination, not later than March 7, 1966 ;

Autumn examination, not later than October 3, 1966.

The fees of all internal candidates must be paid, by arrangement with the Committee, either through the local education authority or through the school or college concerned.

(2) *External candidates*

Candidates who are not entered by the Head of a school or college are regarded as "external" candidates. Every external candidate is required to complete an individual entry form (Form E).

(*a*) *Summer examination*

Entry forms may be obtained on application early in February ; completed entry forms should be sent, together with the appropriate fee, so as to reach this office not later than March 7, 1966.

In special circumstances an application by an external candidate for admission to the summer examination may be accepted after March 7, 1966. Every entry received between March 7 and April 1, 1966, inclusive, must be accompanied by a late fee of £1 1s. 0d. in addition to the normal fee. No application for admission to the examination will be accepted after April 1, 1966.

(*b*) *Autumn examination*

Entry forms for the autumn examination may be obtained on application early in September ; completed entry forms should be sent, together with the appropriate fee, so as to reach this office not later than October 3, 1966.

In special circumstances an application by an external candidate for admission to the autumn examination may be accepted after October 3, 1966. Every entry received between October 3 and 15, 1966, inclusive, must be accompanied by a late fee of £1 1s. 0d., in addition to the normal fee. No application for admission to the autumn examination will be accepted after October 17, 1966.

XIII. *Examination fees*

Information regarding the scale of fees payable in respect of the 1966 examination may be obtained from the Secretary, 30, Cathedral Road, Cardiff.

EXAMINATION SCHEDULES

GENERAL NOTE

In all subjects marks may be deducted for untidy arrangement of the work, for bad spelling, and for illegible handwriting or figures as well as for neglect to observe the instructions on the examination papers and answer books.

1 ENGLISH LANGUAGE

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

Part I (1 hour)

An essay in English on any one of a number of subjects. The main object will be to test power of thought, expression, and arrangement.

Part II (2 hours)

A précis of a long prose passage.

Questions involving such knowledge of analysis, synthesis, accidence, and syntax as may be necessary for the writing of correct English.

Questions to test knowledge of the correct meaning and use of words and phrases.

Questions to test the understanding of a simple passage of prose or verse

Questions of a simple type on letter-writing may be included.

2 ENGLISH

Ordinary level

Candidates will be required to take one paper, **O a** *or* **O b,** *of two and a half hours.*

English Literature

O a

Questions will be asked on the literary history, form, and subject matter of the books prescribed for study. It is expected that some portions of the texts studied will be committed to memory.

For detailed study :—

(1) Shakespeare : *Either* (*a*) *The Merchant of Venice,*
or (*b*) *Richard II.*

Ordinary level—*continued*

(2) *Either* (*a*) Palgrave's *Golden Treasury* (World's Classics, school edition). The following poems :—

Keats : *On first looking into Chapman's Homer* (166), *Ode on the Poets* (167), *La Belle Dame sans Merci* (193), *The Terror of Death* (199), *The Mermaid Tavern* (229), *Ode to a Nightingale* (244), *Ode to Autumn* (255), *The Realm of Fancy* (270).

Tennyson : *St. Agnes' Eve* (323), *Sir Galahad* (324), *Break, Break, Break* (325), *The Brook* (326), *The splendour falls* (328), *Tears, idle tears* (329), *O Swallow, Swallow* (330), *Now sleeps the crimson petal* (331), *Come down, O maid* (332), *From 'In Memoriam'* (333), *Come into the garden, Maud* (334).

Browning : *The year's at the spring* (338), *The Lost Leader* (340), *Home-Thoughts, from Abroad* (341), *Home-Thoughts, from the Sea* (342), *Misconceptions* (343), *A Woman's Last Word* (344), *Porphyria's Lover* (347), *Prospice* (349).

or (*b*) Wollman : *Ten Twentieth-Century Poets* (Harrap). The poems of Walter de la Mare, Robert Frost, Thomas Hardy, and Edward Thomas.

For general reading :—

(1) One of the following prose works :—

Goldsmith : *The Vicar of Wakefield.*
George Eliot : *The Mill on the Floss.*
Collins : *The Moonstone.*
William Golding : *Lord of the Flies* (Faber, school edition).

(2) One of the following dramatic works :—

Sheridan : *The Rivals.*
Shaw : *Androcles and the Lion* (the edition published by Longmans, Green and Co., and edited by A. C. Ward, is recommended, but not specified).
Wilde : *The Importance of Being Earnest.*
Christopher Fry : *The Boy with a Cart.*

O b

Questions will be set to test the candidates' general reading and knowledge of English books.

Ordinary level—*continued*

The course of general reading should include, amongst other books, some of Shakespeare's plays, an anthology of verse, and some of the chief works of the most famous prose writers.

Palgrave's *Golden Treasury* (World's Classics) is suggested as the anthology of verse.

Paper **O b** will contain a very wide choice of questions and will as far as possible be framed so as to give candidates an opportunity of obtaining credit for any private reading they have done.

Questions 1 and 2 will be compulsory.

Question 1 will allow a choice of *either* (i) a question on contexts *or* (ii) a passage of prose for original comment.

Question 2 will be based on the study of a play by Shakespeare.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours. A special paper,* **S,** *of three hours, will also be set.*

Candidates will be judged by their powers of criticism and interpretation, by their skill in the orderly treatment of a theme, and by their command of expression. Credit will be given for apt quotations from the texts read.

The history of literature will not be part of the examination, except in so far as a knowledge of the historical setting is necessary for the understanding of the matter or form of the texts prescribed for study.

A detailed knowledge of the matter and form of the prescribed books will be expected.

A1

(*a*) A question based on given passages from any of the prescribed texts, excluding those of Chaucer ;

(*b*) Questions to test knowledge and appreciation of the following books :—

Chaucer : *The Prologue to the Canterbury Tales* and *The Nun's Priest's Tale.*

Shakespeare : *Antony and Cleopatra* and *The Winter's Tale.*

Milton : *Samson Agonistes* and *Comus.*

Wordsworth : *Selections* (ed. B. I. Evans).

Advanced level—*continued*

A2

Candidates will be required to study four books, **one** from each of the sections A, B, C, and D given below. In the examination, candidates will be asked to answer a compulsory question on practical criticism, together with three other questions of which not more than **one** may be taken from any section.

Section A, Poetry

(1) *Eight Metaphysical Poets* (ed. Dalglish : Heinemann).
(2) Dryden : *Absalom and Achitophel,* Part I.
(3) Browning : *Men and Women.*
(4) *Ten Twentieth-Century Poets* (ed. Wollman : Harrap).

Section B, Drama

(1) Jonson : *The Alchemist.*
(2) Sheridan : *The Rivals* and *The School for Scandal.*
(3) Sean O'Casey : *Juno and the Paycock.*
(4) T. S. Eliot : *Murder in the Cathedral.*

Section C, Fiction (Novel form)

(1) Swift : *Gulliver's Travels.*
(2) Dickens : *Great Expectations.*
(3) Conrad : *The Secret Agent.*
(4) Forster : *A Passage to India.*

Section D, Discursive Prose

(1) *English Critical Essays* (selected by E. D. Jones ; World's Classics, O.U.P.), Vol. 1—Sixteenth to Eighteenth Centuries ; the following essays only :—
Sir Philip Sidney : *An Apologie for Poetry.*
Francis Bacon : *The Nature of Poetry.*
(2) Johnson : *Selections* (ed. Reynolds ; Ginn).
(3) Hazlitt : *The Spirit of the Age* (Everyman Library).
(4) J. S. Mill : *Utilitarianism* and *On Liberty* (Everyman Library).

Special paper

The syllabus is the same as that for the basic papers **A 1** and **A 2.** The paper will consist of three questions to test (*a*) literary appreciation, (*b*) comprehension, and (*c*) the development of arguments on topics of general literary interest.

3 WELSH LANGUAGE

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

This schedule is intended for candidates who habitually speak Welsh or whose acquaintance with the language is sufficient to enable them to read and write it with ease.

All the questions will be in Welsh and all the answers must be written in Welsh.

Rhan I (1 awr)

Ysgrifennu traethawd yn Gymraeg ar unrhyw un o nifer o bynciau a roddir i ddewis ohonynt. Y prif amcan fydd profi gallu'r ymgeiswyr i feddwl a mynegi eu meddyliau'n drefnus a chywir, ond gosodir pwys hefyd ar ansawdd y traethodau.

Rhan II (2 awr)

Ysgrifennu crynodeb o ddarn hir o ryddiaith Gymraeg.

Cwestiynau i brofi gallu'r ymgeiswyr i arfer geiriau a brawddegau a phriod-ddulliau Cymraeg yn gywir.

Cwestiynau ar ramadeg (ffurfdroadau, cydberthynas ffurfiau ac elfennau cystrawen, gan gynnwys rheolau treigladau dechreuol).

Aralleirio neu egluro darn o ryddiaith neu farddoniaeth.

4 WELSH

Ordinary level

Candidates will be required to take one of the following schedules : Welsh **O 1,** Welsh **O 2,** or Welsh **O 3.**

Welsh O 1 (for candidates whose first language is Welsh).

Candidates will be required to take one paper of two and a half hours in Welsh Literature.

All the questions will be set in Welsh and all the answers must be written in Welsh.

Astudio'r llyfrau a ganlyn :—

(*a*) *Naill ai* (i) Daniel Owen : *Gwen Tomos* (Hughes ai Fab).

neu (ii) T. Rowland Hughes : *Chwalfa* (Gwasg Aberystwyth).

(*b*) Saunders Lewis : *Esther* (Llyfrau'r Dryw).

(*c*) *Cerddi Diweddar Cymru* (gol. H. Meurig Evans : Llyfrau'r Dryw).

Rhifau 1, 4, 5, 6, 21, 27, 31, 35, 40, 43, 45, 49, 54, 59, 65, 76, 83, 86, 95, 100.

(*d*) I. D. Hooson : *Y Gwin a Cherddi Eraill* (Gwasg Gee).

Ordinary level—*continued*

Rhoddir dewis o nifer o gwestiynau ar gynnwys y llyfrau gosod ac ar bynciau llenyddol a berthyn iddynt. *O Cerddi Diweddar Cymru* yn unig y dewisir dyfyniadau'r cwestiwn ar y cyd-destun.

Rhoddir cyfle i'r ymgeiswyr sôn am lyfrau neu awduron nas enwir ymhlith y testunau gosod.

Welsh O 2 (for candidates offering Welsh as a second language).

Candidates will be required to take two papers, **O 2 a** *and* **O 2 b,** *each of two and a half hours, and an oral examination.*

The questions will be set in Welsh with English translations of them. Unless otherwise stated, answers may be written in either Welsh or English.

O 2 a Cyfansoddi : ysgrifennu yn Gymraeg draethawd (tua 200 o eiriau) ar unrhyw un o nifer o bynciau hawdd a roddir i ddewis ohonynt.

Cyfieithu i'r Gymraeg ddarn byr o Saesneg syml, ***neu*** nifer o frawddegau hawdd.

Cwestiynau ar elfennau gramadeg : rhannau ymadrodd, ffurfdroadau, cydberthynas ffurfiau ac elfennau cystrawen (swydd a threfn geiriau mewn brawddeg a rheolau treigladau dechreuol).

Arddywediad : ysgrifennu darn o ryddiaith Gymraeg a ddarllenir yn uchel ar y pryd gan yr athro.

O 2 b Astudio'r llyfrau a ganlyn :—

(*a*) *Naill ai* (i) Daniel Owen : *Gwen Tomos* (Hughes a'i Fab).

neu (ii) T. Rowland Hughes : *Chwalfa* (Gwasg Aberystwyth).

(*b*) *Cerddi Diweddar Cymru* (gol. H. Meurig Evans : Llyfrau'r Dryw) Rhifau 1, 4, 5, 6, 21, 27, 31, 35, 40, 43, 45, 49, 54, 59, 65, 76, 83, 86, 95, 100.

Adran I. Cyfieithu i'r Saesneg ddarnau o'r llyfrau gosod ac ateb cwestiynau ar eu cynnwys ac ar bynciau a berthyn iddynt. Rhoddir dewis o'r cwestiynau yn yr adran hon.

Adran II. Cyfieithu i'r Saesneg ddarn syml o ryddiaith o lyfrau eraill heb eu paratoi.

Ordinary level—*continued*

Welsh O 3 (for candidates offering Welsh as a foreign language*).

Candidates will be required to take two papers, **O 3 a** *and* **O 3 b,** *each of two and a half hours, and an oral examination.*

O 3 a An essay in Welsh.
A passage of prose for translation into Welsh.
Questions to test knowledge of grammar.
Dictation : A passage from an easy Welsh text.

O 3 b Unprepared passages of prose for translation into English.

A comprehension test.

Oral (for candidates taking **O 2** or **O 3** papers).

The Oral examination will include Reading and Conversation.

Advanced level

Candidates may offer either **Welsh (Home Language)** or **Welsh (Modern Language).**

WELSH (Home Language)

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours. A special paper,* **S,** *of three hours, will also be set.*

The questions will be set in Welsh and must be answered in Welsh.

A 1 (*a*) An essay.

(*b*) Questions, of which **three** must be answered, will be set on five books, viz.:—(i) a medieval Welsh text, (ii) a prose work of the seventeenth or eighteenth century, (iii) a modern prose work, (iv) a volume of verse in strict metre, (v) a volume of modern verse.

Books prescribed for detailed study :—

(1) *Chwedlau Odo* (gol. Syr Ifor Williams : Gwasg Prifysgol Cymru).

(2) Ellis Wynne: *Gweledigaeth Uffern.*

(3) D. J. Williams : *Yn Chwech ar Hugain Oed* (Gwasg Aberystwyth), tt. 1 – 86.

** Heads of schools will be required to certify that all their candidates offering Welsh* O 3 *have acquired their knowledge of Welsh by studying it as a foreign language.*

Advanced level—*continued*

(4) *The Oxford Book of Welsh Verse* (rhifau 43, 46, 49, 51, 53, 68, 75, 79, 86, 88, 89, 92, 93).

(5) W. J. Gruffydd : *Ynys yr Hud a Chaneuon Eraill* (Hughes a'i Fab).

Short passages will be given for comment and for explanation with reference to the context.

Questions will also be set on the language (syntax, style, vocabulary) and on the subject matter.

A 2

(*a*) Questions will be set on the style, matter, and literary relations of **four** books, to be selected from the following list :—

(1) *Erthyglau a Llythyrau Emrys ap Iwan*, II (gol. D. M. Lloyd ; Clwb Llyfrau Cymreig, Gwasg Aberystwyth), tt. 45–169.

(2) W. J. Gruffydd : *Hen Atgofion* (Gwasg Aberystwyth).

(3) Huw Lloyd Edwards : *Y Gŵr o Wlad Us* (Gwasg Gee).

(4) T. Rowland Hughes : *O Law i Law* (Gwasg Aberystwyth).

(5) Kate Roberts : *Tê yn y Grug* (Gwasg Gee).

(6) Iorwerth C. Peate : *Canu Chwarter Canrif* (Gwasg Gee).

(7) Saunders Lewis : *Siwan a Cherddi Eraill* (Llyfrau'r Dryw), tt. 33–88.

(8) Daniel Owen : *Enoc Huws* (argraffiad gwreiddiol neu ddiwygiedig).

Candidates will be required to answer questions on each of the books selected.

(*b*) A question on grammatical terms and forms.

Special paper

(*a*) An essay based on the subject matter of the books set at the Advanced level.

(*b*) Passages in prose and/or verse for criticism and appreciation. The passages will not be taken from any of the prescribed books.

WELSH (Modern Language)*

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and an oral examination. A special paper,* **S,** *of three hours, will also be set.*

A 1

Candidates will be required to make a detailed study of the books prescribed and to answer five questions, two from each of sections (*a*) and (*b*), and one from section (*c*).

(*a*) Textual analysis and appreciation of a passage of prose and a passage of verse, chosen from the books prescribed.

(*b*) Questions on the language, nature, and content of the books prescribed.

(*c*) Questions on Welsh life and culture.

Books prescribed for detailed study:—

(1) W. J. Gruffydd : *Hen Atgofion* (Gwasg Aberystwyth).

(2) Kate Roberts : *Tê yn y Grug* (Gwasg Gee).

(3) W. J. Gruffydd : *Ynys yr Hud a Chaneuon Eraill* (Hughes a'i Fab), tt. 1–23, 42–64 ; a
Iorwerth C. Peate : *Canu Chwarter Canrif* (Gwasg Gee), tt. 14–23, 35–51, 61–77.

(4) Daniel Owen : *Enoc Huws* (argraffiad gwreiddiol neu ddiwygiedig).

Welsh Life and Culture

No book is prescribed for special study, but the following may be found useful :—

Wyn Griffith : *The Welsh* (Pelican Books).

D. M. and E. M. Lloyd : *A Book of Wales* (Collins).

The Land of the Red Dragon (University of Wales Press).

Cyfres Dathlu Gwyl Ddewi (University of Wales Press).

R. T. Jenkins : *Y Ffordd yng Nghymru* (Hughes a'i Fab).

A 2

(*a*) Translation of a passage of English prose into Welsh.

(*b*) Translation of an unprepared passage of Welsh prose into English.

(*c*) An essay in Welsh on a topic of general interest.

Candidates must satisfy the examiner in each of sections (*a*) and (*c*).

* Heads of schools will be required to certify that all their candidates offering Welsh (Modern Language) have acquired their knowledge of Welsh by studying it as a foreign language.

Advanced level—*continued*

Oral

The Oral examination will include Reading, Conversation, and Dictation.

Special paper

(*a*) Translation from English into Welsh.

(*b*) Questions to test powers of literary appreciation or critical analysis, with or without translation, of an unprepared passage of Welsh prose and/or verse.

5 GREEK

Ordinary level

Candidates will be required to take two papers, either **O a** *or* **O b,** *and* **O c,** *each of two and a half hours.*

O a Unprepared translation of passages of Attic prose and poetry.

O b

(1) *Either* Xenophon, *Anabasis* I (ed. Walpole ; Macmillan Elementary Classics) ; chapters 4 (commencing at §6, ἐντεῦθεν ἐξελαύνει διὰ Συρίας), 5, 7, 8.

or Plato, *Crito* (ed. Adam ; Cambridge University Press Elementary Classics) omitting chapters 6–10.

(2) *Either* Euripides, *Scenes from Iphigenia in Aulis and Iphigenia in Tauris* (ed. Kennedy ; Macmillan Modern School Classics), the first part "Iphigenia in Aulis".

or Aristophanes, *Scenes from the Birds* (ed. Oldaker ; Cambridge University Press Elementary Classics).

O c Unprepared translation of a passage of Attic prose.

Questions on the main facts of Attic Greek accidence and syntax.

Translation into Greek of English sentences, in illustration of the rules of syntax, a vocabulary of the less familiar words being given.

GREEK—*continued*

Advanced level

Candidates will be required to take three basic papers, **A 1, A 2,** *and* **A 3,** *each of two and a half hours. A special paper,* **S,** *of two and a half hours, will also be set.*

A1 *Prescribed Books*

Two books, one of verse and one of prose, to be chosen from the list given below, are prescribed for special study. A knowledge will be expected of the simplest metres found in the verse.

(1) *Either* Homer, *Iliad* XI and XII (verses 1–289),

or Aeschylus, *Seven against Thebes.*

(2) *Either* Thucydides, Book I, 1–66,

or Lysias, *Orationes* V and X (ed. E. S. Shuckburgh : Macmillan).

Note.—When no special edition is prescribed the Examiners will make use of the Oxford Classical Texts (Clarendon Press, Oxford).

The paper will comprise :—

(*a*) Passages for translation into English.

(*b*) Passages for comment on subject matter, but not necessarily to be translated.

(*c*) Passages for comment on grammar and syntax, and for scansion.

(*d*) An essay question on the prescribed books of prose.

A2 (*a*) Prose composition.

(*b*) Prose unprepared translation.

A3 (*a*) Verse unprepared translation.

(*b*) Literature.

Candidates will be required to answer :—

(i) an essay question on the prescribed books of verse ;

(ii) *two* questions on the following authors : Homer, Sophocles, Aristophanes, Herodotus, Plato and Lucian. One question, which will contain alternatives, will be set on each author. Some of the following works should be read, partly in the original and partly in translation :—

Homer : *Odyssey* V–VII.
Sophocles : *Antigone.*
Aristophanes : *Knights.*
Herodotus : Book VIII.
Plato : *Republic* X.
Lucian : *Vera Historia.*

Advanced level—*continued*

Special paper

(*a*) Prose composition.

(*b*) Prose unprepared translation.

(*c*) Verse unprepared translation. (Alternative passages will be set from Homer and from the Iambic narrative or dialogue of Tragedy.)

6 LATIN

Ordinary level

Candidates will be required to take two papers, either **O a** *or* **O b,** *and* **O c,** *each of two and a half hours.*

O a Unprepared translation of Latin prose and verse passages.

Candidates will be expected to have a knowledge of the scansion of the Hexameter and Elegiac couplet.

O b

(1) *Either* Caesar, *De Bello Gallico*, Book III.

or Hannibal Triumphant (ed. A. H. Nash-Williams: Macmillan): chapters 1–5, 7–20, 26–30 (inclusive).

(2) *Either* Virgil, *Aeneid*, Book II, lines 370–804.

or A First Book of Latin Poetry (ed. Flewett and Pantin: Macmillan), Part I.

Note.—When no special edition is prescribed the Examiners will make use of the Oxford Classical Texts (Clarendon Press, Oxford).

A knowledge of the scansion of metres other than the Hexameter and Elegiac couplet will not be required.

Translation into English of passages from the prepared books.

An unprepared passage taken from the prose author chosen by the candidate will also be set for translation.

Questions on the subject matter of the prepared books and on the prosody of the verse.

Ordinary level—*continued*

O c Questions on Latin Grammar.

Translation into Latin *either* (*a*) of English sentences in illustration of rules of syntax, *or* (*b*) of an easy continuous passage of English prose.

Unprepared translation of a Latin prose passage.

Advanced level

Candidates will be required to take three basic papers, **A 1, A 2,** *and* **A 3,** *each of two and a half hours. A special paper,* **S,** *of two and a half hours, will also be set.*

A1 *Prescribed Books*

Two books, one of verse and one of prose, to be chosen from the list given below, are prescribed for detailed study. Candidates will be expected to show a knowledge of the Hexameter or, when appropriate to the authors prescribed, of the Elegiac metre or of the simpler lyric metres.

(1) *Either* Cicero : *Pro Milone,*
or Tacitus : *Annals* I, chapters 16–71 (ed. N. Miller ; Methuen).

(2) *Either* Virgil : *Eclogues* I, IV, IX and *Georgics* IV,
or Lucretius : Book V, lines 1–90 and 783–1457.

Note.—When no special edition is prescribed the Examiners will make use of the Oxford Classical Texts (Clarendon Press, Oxford).

The paper will comprise :—

(*a*) Passages for translation into English.

(*b*) Passages for comment on subject matter, but not necessarily to be translated.

(*c*) Passages for comment on grammar and syntax, and for scansion.

(*d*) An essay question on the prescribed books of prose.

A2 (*a*) Prose composition.

(*b*) Prose unprepared translation.

A3 (*a*) Verse unprepared translation.

(*b*) Literature.

Candidates will be required to answer—

(i) an essay question on the prescribed books of verse ;

(ii) *two* questions on the following authors :

Cicero, Livy, Virgil, Horace, and Juvenal ; with special reference to Cicero, *Philippic* II ; Livy, Book XXII ; Virgil, *Aeneid* VIII ; Horace, *Satires* I, 1, 3, 4, 5, 6, 9, 10.

Advanced level—*continued*

One question, which will contain alternatives, will be set on each author. Candidates will be expected to show some first-hand acquaintance with the authors whom they have chosen to study.

Special paper

(*a*) Prose composition.

(*b*) Prose and/or verse unprepared translation.

7 FRENCH

Ordinary level

Candidates will be required to take two papers, **O a** *and* **O b,** *each of two hours, and an oral examination.*

O a Translation into English of unprepared prose passages.

O b Translation into French of a simple English passage of a general character and of a shorter passage intended to test the candidates' knowledge of grammar and idiom.

Free Composition on a familiar subject, an outline of the treatment being given.

Dictation : A passage from an easy French text. [The punctuation will be given in French.]

Oral. The oral examination will include Reading and Conversation. Special stress will be laid on distinct enunciation and good intonation.

Advanced level

Candidates will be required to take three basic papers, **A 1** *(three hours),* **A 2** *(one and a half hours), and* **A 3** *(two and a half hours), and an oral examination. A special paper,* **S,** *of three hours, will also be set.*

A1 Five questions to be answered, including both questions in section (*a*), at least two questions from section (*b*), and not more than one question from section (*c*).

(*a*) Textual analysis and appreciation of a passage of prose and a passage of verse, chosen from the books prescribed for detailed study.

(*b*) Questions on the language, nature, and content of the books prescribed for detailed study.

(*c*) Questions on French civilization. (The questions set in this section will be optional.)

Advanced level—*continued*

Books prescribed for detailed study :—

(1) *Twelve French Poets* (ed. D. Parmée ; Longmans, Green and Co.). The poems of Vigny, Hugo, Leconte de Lisle, Baudelaire.

(2) *Either* Molière : *Le Tartuffe* (ed. Ledésert ; Harrap),
or Corneille : *Le Cid* (ed. Wilson ; Harrap).

(3) *Either* Balzac : *Le Colonel Chabert, Gobseck* (ed. A. G. Lehmann ; Harrap),
or Camus : *La Peste* (ed. W. J. Strachan ; Methuen).

(4) *Either* Anouilh : *Becket* (ed. W. D. Howarth ; Harrap),
or Pagnol : *La Gloire de mon père* (ed. J. Marks ; Harrap).

French Civilization

The questions under this heading will deal with recent developments in French life and society, including such aspects as education, government, law, agriculture, and industry. Candidates should study the following :—

La France d'aujourd'hui (Harrap, London/Hatier, Paris, 3rd edition, 1961), excluding pp. 225–286 ;

La France by R. P. L. and D. M. Ledésert and M. H. Smith (Harrap, 3rd edition, 1960).

A2 Translation into English of two unprepared passages. Three passages will be set, the first of which, a prose passage, will be compulsory ; for the second, candidates will have a choice of a prose or verse passage.

A3 (*a*) Translation of a passage of English prose into French.

(*b*) A simple essay in French on a topic of general interest.

Oral. The oral examination will include Reading, Conversation, and Dictation. Special stress will be laid on distinct enunciation and good intonation.

Advanced level—*continued*

Special paper

(*a*) Translation from English into French.

(*b*) Questions to test powers of literary appreciation or critical analysis, with or without translation, of an unprepared passage of French prose and/or verse.

8 GERMAN

Ordinary level

Candidates will be required to take two papers, **O a** *and* **O b,** *each of two hours, and an oral examination.*

O a Translation into English of unprepared prose passages.

O b Translation into German of a simple English passage of a general character and of a shorter passage intended to test the candidates' knowledge of grammar and idiom.

Free Composition on a familiar subject, an outline of the treatment being given.

Dictation : A passage from an easy German text.

Oral. The oral examination will include Reading and Conversation. Special stress will be laid on distinct enunciation and good intonation.

Advanced level

Candidates will be required to take three basic papers, **A 1** *(three hours),* **A 2** *(one and a half hours), and* **A 3** *(two and a half hours), and an oral examination. A special paper,* **S,** *of three hours, will also be set.*

A1 Five questions to be answered, two from section (*a*) and three from section (*b*).

(*a*) Textual analysis and appreciation of a passage of prose and a passage of verse, chosen from the books prescribed for detailed study.

(*b*) Questions on the language, nature, and content of the following books prescribed for detailed study :—

(1) *Either* Goethe : *Torquato Tasso,*
or Schiller : *Maria Stuart.*

(2) *German Lyrics and Ballads* (ed. Vos and Barba ; Harrap), the following poems : Klopstock, *Das Rosenband, Die frühen Gräber* ; Claudius, *Der Tod und das Mädchen, Abendlied* ; Bürger, *Lenore* ;

Advanced level—*continued*

Goethe, *Willkommen und Abschied, Mailied, Heidenröslein, Der König in Thule, Prometheus, Auf dem See, An den Mond, Über allen Gipfeln, Erlkönig, Wer nie sein Brot mit Tränen aß, Mignon (Kennst du das Land . . .), Das Göttliche, Gefunden, Aussöhnung*; Schiller, *Das Mädchen aus der Fremde, Die Worte des Glaubens, Das Lied von der Glocke, Nänie*; Brentano, *Sprich aus der Ferne, Die Lore Lay*; Mörike, *Um Mitternacht, Er ist's, Das verlassene Mägdlein, Denk' es, o Seele!*; Heine, *Die Grenadiere, Auf Flügeln des Gesanges, Ein Fichtenbaum steht einsam, Ein Jüngling liebt ein Mädchen, Wir saßen am Fischerhause, Du schönes Fischermädchen, Das Meer erglänzte weit hinaus, Nordseelieder (Erklärung, Seegespenst), Leise zieht durch mein Gemüt*; Liliencron, *Die Musik kommt, Wer weiß wo*; Volkslieder: *Zwei Königskinder, Der Tod als Schnitter, Ich hört' ein Sichellin rauschen, Dort hoch auf jenem Berge, Innsbruck ich muß dich lassen.*

(The above poems may also be found in *The Harrap Anthology of German Poetry* (ed. Closs and Williams)).

(3) *Either* C. F. Meyer: *Der Schuß von der Kanzel,*
or Gottfried Keller: *Kleider machen Leute.*

(4) *Either* Fritz Hochwälder: *Das heilige Experiment,*
or Thomas Mann: *Tonio Kröger.*

A2 Translation into English of two unprepared passages.

Three passages will be set, the first of which, a prose passage, will be compulsory; for the second, candidates will have a choice of a prose or verse passage.

A3 (*a*) Translation of a passage of English prose into German.

(*b*) A simple essay in German on a topic of general interest.

Oral. The oral examination will include Reading, Conversation, and Dictation. Special stress will be laid on distinct enunciation and good intonation.

Special paper

(*a*) Translation from English into German.

(*b*) Questions to test powers of literary appreciation or critical analysis, with or without translation, of an unprepared passage of German prose and/or verse.

Ordinary level

Candidates will be required to take two papers, **O a** *and* **O b,** *each of two hours, and an oral examination.*

O a Translation into English of unprepared prose passages.

O b Translation into Spanish of a simple English passage of a general character, and of a shorter passage intended to test the candidates' knowledge of grammar and idiom.

Free Composition on a familiar subject, an outline of the treatment being given.

Dictation : A passage from an easy Spanish text.

Oral. The oral examination will include Reading and Conversation. Special stress will be laid on distinct enunciation and good intonation.

Advanced level

Candidates will be required to take three basic papers, **A 1** *(three hours),* **A 2** *(one and a half hours), and* **A 3** *(two and a half hours), and an oral examination. A special paper,* **S,** *of three hours, will also be set.*

A1 Five questions to be answered, two from section (*a*) and three from section (*b*).

(*a*) Textual analysis and appreciation of a passage of prose and a passage of verse, chosen from the books prescribed for detailed study.

(*b*) Questions on the language, nature, and content of the following books prescribed for detailed study :—

(1) Cervantes, *Novelas ejemplares* (any edition) : *La ilustre fregona, La Gitanilla, Rinconete y Cortadillo,* and *El coloquio de los perros.*

(2) *Either* Gil Vicente, *Obras dramáticas castellanas* (Clásicos Castellanos) : *La Sibila Casandra* and *Los Cuatro Tiempos* ;
or García Lorca, *La Zapatera prodigiosa* (Harrap).

(3) *Either* Dámaso Alonso, *Hijos de la ira* (Austral), omitting the following three sections : (1) *Vos del árbol* to *Yo,* inclusive ; (2) *La madre* to *La obsesión,* inclusive ; (3) *De Profundis* and *A la Virgen* ;
or The Harrap Anthology of Spanish Poetry : Villasandino, *Cantiga* (pp. 145–46) ; Santillana (omitting *Canción* and *La Comedieta de Ponza*) ; Jorge Manrique, *Coplas* ; and pp. 421–50.

Advanced level—*continued*

(4) *Either* C. J. Cela, *Viaje a la Alcarria* (Harrap), *or* J. L. Borges, *Ficciones* (Emecé, Buenos Aires): *Tlön, Uqbar . . ., La lotería en Babilonia*, and the stories in the section *Artificios*, omitting *El fin* and *La secta del Fénix*.

A2 Translation into English of two unprepared passages. Three passages will be set, the first of which, a prose passage, will be compulsory; for the second, candidates will have a choice of a prose or verse passage.

A3 (*a*) Translation of a passage of English prose into Spanish.

(*b*) A simple essay in Spanish on a topic of general interest.

Oral. The oral examination will include Reading, Conversation, and Dictation. Special stress will be laid on distinct enunciation and good intonation.

Special paper

(*a*) Translation from English into Spanish.

(*b*) Questions to test powers of literary appreciation or critical analysis, with or without translation, of an unprepared passage of Spanish prose and/or verse.

10 ANY OTHER APPROVED LANGUAGE

Application for permission to offer a language other than those named in Regulation V may be made in accordance with Regulation VII.

11 SCRIPTURE KNOWLEDGE

Ordinary level

Candidates will be required to take two papers, each of two hours.

Candidates must offer **one** of the Old Testament papers (**O a, O b, O c**) and **one** of the New Testament papers (**O d, O e, O f**). Candidates of the Jewish faith may offer two Old Testament papers provided application is made by September 30 in the year preceding the examination.

Candidates may write their answers either in English or in Welsh.

The Revised Version of the English Bible will be used, but question papers based on the Douay Version will be set provided application is made by June 1 in the year preceding the examination.

Ordinary level—*continued*

Primary emphasis is laid on the content, but questions of general introduction to the book or books prescribed, e.g. authorship, date, structure, may be set.

OLD TESTAMENT

O a Moses, Joshua, and the Judges.

Exodus i. 8–14, ii. 1–22, iii. 1–16, iv. 10–17, vi. 2–9, xii. 1–36, xiv. 1–31, xix. 16–xx. 21, xxxii. 1–35, xxxiv. 1–35; Numbers xxvii. 12–23; Joshua ii. 1–24, iii. 9–iv. 11, v. 13–vii, xxiv; Judges i. 1–36, iv–v, vi. 11–vii. 25, xi, xiii. 9–xvi. 31.

O b The Eighth Century.

II Kings xiv–xx; Isaiah i–ii. 4, v. 1–7, vi. 1–xi. 9, xxviii–xxxi; Hosea iii, v–vi, xiv; Amos iii–vii; Micah i–iii, vi. 1–8.

O c The Exilic Period.

Isaiah xl–lv; Lamentations ii; Ezekiel i, iv, viii, xviii, xxiv, xxxiii–xxxvii.

NEW TESTAMENT

O d *St. Luke.*

Textbook recommended: *St. Luke* (ed. Balmforth; The School Clarendon Bible).

O e Acts i–xv.

Textbooks recommended: *The Acts of the Apostles* (edited A. W. F. Blunt; The School Clarendon Bible) or *The Acts of the Apostles* (edited H. K. Luce; A. and C. Black).

O f Greek Text of the New Testament.

A part of the Greek text of *either* the Gospel prescribed for **O d** *or* the portion of Acts prescribed for **O e.** Schools wishing to present candidates for this paper must make their application by September 30 in the year preceding the examination, indicating which portion of the Greek text has been studied.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours. A special paper,* **S,** *of three hours, will also be set.*

Candidates may write their answers either in English or in Welsh.

Advanced level—*continued*

Candidates are expected to show an accurate knowledge of the texts, and to be able to quote verses in support of their answers.

In the English versions of the questions, the passages set for comment will be taken from the Revised Version of the Bible.

A general knowledge of Biblical Introduction will be expected, and candidates should study the specified texts in the wider literary and historical context of the Bible as a whole.

A1 Old Testament

A general knowledge of the history, religion, and literature of the Hebrews during **one** of the periods given below :—

(*a*) *The Early and Pre-monarchic Periods*, with a special study of Genesis i–iii, vi. 5–ix. 17, xi. 1–9, xii–xiii, xviii. 16–33, xxii. 1–19, xxviii. 10–xxix. 20, xxxvii, xli–xlvi. 7 ; Exodus i–vi. 8, xii–xiv, xvi, xviii–xx. 21 ; Numbers x. 29–36, xii, xxi–xxii, xxiv. 1–14 ; Deuteronomy v. 1–22, vi. 1–15 ; Joshua ii–viii ; Judges i–ii. 5, iv–v, ix. 1–21, xvii–xviii.

(*b*) *The United and the Divided Kingdom*, with a special study of I Samuel i, iii, ix–x. 16, xi, xv–xvi, xxxi ; II Samuel i, iii. 1, iv–v ; I Kings i–iii, v–vi. 13, viii, xi–xii, xiv. 21–31, xv. 9–24, xvi. 21–xvii. 16, xviii. 19–xix, xxi–xxii. 40 ; II Kings ix–x. 36, xiv, xv. 17–31, xvii ; Isaiah i–ii. 4, v. 1–7, vi–xi. 9 ; Hosea iii, v–vi, xiv ; Amos iii–vii; Micah i–iii, vi. 1–8.

(*c*) *The Surviving Monarchy and the Babylonian Exile*, with a special study of II Kings xviii–xxv ; Isaiah xl–lv ; Jeremiah i–iv, vii–viii, xv. 15–21, xviii. 1–10, xix–xxii, xxxi. 31–34, xl–xli ; Lamentations ii ; Ezekiel i, iv, viii, xviii, xxiv, xxxiii–xxxvii ; Nahum ii ; Habakkuk i–ii.

(*d*) *The Restoration and Greek Periods*, with a special study of Ezra i, iii–vii, viii. 15–x. 15 ; Nehemiah i–ii, iv–vii. 4, viii, xiii ; Job iii. 2–15, iv. 1–11, vii. 12–21, xiii. 13–28, xiv. 13–15, xvi. 18–21, xix. 25–27, xxxviii. 1–21, xl. 1–5 ; Psalms i, ii, viii, xix, lxviii, cx ; Proverbs i. 1–19, viii. 12–31, xvi. 10–15, xxxi. 10–31 ; Ecclesiastes i. 1–11, iii. 16–22, viii. 10–15, xi. 7–xii. 8 ; Daniel i–viii ; Joel ii ; Haggai ; Zechariah.

Advanced level—*continued*

A2 New Testament

The history, religion, and literature of the New Testament with special reference to :—

Either (*a*) (i) the Gospel according to St. John,
(ii) I Corinthians, chapters i–vii ; I Thessalonians ; and Revelation, chapters i–v ;

or (*b*) I Corinthians, chapters i–vii ; I Thessalonians ; and Revelation, chapters i–v with a study of the Greek text of St. John ix–xxi.

Special paper

The paper will be based on the syllabus of the other Advanced level papers and will include optional questions on the Greek text of St. John, ix–xxi.

12 HISTORY

Welsh versions of questions on Welsh History will be provided, in addition to the English versions, and candidates may answer such questions in English or Welsh.

Ordinary level

Candidates will be required to take one of the following papers, **O a, O b, O c, O d, O e, O f,** *each of two and a half hours.*

O a History of England and Wales from 800 to 1485.

O b History of England and Wales from 1485 to 1763.

O c History of England and Wales from 1760 to 1914.

O d History of England and Wales from 1815 to 1939.

O e European History from 1815 to 1939.

O f Social and Economic History of England and Wales from 1760 to 1939.*

O a, O b, O c, O d. Candidates offering these papers will be expected to show a general knowledge of the political history of the selected period, and importance will be attached to the following aspects :—

(i) the sequence of the main stages in the social, religious and economic development of the country, **with special reference to Wales.** (Candidates will be required to answer at least one, but not more than two, of the questions on Welsh History.)

(ii) the relations at critical times between the various parts of the British Isles, and between the British Isles and the Continent ;

* Syllabus supplied on application.

Ordinary level—*continued*

(iii) an outline of the growth of the British Empire (so far as relevant to the period);

(iv) the influence of geographical factors on the various movements.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours. A special paper,* **S,** *of three hours, will also be set.*

A1 *History of England and Wales*

The examination paper will be divided into the following periods :—

(*a*) 55 B.C.–A.D. 1066
(*b*) 1066 – 1485
(*c*) 1485 – 1714
(*d*) 1714 – 1832
(*e*) 1832 – 1939

Fourteen questions, of which four will be on Welsh History, will be set on each period.

Candidates will be required to answer five questions, which may be taken from **one** period only, or from **two** consecutive periods. Candidates will be required to answer at least one but not more than two of the questions on Welsh History.

A2 *European History*

The examination paper will be divided into the following periods :

(*a*) 395–1046
(*b*) 1046–1494
(*c*) 1494–1715
(*d*) 1715–1830
(*e*) 1830–1939

Twelve questions will be set on each period.

Candidates will be required to answer five questions, which may be taken from **one** period only, or from **two** consecutive periods.

Special paper

The paper will be based on the syllabus of the other Advanced level papers. The candidate will be given a wide choice of questions, including general questions, on the periods studied for the **A 1** and **A 2** papers ; of these questions the candidate must answer not more than four.

13 GREEK AND ROMAN HISTORY

Ordinary level*

Candidates will be required to take one paper, **O,** *of two and a half hours.*

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours. A special paper,* **S,** *of three hours, will also be set.*

A 1 History of Greece from 600 B.C. to 362 B.C.

A 2 History of Rome from 218 B.C. to A.D. 14.

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

14 GEOGRAPHY

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

(*a*) *Map work*

(i) A knowledge of British Ordnance Survey maps of the scales 1 in. and 2½ in. to one mile.

(ii) A study of the land forms illustrated by such maps together with the work of such modifying agents as water, sea, ice.

(iii) A study of human activities as shown on such maps.

N.B. The basis of the study of this section should be maps of the home area.

(*b*) *General Geography*

(i) The principal movements of the earth. Time. Seasons.

(ii) Configuration and surface characteristics of the continents (e.g. old and folded mountains ; ancient stable masses ; glaciated, alluvial, and other lowlands).

(iii) The world distribution of temperature, winds and rainfall.

(iv) The factors determining weather and climate.

(v) The major climatic regions of the world based primarily on the seasonal distribution of rainfall, viz. all season ; hot season ; cold season ; arid.

(vi) The major natural vegetation regions, viz. forests (equatorial, monsoon, warm temperate, deciduous, coniferous) ; grasslands (savanna, steppe) ; Mediterranean ; desert and scrub.

* Syllabus supplied on application.

Ordinary level—*continued*

(vii) Human occupations and activities in relation to (i) to (vi) above.

(*c*) The British Isles, with special reference to Wales, studied as illustrative of the general principles of world geography.

(*d*) A simple study of the geography of the continents on the bases of relief, climate, natural vegetation, main products, and contributions to world trade.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination. A special paper,* **S,** *of three hours, will also be set.*

Candidates must reach a satisfactory standard in the practical as well as in the written examination.

A1

General Physical Geography

The surface configuration of the major relief regions of the world ; the work of rivers, ice, wind, and sea, with examples, where possible, from the British Isles ; the work of earth-movements (volcanoes, faults, folds, etc.) ; the development of surface features under the action of all of these processes. The factors and elements of climate ; the delimitation of climatic provinces and of the associated vegetation regions ; the major soil regions of the world (viz. Podsol, Brown Forest Soil, Chernozem and Lateritic Soil regions) in their relation to climate and vegetation regions. Ocean currents as they affect climate.

General Human Geography

The broad current distribution of the main cultural divisions of mankind, viz. hunters and collectors, shifting cultivators, primitive pastoralists, primitive ploughmen, westernized industrial societies. The physical, political, social, and economic conditions of production of the following major products, viz. rice, wheat, sheep and cattle, coal, iron ore, timber and paper pulp, and the trade routes and transport problems associated with them.

A2

Regional Geography

(*a*) A broad regional study of the contemporary geography of the British Isles, with particular reference to Wales.

(*b*) A broad regional study of the contemporary geography of *one* of the following :

(i) Europe (defined as the area west of the Urals) ;

Advanced level—*continued*

(ii) North America (defined as the area north of, and excluding, Mexico) ;

(iii) The Monsoon Lands of Asia (China, Japan, India, Pakistan, Burma, Malaya).

Questions may be set on geographical aspects of contemporary problems in the special region.

Practical Examination

(*a*) Exercises on topographical maps including, in particular, Ordnance Survey maps on the scales one inch to one mile and two and a half inches to one mile. (Candidates should be able to distinguish the main regions on a given topographic sheet and should also know the main features of the cartography of these maps.)

(*b*) The study of map projections, with particular reference to five simple types, viz. Zenithal Equidistant, Bonne, Conic with two standard parallels, Mollweide including the interrupted case, Mercator. There should be a special emphasis upon their practical uses and properties. A knowledge of the construction of graticules will not be expected.

(*c*) Simple statistical exercises involving the use of dots, shading, proportional symbols, and graphs.

The Practical Examination will be of three hours' duration. The candidates' practical notebooks should be available. The discipline of keeping practical notebooks, containing a record of the work done by the candidate during his course of study, is regarded as of great importance.

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

15 ECONOMICS

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours.*

The treatment of this syllabus is intended to be mainly descriptive.

1. *Introduction.* Description of the principal features of the economic structure and activity of the United Kingdom at the present time. Other types of economic system.
2. *Classification of Economic Goods.* Consumption and investment goods. Single use and durable use goods.

Ordinary level—*continued*

3. *Population.* Size, sex, and age distribution. Geographical and occupational distribution.
4. *Factors of Production.* Capital and labour; division of labour; methods of wage payment; Trade Unions; capital and income distribution; goods and money; concepts of capital.
5. *Organization of Industry and Agriculture in Britain.* Location of industry. The structure and problems of the following British industries: coal, iron and steel, agriculture.
6. *The Pricing System.* Simple statement of the economic problem and the functions of price. Introduction to the notions of demand and supply. (No formal and systematic knowledge of economic theory will be required.)
7. *Money and Banking.* The advantages of money; the role of the commercial banks, the Bank of England; the principal institutions of the City.
8. *International Trade.* International specialization of trade. The balance of trade and the balance of payments. Imports and exports and the terms of trade.
9. *The National Budget.* The main items of government expenditure and sources of revenue—excluding the theory of the incidence of taxation.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours. A special paper,* **S,** *of three hours, will also be set.*

A1 Principles of Economics.

The object of this course should be to provide an introduction to elementary economic theory, but it should be noted that knowledge of the history of economic thought is not required, nor are any but the simplest analytical methods. Although some diagrammatic treatment may be relevant, the syllabus does not involve knowledge of advanced geometrical or algebraic methods. The emphasis should be on providing candidates with a firm and precise understanding of fundamental economic concepts (e.g. elasticity, diminishing returns) and their uses, rather than a vague and general understanding of analytical concepts and tools appropriate to advanced analysis (e.g. duopoly, multiplier).

(1) *Scope and Method of Economics*—definition of economic concepts.

Advanced level—*continued*

(2) *Production of Wealth*—division of labour—laws of return, combination of factors—elasticity of supply.

(3) *Demand Theory*—diminishing utility, substitution and elasticity.

(4) *Theory of the Market*—short run and long run effects—price determination under competition and monopoly—effect of simple disturbances (e.g. changes in supply, demand, taxes, etc.) on goods and on factors.

(5) *Personal and Business Incomes*—elements of theory of wages, rent, interest, and profits.

(6) *The National Income*—its meaning and composition. Introduction to the theory of employment.

(7) *The British Monetary and Banking System.*

(8) *International Trade*—theory of comparative costs. The balance of payments and foreign exchanges.

A2 Aspects of British Economic History from 1760 to 1939.

The growth and pattern of industry and agriculture. The development of transport, foreign trade, and the banking system.

The evolution of social legislation, state intervention, financial policy, and industrial relations.

The growth and distribution of population.

The course of wages, prices, and employment since 1850.

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

16 MATHEMATICS

Ordinary level

Candidates may offer either Syllabus I or Syllabus II.

Candidates offering Mathematics may also offer an optional paper of two and a half hours either in Trigonometry (**O d**) *or in Co-ordinate Geometry and Calculus* (**O e**).

SYLLABUS I

Candidates will be required to take three papers, **O a, O b, O c,** *each of two hours.*

Each paper will be divided into two sections. Section A will consist of three questions to be attempted by all candidates; they will be elementary in type, and may consist of two or three short parts. Section B of each paper will allow a choice of questions which may test a knowledge of other parts of the syllabus.

Ordinary level—*continued*

Candidates will require the following instruments: a ruler graduated in inches and centimetres, a set square, compasses, and a protractor.

Candidates will be expected to show that they know how to use four-figure tables of logarithms and trigonometrical functions.

O a *Arithmetic*

Elementary arithmetical processes, including the resolution of numbers into their prime factors.

The commoner systems of weights, measures, and money, including metric units ; practice.

Fractions, decimals, ratio, percentage.

Averages.

Square root.

Use of logarithm tables ; significant figures.

(Questions may be set on the applications of these processes to problems of everyday life in the home and community, e.g. profit and loss, simple and compound interest, rates and taxes, stocks and shares, average speed. The questions will not involve complicated operations or assume knowledge of uncommon technical terms, but candidates will be expected to know the meaning and use of such terms as "rateable value", "taxable income", "discount".)

Mensuration : rectangle, triangle, rectangular block, pyramid, circle, cylinder, cone, and sphere. Formulae for the pyramid, cone, and sphere need not be memorized.

(The use of algebraical symbols will be allowed.)

O b *Algebra*

The construction and use of formulae ; their inversion (change of subject).

The use of indices (only simple examples of fractional and negative indices will be set).

Straightforward factors of simple algebraic expressions (conventional factors of a complicated type will not be set, e.g., $a^3 + b^3$; $a^2 - 2ab + b^2 - c^2$; $a^2b + b - ab^2 - a$) ; use of remainder theorem.

Fractions whose denominators are single terms or linear expressions.

Ordinary level—*continued*

Equations of the first degree with one or two unknowns; quadratic equations with one unknown ; simultaneous quadratic equations (one linear and one quadratic) ; literal equations with one unknown ; easy problems.

Graphs of statistics ; direct and inverse variation (such as, y is inversely proportional to x^2, y varies as x^3), and their graphical representation ; straightforward graphs of functions such as $x^2 - 2x - 3$, $x^3 - 3x + 1$, $\frac{a}{x}$ (for graphs of functions involving $\frac{1}{x}$ or $\frac{1}{x^2}$, the range of values of x will not include $x = 0$) ; the equation of a straight line in the form $y = mx + c$; gradient of a line ; maximum and minimum values.

Arithmetical and geometrical series (not infinite).

Use of logarithms.

0 c *Geometry*

Elementary practical and theoretical geometry of triangles, parallelograms, rectilineal figures and circles, including numerical applications, based upon the constructions and theorems set out below. Proofs of theorems marked with an asterisk will not be asked for, but these theorems may be used in the solution of problems or riders. Certain of the theorems in the list have useful converses to which no explicit reference is made. Knowledge of such converse theorems may be expected in the solution of problems or riders, though their proofs will not be demanded. The sequence of theorems is not laid down as an order of treatment. Any proof which seems to the examiners to be part of a logical geometrical sequence will be accepted. Thus, the mid-point theorem may be proved by congruence, by areas, or by similarity.

Practical Geometry

Bisection of angles and of straight lines.

Construction of perpendiculars to straight lines.

Construction of an angle equal to a given angle.

Construction of parallels to a given straight line.

Simple examples of the construction from sufficient data of triangles and quadrilaterals.

Division of straight lines into a given number of equal parts or into parts in any given ratio.

Ordinary level—*continued*

Construction of a triangle equal in area to a given polygon.

Construction of tangents to a circle and of common tangents to two circles.

Construction of circumscribed, inscribed, and escribed circles of a triangle.

Simple examples of the construction of circles from sufficient data, including that of a segment containing a given angle.

Construction of regular figures of three, four, six, or eight sides in or about a given circle.

Construction of a square equal in area to a given rectangle.

Theoretical Geometry

*The properties of angles at a point.

*The properties of parallel straight lines.

The exterior angle of a triangle is equal to the sum of the two opposite interior angles; the sum of the angles of a triangle is equal to two right-angles.

The sum of the angles of a polygon of n sides is equal to $(2n - 4)$ right-angles; the sum of the exterior angles is equal to four right-angles.

*The four tests of congruence of triangles.

If two sides of a triangle are equal, the angles opposite to these sides are equal; and the converse.

If two sides of a triangle are unequal, the greater side has the greater angle opposite to it; and the converse.

The opposite sides and angles of a parallelogram are equal, each diagonal bisects the parallelogram, and the diagonals bisect each other.

The diagonals of a rhombus bisect the angles of the figure, and are perpendicular to one another.

The diagonals of a rectangle are equal to one another.

A quadrilateral is a parallelogram (*a*) if its opposite angles are equal, or (*b*) if its opposite sides are equal, or (*c*) if its diagonals bisect one another, or (*d*) if one pair of opposite sides are equal and parallel.

If three or more parallel lines cut off equal intercepts from one straight line which meets them, then the intercepts on any other straight line which meets them are also equal.

(**Proofs of these theorems will not be expected.*)

Ordinary level—*continued*

The line joining the mid-points of two sides of a triangle is parallel to and equal to one-half of the third side.

A point which is equidistant from two fixed points lies on the perpendicular bisector of the straight line joining the two fixed points; conversely, any point on this perpendicular bisector is equidistant from the two fixed points.

A point which is equidistant from two intersecting straight lines lies on one or other of the bisectors of the angles between the two straight lines; conversely, any point on either of these bisectors is equidistant from the two straight lines.

Other simple loci with easy extensions to three dimensions.

Parallelograms on the same base and between the same parallels are equal in area.

Triangles on the same base and between the same parallels are equal in area; equal triangles on the same side of the same base lie between the same parallels.

In a right-angled triangle the square described on the hypotenuse is equal to the sum of the squares described on the other two sides; and the converse.

A straight line drawn from the centre of a circle to the mid-point of a chord which is not a diameter is at right-angles to the chord; conversely, the perpendicular to a chord from the centre of a circle bisects the chord.

Equal chords of a circle are equidistant from the centre; and the converse.

*The tangent at any point of a circle, and the radius through the point, are perpendicular to one another.

The tangents drawn to a circle from an external point are equal.

If two circles touch, their centres and the point of contact are collinear.

The angle which an arc of a circle subtends at the centre is double that which it subtends at any point on the remaining part of the circumference.

Angles in the same segment of a circle are equal; conversely, if the line joining two points subtends equal angles at two other points on the same side of it, the four points lie on a circle.

The angle in a semicircle is a right-angle.

(**Proof of this theorem will not be expected.*)

Ordinary level—*continued*

The opposite angles of a cyclic quadrilateral are supplementary ; the exterior angle of a cyclic quadrilateral is equal to the interior and opposite angle ; the converses.

*In equal circles or in the same circle, (i) equal arcs subtend equal angles at the centre, or at the circumference, and the converse ; (ii) the chords of equal arcs are equal, and the converse.

If a straight line touch a circle and through the point of contact a chord be drawn, the angles between the chord and the tangent are equal to the angles in the alternate segments.

A straight line drawn parallel to one side of a triangle divides the other two sides proportionally ; and the converse.

*If two triangles are equiangular, their corresponding sides are proportional ; and the converse.

*If two triangles have one angle of the one equal to one angle of the other and the sides about these angles proportional, the triangles are similar.

The internal bisector of an angle of a triangle divides the opposite side internally in the ratio of the sides containing the angle ; and likewise the external bisector externally.

The ratio of the areas of similar triangles is equal to the ratio of the squares on corresponding sides.

If two chords of a circle intersect either inside or outside a circle, the rectangle contained by the parts of one is equal to the rectangle contained by the parts of the other.

If, from a point outside a circle, a secant and a tangent to the circle be drawn, the square on the tangent is equal to the rectangle contained by the whole secant and the part outside the circle.

Three-Dimensional Figures

The forms of the rectangular block, pyramid, prism, cylinder, cone, and sphere (including calculations of lengths and of angles between two planes and between a plane and a straight line).

Trigonometry for **O a, O b, and O c**

(Questions set in Section A of each paper will be capable of a solution involving right-angled triangles only.)

The sine, cosine, and tangent of an angle, acute or obtuse.

(**Proofs of these theorems will not be expected.*)

Ordinary level—*continued*

The sine and cosine rules for a triangle.

The area formula for a triangle : $\frac{1}{2}bc \sin A$.

Easy applications ; simple problems on heights and distances in two dimensions ; bearings, such as N.W., N. 60°W., 300°.

(The ambiguous case in the solution of triangles is excluded.)

SYLLABUS II

Candidates will be required to take **two** *papers,* **O a** *and* **O b,** *each of two and a half hours.*

Each paper will be divided into two sections. Section A will consist of three questions to be attempted by all candidates ; they will be elementary in type, and may consist of two or three short parts. Section B will consist of six questions, of which four are to be attempted.

Each paper may contain questions on any part of the syllabus, and the solution of a question may involve knowledge of more than one part of the syllabus.

Candidates will require the following instruments : a ruler graduated in inches and centimetres, a set square, compasses, and a protractor.

Candidates will be expected to show that they know how to use four-figure tables of logarithms and trigonometrical functions.

Arithmetic and Mensuration.

The ordinary elementary arithmetical processes.

The commoner systems of weights, measures, and money, including metric units ; practice.

Fractions, decimals, ratio, percentage.

Averages, including average speed.

Use of common logarithms, and tables of squares, square roots, and reciprocals ; significant figures.

Applications of the foregoing to problems of everyday life in the home and community, e.g. profit and loss, simple and compound interest, rates and taxes, domestic energy. The questions will not involve complicated operations or uncommon technical terms.

Mensuration of the rectangle, triangle, rectangular block, pyramid, circle, cylinder, cone, and sphere.

(The use of algebraic symbols will be allowed.)

Algebra

Construction and use of formulae ; their inversion (change of subject).

Use of indices (only simple examples of fractional and negative indices will be set).

Ordinary level—*continued*

Common factors, factors of $a^2 - b^2$, $a^3 \pm b^3$, easy trinomial factors, and simple extensions.

Use of the remainder theorem.

Simple fractions whose denominators are single terms or linear expressions.

Linear equations; quadratic equations with one unknown; simultaneous equations (at least one linear) in two variables; easy problems.

Graphs of statistics; direct and inverse variation (e.g. y is inversely proportional to x^2, y varies as x^3) and their graphical representation; sketch graphs; straightforward graphs of rational algebraic functions of the form $y = Ax^3 + Bx^2 + Cx + D + \frac{E}{x} + \frac{F}{x^2}$, where constants are numerical, and at least three of them are zero (for graphs of functions involving $\frac{1}{x}$ or $\frac{1}{x^2}$, the range of values of x will not include $x = 0$); maximum and minimum values. Co-ordinates; the gradient of a line; the equation of a straight line in the form $y = mx + c$; rates of increase; distance-time and speed-time curves and their gradients. Candidates are *not* required to have any knowledge of the Calculus, but the use of it will be allowed.

Geometry

A sound knowledge of the constructions and propositions given in the **O c** section of Syllabus I, and the ability to apply them, will be required.

No formal proof will be expected in Section A of the papers. In Section B, proofs (by geometrical or trigonometrical methods) may be required of any of the following propositions:

The exterior angle of a triangle is equal to the sum of the two interior opposite angles; the sum of the angles of a triangle is equal to two right-angles.

If two sides of a triangle are equal, the angles opposite to these sides are equal, and the converse.

The opposite sides and angles of a parallelogram are equal, and the diagonals bisect each other.

The line joining the mid-points of two sides of a triangle is parallel to and equal to one-half of the third side.

A straight line drawn from the centre of a circle to the mid-point of a chord which is not a diameter is at right-angles to the chord; conversely, the perpendicular to a chord from the centre of a circle bisects the chord.

Ordinary level—*continued*

The tangents drawn to a circle from an external point are equal.

The angle which an arc of a circle subtends at the centre is double that which it subtends at any point on the remaining part of the circumference.

Parallelograms on the same base and between the same parallels are equal in area.

The theorem of Pythagoras.

If two chords of a circle intersect either inside or outside a circle, the rectangle contained by the parts of one is equal to the rectangle contained by the parts of the other.

Trigonometry

(Questions set in Section A of the papers will be capable of a solution involving right-angled triangles only.)

The sine, cosine, and tangent of an angle, acute or obtuse, including graphs of these functions.

The area formulae $\frac{1}{2}bc \sin A$, $\sqrt{s(s-a)(s-b)(s-c)}$.

The sine rule for a triangle (questions will *not* be set on the ambiguous case). The cosine rule.

The theorem of Pythagoras, $\sin^2 A + \cos^2 A = 1$.

Easy applications :—Bearings, heights and distances, simple problems in two dimensions.

Practical Applications

Problems for solution by calculation, drawing or geometrical reasoning on the following :—

Simple map problems involving scales, contours, slopes, etc. Heights and distances, involving the nautical mile, the knot, position by two bearings, etc.

The areas of irregular figures, including the mid-ordinate rule.

Simple plans and elevations.

Great and small circles of a sphere ; latitude and longitude.

Three-dimensional problems involving solution by analysis into plane figures.

O d (*Optional*) *Trigonometry*

Circular measure ; trigonometrical ratios of angles up to four right-angles ; special values for 0°, 30°, 45°, and their multiples.

The sine, cosine, and tangent rules for a triangle.

*The trigonometrical ratios of $A \pm B$, $2A$, and $\frac{1}{2}A$.

*The sine, cosine, and tangent of the half-angles of a triangle in terms of the sides.

(* *Proofs of these formulae will not be expected.*)

Ordinary level—*continued*

Numerical solution of triangles, using these formulae.
Bearings ; heights and distances ; simple problems in three dimensions.
Elementary trigonometrical graphs, and the approximate solution of simple trigonometrical equations by graphical methods.
Simple identities and trigonometrical equations.

O e *(Optional) Co-ordinate Geometry and Calculus*

Co-ordinate Geometry

Rectangular axes and co-ordinates. Co-ordinates of mid-point. Distance between two points.
Idea of the equation to a curve.
Gradient. Equation of a straight line in the forms $y = mx + c$, $y - y_1 = m(x - x_1)$. Any first degree equation represents a line.
Equations of lines parallel and perpendicular to a given line.
*The formula for the distance of a point from a line.
Equations of simple loci, defined by distance relations.

Calculus

Calculation of gradient from first principles in simple cases.
*Differentiation of x^n and of simple polynomials.
Rates of change.
Equations to tangents and normals.
Maximum and minimum values.
*Differentiation in simple cases of a product, a quotient, a function of a function.
*Differentiation of $\sin x$ and $\cos x$.
Integration as the reverse of differentiation.
Applications to the kinematics of a particle moving in a straight line.
Definite integrals. Applications to simple areas and volumes of revolution.

(**No formal proofs of these results will be required in the examination, but it is expected that such proofs will have been demonstrated to the candidates.*

Questions on the distance of a point from a line will not involve considerations of sign.

For the differentiation of sin x and cos x it will be necessary for the candidate to understand radian measure and certain results in trigonometry, but questions will not be set on these incidental topics.)

17 ADDITIONAL MATHEMATICS

Ordinary level

Candidates will be required to take two papers, **O a** *and* **O b,** *each of two and a half hours.*

Further Algebra, Geometry, and Trigonometry

Simple finite series including the sum of the squares of the natural numbers. The method of mathematical induction. The Binomial Theorem for positive integral index. Theory of the quadratic function and quadratic equation.

Further work on the applications of the syllabus for Mathematics **O c**. Inversion applied to plane figures involving straight lines and circles, and treated by the methods of pure geometry.

Circular measure; length of arc; area of sector. Trigonometrical ratios of angles of any magnitude and their graphs. *Formulae for the sine, cosine, tangent of $(A + B)$ and for the sums or differences of two sines or two cosines. Solution of triangles including the tangent rule* and the half-angle formulae*. Easy trigonometrical equations and identities.

Co-ordinate Geometry and Calculus

Rectangular axes and co-ordinates. Co-ordinates of mid-point. Distance between points. Idea of equation to curve. Gradient. Equation of a straight line in the forms $y = mx + c$, $y - y_1 = m(x - x_1)$. Any first degree equation represents a straight line. Lines parallel and perpendicular to a given line. Distance of a point from a line†. Equations of simple loci, defined by distance relations. Equation of a circle: centre, radius. The parabola $y^2 = 4ax$. Parameters; $(a \cos \theta, a \sin \theta)$ and $(at^2, 2at)$. Gradient of a curve from first principles in simple cases. *Differentiation of x^n, and of polynomials. Rates of change. Equations to tangents and normals. Maximum and minimum values. *Differentiation in simple cases of product, quotient, function of a function.

*Differentiation of $\sin x$ and $\cos x$.

Integration as the reverse of differentiation.

* No formal proofs of these results will be required in the examination, but it is expected that such proofs will have been demonstrated to the candidates.

† Questions on distance of a point from a line will not involve considerations of sign.

Ordinary level—*continued*

Applications to the kinematics of a particle moving in a straight line.

Definite integrals. Simple areas and volumes of revolution.

Mechanics

The composition and resolution of velocities and accelerations in a plane. Constant acceleration formulae, vertical motion under gravity, easy examples of projectiles. Composition and resolution of forces : triangle, parallelogram and polygon of forces. Moment of a force. Parallel forces. Simple cases of equilibrium of particle and rigid body. Centre of gravity. Friction. Work. Machines : mechanical advantage and efficiency.

The laws of motion ; mass, momentum, energy, power. Simple examples of the conservation of energy and of linear momentum.

18, 19, 20
MATHEMATICS AT THE ADVANCED LEVEL

Candidates will require the following instruments : flat ruler graduated on one side to inch measure and on the other side to centimetre measure, set square, compasses, protractor.

Candidates will be expected to show that they know how to use tables of four-figure logarithms. Graphical solutions may be required.

The syllabuses are arranged for convenience by topics. The order is not meant to imply any necessity for a corresponding order of treatment.

18 PURE AND APPLIED MATHEMATICS

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours. A special paper,* **S,** *of three hours, will also be set.*

A1 Pure Mathematics. The question paper set in the examination is intended to test the candidates' grasp of fundamental principles rather than memory for formulae.

A2 Applied Mathematics. The question paper set in the examination is intended to test the candidates' understanding of the basic concepts of Newtonian mechanics.

Advanced level—*continued*

Algebra and Calculus

Notation and fundamental laws and processes ; indices, logarithms to any base, surds and their manipulation ; ratio and proportion and the associated rules ; factorization ; partial fractions ; the binomial formula for positive integral indices ; summation of simple series including such finite series as Σnx^n, Σn, Σn^2 and series derivable from them.

The numerical and graphical treatment of algebraic functions, trigonometric functions and their inverses, and simple exponential and logarithmic functions.

Complex numbers. Representation by points in Cartesian and polar co-ordinates (Argand diagram) ; addition, subtraction, multiplication, division and equality of complex numbers.

The theory of quadratic functions and equations ; simultaneous equations of the first degree and simple cases of such equations of higher degree ; numerical and graphical methods of solving equations, including trigonometric and other simple transcendental equations. (Horner's method and Newton's rule will not be required.)

Differentiation, including the standard rules for composite functions ; derivatives of the algebraic, exponential, logarithmic, and trigonometric functions and their inverses, and simple combinations of them (but formal proofs from first principles of the differentiation of anything other than algebraic functions will not be required). Applications to (i) simple problems of maxima and minima, (ii) geometry in finding slopes of tangents and normals and finding turning points.

Integration. Definite and indefinite integrals ; simple integrals immediately reducible to elementary standard forms (including $\int \frac{dx}{\sqrt{(a^2 - x^2)}}$ and $\int \frac{dx}{x^2 + a^2}$) by such methods as substitution, integration by parts, rationalization and the use of simple partial fractions. Simple applications to the evaluation of plane area, volumes of solids of revolution and surface areas of circular cone and sphere.

Geometry and Trigonometry

Trigonometry. General definitions and properties of the trigonometric functions of angles of any magnitude and their inverses. The addition formulae and their modifications ; the simpler multiple and submultiple angle formulae. The application of trigonometry to simple problems in two dimensions.

Advanced level—*continued*

Graphs and co-ordinate geometry. Rectangular Cartesian co-ordinates ; fundamental distance and angle formulae ; applications to loci with simple equations in Cartesian or parametric form and in particular to the straight line, circle (including its general Cartesian form) and parabola ; finding equations of chords, tangents and normals. Candidates will be expected to translate geometrical ideas into algebraic form and vice versa (proofs in whole or in part by the methods of pure geometry or by vector methods will be accepted) and should know methods which have general application rather than those of use only with particular curves ; a knowledge of the detailed properties of curves other than the circle will not be expected.

Vectors

Scalar and vector quantities ; graphical representation of vectors ; addition, subtraction ; product of a scalar and a vector ; scalar product **a.b** of two vectors ; commutative, associative, distributive laws ; resolutes and components ; displacement, position vector ; position vector of a point dividing in a given ratio the distance between two given points. Simple applications to geometry, kinematics, statics and dynamics.

Centre of Mass

Determination of centre of mass for lamina and cylinder, including the use of integration in simple cases.

Statics

Force ; resolved part ; forces at a point ; parallel forces ; moment of a force about a point ; couple ; system of coplanar forces ; equivalence to a single force and a couple ; resultant ; equivalent coplanar systems ; centre of gravity.

Laws of friction ; Hooke's law applied to elastic strings and springs.

Equilibrium of a particle, a rigid body and systems of rigid bodies subjected to coplanar forces. Simple practical applications. (Graphical methods, involving scale drawings, will not be required. Although the energy criterion for equilibrium may be found useful, no question will be set that cannot be solved easily without its use.)

Advanced level—*continued*

Kinematics

Rectilinear motion. Displacement, velocity, acceleration ; $\frac{dv}{dt} = v\frac{dv}{dx}$; determination of position, velocity and acceleration by integration or differentiation ; simple equations of motion in which the acceleration is given as a function of time, position or velocity, or is constant ; derivation of the standard formulae for simple harmonic motion.

Motion in a plane. Displacement, velocity, acceleration of a point ; angular velocity and acceleration of a line ; uniform and non-uniform motion in a circle.

Motion of two particles. Relative position, velocity and acceleration ; simple applications to the relative motion of two points on a line and in a plane.

Dynamics

Newton's laws of motion and their implications ; force, mass, distance and time ; units and dimensions.

Motion of a particle on a straight line. Linear momentum ; kinetic energy ; work ; potential energy, and in particular gravitational and elastic energy ; relationship between work done by non-conservative forces and the sum of kinetic and potential energy ; conservation of energy ; impulse and impulsive force. Applications to motion on a fixed inclined plane, simple harmonic motion and other simple problems.

Motion of a particle in a plane. The extension of the ideas of the last paragraph to the motion of a particle in a plane, with applications to the free motion of a particle under gravity, circular motion (including motion in a vertical circle and the simple pendulum) and other simple problems.

Motion of two interacting particles on a straight line ; motion of centre of mass ; collisions ; conservation of momentum ; coefficient of restitution, Newton's experimental law.

Motion of two particles connected by a light inextensible string passing over a fixed pulley or edge of table, etc. ; direct collision of two spheres, or of sphere and plane ; practical problems on power, work, and energy.

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

19 PURE MATHEMATICS

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours. A special paper,* **S,** *of three hours, will also be set.*

The question papers set in the examination are intended to test the candidates' grasp of fundamental principles rather than memory for formulae. The papers, **A 1** and **A 2,** may each contain questions on any part of the syllabus, but in the main the content of the papers will be as follows :—

A 1 Algebra, Differentiation and Integration.

A 2 Geometry, Trigonometry, Application of Calculus.

Algebra and Calculus

Notation and fundamental laws and processes ; indices, logarithms to any base, surds and their manipulation ; ratio and proportion and the associated rules ; factorization ; partial fractions ; the binomial formula for positive integral indices ; summation of series such as

$$\Sigma nx^2, \quad \Sigma n, \quad \Sigma n^2, \quad \Sigma \frac{1}{n(n+1)}.$$

Elementary permutations and combinations.

The numerical and graphical treatment of the algebraic, exponential, logarithmic, trigonometric, and hyperbolic functions and their inverses.

Complex numbers. Representation by points in Cartesian and polar co-ordinates (Argand diagram) ; addition, subtraction, multiplication, division and equality of complex numbers. De Moivre's theorem with applications to trigonometry. The nth roots of numbers.

Determinants of order up to the third and their evaluation ; solution of simultaneous linear equations by determinants.

The theory of quadratic functions and equations ; simple cases of simultaneous equations of degree higher than unity ; numerical and graphical methods of solving equations including trigonometric and other simple transcendental equations ; elements of the theory of equations including the general relations between roots and coefficients.

Advanced level—*continued*

The idea of a limit; the limits of sums, differences, products, and ratios; differentiation, including the standard rules for composite functions; derivations of the algebraic, exponential, logarithmic, trigonometric, and hyperbolic functions and their inverses, and simple combinations of them (but formal proofs from first principles of the differentiation of anything other than algebraic functions will not be required). Applications to (i) simple problems of maxima and minima, (ii) geometry in finding slopes of tangents and normals and finding turning points.

Integration. Definite and indefinite integrals; integration by substitution and integration by parts, applied to the integration of products of small positive powers of sines and cosines and to integrals obtained by modification of such forms as

$$\int \frac{dx}{ax^2 + bx + c}, \quad \int \frac{dx}{\sqrt{(ax^2 + bx + c)}}, \quad \int \sqrt{(ax^2 + bx + c)}\, dx,$$

$$\int \frac{dx}{a + b\cos x}, \text{ and also } \int e^{ax} \cos bx\, dx.$$

Application of integration to the mensuration of areas, volumes, and lengths of arcs of curves in Cartesian or parametric form.

Geometry and Trigonometry

Trigonometry. General definitions and properties of the trigonometric functions of angles of any magnitude and their inverses. The addition formulae and their modifications; the simpler multiple and submultiple angle formulae. The application of trigonometry to problems in two and three dimensions. Simple trigonometric series.

General relations of points, lines, and planes; elementary geometry of the parallelepiped, tetrahedron, pyramid, cylinder, cone, and sphere, including their mensuration.

Graphs and co-ordinate geometry. Rectangular Cartesian co-ordinates; transformation of co-ordinates by translation of axes (directions unchanged) or rotation (origin remaining fixed); fundamental distance and angle formulae; applications to loci with simple equations in Cartesian or parametric form; finding equations of chords, tangents, and normals. Candidates will be expected to translate geometrical ideas

Advanced level—*continued.*

into algebraic form and vice versa (proofs in whole or in part by methods of pure geometry or by vector methods will be accepted) and should know methods which have general application rather than those of use only with particular curves; a knowledge of the detailed properties of curves other than the circle will not be expected.

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

20 APPLIED MATHEMATICS

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours. A special paper,* **S,** *of three hours, will also be set.*

The question papers set in the examination are intended to test the candidates' grasp of fundamental principles rather than memory for formulae. The papers, **A 1** and **A 2,** may each contain questions on any part of the syllabus, but in the main the content of the papers will be as follows :—

A1 Vectors and Statics.

A2 Kinematics and Dynamics.

Vectors

Scalar and vector quantities; graphical representation of vectors; addition and subtraction; product of a scalar and a vector; scalar product **a.b** of two vectors; commutative, associative, distributive laws; resolutes and components; displacement, position vector; position vector of a point dividing in a given ratio the distance between two given points; centroid of a set of weighted points. Simple applications to geometry, kinematics, statics, and dynamics; simple applications of vectors in three dimensions may be set.

Mass Systems

Determination of the mass centre, and of moments of inertia, for simple line, surface and volume distributions of matter. Moments of inertia of a uniform lamina about axes in its plane, and about axes perpendicular to its plane; moments of inertia of uniform surfaces and solids of revolution about the axis of symmetry, and about axes perpendicular to this axis; the parallel axes theorem.

Advanced level—*continued*

Statics

Force ; resolved part ; forces at a point ; parallel forces ; moment of a force about a point ; couple ; system of coplanar forces ; equivalence to a single force and a couple ; resultant ; equivalent systems of forces ; analytical reduction by reference to co-ordinate axes ; centre of gravity.

Laws of friction ; Hooke's Law applied to elastic strings and springs.

Equilibrium of particles and of rigid bodies under the action of coplanar forces. Simple practical applications. (Graphical methods, involving scale drawings, will not be required. Simple three-dimensional problems on the equilibrium of a rigid body subject to concurrent or parallel forces may be set.)

Work and energy ; work done by a force in simple and general cases ; potential energy (elastic and gravitational in particular) ; the energy criteria for equilibrium and stability.

Kinematics

Rectilinear motion. Displacement, velocity, acceleration ; $\frac{dv}{dt} = v\frac{dv}{dx}$; determination of position, velocity, and acceleration by integration or differentiation ; simple equations of motion in which the acceleration is given as a function of time, position or velocity, or is constant ; derivation of the standard formulae for simple harmonic motion.

Motion in a plane. Displacement, velocity, and acceleration of a point ; angular velocity and acceleration ; uniform and non-uniform motion in a circle ; relative velocity and acceleration. The motion of a lamina in its plane ; representation of the general motion as a translation together with a rotation ; instantaneous centre.

Dynamics

Newton's laws of motion and their implications ; force, mass, distance, and time ; units and dimensions. Linear momentum ; kinetic energy ; work ; potential energy ; power. Relationship between the work done by non-conservative forces and the sum of kinetic and potential energies ; conservation of energy. Impulse and impulsive forces.

Advanced level—*continued*

Rectilinear motion. Simple harmonic motion and other cases of motion under the action of a variable force ; motion on a fixed inclined plane.

Motion of a particle in a plane. Free motion under gravity, and other simple cases of motion using Cartesian co-ordinates ; motion in a vertical circle ; the simple pendulum ; the conical pendulum. Angular momentum and its relation to the forces acting.

Motion of a system of interacting particles. Motion of the mass centre and motion relative to the mass centre ; the conservation of linear momentum. The continuous and impulsive motion of two connected particles ; direct and oblique impact of two spheres, and of a particle with a fixed or moving plane ; Newton's experimental law and energy losses ; effect of explosions as in the firing of projectiles and the splitting of a moving body into two or more parts. Motion of particles subject to smooth constraints, e.g. particles connected by light inelastic strings passing over fixed or movable pulleys.

Motion of a rigid body about a fixed axis ; energy and angular momentum ; the compound pendulum (including reaction of the axis).

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

21 PHYSICS

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours.*

The examination paper will be divided into three sections, viz.—Section A : Mechanics. Section B : Heat, Light, and Sound. Section C : Magnetism and Electricity.

Section A *Mechanics*

Measurement of time, mass, length, area, and volume. Density and relative density.

Metric and British systems of weights and measures.

The beam and spring balance.

The fundamental notions of velocity and acceleration ; vertically falling bodies ; Newton's Laws of Motion ; momentum and force ; energy, work, and power.

Ordinary level—*continued*

The composition and resolution of forces in one plane ; moments of forces ; weight, centre of gravity ; simple machines and their properties ; stable, unstable, and neutral equilibrium ; conditions for the equilibrium of three forces.

Fluid pressure ; the principle of Archimedes and its application ; flotation; the pressure of the atmosphere; the barometer. Boyle's Law.

Section B *Heat, Light, and Sound*

Heat

Temperature : Centigrade and Fahrenheit scales. Construction and use of mercury thermometers ; maximum and minimum thermometers.

Expansion of solids, liquids, and gases with rise of temperature. Charles's Law.

Quantity of heat ; specific heat and its measurement by method of mixtures. Thermal capacity. Change of state. Latent heat. Melting point, boiling point, vapour pressure. The transfer of heat. Heat as a form of energy ; simple examples of transformation of energy.

Light

Propagation of light. Reflection of light at plane, concave and convex spherical surfaces, and the formation of images (graphical treatment only). Refraction at plane surfaces and by prisms. Refractive index. The spectrum. Colour. Formation of images by concave and convex lenses (graphical treatment only), with such applications as the optical properties of the camera and the eye. The combination of two lenses to form a simple microscope or telescope. Comparison of candle power by simple photometer.

Sound

The production and transmission of sound. Noises and musical notes. Elementary treatment of vibration of stretched strings and of air in pipes.

Section C *Magnetism and Electricity*

Simple phenomena of magnetism. Earth's magnetism (qualitative treatment only). Lines of force. (A knowledge of quantitative magnetometry is not required.)

Ordinary level—*continued*

Effects of passage of current : magnetic, chemical, heating. Principle and construction of a simple type of galvanometer. (Questions on the use of the full formula for the tangent galvanometer will not be set.)

The simple cells. Wet and dry Leclanché.

Electromotive force. Ohm's Law. Resistance. Specific resistance. Power. Use of voltmeter and ammeter.

Simple chemical effects of currents and elementary ideas of electrolysis.

Elementary electromagnetism. Elementary ideas of induced currents. Simple qualitative treatment of alternating current, and simple consideration of its application in the transformer. Simple treatment of the dynamo and the motor.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination. A special paper,* **S,** *of three hours, will also be set.*

Candidates must reach a satisfactory standard in the practical as well as in the written examination.

Candidates must possess an adequate knowledge of the subject matter of the schedule in Physics at the Ordinary level.

A1. Section A : Mechanics and Properties of Matter.
Section B : Optics.
Section C : Vibrations and Sound.

A2. Section A : Electricity and Magnetism.
Section B : Heat.

In each of papers **A 1** and **A 2,** a total of six questions is to be answered.

In **A 1,** at least two must be chosen from section A, and at least one from each of sections B and C. In **A 2,** four must be chosen from section A and two from section B.

The questions set will lay emphasis on a thorough understanding of physical principles and their applications. A familiarity with magnitudes and with numerical calculations will be assumed, but problems will not be set in which the main interest is mathematical.

It will be assumed that candidates are familiar with systematic work in a suitably equipped laboratory.

Advanced level—*continued*

The exercises set in the practical examination will not involve knowledge of theory outside the syllabus, and will in general be tests of manual skill, intelligent use of apparatus, care in experiment, and the ability to present numerical results clearly and methodically.

Mechanics and Properties of Matter

Kinematics of uniform and uniformly accelerated motion of a particle in a straight line.

Vector and scalar quantities. Composition and resolution of vectors: parallelogram and triangle laws. Relative motion.

Newton's laws of motion. Mass and weight. Conservation of momentum.

Motion under gravity.

Relations between force, energy, work, power.

Friction, including static and kinetic friction, with applications.

Kinetic and potential energy. Conservation of energy.

Statical equilibrium of rigid bodies under the action of coplanar forces; centre of gravity.

Principle of moments; the beam balance and its sensitivity.

Uniform circular motion.

Kinetic energy of rotation; meaning of moments of inertia. Experimental determination of the moment of inertia of a fly-wheel.

Fluid statics: thrust on immersed plane surfaces. Archimedes' principle.

General ideas on elasticity. Hooke's law. Detailed study of stretching of a wire: elastic limit, yield point, permanent set, work done in stretching, Young's modulus.

Practical applications of elastic properties of materials.

Surface tension: definition and descriptive theory. Measurement by simple methods. Excess pressure in drops and bubbles.

Units and dimensions of physical quantities. Use of dimensional equations.

Optics

Reflection and refraction at plane and spherical surfaces. The paraboloidal mirror. Reflection caustic at spherical surfaces.

Advanced level—*continued*

Deviation in small angle prism and its application to thin lens theory.

Minimum deviation in prisms : determination of refractive index.

Thin converging and diverging lenses (spherical).

Images produced by lenses and mirrors. Focal length, focal power, the dioptre.

Relations between focal length, refractive index, and radii of curvature of faces of thin lenses. Thin lenses in contact.

The eye : defects of vision and their correction.

Optical instruments : camera, magnifying glass, compound microscope, refracting telescopes (astronomical, Galilean, terrestrial, prismatic), omitting detailed study of eyepieces.

Photometry : inverse square law, cosine law. Candle-power, foot-candle, lumen.

Comparison of candle-powers : measurement of intensity of illumination. Photometers.

Velocity of light : its determination by one astronomical and one terrestrial method.

Dispersion in prism, pure spectrum, the spectrometer. Emission and absorption spectra. The solar spectrum.

Ultra-violet and infra-red radiation. Properties and methods of detection.

Historical approach to the theories of the nature of light. Simple ideas of interference and polarization.

Vibrations and Sound

Vibratory motion. Simple harmonic motion with simple examples (simple pendulum, loaded spring, suspended magnet).

Elementary ideas on damping of vibrations.

Forced vibrations, resonance.

Essential features of progressive wave-motion.

Transmission of sound. Factors affecting velocity of sound in air and other media.

Sources of sound : pitch, quality, loudness.

Principle of superposition : stationary waves, beats. Vibrations of air-columns and stretched strings. Kundt's tube.

General ideas on musical instruments from the physical standpoint. Diatonic and equally tempered scales.

Recording and reproduction of sound.

Electricity and Magnetism

Axial and equatorial fields of a bar magnet. Magnetic moment.

Advanced level—*continued*

Terrestrial magnetism : general study of earth's magnetic field, and measurement of its horizontal component.

Magnetic properties of ferromagnetic materials, especially iron and steel. Magnetic hysteresis. I-H curve.

Static electrification. Forces between charges. Electric intensity. Potential.

Laws of electrostatic induction. The Van de Graaff machine.

Capacity of a conductor : isolated sphere.

Condensers : capacities of parallel-plate and spherical condensers.

Electrostatic and practical units of capacity.

Capacities of condensers in series and in parallel. Effect of dielectric on capacity.

Energy of charged condenser.

Magnetic field at centre of circular current. Electromagnetic unit of current, the ampere.

Tangent galvanometer and simple moving-magnet galvanometers.

Magnetic field due to current in long straight wire : field inside long solenoid. (Proof of formulae not required.)

Electromagnetic unit of potential difference : the volt.

Ohm's law : the ohm.

Circuit equations : Kirchhoff's laws.

Heating effects of currents : electrical energy and power : the kilowatt and kilowatt-hour.

Force on current in magnetic field : moving-coil galvanometer.

Ammeters and voltmeters. Range multipliers. Multi-range meters.

Wheatstone's bridge. The potentiometer. Use of potentiometer to measure potential difference, resistance, and current.

Electrolysis : Faraday's laws, electrochemical equivalent. Simple ionic theory. Elementary discussion of primary cells and accumulators.

Thermo-electricity. Seebeck and Peltier effects. Use of thermocouples as thermometers.

Electromagnetic induction. Faraday's and Lenz's laws.

Electromotive force induced in coil rotating in magnetic field. A.C. and D.C. generators (simple treatment only).

Simple treatment of D.C. motor, including back E.M.F.

Induction coil, transformer.

Alternating currents : instruments for measuring alternating currents and voltages (electrostatic voltmeter, moving-iron instruments, rectifier instruments).

Advanced level—*continued*

Measurement of frequency of A.C. mains.

Meaning of R.M.S. values of current and potential difference.

Cathode rays and X-rays. Hot cathode X-ray tube. Principles of construction and action of the cathode ray tube, and simple applications. Diode and triode thermionic valves and their characteristic curves. Use of diode valve as rectifier. Use of triode valve as amplifier (resistance-capacity only).

Simple treatment of the structure of the atom.

Heat

The meaning of temperature, and of a scale of temperature. Principles of thermometry.

Coefficients of linear, superficial, and cubical expansion of solids, and the relations between them.

Coefficients of real and apparent expansion of liquids. Anomalous expansion of water.

Expansion of gases at constant pressure, and change of pressure at constant volume.

The gas laws and the gas equation. Meaning of the gas constant R.

Kinetic theory of gases applied to an ideal gas.

General principles of calorimetry.

Specific heats of solids and liquids. Newton's law of cooling. Simple cooling corrections. The calorie, British Thermal Unit, therm.

Change of state. Latent heat. Effect of pressure on freezing-points. Regelation of ice.

Evaporation. Saturated and unsaturated vapours : vapour pressure. Partial pressures.

Cooling due to evaporation, its explanation in terms of kinetic theory and its practical application.

Boiling. Effect of pressure on boiling points.

Atmospheric water vapour, relative humidity.

Hygrometry : dew-point and wet and dry bulb hygrometer.

The two principal specific heats of gases.

Adiabatic and isothermal changes. The equation $pV^{\gamma} = k$ (without proof) and its application, e.g. to transmission of sound and to adiabatic heating and cooling.

Heat and work. Determination of J by one mechanical method.

Thermal conductivity : methods of determination of conductivity of good and bad conductors (solids only).

Convection.

Heat radiation : its place in the electromagnetic spectrum, and methods of detection.

Advanced level—*continued*

Emission, reflection, and absorption of heat radiation.

Note.—The questions set in the examination will presume that the subject matter of the syllabus has been studied experimentally and that systematic work in a suitably equipped laboratory has formed a prominent part of the course of study.

Laboratory note-books must be available for inspection at the Practical examination.

Special paper

The paper will be based on the syllabus of the other Advanced level papers. Ten questions will be set, of which four are to be answered.

22 CHEMISTRY

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours.*

Physical and chemical changes. Elements, compounds and mixtures. Reasons for considering air to be a mixture. Methods for the separation of mixtures, e.g. solution and filtration, distillation (with simple cases of fractional distillation), sublimation and fractional crystallization (simple case only).

Chief constituents of air. Detection of water vapour and carbon dioxide in air. Determination of the proportion by volume of oxygen in air (any simple method).

Proof that water is composed of hydrogen and oxygen. Composition of water (*a*) by weight, (*b*) by volume. Water as a solvent for solids and gases. Saturated solutions. Solubility and its determination for solids in water. Effect of temperature on the solubility of a solid in water. Solubility curves. Water of crystallization, including experimental determinations of amount and simple calculations thereon. Efflorescence and deliquescence. Simple treatment of the differences between colloidal and true solutions, e.g. milk as a colloidal dispersion of fat in water. Hard and soft water. Temporary and permanent hardness. Disadvantages of hard water. Methods of softening hard waters.

Characteristics of acids, bases and salts. Formation of acids by (*a*) action of water on oxides of non-metals, (*b*) action of one acid on the salt of a more volatile acid. Formation of salts by action of (*a*) acids on metal, oxide of metal and carbonate of metal, (*b*) neutralization of alkali with acid, (*c*) double decomposition with precipitation and filtration. Examples of acid salts and simple idea of basicity. Bases, oxides and hydroxides and their formation.

Ordinary level—*continued*

Equivalent weights of elements. Determination by (*a*) hydrogen displacement, including calculations involving the application of the gas laws, (*b*) direct combination with oxygen, (*c*) conversion of metal to oxide by treatment with concentrated nitric acid, (*d*) reduction of oxide to metal, and (*e*) replacement of one metal by another. Equivalent weights of acids and alkalis. Direct titration of acids and alkalis, using methyl orange as indicator. Equivalence of normal solutions.

The law of conservation of mass. The law of constant composition. The law of multiple proportions. Simple outline of the Dalton atomic theory. Atomic weights and the relation between atomic weight and equivalent weight. Simple conception of valency. Chemical formulae and calculations of chemical compositions therefrom. Chemical equations, their meaning and use. Application of the law of Dulong and Petit to the determination of atomic weights.

Gay-Lussac's law of combining volumes ; its verification and application to the determination of the compositions of water, carbon dioxide, sulphur dioxide and hydrogen chloride. Avogadro's hypothesis ; proof that molecules of hydrogen, chlorine and oxygen contain at least two atoms. Molecular weight. Gram-molecular volume. Relation between molecular weight and vapour density. (The practical determination of vapour density is not expected.)

Faraday's laws of electrolysis. Simple conception of the ionic theory. Electrolysis of the following aqueous solutions : dilute sulphuric acid, copper sulphate, sodium sulphate, and sodium chloride.

Oxidation and reduction. Oxidizing and reducing agents ; methods of their detection. Simple cases of reversible reactions. The use of catalysts to alter speeds of reactions. Simple study of the effect of the surface area of catalysts with special reference to the "contact process".

Non-metals and their compounds

Preparation of oxygen (*a*) in the laboratory, (*b*) commercially from liquid air. Properties and uses of oxygen. Classification of oxides. Laboratory preparation of hydrogen, (*a*) from acids, (*b*) from steam, (*c*) from cold water (using calcium) ; commercial preparation from steam. Properties and uses of hydrogen.

Ordinary level—*continued*

Atmospheric nitrogen ; pure nitrogen prepared from a chemical compound, properties and uses of nitrogen. Laboratory preparations of ammonia ; its synthesis from nitrogen and hydrogen ; its properties and uses ; the formation and properties of ammonium salts ; the oxidation of ammonia in the soil and catalytically. Preparation of nitric acid from sodium or potassium nitrate ; chemistry of the catalytic oxidation of ammonia. Reactions of nitric acid as (*a*) an acid, (*b*) an oxidizing agent. Effect of heating typical nitrates. Preparation and properties of nitric oxide and nitrogen peroxide. The nitrogen cycle in nature.

Carbon. Properties and uses of charcoal and graphite. Simple study of the allotropy of carbon. Oxides of carbon. Preparation and properties of carbon dioxide ; its uses, and ways in which it is being continually added to the atmosphere. Combustion of carbon and carbon-containing substances in (*a*) plentiful (*b*) limited supplies of air. Preparation of carbon monoxide from the elements and by reduction of carbon dioxide ; its chief properties and its use as a reducing agent. Destructive distillation of coal to produce coal gas, coke, and coal-tar. The bunsen burner and its flames. Combustion of a candle considered as typical of a hydrocarbon. *Water gas and producer gas.

Sulphur : its extraction and uses, its allotropy, its physical properties. Preparation and properties of sulphur dioxide ; sulphurous acid as a bleaching agent and preservative. *Commercial preparation of sulphuric acid by the "contact process". Properties of sulphuric acid as an acid, an oxidizing agent, and as a dehydrating agent. Preparation and reactions of hydrogen sulphide ; the part it plays in atmospheric pollution.

Production of chlorine by the electrolysis of brine and by the oxidation of hydrochloric acid. Its properties and reactions together with the preparation and uses of bleaching powder and sodium hypochlorite ; chlorine water. Preparation of hydrogen chloride (*a*) by direct combination, (*b*) from common salt. Its properties and reactions.

Differences between metals and non-metals. *General ideas as to methods of extraction of metals from their ores with particular reference to iron, zinc, and copper. The chief properties and uses of the following metals :—sodium potassium, calcium, aluminium, zinc, magnesium, iron, copper, and lead. Preparation, properties and uses of the following compounds

* A knowledge of the details of commercial plants is not required.

Ordinary level—*continued*

of the metals: sodium hydroxide, sodium carbonate and bicarbonate, sodium chloride, sodium sulphate, together with the corresponding compounds of potassium, calcium oxide, calcium hydroxide, calcium carbonate, calcium sulphate, calcium chloride, magnesium oxide, magnesium sulphate, zinc oxide, zinc sulphate, lead monoxide, red lead, lead nitrate, lead carbonate, lead sulphate, ferric oxide, ferric hydroxide, ferrous sulphate, cupric oxide, cupric hydroxide, cupric sulphate, copper nitrate.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination. A special paper,* **S,** *of three hours, will also be set.*

A 1 Section A: Mainly General and Physical Chemistry.
Section B: Organic Chemistry.

A 2 Section A: Mainly Inorganic Chemistry.
Section B: Organic Chemistry.

Candidates will be assumed to possess an adequate knowledge of the subject matter of the schedule in Chemistry at the Ordinary level. Questions containing numerical problems will be set to assess the understanding of quantitative aspects of the subject, and knowledge of the chemical principles, reactions and calculations involved in the Practical Schedule may be tested in the written papers.

Candidates must reach a satisfactory standard in the practical as well as in the written examination.

General and Physical Chemistry

(1) (*a*) Classical atomic theory. Quantitative laws of chemical combination. Methods of determining the equivalents of elements and compounds.

(*b*) The gas laws and the ideal gas equation, $PV = nRT$. A simple treatment (mainly qualitative) of the kinetic theory of gases. (Mathematical derivation of the gas laws is not required.) Gaseous diffusion; Graham's law. The law of partial pressures. Qualitative treatment of deviations from the ideal gas laws.

(*c*) The determination of vapour densities by the methods of Victor Meyer and Dumas. Gay-Lussac's law of volumes. Avogadro's hypothesis; gram-molecular volume. Molecular weights of volatile compounds. Atomic weight determination by Cannizzaro's and Dulong and Petit's methods. (The method of limiting densities is excluded.)

Advanced level—*continued*

(*d*) Experimental methods used for determining the volume composition and molecular formulae of the following compounds: water vapour, hydrogen chloride, ammonia, ozone, sulphur dioxide, carbon monoxide, carbon dioxide. Eudiometric determination of the molecular formulae of hydrocarbons.

(2) (*a*) The periodic classification of the elements, illustrated by a comparative study of the physical and chemical properties of the elements of the short periods and of groups 0, 1, 2, 4, 5, and 7 as well as their principal compounds (e.g. oxides, chlorides, hydrides).

(*b*) The main characteristics of "transition" elements as exemplified by the chemistry of chromium, manganese, iron, cobalt and nickel.

(3) (*a*) Modern Atomic Theory: subatomic elementary particles; the electron, proton, and neutron. Evidence for the existence of the nucleus; nuclear charge and atomic number. The structure of the atom in terms of neutrons, protons, and orbital electrons; isotopes and isobares. Natural radioactivity; alpha, beta and gamma radiations. The displacement laws relating to the effect of emission of alpha and beta radiation on position in the periodic table.

(*b*) Atomic number and the electronic constitution of elements; their significance in relation to periodicity in properties with particular reference to the elements of the short periods and their compounds.

(4) (*a*) The electronic theory of valency (qualitative treatment only). Electrovalence, normal and co-ordinate covalence. The relation between position in the periodic table and type of valence exhibited, illustrated mainly by the elements of atomic numbers 1 to 18.

(*b*) The general physical (solubility, volatility, electrical conductance) and chemical properties associated with electrovalence and covalence, illustrated by typical elements and compounds covered in the syllabus.

(5) Simple methods of determining solubilities of solids and gases in liquids. Henry's law. Raoult's law. Lowering of vapour pressure, freezing point depression, boiling point elevation, osmotic pressure, and their application to the determination of molecular weights of non-volatile solutes in dilute solutions. (Knowledge of practical details is only required for the freezing point and boiling point methods.) Molecular association of solutes as indicated by molecular weight determinations.

Advanced level—*continued*

(6) A general study of chemical reactions, especially those occurring in homogeneous gaseous or liquid systems.

(*a*) A simple qualitative kinetic treatment of reaction velocity (excluding order of reaction). The effect of variations in concentration (pressure) and temperature on reaction rate.

(*b*) The law of mass action ; its application to reversible reactions ; deduction of the equilibrium constant. The effects of variations of temperature and concentration (pressure) on the position of equilibrium ; Le Chatelier's principle and its applications. Exothermic and endothermic reactions and their significance in relation to chemical equilibrium. (Numerical calculations on Hess's Law will not be required.) Thermal dissociation and its study by means of vapour density measurements in gaseous systems.

(*c*) The influence of catalysts, illustrated by typical examples of homogeneous and heterogeneous catalysis and especially by relevant reactions referred to in Section 5 of the Inorganic Chemistry section of the syllabus.

(7) (*a*) Faraday's laws of electrolysis ; electrochemical equivalents. The application of knowledge of the electrochemical series to simple qualitative problems in electrolysis.

(*b*) The elementary theory of ionic dissociation, its experimental basis and applications. (Quantitative treatment of ionic mobilities and transport numbers is not required.) Characteristics of strong and weak electrolytes. (Debye-Huckel theory of strong electrolytes is not required.) Evidence of ionic dissociation from colligative properties and the conductance of electrolyte solutions (see paragraph 5 above).

(*c*) Ionic equilibria ; application of the law of mass action to the dissociation of weak electrolytes (Ostwald's dilution law) ; dissociation constants. The ionic product of water and the concept of pH. The titration curves of strong and weak acids and bases and the application of the ionic theory to the use of common indicators. Qualitative treatment of the hydrolysis of salts.

Solubility products and their applications in qualitative and quantitative analysis (simple calculations only will be set). The solubility in strong acids of insoluble salts of weak acids.

Advanced level—*continued*

(*d*) Oxidation and reduction. General treatment of typical oxidation-reduction reactions including the electronic explanation in simple systems involving electron transfers; the use of ionic equations. Applications in volumetric analysis. (Knowledge of oxidation-reduction potentials is not required.)

Inorganic Chemistry

(1) The electrochemical series. The general methods of preparation and properties of metals and their compounds in relation to position in the series.

(2) General methods of preparation and properties of :—

(*a*) the oxides and chlorides of the metals and non-metals;

(*b*) the hydrides of the non-metals.

(3) (*a*) A study of the chemistry of the following metals (including the essential principles and chemical reactions involved in their commercial production) and their principal compounds: sodium, copper, magnesium, calcium, zinc, aluminium, lead, iron.

(*b*) Other elements are to be studied as already indicated in paragraph 2(*a*) of the General and Physical Chemistry section of the syllabus.

(4) A study of the following :—

(*a*) Hydrogen : water, hydrogen peroxide.

(*b*) Carbon : carbon monoxide, producer gas, water gas; carbon dioxide, carbonic acid and its salts.

(*c*) Nitrogen : ammonia and its salts; production of nitrogen compounds from atmospheric nitrogen; nitrous oxide, nitric oxide, nitrogen dioxide; nitric and nitrous acids and their salts.

(*d*) Phosphorus : Phosphine; phosphorus pentoxide, orthophosphoric acid and its salts; phosphorous chlorides.

(*e*) Arsenic : arsine, arsenious oxide; tests for arsenic.

(*f*) Oxygen : ozone; the classification of oxides.

(*g*) The inert gases.

Advanced level—*continued*

(*h*) Sulphur : hydrogen sulphide and sulphides with special reference to their importance in analytical chemistry ; sulphur dioxide, sulphur trioxide, sulphurous and sulphuric acids and their salts ; sodium thiosulphate.

(*i*) The halogens : fluorine very briefly ; halogen hydrides ; hypochlorous acid, hypochlorites, bleaching powder ; chlorates and iodates.

(5) The essential principles and chemical reactions involved in the commercial production of the following (technical and engineering details of manufacturing processes are not required) : coal gas ; producer gas ; water gas ; carbon monoxide ; hydrogen ; ammonia ; nitric acid ; hydrochloric acid ; sulphuric acid ; sodium carbonate ; sodium hydroxide ; chlorine.

(6) The reactions employed in the volumetric and qualitative analysis sections of the syllabus.

Organic Chemistry

(1) General methods of purification of organic compounds. Melting points and mixed melting points as criteria of purity. The methods and reactions used in the qualitative detection of the elements—nitrogen, sulphur, chlorine, bromine and iodine (either singly or in the presence of one another) in organic compounds.

(2) The principles underlying the determination of empirical and molecular formulae. The experimental evidence and reasoning used in the deduction of the structural formulae of ethyl alcohol, ethylene, acetaldehyde, acetone and acetic acid.

(3) Structural isomerism : chain isomerism and position isomerism. A sufficient knowledge of the tetrahedral disposition of the carbon valence bonds is required to enable the inadequacy of planar formulae (e.g. the absence of isomers of CH_2X_2) to be understood. (Knowledge of geometric isomerism and optical isomerism is not required.) Candidates are expected to be able to write structural formulae (either in graphic or linear abbreviated form) to illustrate the possibilities of isomerism implied in simple molecular formulae such as :—$C_4H_{10}O$ or $C_4H_{11}N$.

Advanced level—*continued*

(4) Homologous series: general formulae; general methods of preparation. Chemical properties as functions of characteristic groups, illustrated by the chemistry of the following functional groups: hydroxyl (in primary and secondary alcohols); halide i.e., chloride, bromide and iodide (the Grignard reaction is not required); cyanide; primary amine; carbonyl (aldehyde and ketone); carboxyl; acid amide; acid chloride; ester.

The general significance of the following: substitution, addition, unsaturation, hydrolysis, dehydration, condensation.

(5) Comparison of the chemical properties of ethylene and benzene. (Questions will not be set on the structure of benzene.) Nuclear substitution reactions of benzene: bromination, nitration and sulphonation. The isomerism of disubstituted derivatives of benzene. Directive influence of the following groups:—methyl, hydroxyl, amine, carboxyl, nitro and halogen, in nuclear substitution.

The formation of phenol from benzenesulphonic acid and of aniline from nitrobenzene.

(6) Comparison of the chemical properties of the following groups in aliphatic and nuclear-aromatic attachment: hydroxyl, halogen and primary amine.

(7) A knowledge is required of essential experimental details involved in the laboratory methods of preparation and purification of ethylene and ethylene dibromide; iodoform, ethyl iodide; acetone bisulphite compound; acetamide; ethyl acetate, benzoic acid by hydrolysis of ethyl benzoate; nitrobenzene, aniline, aniline hydrochloride, acetanilide.

Practical Examination

Candidates should have followed a systematic course of experimental work and should be reasonably competent in the assembly and use of common apparatus and in general laboratory operations. They should be able to use a simple analytical balance effectively and to weigh by difference to the nearest centigram ($\pm$ 5 milligrams). Candidates will be required to bring their original laboratory note-books to the examination. Books of reference may be used during the practical examination.

The practical examination will include tests in volumetric and qualitative analysis.

Advanced level—*continued*

(1) *Volumetric Analysis*

The test will include the standard methods used in the volumetric determination of :—

(i) acids and bases, including carbonates but excluding barium hydroxide ;

(ii) ferrous iron, oxalic acid and oxalates, hydrogen peroxide and metal peroxides, using potassium permanganate ; ferrous iron, using potassium dichromate (internal indicator only) ;

(iii) iodine (and hence oxidizing agents), using sodium thiosulphate ;

(iv) halides in neutral solution, using silver nitrate (chromate indicator only).

Candidates will be expected to show evidence of a simple appreciation of the limits of accuracy which are possible and to calculate and express their results accordingly. Accuracy in quantitative work will be assessed in relation to the limits of error of the equipment actually used by the candidates.

(2) *Qualitative Analysis*

The general principles and procedures used in a simple standard scheme of systematic qualitative inorganic analysis. This should include the methods and reactions used in :—

(*a*) the separation and/or identification of the cations of lead, silver, mercury, bismuth, copper, cadmium, arsenic, antimony, tin, iron, chromium, aluminium, zinc, manganese, cobalt, nickel, barium, calcium, strontium, magnesium, potassium, ammonia ;

(*b*) the identification of the following anions in simple salts or in mixtures in which the anions do not interfere with the identification of one another : carbonate, nitrite, sulphide, sulphite, sulphate, chloride, bromide, iodide, nitrate, orthophosphate ;

(*c*) the identification of the following anions in simple salts only : chromate, dichromate, thiosulphate, permanganate.

The maximum number of ions to be identified in any mixture will be four, of which not more than three may be anions. No mixture will contain two cations in the same analytical group and phosphate separations will not be required.

Advanced level—*continued*

Qualitative exercises may also be set which are designed to assess the candidates' accuracy in experimental observation, description and deduction.

Special paper

Section A : Mainly General and Physical Chemistry (*Three* questions).

Section B : Mainly Inorganic Chemistry (*Three* questions)

Section C : Organic Chemistry (*Three* questions).

Four questions must be attempted, at least one from each section.

The paper will be based on the syllabus of the other Advanced level papers.

23 BOTANY

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours.*

Candidates will be expected to have an elementary knowledge of Chemistry and Physics necessary to a proper understanding of Plant Physiology.

1. The external morphology and functions of roots, stems and leaves of a green herbaceous plant and of a woody perennial. The internal anatomy of these organs as seen by means of a hand lens. Seasonal change.

2. Plant physiology, illustrated by simple experiments : absorption of water, osmosis, the intake of solutes, transpiration, photosynthesis, respiration, growth, etiolation, geotropism, phototropism.

3. Correlation between morphology and environment, as illustrated by water plants, climbing plants, and insectivorous plants.

The ecology of any one selected habitat, e.g. sea-shore, wood, pond, etc.

4. The structure of a named flower and the functions of its various parts. The methods of pollination of common flowers. Fertilization. The development of seeds and fruits. (A study of microscopical detail will not be required, but the passage of male nuclei down the pollen tube and fusion with the egg nucleus should be appreciated.)

Ordinary level—*continued*

5. The structure and methods of dispersal of seeds and fruits. Germination of seeds, the conditions necessary for germination, and an outline of the changes undergone by reserve foods before they can be absorbed.

6. The morphology of tubers, bulbs, corms and other structures adapted for food storage and for vegetative reproduction. Simple tests for reserve foods.

7. The external morphology of the vegetative parts of at least four common trees, including one conifer.

8. An elementary study of the soil. Simple experiments to show the water, humus and calcium carbonate content and to compare the properties of sandy, clay and calcareous soils.

9. The principles of a natural classification. The general characters of the following families :—Ranunculaceae, Cruciferae, Rosaceae, Leguminosae, Primulaceae, Labiatae, Scrophulariaceae, Liliaceae, and Iridaceae.

10. Non-flowering plants : *Spirogyra*, *Mucor*, Yeast, a parasitic fungus of economic importance (e.g. *Pythium*, potato blight, apple mildew, *Botrytis*), a fern (e.g. male fern or bracken).

An elementary knowledge only will be required, based as far as possible on a study of fresh material : *Spirogyra* as a filament of green cells, *Mucor* as one cause of mouldiness readily dispersed and ubiquitous, yeast as causing fermentation while it multiplies, the parasitic fungus as a cause of disease, the fern as illustrating alternation of generations. The microscope or microprojector should be used to demonstrate the cells of *Spirogyra*, the mycelium and asexual spores of *Mucor*, the budding of yeast cells and the archegonia, antheridia, spermatozoids and spores of the fern.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination. A special paper,* **S,** *of three hours, will also be set.*

A1 Questions mainly relating to Sections A, B, C1, and F of syllabus.

A2 Questions mainly relating to Sections C2, D, and E of syllabus.

Advanced level—*continued*

Candidates must reach a satisfactory standard in the practical examination as well as in the written examination.

At the practical examination candidates may be examined on their ability to use a simple British Flora, draw microscope preparations, make simple stained microscope preparations, carry out simple physiological experiments, identify and draw plants or parts of them. The necessity for accurate drawings is emphasized. Practical notebooks which record the candidate's observations and the results of his own experiments in the field and laboratory must be available at the practical examination.

Throughout the study of the subject, living plants should be used wherever possible, structure should be related to function, and observation of plants in their natural environment all through the year should be encouraged. Theory should be illustrated wherever possible by practical work, but where this is not practicable candidates should be aware of the kind of evidence on which theories are based.

A. *The nature and activities of protoplasm.*

The cell as a unit of life ; the cell theory. The nucleus, cytoplasm and organelles, including their fine structure. The nuclear and plasma membranes. The structure, chemistry, and physical properties of cell walls.

Organic compounds, particularly proteins, carbohydrates, lipids, and nucleic acids. The chemical nature and biological properties of enzymes.

Autotrophic and heterotrophic nutrition ; mineral requirements of plants ; uptake and assimilation of mineral ions.

Aerobic and anaerobic respiration ; steps in the respiratory breakdown of carbohydrates with special reference to release and transfer of free energy ; the role of phosphorous compounds ; biological oxidation ; dehydrogenases and oxidases.

Mitosis and cytokinesis. Meiosis. Alternation of syngamy and reduction.

Introduction to nucleic acids, DNA replication and the transmission of the genetic code ; the roles of DNA and RNA in protein synthesis.

Introduction to viruses and speculation on the origin of life.

Advanced level—*continued*

Practical Work.

Cell structure should be studied in a range of cells, both living and fixed, e.g. onion skin, *Tradescantia* staminal hairs, *Elodea* leaf cells, rose hip cells, snowberry fruit cells.

Qualitative tests for carbohydrates, fats, and proteins. The colloidal properties of proteins. Properties of enzymes as illustrated by simple experiments with diastase, invertase, and urease. In the enzyme experiments, the essential conditions for the reactions should be understood, i.e., the use of buffers to maintain a suitable pH, the necessity of a control reaction. The separation of amino acids by paper chromatography.

Mitosis and meiosis in plant material, using prepared slides and root tip squashes.

B. *Heredity and evolution.*

Heritable and non-heritable variation. Outline of Mendelian inheritance for not more than two pairs of characters. Evidence connecting inheritance with the chromosomes. Introduction to linkage, crossing-over, and sex chromosomes. Outline of chromosome and gene mutation.

A brief historical review of evolutionary theory ; an elementary consideration of the present status of Darwin's Theory of Natural Selection.

Practical Work.

The quantitative study of variation in plants and animals as illustrated, for example, by variation in leaf-size or number of flower parts ; analysis of the data by calculation of the mean and standard deviation.

The study of Mendelian segregation, using suitable material, e.g. maize ears, barley, *Drosophila*, asci of *Neurospora* or *Sordaria*.

C. (I) *Form and function.*

The form and structure of plants from a developmental and functional approach. The main differences in form and structure between dicotyledons and monocotyledons. An elementary treatment of lateral and apical meristems and differentiation of the tissues in root and stem ; the development of the leaf. The mature structure of root, stem, and leaf of monocotyledons and dicotyledons. Secondary growth in dicotyledons.

Advanced level—*continued*

Plant life forms—modifications of the plant body in relation to habitat, perennation and propagation in woody and herbaceous plants. Seasonal changes in trees and herbs ; leaf fall.

Sexual reproduction in flowering plants ; insect-pollinated and wind-pollinated flowers ; development and mature structure of embryo sac, anther and pollen grain. Methods of pollination ; fertilization; development of the embryo and fruit. Fruit and seed dispersal.

(II) *Review of the plant kingdom.*

The meaning of the terms—variety, species, genus, family.

The outline of classification of plants and a general study of the structure and life-histories of the following :

Bacteria—their importance in disease and decay and in industrial processes.

Fungi—a study of the fungi with special reference to the principles of saprophytism, parasitism, symbiosis and antibiosis. *Mucor, Saccharomyces, Pythium* or *Puccinia* or *Sphaerotheca, Penicillium, Agaricus,* Mycorrhiza.

Algae—*Chlamydomonas, Spirogyra, Fucus* or *Laminaria.*

Bryophyta—*Pellia, Mnium hornum* or another named moss.

Pteridophyta—*Dryopteris, Lycopodium, Selaginella.*

A detailed knowledge of the anatomy of the Bryophyta and Pteridophyta is not required except so far as it is necessary in the study of the life-histories.

Gymnospermae—*Pinus* (a detailed knowledge of the anatomy of the leaf is required but **not** of the root and stem).

Angiospermae—the main floral and vegetative characters used in the classification of the Ranunculaceae, Rosaceae, Labiatae, Leguminosae, Compositae, Liliaceae, and Graminae, and a detailed study of the range of floral structures seen in either the Ranunculaceae or Rosaceae.

Practical Work.

The examination of living material of all the types studied should be made whenever possible. The microscopic examination of the higher plant (both mono-

Advanced level—*continued*

cotyledon and dicotyledon) should include the structure of the stem (including secondary growth), the root (including secondary growth) and the leaf; macerations and longitudinal as well as transverse sections of the stem should be studied. Candidates should be able to cut their own sections and have some acquaintance with simple staining techniques, but they will not be required to cut sections in the examination. A detailed study of the anatomy of the Bryophyta, Pteridophyta, and of the root and stem of *Pinus* is not required except in so far as it is needed in the study of the life-history.

Candidates should be able to make a detailed investigation of floral structures and be able to identify species using a British Flora.

D. *Plant physiology and biochemistry.*

Water relations of plant cells; transpiration; the uptake and movement of water in the plant.

Photosynthesis, the influence of external and internal factors; the chloroplast pigments; the assimilation of carbon dioxide; photophosphorylation. The storage and translocation of carbohydrates.

The synthesis, storage, and degradation of fats.

The general physiology of growth and development. Measurement of growth; growth curves for a colony of unicellular organisms and for higher plants. The role of hormones in the control of the growth of root and shoot, fruit development, cambial activity and organ maturation. Polarity. Etiolation. Effects of day length and winter chilling on vegetative development and reproduction in higher plants. Dormancy and germination in seeds.

Plant movements; the responses to external stimuli—geotropism and phototropism in higher plants.

Practical Work.

The following list of problems indicates the range of experimental work in plant physiology with which the candidate should be familiar. It is emphasised that as far as possible candidates should cover this part of the practical syllabus by themselves performing the experiments.

Advanced level—*continued*

Measurement of osmotic pressure. The suction pressure (diffusion pressure deficit) of plant cells. The path of water transport in the stem ; the use of water in the stem under leaf suction ; measurement of the rate of transpiration. Demonstration of root pressure.

Measurement of the rates of respiration and photosynthesis and study of the influence of external factors in these processes. Determination of respiratory quotients. Determination of dehydrogenase activity by the use of tetrazolium salts and the method of Thunberg. The chloroplast pigments, examination of their absorption spectra with a hand spectroscope.

The mineral element requirements and main symptoms of mineral element deficiencies in an angiosperm as demonstrated by sand or water culture. Experiments on germination. Diurnal variation in the growth of a shoot. Circumnutation. Simple experiments to demonstrate the effect of auxin on the linear growth of shoots and roots, on root initiation in cuttings and on callus formation in the bean epicotyl. Experiments on geotropism and phototropism to demonstrate regions of perception and response.

E. *Ecology.*

An appreciation of the physiographic, climatic, edaphic, and biotic factors of two chosen environments and of the influence of these factors upon the vegetation ; the interrelationships of the plants and animals within the chosen habitats ; plant competition and succession.

The soil as a medium for plant growth ; effects of mineral, humus, and water content, pH reaction, and temperature of soil. The role of micro-organisms in decay ; the carbon and nitrogen cycles. Plants as the ultimate source of food of animals ; food chains.

Practical Work.

A study *in the field* of the plant community in *two* well defined habitats, e.g. intertidal zone, salt marsh ; sand-dune ; pond, stream, or lake ; bog or wet heath ; fen ; reedswamp ; woodland or hedgerow ; semi-natural grassland or heath. (Candidates should be able to use a simple British Flora in identifying plants, and they should know at least 30 common dominant British species.)

Advanced level—*continued*

F. *Applied Botany.*

The principles involved in food production as illustrated in the study of : weed problem, biology of cereals ; soil and water conservation ; rotation of crops ; disease control ; plant breeding.

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

24 BIOLOGY

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours.*

Candidates will be expected to possess a knowledge of those portions of Elementary Chemistry and Physics which are necessary to a proper understanding of the subject matter of the Syllabus, and to show by their answers that their knowledge of the subject has included a study of living plants and animals and of experiments which they themselves have performed. A knowledge of minute structure is not required; it is, however, essential that a hand lens should be in frequent use. Microscopic examination is required only of the smaller organisms and blood corpuscles.

General

An elementary study of the chemical composition of the living organism. The importance of water, carbohydrates, proteins, fats, and mineral salts to its maintenance. The need for energy and the importance of carbohydrates and sunlight as sources of energy ; the carbon cycle. The need for nitrogen and an elementary study of the factors of the circulation of nitrogen.

The activities which are characteristic of living organisms : irritability, movement, respiration, nutrition, growth, excretion, and reproduction. Protoplasm as the essential constituent of living organisms and the conditions under which life can exist. Seasonal change.

Ordinary level—*continued*

The difference in the mode of nutrition between plants and animals. The green plant as an organism adapted for absorbing sun-energy and utilizing this energy to build up carbon compounds to serve as food, and the animal as an organism adapted for exploiting plants either directly or indirectly.

The relation of the organism to its environment as studied either in the field by the investigation of the sea-shore, a pond, a wood, or any other such area selected by the teacher, or, alternatively, by the observation of living plants and animals by means of aquaria or otherwise in the laboratory.

Plants

Flowering Plants

Structure and physiology of leaf, root, and shoot. Outlines of the external morphology of a herbaceous plant and of a tree, and of as much internal structure as can be made out by the use of a hand lens. The adaptations of a green leaf that enable it to absorb sun-energy and carbon-dioxide; the processes of photosynthesis, respiration, and transpiration. The root and its structural adaptations for the absorption of water and mineral salts from the soil; the process of osmosis. The stem and conduction.

Reproduction. Sexual and vegetative—the advantages and disadvantages of each method. The structure of typical flowers and the functions of their various parts; pollination and fertilization treated without reference to microscopic detail; arrangements for promoting cross-pollination. The development and structure of simple types of fruit and seed; fruit and seed dispersal; the conditions necessary for the germination of seeds; germination as illustrated by the broad bean and maize or wheat. The morphology of a few organs of vegetative propagation.

Response. The response of various parts of the plant to external stimuli. The physiological processes of geotropism, heliotropism, etiolation, and hydrotropism. To be treated experimentally.

Adaptation to environment. The adaptations of plants to their environment as illustrated by climbing plants, water plants, mesophytes, and xerophytes.

Ordinary level—*continued*

Non-flowering Plants

The structure, life-history, and nutrition of a unicellular green alga *or* of *Spirogyra* and of *Mucor or* other mould fungus. The life-history of a Fern as illustrative of the alternation of a sporophyte with a gametophyte generation. Asexual and sexual reproduction—the advantages and disadvantages of each method.

Animals

General structure and physiology of a mammal

The external features, gross internal anatomy and physiology of a small mammal such as the Rabbit, Rat, or Guinea-pig, including the following organ systems: The alimentary system with its associated glands; enzyme action and the process of digestion. The heart and blood vessels (the names of the vessels, other than venae cavae, arterial trunk, and pulmonaries, are not required), the blood and its corpuscles. The lungs and the kidneys. The brain (dorsal view *in situ*) and the nervous system (the names and distribution of the cranial nerves, other than the second, fourth, and fifth, are not required); the theory of reflex action; the organs of sight, hearing, touch, taste, and smell (histology of these organs is not required). The skeleton without details of skull and vertebral column; the attachment of a typical muscle to the skeleton; movement. The reproductive system, development and growth.

The emergence of bilateral symmetry and a head

The external features of *Amoeba*, *Hydra*, *Nereis*, any insect, and a mammal. This series is selected to illustrate the emergence of bilateral symmetry and a head in the animal kingdom associated with locomotion, and in the higher forms, with a compact skeleton and high sensitivity. The compact skeleton may be external (insect) or internal (mammal).

Habits of life

The habits of life, particularly mode of feeding, respiration, locomotion, and reproduction, as illustrated by *Amoeba*, *Hydra*, Earthworm, any insect with a metamorphosis, a Fish, the Frog (including metamorphosis), and a Bird.

No dissection by the pupils themselves is necessary; it is, however, essential that they should be shown frequently a dissection of a small mammal and the living animals mentioned.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination. A special paper,* **S,** *of three hours, will also be set.*

A1 Questions mainly relating to Sections A, B, and E of syllabus.

A2 Part 1. Questions mainly relating to Section C of syllabus.

Part 2. Questions mainly relating to Section D of syllabus.

Candidates must reach a satisfactory standard in the practical examination as well as in the written examination.

Although the form and function of plants and animals have been shown separately in Sections C and D, where appropriate, questions will be set on both papers which involve the formulation of general biological principles which emerge from the subject matter of Sections C and D, e.g. in cell water relations, gaseous exchange, levels of cellular organisation, embryology and development, and sexual differentiation.

The specific organisms mentioned in Sections C and D are suggested simply as *examples* of types which may be chosen. It is recognised that other types of organisms may be equally suitable, and the use of such alternative organisms is especially desirable where they can be more readily obtained as living material or can be studied in the field in the vicinity of the school.

At the practical examination candidates may be examined on their ability to dissect animals and record by drawing, draw microscopic preparations, carry out simple physiological experiments, identify and draw animals and plants (or parts of them), and identify, with reasons, suitable material. Practical notebooks which record the candidate's observations and the results of his own investigations in the field and laboratory must be available at the practical examination.

Throughout the study of the subject, living organisms should be used wherever possible, structure should be related to function, and observation of organisms in their natural environment should be encouraged. Theory should be illustrated wherever possible by practical work, but where this is not practicable candidates should be aware of the kind of evidence on which theories are based.

Advanced level—*continued*

A. *The nature and activities of protoplasm.*

The cell as a unit of life ; the cell theory. The nucleus, cytoplasm and organelles, including their fine structure. The nuclear and plasma membranes. Outer coat of animal cells and plant cell walls.

Carbon compounds. Proteins. Enzymes. Energy transformation. Photosynthesis and chemosynthesis. Storage of energy in carbohydrates and fats. Nutrition in autotrophic and heterotrophic organisms. Outline of the essential steps in respiratory breakdown of carbohydrates, with special reference to the release and transfer of free energy. Aerobic and anaerobic respiration.

Mitosis and cytokinesis. Meiosis. Alternation of syngamy and reduction.

Introduction to nucleic acids, DNA replication and the transmission of the genetic code, outline of the roles of DNA and RNA in protein synthesis. Introduction to viruses and speculation on the origin of life.

Practical Work.

Cell structure should be studied in a range of cells, both living and fixed, e.g. onion skin, squamous cells from the human cheek, *Tradescantia* staminal hairs, *Elodea* leaf cells, *Amoeba*.

Qualitative tests for carbohydrates, fats, and proteins. The colloidal properties of proteins. Properties of enzymes as illustrated by simple experiments with diastase, invertase, and urease. In the enzyme experiments, the essential conditions for the reactions should be understood, i.e., the use of buffers to maintain a suitable pH, the necessity of a control reaction. The separation of amino acids by paper chromatography.

Measurement of respiration rate by means of a simple respirometer ; respiratory quotients ; fermentation by yeast.

Mitosis and meiosis in plant and animal material, using prepared slides.

B. *Heredity and evolution.*

Heritable and non-heritable variation. Outlines of Mendelian inheritance for not more than two pairs of characters. Evidence connecting inheritance with the chromosomes. Introduction to linkage, crossing-over, sex chromosomes, and sex-linkage, illustrated by haemophilia in man, white eye in *Drosophila*. Outline of gene mutation.

Advanced level—*continued*

Outline of the concept of evolution and of the evidence supporting it for both plants and animals. Principles of Darwin's Theory of Natural Selection and an elementary consideration of its present status in the light of modern genetics.

Practical Work.

The quantitative study of variation in plants and animals as illustrated, for example, by variation in leaf-size or number of flower parts.

The study of Mendelian segregation, e.g. maize ears, barley, *Drosophila*, asci of *Neurospora*, or *Sordaria*.

C. *Plant form and function.*

The form and structure of flowering plants, as illustrated by a named dicotyledon, from a developmental and functional approach. The main difference in form and structure between dicotyledons and monocotyledons (detailed structure of the latter not required). An elementary treatment of the apical meristems and differentiation of the tissues in root and stem ; the development of the leaf. The mature structure of root, stem, and leaf. Secondary growth in dicotyledons.

Sexual reproduction in flowering plants ; insect-pollinated and wind-pollinated flowers ; structure of mature embryo-sac, anther and pollen grain. Methods of pollination; fertilization; development of the embryo and fruit.

The outlines of classification of plants and a general study of the structure and life-cycles of suitable examples to illustrate increasing complexity ; Algae, e.g. *Chlamydomonas*, *Spirogyra*, and *Fucus* ; Fungi, e.g. *Mucor* ; Bryophyta, e.g. *Funaria* ; Pteridophyta, e.g. Fern and *Selaginella*. The place of meiosis in the life-cycle. (A detailed study of the anatomy of the Bryophyta and Pteridophyta is not required, except in so far as it is needed in the study of the life-history.)

General physiology of the green plant. Cell water-relations. Water-relations of the whole plant ; uptake and conduction of water ; transpiration. Mineral nutrition and salt uptake. Further aspects of photosynthesis and respiration (see also Section A), especially the effects of external factors on gaseous exchange by the green plant. The translocation of metabolites ; breakdown of reserve materials in seeds.

Advanced level—*continued*

The physiology of growth and development. Contrasting patterns of growth in animals and plants. Measurement of growth. Introduction to growth hormones and their role in the growth of the shoot and root, and in fruit development, cambial activity, and root initiation. The annual cycle of development. Effects of daylength and winter chilling on vegetative development and reproduction in higher plants; dormancy in seeds and buds.

Plant movements. The responses of plants to external stimuli as a general property of organisms; geotropism and phototropism in the higher plant. (Treatment of their mechanism is not required.)

Practical Work.

The examination of live material of all the types studied should be made whenever possible. The microscopic examination of the higher plant should be limited to the dicotyledon, and should include the structure of the stem (including secondary growth), the root (primary structure only), and the leaf; longitudinal as well as transverse sections of the stem should be studied. Candidates should be able to cut their own sections and have some acquaintance with simple staining techniques, but they will not be required to cut sections in the examination.

The following experimental work should be carried out individually or as class demonstrations :—

Measurement of osmotic pressure and suction pressure. The path of water transport in the stem; the rise of water in the stem under leaf suction; the measurement of transpiration rate. The effects of external factors on rate of photosynthesis, using the "bubbler" method. Experiments on germination. Experiments on geotropism and phototropism, to demonstrate regions of perception and response.

D. *Animal form and function.*

(*a*) *The diversity of animal form and function.* A study of organisms to illustrate increasing complexity of body form and of systems of nutrition, exchange of gases, excretion and osmoregulation, support and locomotion, response to stimuli and co-ordination, reproduction, and life-history.

Acellular or unicellular organisms, e.g. *Amoeba* and *Euglena*.

Advanced level—*continued*

The diploblastic organism, e.g. *Hydra*, illustrating morphological differentiation and physiological division of labour.

The triploblastic coelomate, e.g. the annelid earthworm, to illustrate metameric segmentation, the formation of a coelom and the establishment of body systems. Adaptation to environment.

The external features, only, of an Arthropod, e.g. crayfish or cockroach, to illustrate the division of the body into the tagmata of head, thorax, and abdomen. Cephalisation. Feeding, without named details of mouth parts.

The aquatic vertebrate, e.g. dogfish, as illustrating the basic plan of vertebrate organisation. An outline study of the body systems should be made with particular attention only to the relationship between the blood system and the gills ; the roles of the buccal cavity and pharynx in respiration ; the structure of the brain and the distribution of the cranial nerves ; the myotome muscles and segmentation.

Rabbit, rat, or guinea pig. A study of the structure, function, and physiology, of a land-living mammal.

(*b*) *Cells and cell communities in development.* Gametogenesis as a process for producing the germ cells. Nature of the germ cells. Sperm and ovum. Fertilization. Indeterminate cleavage in the regulation egg of the frog. Cleavage seen as a process initiating multicellularity. Blastomeres of developing "egg" of frog held together by elastic coat to retain shape. The formative movements of the conversion of the blastula into the gastrula stage of the frog. Growth patterns in animals, the measurement of growth.

Characteristics of some differentiated cell-types of the metazoan. White blood cells as an example of a phagocytic amoeboid cell. Epithelial cells of frog's skin or gut. Connective tissue and muscle cells of which supporting structures are composed. Nerve cells. Cohesion of cells to form tissues and organs.

Hormones as chemical messengers between cells. Hormonal control of development as illustrated by the role of thyroxine in the metamorphosis of the frog.

Advanced level—*continued*

A general account of the effects of endocrine secretions derived from the pituitary, thyroid, adrenals, islets of Langerhans, and the gonads, of the mammal. The role of hormones in carbohydrate metabolism.

(*c*) *Behaviour.* Inborn behaviour illustrated by a study of the life-history of the stickleback and of the honey bee.

Learned behaviour; (i) habituation, (ii) associative learning—conditioned reflexes, trial and error, (iii) insight learning.

Practical Work.

(*a*) The examination, where possible, of live material of the organisms studied under D (*a*). The study of: the anatomy of a diploblastic organism, e.g. *Hydra*; an annelid, e.g., the earthworm, by dissection (excluding a detailed study of the reproductive and excretory systems) and by a transverse section through the intestinal region (including the histology of the body wall and gut wall); the external features of an arthropod, e.g., crayfish or cockroach; an aquatic vertebrate, e.g., the dogfish, by dissection of the afferent branchial and epibranchial arteries, of the brain and cranial nerves (an outline demonstration only of the other systems is required and without named details of the parts, e.g., the cartilages of the visceral skeleton); a mammal, e.g., rabbit or rat or guinea pig, to display the alimentary canal, the blood system, the thorax and the neck (of the neck nerves, only the main branch of the vagus need be dissected), the reproductive and urinary systems, museum preparation of the dorsal and ventral views of the brain omitting the cranial nerves; the skeleton of the rabbit omitting details of the skull; the dentition of man, a carnivore, e.g., dog, and a herbivore, e.g., rabbit.

Simple experiments on external respiration, digestion (e.g. saliva, pepsin), vision, skin sensation and taste should be performed on the human subject.

(*b*) The examination of sections of the ovary and testis of *Hydra*, of the contents of the seminal vesicles of the earthworm, of the ovary and testis of a mammal to illustrate gametogenesis.

The examination of embryological material of frog up to the gastrula stage using living material, sections and models.

Advanced level—*continued*

The examination of the following tissues of a mammal: pavement, columnar, ciliated and stratified epithelia; areolar connective tissue, hyaline cartilage and bone; nerve cells with medullated nerve fibres; smooth and striated muscle fibres; red and white blood corpuscles. The gross anatomical features of transverse sections of the spinal cord, skin and intestine.

E. *The inter-relationships of plants and animals.*

The study *in the field* of the natural history, and of the adaptation to their environments, of plants and animals of one well-defined habitat, e.g. seashore, pond, marsh, bog, heath, wood, or hedgerow.

A study of the physiographic, climatic, edaphic, and biotic factors of the chosen environments and of the influence of these factors upon the plants and animals. The inter-relationships of the plants and animals within the chosen habitat.

The soil. The role of micro-organisms in decay; the carbon and nitrogen cycles. Plants as the ultimate source of food of animals; food chains.

Symbiosis and parasitism illustrated by reference to: the symbionts of *Hydra* and of the root nodules of the Leguminosae, the life-history of the malarial organism and of its vector the mosquito, the life-history of a parasitic fungus.

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

25 HUMAN BIOLOGY

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours.*

It will be assumed that candidates have previously pursued a course of Elementary Science, including Biology, and that they have a sufficient knowledge of Physics and Chemistry to be able to understand the Physiology and Hygiene included in the work.

Ordinary level—*continued*

1. General principles : the attributes of living organisms with special reference to man. The living cell as a unit of life. Distinction between cells, tissues, and organs. The interaction between living organisms and their environment. The comparison between plants and animals. The interdependence of plants and animals. Plants as the ultimate source of man's food. The relationship between form and function.

2. Man as a mammal. General structure of a mammal. Position of the principal organs of the body in relation to one another. (It is suggested that the rabbit or guinea-pig be used for demonstration dissections by the teacher to illustrate general anatomy.)

3. The skeleton and its functions. Types of joints : gliding joints, pivot, ball and socket, hinge, immovable joints. Muscles, their origin and insertion in relation to movement. Candidates should be familiar with the idea that movement is brought about by the co-ordinated contraction and relaxation of opposing sets of muscles. The principle of levers applied to movement of joints. The characteristics of good posture. The importance of exercise. Work, fatigue, rest.

4. Circulatory system. Position of the heart in the thoracic cavity. Structure and action of the heart. Structure and functions of the blood ; circulation of the blood ; candidates will be expected to know the main course of blood circulation—the names of blood vessels will not be required other than aorta, superior and inferior venae cavae, pulmonary artery and vein, portal vein. Lymph and lymphatics.

5. The respiratory system. Lungs ; trachea, bronchi, alveoli. The mechanism of breathing. Internal respiration leading to the provision of energy for the activities of life. The difference between fresh air and expired air. Importance of nose breathing ; function of the mucous membrane. Simple investigation of the relation between breathing, the heart beat and muscular activity. Variation in the composition of air ; the value of ventilation (to be considered also under regulation of temperature (see paragraph 8)).

6. Food and its uses. Basic food requirements ; proteins, carbohydrates, and fats ; mineral salts, vitamins, and water. The importance of a balanced diet and of regular meals. Food requirements during infancy, childhood, and adult life. Relative requirements of manual and sedentary workers.

Ordinary level—*continued*

7. The alimentary canal. The structure and function of teeth. Digestion of food in the mouth, stomach, and small intestine. Food absorption and transport. Functions of the large intestine. Enzymes; simple experiments with enzymes, e.g. pepsin and diastase (or ptyalin in saliva) to illustrate their properties. Liver and pancreas.

8. The structure and functions of the skin; regulation of body temperature. The importance of suitable clothing. The dangers resulting from dirty skin and hair.

9. The excretory system: kidneys. Structure and functions of the kidneys and bladder. (The kidneys should be regarded as being composed of a system of tubes supplied by blood vessels and leading to ureters, and no details of the course of the tubules or of the blood vessels will be expected.)

10. The nervous system; the brain and spinal cord. Reflex action; conditioned reflexes. Voluntary actions; habit formation. The effect of drugs in common use, e.g. alcohol. Sleep. The sense organs and their work; the skin as a sense organ; organs of taste and smell. The general structure and action of the eye and ear. Long sight and short sight. The inner ear should be treated as consisting of a cochlea sensitive to vibration and semicircular canals sensitive to position.

11. Hormones; simple treatment of endocrine secretions, using not more than two examples.

12. Reproduction and heredity. Male and female organs. Development of fertilized ovum, excluding details of cell division; an outline of the growth of the foetus. Special needs of the pregnant woman. An outline of Mendelian inheritance applied to one pair of hereditary factors.

13. Diseases and how they are spread. Simple study of micro-organisms in relation to disease. Simple experiments to show the presence of micro-organisms in air, water, milk, and on the hands. Insects as carriers of disease. The life history of the housefly. The role of the housefly in spreading diseases, e.g. summer diarrhoea, dysentery, typhoid. Commonly occurring parasites, e.g. worms in children. Immunity; vaccination, immunization; the common cold, influenza, whooping cough, mumps, diphtheria, measles.

14. Individual responsibilities in safeguarding health. Healthy habits and the part they play in preventing disease. The family unit and the responsibilities of parents. Cleanliness in the home.

Ordinary level—*continued*

15. Food storage and preservation. Sources of food contamination. Personal and communal responsibilities in the "handling" of food and food utensils. Cleanliness applied to the preparation, storage, and serving of food.

16. Communal responsibilities ; housing and requirements for health in dwellings. Relation between overcrowding and health. The importance of open spaces, e.g. parks and playgrounds. Town planning. The town water supply. Sources of water supply, e.g. rain water, springs, wells, rivers. Impurities in water and their source ; methods of purification. Water-borne diseases, e.g. typhoid. Disposal of waste matter, including kitchen waste and sewage.

17. Public health services in connexion with sanitation. The inspection of food. Laws to safeguard the health of factory workers. Notification of infectious diseases, e.g. diphtheria, scarlet fever, measles. Importance of isolation ; disinfection of house, clothing, and utensils. The importance of sunlight to health ; principles involved in the lighting, ventilation and heating of buildings. The part played by the National Health Services.

26 ZOOLOGY

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination. A special paper,* **S,** *of three hours, will also be set.*

A1 Questions mainly relating to Sections C and D of syllabus.

A2 Questions mainly relating to Sections A, B, E, F, and G of syllabus.

Candidates must reach a satisfactory standard in the practical examination as well as in the written examination.

Theory should be illustrated wherever possible by practical work, but where this is not practicable candidates should be aware of the kind of evidence on which theories are based.

Advanced level—*continued*

At the practical examination candidates may be examined on their ability to dissect and record by drawing, draw microscope preparations, make simple stained microscope preparations, carry out simple physiological experiments, identify and draw animals or parts of them, and identify, with reasons, suitable material. The necessity of accuracy in drawings is emphasised. Practical notebooks which record the candidate's observations and the results of his own investigations in the field and laboratory must be available at the practical examination.

A. *The nature and activities of cells.*

The cell as a unit of life ; the cell theory. The nucleus, cytoplasm and organelles, including their fine structure. The nuclear and plasma membranes. Entry of materials into cells ; secretion.

Cell metabolism. Carbohydrates, fats, and proteins as sources of energy and materials for synthesis. Nutrition in autotrophic and heterotrophic organisms. An outline of the steps in the respiratory breakdown of carbohydrates, with special reference to the release and transfer of free energy. Aerobic and anaerobic respiration. The role of enzymes.

Mitosis and cytokinesis ; meiosis ; alternation of syngamy and reduction. An introduction to the nucleic acids ; DNA replication and the transmission of the genetic code, the roles of DNA and RNA in protein synthesis. Introduction to viruses and speculation on the origin of life.

Practical Work.

Differential staining of cells ; basiphil nucleus and acidophil cytoplasm, e.g. blood of mammal and frog.

Examination of prepared slides showing chromosomes (e.g. from salivary gland cells of fruit fly larvae) and mitosis (plant material may be used).

A study of living Protozoa ; amoeboid movement, cytoplasmic streaming, vacuole activity, ciliary movement.

Qualitative tests for carbohydrates, fats and proteins. The colloidal properties of proteins. Properties of enzymes as illustrated by simple experiments with diastase, invertase, and urease. In the enzyme experiments, the essential conditions for the reactions should be understood, i.e., the use of buffers to maintain a suitable pH, the necessity of a control reaction. The separation of amino acids by paper chromatography.

Advanced level—*continued*

The demonstration of cytochrome oxidase activity using the 'Nadi' reagent, and dehydrogenase activity using tetrazolium salts and the method of Thunberg.

B. *Heredity and evolution.*

Heritable and non-heritable variation. Outlines of Mendelian inheritance for not more than two pairs of characters. Evidence connecting inheritance with the chromosomes. Introduction to linkage and crossing over. Sex chromosomes and sex linkage illustrated by haemophilia in man and white eye in *Drosophila*. An outline of chromosome and gene mutation. Human blood groups (A, B, O series and Rhesus factor). Human differences, a biological analysis of the race problem.

The evidence for evolutionary change in animals. An outline of vertebrate evolution ; the evolution of man and his biological uniqueness. A brief historical review of evolutionary theory ; an elementary consideration of the present status of Darwin's Theory of Natural Selection. An outline of the various factors involved in the differentiation of species ; melanism in Lepidoptera.

Practical Work.

The study of variation within a species (see Section F Practical). Mendelian segregation using any suitable material. Human genotypes, e.g. tasting phenyl thiourea.

C. *Classification of the animal kingdom into phyla and classes.*

The following phyla should be studied sufficiently to know what morphological features are used to distinguish animals that belong to each phylum and major class : Protozoa, Coelenterata, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, Chordata.

Practical Work.

Examination and collection, as far as possible, of living representatives of the major classes. Placing animals into classes according to their morphological features.

D. *Animal form and function.*

(1) A study of the general arrangement of the systems and organs as well as the life-cycle and mode of existence of the following organisms : *Amoeba, Plasmodium, Obelia, Fasciola*, earthworm, cockroach, dogfish.

Advanced level—*continued*

Practical Work.

A study of the morphology and anatomy of the following as indicated :—

Earthworm : External features ; general dissection.

Cockroach : External features, including details of the mouth parts ; general dissection.

Dogfish : External features ; general dissection of the body cavity ; detailed dissection of the blood system, cranial nerves and brain; the arrangement of the respiratory system compared to that of a teleost (e.g. herring).

Microscope studies of : *Amoeba* ; *Obelia*, polyp and medusa ; *Fasciola*, whole mount and T.S. ; earthworm T.S.

(2) A detailed study of the anatomy, histology, and physiology of a small mammal, e.g. rabbit, rat, or guinea pig. Also reference to man with respect to hormonal and sensory processes and diet. Particular attention should be paid to the following :—

Maintenance of posture and movement in relation to musculo-skeletal system.

Nutrition. The diet, including an introduction to the deficiency diseases ; digestion and absorption.

Mechanics of the respiratory system dealing with intake of oxygen and output of carbon dioxide. Respiratory quotient.

Arrangement and functions of the blood and lymphatic systems.

Food stores as sources of energy. General metabolism.

Nature and function of the excretory system.

Arrangement and co-ordinating function of the nervous and endocrine systems.

The concept of homeostasis. Regulation of body temperature, body water, and blood sugar.

The reproductive system.

Practical Work.

Complete dissection of the mammal to illustrate the arrangement of organs and systems, except the muscular and peripheral nervous systems. The general topography of the brain. The brain of a sheep or a dog may be substituted for that of a small mammal.

Advanced level—*continued*

The skeleton : the general arrangement including details of bones in a suitable small mammal (e.g. rabbit) ; the skull of a dog should be substituted for that of the rabbit ; dentition in rabbit, dog, and man.

Simple experiments to detect proteinases (acid and alkaline), lipases, carbohydrases (amylase and sucrase). The detection of reducing sugar (maltose and lactose), hydrolysis using paper chromatography. Candidates should be able to obtain these enzymes from suitable animal sources, e.g. mouse alimentary tract, larval blowfly gut.

The study of gaseous exchange during repiration ; measurement of the respiratory rate of a small terrestrial animal using a simple manometer (constant pressure type).

Simple experiments to demonstrate the action of sense organs and reflexes.

Histology : low and high magnification microscope studies of the simple tissues, and the following organs—liver, pancreas, skin, kidney, spinal cord T.S., small intestine T.S., testis and ovary.

E. *Reproduction and development.*

Gametogenesis ; spermatozoa and ova ; fertilization ; cleavage including the effect of yolk ; types of blastulae ; gastrulation ; germ layers ; the origin of the coelom and haemocoele.

The development of frog. External changes up to and including metamorphosis ; internal changes up to the differentiation of the major organ systems ; an outline of the experimental approach to development.

An outline of mammalian development ; oestrous and menstrual cycles ; implantation ; the origin of the embryo ; the origin and functions of the embryonic membranes and allantois ; the placenta ; parturition.

Life cycles ; developmental and growth patterns ; direct and indirect development ; parthenogenesis ; hermaphroditism.

Advanced level—*continued*

Practical Work.

Gametogenesis ; earthworm seminal vesicle smears and mammalian testis T.S. : the development of frog as indicated in the theory section. The mammalian placenta and its relation to the uterine wall (macroscopic).

Life-histories of the types mentioned in Section D, plus a mosquito and dragon-fly. Pond snails (e.g. *Bithynia* sp.) or shore snails (e.g. *Nucella lapillus*) should be examined for stages in the life-history of flukes (not necessarily *Fasciola*).

F. *Ecology.*

A study of the physiographic, climatic, edaphic, and biotic factors of a chosen habitat and the influence of these factors upon the organisms present. An outline of the basic principles involved in food chains, pyramid of numbers and niches.

Modes of life and the inter-relation of living organisms ; autotrophs, heterotrophs, symbiosis, commensalism, mutualism, parasitism, colonial animals and animal colonies.

Population size and food supply with special reference to man ; the application of Biology, including Genetics, to the improvement of agriculture ; the control of pests.

Practical Work.

A study of one habitat (e.g. pond, stream, or seashore region) with special emphasis on the distribution of animals.

The use of keys to identify animals within not more than three families ; identification should in general not demand magnification greater than that of a good hand lens. The families chosen should preferably be representative of the habitat studied for the previous section. The following list of families is given as a guide, but others equally suitable may be chosen :—

Lacunidae, Trochidae, Actiniidae, Portunidae, Balanidae, Gammaridae, Blennidae, Glossiphoniidae, Hydrobiidae, Limnaeidae, Planorbidae, Aeschnidae, Perlidae, Notonectidae, Gerridae, Gyrinidae.

A detailed study of variation in form and size within a single species, e.g. *Littorina* sp., *Patella* sp., *Limnaea* sp., *Cepaea* sp.

The names of the families and species studied must be submitted to the Examiner.

Advanced level—*continued*

G. *Animal behaviour.*

An outline of the physiological basis of behaviour; receptors, co-ordination and effectors. Simple reflexes, conditioned reflexes. Orientation behaviour to light and relative humidity. Instinctive behaviour, illustrated largely by a study of the honey-bee. Learning and intelligence.

Practical Work.

Simple human reflexes. The reaction of animals to light, e.g. blowfly, larva and adult. The behaviour of woodlice (*Porcellio* or *Oniscus*) in a humidity gradient.

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

27 GEOLOGY

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

Candidates will be expected to illustrate their answers by diagrams, maps and sections, and may be asked to classify specimens of common fossils, and to identify examples of the rocks and minerals mentioned below and to give brief descriptions of them.

Special weight will be attached to evidence of personal observations made by the candidates during field work.

Weathering, erosion, transportation and deposition, as effected by the following geological agents: rain, rivers, lakes and underground waters; winds; temperature changes; plants and animals; frost; glaciers and ice-sheets; the sea.

Processes of sedimentation together with the modes of origin and the characteristics of the following rock types: conglomerate, sandstone, mudstone, shale, marl, limestone, and coal.

The evidence for and the effects of earth movements. Simple folds and simple faults.

An outline of the stratigraphical column with particular reference to the use of fossils, the latter to be restricted to representative examples of each of the following groups (only the morphology of the fossils is to be studied): graptolites, corals, echinoids, crinoids, brachiopods, lamellibranchs, cephalopods, trilobites, and coal-measure plants.

Ordinary level—*continued*

The physical and chemical properties of quartz, felspar, mica, hornblende, augite, magnetite, haematite, limonite, pyrites, galena, calcite, fluorspar, rock salt, gypsum, and graphite.

Igneous rocks and their modes of occurrence as lavas and intrusions. The characters of granite, gabbro, rhyolite, basalt, porphyry, and dolerite.

Geological control of the development of topographical features.

Outline of the geology of any area which has been studied in the field.

The meaning and the use of simple geological maps showing conformable and unconformable series, simple non-pitching folds, and normal inclined and normal vertical faults. The drawing of simple geological sections.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination. A special paper,* **S,** *of three hours, will also be set.*

A1 Mainly physical and structural geology.

A2 Mainly palaeontology, stratigraphy, petrology, mineralogy, and crystallography.

Candidates must reach a satisfactory standard in the practical as well as in the written examination. In the written examination, questions may be set on any part of the syllabus for the practical work.

Candidates will be expected to illustrate their answers by diagrams, maps, and sections, and will be asked to classify specimens of common fossils, and to identify specimens of the more important rocks and minerals.

Special weight will be attached to evidence of personal observations made by the candidates during field work. A record of field work and of laboratory work must be available for inspection.

Mineralogy and Crystallography

A study of the elements of symmetry of the cubic, orthorhombic, hexagonal, and monoclinic systems.

Advanced level—*continued*

The more important minerals of the earth's crust—their composition, characters, and modes of occurrence. *Silicates* : quartz, orthoclase, plagioclase, augite, hornblende, muscovite, biotite, olivine, serpentine, talc, asbestos, garnet, tourmaline. *Metallic minerals* : native copper, pyrites, chalcopyrites, malachite, azurite, magnetite, haematite, galena, sphalerite. *Non-metallic minerals* : corundum, barytes, calcite, gypsum, apatite, fluorspar, graphite, rock salt, sulphur.

Physical Geology

The work of the atmospheric agencies, surface and underground waters and ice, as agents of denudation and deposition. The work of the ocean ; characters of coast-lines ; marine deposits ; the part played by organisms.

Earthquakes—internal composition of the earth ; its temperature and density. Volcanoes and vulcanicity.

The development of land-forms by earth movements, denudation and deposition ; mountains, plains, and plateaux, coast-lines, and drainage systems.

Petrology

Sedimentary rocks—their classification and usual modes of formation.

Igneous rocks—igneous activity ; the igneous rocks—their modes of occurrence and classification.

Metamorphic rocks—the main types of metamorphism as illustrated by the origin of slate, gneiss, schist, and marble.

Structural Geology

Joints, folds, faults, and unconformities.

Palaeontology

The morphology of the genera listed below should be studied as illustrative of the groups to which they belong :—

Graptolites : Dictyonema. Didymograptus. Climacograptus. Monograptus.

Corals : Zaphrentis. Dibunophyllum. Lonsdaleia. Lithostrotion.

Brachiopods : Lingula. Leptaena. Productus. Chonetes. Orthis. Pentamerus. Rhynchonella. Terebratula. Spirifer. Athyris.

Advanced level—*continued*

Lamellibranchs: Nucula. Trigonia. Cardium. Cyrena. Arca. Modiola. Mytilus. Mya. Gryphaea.

Cephalopods: Orthoceras. Nautilus. Gastrioceras. Dactylioceras or Hildoceras. Hoplites.

Trilobites: Calymene. Trinucleus. Ogygia. Encrinurus. Dalmanites.

Echinoids: Conulus. Cidaris. Micraster.

Crinoids: Apiocrinus. Marsupites.

Plants (coal measure plants only).

Modes of preservation in fossils.

Stratigraphy

The measurement and subdivision of geological time. A brief summary of the stratigraphic subdivision of the geological time scale. The use of fossils in stratigraphy. The principles of stratigraphy as illustrated by the Palaeozoic rocks of Britain. A study of the geology of the school district or of an area selected by the school.

In stratigraphy it will be necessary to name many fossils to illustrate the ideas of correlation, stratigraphical subdivision, etc. These fossils will be studied from the standpoint of progressive change shown and the use made of such change in stratigraphy, rather than from a detailed morphological standpoint.

Practical work

Interpretation of simple geological and topographical maps.

Identification and description of hand specimens of the principal minerals and of the chief rock types.

Identification and description of fossils.

Field work—the geology of the school district or of a selected area.

Special paper

The paper will be based on the syllabus of the other Advanced level papers.

GENERAL SCIENCE

Ordinary level

Candidates will be required to take two papers, **O a,** *of one hour, and* **O b,** *of two and a half hours.*

Both papers O a and O b will be based on the parts of the syllabus below not printed in SMALL CAPITALS. **Paper O a will consist of short questions. Paper O b will be divided into three sections: Physics, Chemistry, and Biology. Each section will contain five questions; two questions from each section must be attempted.**

ADDITIONAL GENERAL SCIENCE

Ordinary level

Candidates will be required to take one paper, **O c,** *of two and a half hours.*

Additional General Science can be offered only in conjunction with General Science, and candidates offering the subject must therefore take papers O a and O b prescribed above and, in addition, paper O c containing questions of a harder type based on the full syllabus, including the parts printed in SMALL CAPITALS. **This paper will be divided into three sections, as in paper O b, and two questions must be attempted from each section.**

Questions will be framed to test the candidates' knowledge of facts and principles, and the application of these to the phenomena of everyday life. In general, the subject matter of the syllabus should be studied from a qualitative point of view, but quantitative methods will be necessary for a proper study of some sections of the syllabus.

SECTION I

The solar system and its place in the universe. Eclipses. Phases of the moon.

Rocks, igneous, sedimentary, and metamorphic. Water, wind, and ice as agents of denudation and transport.

Classification of matter as solid, liquid, and gas. Density, and its determination by direct measurement of mass and volume. RELATIVE DENSITY (SPECIFIC GRAVITY). Principle of Archimedes. DETERMINATION OF RELATIVE DENSITY OF A SOLID BY ARCHIMEDES' PRINCIPLE, AND OF A LIQUID BY RELATIVE DENSITY BOTTLE. Common hydrometers. Flotation in liquids and in air; application to ships, balloons, submarines; Plimsoll line.

Ordinary level—*continued*

Air pressure, simple barometer, aneroid barometer, Fortin barometer. BOYLE'S LAW. Lift and force pumps. The siphon. Hydrostatic level and everyday application. Simple experimental treatment of surface tension, capillarity, diffusion, osmosis.

Velocity and uniform acceleration. COMPOSITION OF VELOCITIES. SIMPLE PENDULUM.

Force. COMPOSITION OF FORCES. Hooke's Law. Spring balance. Moments. CENTRE OF GRAVITY. STABLE AND UNSTABLE EQUILIBRIUM.

Simple ideas of work. Simple machines (lever, WHEEL AND AXLE, single-string pulley system, inclined plane, SCREW, GEARED WHEELS). Mechanical advantage, velocity ratio, efficiency.

Energy, potential and kinetic. Transformation and conservation of energy. POWER. HORSE POWER.

Heat as a form of energy. Sources of heat. Effects of heat : change of temperature, change of state, change of size (qualitative only), chemical change. COEFFICIENT OF LINEAR EXPANSION. Everyday applications and consequences of thermal expansion. Thermometers, including maximum, minimum, and clinical. Determination of fixed points of C. and F. scales. CONVERSION OF SCALES. Anomalous expansion of water and its consequences in nature. DETERMINATION OF COEFFICIENT OF EXPANSION OF LIQUIDS AND GASES. CHARLES'S LAW. ABSOLUTE TEMPERATURE.

Units of heat : calorie, kilogram calorie, B.T.U., therm. DETERMINATION OF THERMAL CAPACITY. SPECIFIC HEAT. MECHANICAL EQUIVALENT OF HEAT. SIMPLE TREATMENT OF THE STEAM ENGINE AND THE INTERNAL COMBUSTION ENGINE. Change of state : meaning of latent heat and simple everyday illustrations. REFRIGERATION. DETERMINATION OF LATENT HEATS OF FUSION AND VAPORIZATION. DETERMINATION OF MELTING POINT FROM A COOLING CURVE.

Atmospheric moisture, dew, mist, fog, clouds. Vapour pressure. MEANING OF DEW POINT AND RELATIVE HUMIDITY.

Effects of pressure and of dissolved substances on the boiling point and freezing point of a liquid, treated qualitatively.

Transference of heat : conduction, convection, and radiation. Everyday applications, such as ventilation, hot water systems, heat insulation.

Ordinary level—*continued*

Production and propagation of sound. SIMPLE CONCEPTION OF TRANSVERSE AND LONGITUDINAL WAVE MOTION. Wave length, frequency, velocity, pitch. Variation of pitch with length and tension of a vibrating string, and with length of an air column, treated qualitatively. Velocity of sound in air. THE DIRECT MEASUREMENT OF VELOCITY OF SOUND. ECHOES.

Luminous and non-luminous bodies. Rectilinear propagation of light. Shadows and eclipses. Reflection at a plane surface, laws of reflection. Reflection at concave AND CONVEX surfaces. Graphical methods of finding the position and size of the image ; real and virtual images. Refraction. SNELL'S LAW. CRITICAL ANGLE. Convex and concave lenses. Graphical methods of finding the position and size of the image. Simple structure of the human eye ; cause and correction of long and short sight ; the blind spot. ACCOMMODATION. SIMPLE FORMS OF TELESCOPE AND MICROSCOPE. Refraction by a prism ; dispersion and colour. The spectrum. SIMPLE PHOTOMETER.

Simple treatment of the properties of magnets : perpanent and temporary magnets. The earth as a magnet. The compass. Simple magnetic fields. The magnetic effect of an electric current. Electromagnets and their uses. Electric bell. Thermal effect of a current.

Practical units of measurement in current electricity. SIMPLE CALCULATIONS ON COST OF POWER CONSUMED BY ELECTRICAL APPLIANCES. Application of Ohm's Law to simple circuits (no verification of the Law will be needed). RESISTANCES IN SERIES AND PARALLEL. Chemical effects of a current. Electrolysis of dilute sulphuric acid, and copper sulphate solution. Application to the purification of copper. Electroplating.

ELECTROMAGNETIC INDUCTION. STUDY OF SIMPLE ELECTRIC MOTOR AND DYNAMO.

The simple cell ; polarization. LECLANCHÉ CELL, DRY CELL, THE LEAD ACCUMULATOR. WIRING OF BUILDINGS : SWITCHES ; fuses.

SECTION II

Elements, compounds, and mixtures. Law of Constant Composition (Definite Proportions). DALTON'S ATOMIC THEORY. USE OF SYMBOLS, FORMULAE, ATOMIC WEIGHTS, MOLECULAR WEIGHTS, AND CHEMICAL EQUATIONS. DETERMINATION OF EQUIVALENTS BY DISPLACEMENT OF HYDROGEN AND COMBINATION WITH OXYGEN.

Ordinary level—*continued*

Composition of the atmosphere: air as a mixture. Burning, rusting, and respiration. Preparation of oxygen from mercuric oxide and from potassium chlorate. Catalysis. LIQUEFACTION AND FRACTIONAL EVAPORATION OF AIR. Properties of oxygen. Acidic and basic oxides. Oxidation and reduction in terms of the addition or subtraction of hydrogen and oxygen only.

Natural waters: water as a solvent. Solubility, SOLUBILITY CURVES. Filtration, evaporation, crystallization. Water of crystallization. Importance of solubility of oxygen to aquatic life, and of the solubility of carbon dioxide in natural phenomena.

Preparation of hydrogen by the action of metals on water (or steam) or acids. Properties of hydrogen, especially its combustion in air and as a reducing agent. Composition of water by volume (electrolytically) AND BY WEIGHT. Uses of hydrogen. Commercial preparation of hydrogen from steam using red-hot iron (reversible reaction).

Acids, bases, and salts. Methods of preparing simple salts by neutralization.

Carbon. ALLOTROPES OF CARBON. Combustion to carbon dioxide. Production of carbon dioxide in fermentation and decay. Preparation of carbon dioxide by acid on a carbonate. Properties and uses of the gas. Carbon cycle in nature. Carbon monoxide, preparation from red-hot coke and carbon dioxide. Carbon monoxide as a fuel and reducing agent. Coal gas, WATER GAS, PRODUCER GAS. Simple account of the manufacture AND PURIFICATION of coal gas, AND THE IMPORTANCE OF THE PRIMARY BY-PRODUCTS. FATS AND THEIR CONVERSION INTO SOAP AND GLYCEROL.

Limestone and other natural forms of calcium carbonate. Quicklime and slaked lime. Lime water, mortar and cement. Formation of calcium bicarbonate and its effect on water; stalagmites, stalactites, hardness of water, boiler scale, "fur" in kettles. Hard and soft waters. SOFTENING OF HARD WATER.

Sulphur (ALLOTROPIC FORMS), extraction and uses. Production of sulphur dioxide by oxidation of sulphur and IRON PYRITES. Bleaching and germicidal properties of sulphur dioxide. ITS CONVERSION TO SULPHUR TRIOXIDE LEADING TO SIMPLE MANUFACTURE OF SULPHURIC ACID BY THE CONTACT PROCESS. SULPHURIC ACID AS A DEHYDRATING AGENT.

Ordinary level—*continued*

Common salt and hydrochloric acid. PREPARATION OF CHLORINE BY OXIDATION OF HYDROCHLORIC ACID. BLEACHING ACTION OF CHLORINE; STERILIZATION OF WATER; BLEACHING POWDER.

Ammonia. HABER PROCESS (NO TECHNICAL DETAILS). Nitrogen cycle in nature. NITRIC ACID: MANUFACTURE FROM AMMONIA (NO TECHNICAL DETAILS). Fertilizers.

Comparison of metals and non-metals. Indication of methods of extraction of metals from their ores, e.g. (*a*) action of heat and subsequent reduction of the oxides produced, (*b*) electrolysis.

EXTRACTION, PROPERTIES AND USES OF ZINC, COPPER, IRON, AND OF THEIR ALLOYS AND COMPOUNDS IN EVERYDAY USE.

SECTION III

[*A knowledge of minute structure is not required, but a hand lens should be in frequent use.*]

Characteristics of living organisms, distinctions from non-living matter. Protoplasm as the basis of life and the seat of metabolism. Anabolism, resulting in food-building, and katabolism, resulting in liberation of energy (e.g. respiration). The cell as the unit of structure; aggregation of cells into tissues, and tissues into organs.

External organization of a typical herbaceous plant, and functions of its vegetative parts. Absorption and translocation of water and dissolved salts; CULTURE EXPERIMENTS; photosynthesis; carbohydrates as major plant products. FATS, OILS, PROTEINS; the use of carbohydrates in construction, respiration and storage, especially in seeds and in organs of vegetative reproduction. Dependence of animal life on plant life.

Gross anatomy of a mammal in relation to the chief organ systems. Alimentary system; digestion; absorption; circulation and utilization of digested food, respiration, excretion. MAMMALIAN HEART, GROSS STRUCTURE AND CHIEF FUNCTIONS. Balanced diet; vitamins; SPECIAL METHODS OF NUTRITION: PARASITISM, SAPROPHYTISM, SYMBIOSIS, WITH TYPICAL EXAMPLES OF EACH.

Support: movement of organisms and organs; essentials of mammalian skeleton and muscular locomotor movement; JOINTS; MUSCLES; LIMBS. Support in the plant dependent on turgidity and mechanical tissue. Movement in the plant confined to growing tips, and induced by stimuli, e.g. gravity, light.

Ordinary level—*continued*

Sense organs of the animal, eye AND EAR ; NERVOUS SYSTEM AND BRAIN ; simple reflex arc. BRIEF TREATMENT OF ENDOCRINE GLANDS AND HORMONES.

Vegetative reproduction in the plant, rhizomes, bulbs, corms, tubers, GRAFTING AND BUDDING. Sexual reproduction in the plant ; structure of a simple flower found locally (omitting histological details), e.g. foxglove, buttercup ; pollination ; ESSENTIALS OF FERTILIZATION, RESULTING IN SEED PRODUCTION. Special mechanisms of pollination by wind and insects (only one or two named examples of each required). Seed and fruit dispersal. Essentials of mammalian reproduction. Nutrition of embryo plant and animal until independence is attained. OTHER EXAMPLES OF PARENTAL CARE. Germination of pea (or bean) AND WHEAT (OR MAIZE). Bacteria ; their importance in the circulation of matter in Nature ; conditions determining their multiplication, related to methods of food preservation. Importance of bacteria in the human body, including some reference to diseases caused by bacteria, with the principles of immunization.

The dangers of parasites, e.g. Round worm, TAPEWORM, MALARIA PARASITE, flea, and of carriers of parasites, e.g. housefly, rat. CONTROL OF SUCH PESTS, AND ALSO OF THOSE OF CROP PLANTS, INCLUDING, E.G. CABBAGE WHITE BUTTERFLY (INVOLVING RELEVANT DETAILS OF LIFE-HISTORY), AND FUNGI, e.g. POTATO BLIGHT.

30 ENGINEERING SCIENCE

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

The paper will be divided into three sections : Section A—Mechanics, Section B—Heat, and Section C—Electricity and Magnetism. There will be five questions in Section A and three in each of the other two sections. Candidates must attempt six questions in all, including at least two questions from Section A and at least one question from each of the other two sections.

A. *Mechanics.*

Classification of matter as solid, liquid, and gas. Density and its determination by direct measurement of mass and volume. Relative density (specific gravity), Principle of

Ordinary level—*continued*

Archimedes. Determination of relative density of a solid by the Principle of Archimedes and of a liquid by the relative density bottle. Common hydrometers. Flotation in liquids and in air; application to ships, balloons, submarines. Plimsoll line.

Air pressure, simple barometer, aneroid barometer, Fortin barometer. Boyle's law. Lift and force pumps. The siphon. Hydrostatic pressure and its everyday application.

The fundamental notions of velocity and acceleration; vertically falling bodies; Newton's laws of motion; momentum and force. Potential and kinetic energy, work done by a force, work done in rotation, power—horsepower and watt. Graphical representation of work done by a variable force.

Tension, compression, shear; Hooke's law; the spring balance; load-deformation curves; stress and strain; Young's modulus; working stresses, factor of safety.

Moments; parallel forces; couples; centre of gravity; stable, unstable, and neutral equilibrium; triangle of forces; polygon of forces; resolution of forces; concurrent co-planar forces in equilibrium.

Laws of friction, coefficient of friction, lubrication.

Simple machines (levers, wheel and axle, single-string pulley system, inclined plane, screw, geared wheels). Mechanical advantage, velocity ratio, efficiency. Descriptive treatment of the transmission of motion by means of belts and gears.

B. *Heat.*

Effects of heat. Expansion of solids and liquids. Experimental determination of the coefficient of linear expansion of a metal.

Heat and temperature. The Fahrenheit and Centigrade scales of temperature. Temperature conversions. Construction of a liquid thermometer. Alcohol and mercury as thermometric liquids. Units of heat.

The relationship between pressure, volume, and absolute temperature of a gas. Charles's law. The gas equation.

Specific heat and thermal capacity. Determination of specific heat by method of mixtures.

Ordinary level—*continued*

Change of state. Melting point and boiling point. Latent heats of evaporation and fusion. Total heat of dry saturated steam. Elementary use of steam tables. Experimental determination of latent heat of steam and latent heat of fusion of ice.

Heat transfer by conduction, convection, and radiation ; applications.

Heat as a form of energy. The mechanical equivalent of heat and its determination experimentally. The calorific value of a fuel. Elementary treatment of the steam engine, turbine, and four-stroke petrol engine.

C. *Electricity and Magnetism*

Simple phenomena of magnetism. Earth's magnetism and lines of force (omitting quantitative magnetometry). Permanent magnets.

The magnetic, chemical, and heating effects of an electric current.

Conductors and insulators, electromotive force and potential difference, electrical resistance, Ohm's law, verification of Ohm's law. Measurement of resistance by ammeter-voltmeter method. E.M.F., voltage drop, and terminal potential difference. Resistors in series and in parallel. Experimental determination of resistivity.

Elementary treatment of electromagnetism and induced currents ; alternating current. Simple descriptive treatment of the transformer, dynamo, and motor. The mode of action of the simple moving-coil and moving-iron meters.

Electrolysis of water and copper sulphate. Applications of electrolysis in industry. Experimental determination of electrochemical equivalents. The Leclanché dry cell and the lead-acid accumulator.

The units of electrical energy and power. The relationship between electrical energy expended and the heat produced in a circuit.

31 AGRICULTURAL SCIENCE

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

Candidates will be expected to possess a knowledge of those portions of Elementary Chemistry and Physics which are necessary to a proper understanding of the subject matter of the syllabus.

Ordinary level—*continued*

Soils. Formation of soils. Elementary study of soil profiles. Soil constituents—humus, sand, clay. Mechanical analysis of soil. The plant's chief requirements from the soil. Fertilizers and manures—common fertilizers and manures containing nitrogen, phosphorus, and potassium—their occurrence, manufacture, use, composition, and general effects on soils and crops. Lime—types of lime, indications of deficiency in the field, lime requirement of soils. Cultivation : its object and effects. Soil drainage. Chemical, physical, and biological properties. Simple treatment of base exchange, availability of nutrients. Nitrification of organic matter. Fixation of nitrogen by bacteria. Nitrogen cycle.

Plants. Simple morphology and anatomy of a monocotyledonous and a dicotyledonous plant (only a knowledge of the internal anatomy visible by means of a hand lens will be expected). Basic physiological processes—respiration, photosynthesis, absorption of water and nutrients, transpiration. Effect of light, temperature, water, and food supply on plant growth. Reproduction—vegetative reproduction and reproduction by seed. Functions of the parts of a typical flower. Pollination and fertilization. Dispersal of seeds and fruits, with particular reference to common weeds. Germination of seeds and factors affecting germination. Seed testing.

Elementary botany (with particular reference to the parts of economic importance), cultivation, rate of seeding, manuring, and harvesting of wheat, oats, barley, potatoes, swedes, mangolds, beans. Study of the principal cultivated grasses (Italian rye-grass, perennial rye-grass, timothy, cocksfoot) and clovers (red and white clover). Simple study of natural and artificial grassland. Importance of choosing the best variety or strain of a cultivated plant to suit local conditions. Conservation—hay-making, ensilage, storage of potatoes and roots. Common weeds of arable and grassland—methods of weed control including the use of selective herbicides. Diseases and pests of cultivated plants—simple account of the symptoms, effects, life-history, and methods of control of smut of oats, club root of crucifers, blight of potatoes, frit-fly on oats, cabbage white butterfly, turnip flea beetle, potato eelworm, leatherjackets, wireworms.

Animals. Elementary anatomy and physiology of a simple-stomached animal, such as the pig, and of a ruminant, such as the sheep. This should include digestion, absorption, utilization, excretion, respiration, functions of blood, repro-

Ordinary level—*continued*

duction, nervous system, lactation. The feeding of farm animals—constitution of foods—requirements for maintenance and production—simple explanation of food values, e.g. starch equivalent system—protective foods.

Characteristics of local breeds of farm livestock to illustrate the aims of animal breeding.

Milk—its production and its processing into butter and cheese.

The health of farm animals. Malnutrition, common microbial and virus diseases, metabolic disorders, insect and other pests. Animal housing and hygiene.

The farm. Brief historical development of British systems of farming and rotations. Integration of cropping and stocking.

32 HORTICULTURAL SCIENCE*

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

33 MUSIC

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours, and Aural and Sight Singing tests.*

Candidates must satisfy the examiners in both the written examination and the Aural and Sight Singing Tests.

Candidates will be expected to have a thorough knowledge of the rudiments of music.

Theory

(*a*) *Melody writing*

The continuation of a given fragment to make a balanced melody about 8 or 16 bars long, including a modulation to a nearly related key.

(*b*) *Harmony*—in the major key only.

Tonic, supertonic, mediant, subdominant, dominant, and submediant triads in root position and first inversion; dominant seventh in root position and inversions; cadential 6/4 chords; unaccented diatonic passing notes; modulation to dominant.

Four-part harmonization for voices of a short simple melody or of a short simple bass part, at the discretion of the examiner.

(*c*) *Two-part contrapuntal writing for voices*

The addition of a part, not exceeding 8 bars in length, above or below a given melody at the discretion of the examiner.

* Syllabus supplied on application.

Ordinary level—*continued*

(*d*) *History and Set Works*

Three groups of works, viz.: (i) orchestral, (ii) chamber, and (iii) vocal, will be prescribed for study. Candidates must choose for study a work or works from each group according to the choice allowed, and must satisfy the examiner in their knowledge of the main themes and general structure of the prescribed works studied by them and in the general history of Music in the period covered by the life-time of *one* of the composers of the works studied.

Prescribed works for 1966 :

(1) *Either* Benjamin Britten : "Variations and Fugue on a Theme of Purcell" (The Young Person's Guide to the Orchestra), Op. 34 ; history period 1913 to the present ;

or Brahms : "Academic Festival Overture" ; history period 1833–1897.

(2) *Either* Mozart : String Quartet No. 14 in G major, K387 ; history period 1750–1790 ;

or Beethoven : String Quartet No. 4 in C minor, Op. 18, No. 4 ; history period 1770–1830.

(3) *Either* Bach : St. Matthew Passion (BWV 244) (edited by Sir Edward Elgar and Ivor Atkins, and revised in 1938 by Ivor Atkins ; Novello and Co. Ltd.) ; history period 1685–1750 ;

ALL of the following :—

No. 35 O Mensch, bewein' dein' Sünde grosz
(O man, thy grievous sin bemoan)
No. 77 Nun ist der Herr . . .
(And now the Lord to rest is laid)
No. 78 Wir setzen uns
(In tears of grief, dear Lord, we leave thee).

or Schubert : Die schöne Müllerin (D.795) (English version by Augener) ; history period 1800–1830 ;

ALL of the following :—

No. 16 Die Liebe Farbe
No. 17 Die böse Farbe
No. 18 Trock'ne Blumen
No. 19 Der Müller an dem Bach
No. 20 Des Baches Wiegnelied.

A knowledge of minor composers living within the period of history to be studied will not be expected.

Ordinary level—*continued*

Aural and Sight Singing Tests

1. *Aural Tests*

Candidates may be asked :—

(*a*) To write down from dictation a series of six notes (i) in a major (ii) in a minor key, the first note in each case being the tonic.

(*b*) To write down from dictation a melodic phrase 4 bars long in 2/4, 3/4, 4/4, or 6/8 time with quavers as the shortest note-values.

The phrase may be in either a major or minor key, and will be played four times with an interval before each repetition. The tonic chord will be sounded and named before each repetition.

(*c*) To write down from dictation the bass part and to name the chords of a passage in four-part harmony (major key only), containing six chords, of which the first will be the tonic chord in root position and the last two will form an imperfect, interrupted, plagal or perfect cadence. The test will include any of the following chords : the tonic, the supertonic, subdominant, dominant, dominant seventh, submediant, in root positions and first inversions, and will be played four times.

(*d*) To name the changes of key from tonic to dominant major, subdominant major, and submediant minor, each example starting from tonic (major only) and modulating to one key only.

Each test will be played three times, preceded each time by the dominant and tonic chords.

2. *Sight Singing Test*

The candidates will be required to sing at sight a simple melody which will not exceed an octave in range, and will contain no interval greater than a fourth. The melody may be transposed to a key which suits the candidate's voice.

Each candidate will be allowed two attempts.

Optional Practical Examination

Candidates may, in addition, offer themselves for a practical examination (*a*) in singing, or in playing on the pianoforte, or organ, or any approved orchestral instrument, and (*b*) in sight reading.

Copies of the list of approved instruments, together with the works prescribed for the practical examinations in Music, may be obtained from the Welsh Joint Education Committee, 30, Cathedral Road, Cardiff.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination. A special paper,* **S,** *of three hours, will also be set.*

Candidates must satisfy the examiners in the Written as well as in the Practical examination.

A 1 (i) *Harmony.*

Diatonic, together with the higher dominant discords, secondary sevenths with inversions, suspensions, accented and unaccented passing notes and auxiliary notes; modulations from major and minor keys to the five most nearly related keys.

Candidates will be required, at the discretion of the Examiner, either to harmonise a given melody or bass part for voices in four parts, or to add parts for Violin II, Viola, and 'Cello to a given Violin I part.

(ii) *Counterpoint.*

Either Counterpoint in sixteenth-century style for two voices. Candidates will be required to add a contrapuntal part to a given part or to continue a given fragment for 12 or more bars ;

or Counterpoint in the instrumental style of J. S. Bach in two parts either for a keyboard instrument or for two instruments selected from the string group and/or the non-transposing woodwind instruments. Candidates will be required to add a contrapuntal part to a given part, or to continue a given fragment for 12 or more bars in the style of a two-part invention.

A 2 The detailed study of *three* out of the four following prescribed works, together with the study of closely related music contemporary with the works selected :—

	Set Work	*Associated Topic*
J. S. Bach :	Jesu meine Freude	The Church cantatas and motets of J. S. Bach.
Beethoven :	String Quartet in E flat major, Op. 74, "The Harp"	String quartets of the Viennese period (1755–1810).
Dvořák :	Symphony "From the New World" (First two movements)	The Orchestral music of Brahms and Dvořák.

Advanced level—*continued*

Bartók :	Music for Strings, Percussion, and Celesta.	The instrumental music of Bela Bartók.

Practical Examination

1. *Aural Tests*

The scope of the tests is indicated in **A 1** above.

(i) To write from dictation a melody eight bars long in Simple Time or in Compound Duple Time.

(ii) To write from dictation the bass and melody of a single chant, figuring the bass in the traditional manner.

(iii) To name changes of key *either* in a continuous passage (which may contain not more than three modulations) *or* in three separate passages, each of which will contain only one modulation.

2. *Sight-Singing Test*

To sing at sight a given melody of about eight bars in length.

3. (i) To sing, or play on the pianoforte or organ or any approved orchestral instrument, two works, one Classical and one Romantic or Modern, selected from the list of works prescribed by the Committee.

(ii) Sight reading.

Special Paper

1. The harmonisation of a melody for a string quartet.

2. Exercises in Counterpoint. Candidates may choose one of the following sections :—

Either (*a*) the continuation in two parts of a given fragment in the style of Palestrina ;

or (*b*) the continuation of a given fragment in the style of a two-part invention by J. S. Bach.

3. Questions to test the knowledge of any *one* of the set works named in **A 2** selected by the candidate for special study.

Ordinary level

Candidates will be required to take three of the four papers, **O a, O b, O c, O d,** *each of two and a half hours.*

Any medium, other than oil paint, may be used. If Paper **O b** is not offered, candidates must offer a painting in colour in Paper **O a.** Paper of any suitable colour, texture, or surface may be used in the examination provided that its size is not greater than 22 in. by 15 in. or not less than 15 in. by 11 in. Paper for the examination will not, however, be provided by the Joint Committee.

O a *Drawing and Painting from observed forms*

Either (i) A drawing or painting of a group of specified objects in monochrome or colour ;

or (ii) a drawing or painting of a plant, in monochrome or colour ;

or (iii) a drawing or painting from a living model.

O b *Imaginative Composition*

Either (i) Candidates will be required to make an imaginative composition in colour based on one of six given subjects ;

or (ii) Candidates will be asked to make an abstract composition, on a basis suggested by the Examiner, using line, shape, colour, and texture.

O c Design in relation to one of the following crafts :—

(i) Lettering ; (ii) Writing and Illuminating ; (iii) Lino-cutting.

O d *History and Appreciation of Art*

Candidates must offer one of the following sections :—

(i) Painting ; (ii) Sculpture ; (iii) Architecture.

Candidates should be able to express their personal preferences, and give reasons for them ; they should illustrate their answers, wherever possible, by sketches.

Ordinary level—*continued*

(i) *Painting*

Either (*a*) *Italian Painting* as represented by the following :—

Giotto, Masaccio, Fra Angelico, Uccello, Piero della Francesca, Mantegna, Giovanni Bellini, Botticelli, Ghirlandaio, Leonardo da Vinci, Michelangelo, Titian, Raphael, Tintoretto, Caravaggio, Canaletto.

or (*b*) *French Painting* as represented by the following :—

Nicholas Poussin, Claude Lorrain, Watteau, Chardin, Ingres, Delacroix, Daumier, Courbet, Manet, Degas, Monet, Seurat, Cézanne, Gauguin, Van Gogh, Picasso.

or (*c*) *British Painting* as represented by the following :—

Hilliard, Lely, Hogarth, Gainsborough, Reynolds, Wilson, Blake, Turner, Constable, Ford Madox Brown, Whistler, Sickert, Augustus John, Stanley Spencer, Graham Sutherland.

(ii) *Sculpture**

The following sculptors :—

Ghiberti, Donatello, Luca della Robbia and Family, Michelangelo, Cellini, Bernini, Grinling Gibbons, Houdon, Canova, Alfred Stevens, Rodin, Maillol, Gill, Epstein, Moore.

*Schools wishing to offer (ii) Sculpture must apply to the office by September 30th in the year preceding the examination.

(iii) *Architecture in England and Wales*

Either Romanesque and Gothic Architecture ;

or Renaissance Architecture (*circa* 1600–1830) ;

or Architecture since 1830.

Advanced level

Candidates will be required to take paper **A 5** *and two of the basic papers,* **A 1, A 2, A 3,** *and* **A 4,** *each of three hours, and to submit finished works. A special paper* **S,** *of three hours, will also be set.*

Advanced level—*continued*

Drawing paper for the examination will not be provided by the Joint Committee. The paper provided by the schools should be of half-imperial size.

A1 *Either* (i) A drawing or painting in monochrome or in colour, in any medium other than oil paint, of a group of common objects;

or (ii) A painting in colour, in any medium other than oil paint, of a group of common objects arranged in accordance with the candidate's ideas of composition, and against a suitable background of the candidate's invention.

Some or all of the objects used in the composition will be provided for the candidate to inspect, and will remain available for inspection by him throughout the examination.

A2 A drawing or painting in monochrome or in colour, in any medium other than oil paint, of a figure in costume. The whole of the figure must be included.

A3 A composition in monochrome or in colour, in any medium other than oil paint, including not less than three figures, and based upon a subject specified by the Examiner.

A4 A design for a project to be carried out in a specified form of Craftwork chosen from one of the following five groups :—

(*a*) Block printing for illustration and decoration.
(*b*) Manuscript lettering, writing, and illumination.
(*c*) Embroidery, needlework, and appliqué.
(*d*) Weaving and fabric printing.
(*e*) Woodcarving and decorative metalwork.

A5 A written paper on the history and appreciation of art or architecture. One of the following :—

(*a*) Greek and Roman architecture.
(*b*) Gothic architecture in England and Wales.
(*c*) The architecture of England and Wales, 1550–1800.
(*d*) Italian painting, 1200–1600.
(*e*) British painting, 1700–1850.
(*f*) French painting, 1700–1850.

Candidates will be given opportunities of showing their knowledge of original works of architecture or of fine art which they have studied.

Advanced level—*continued*

Finished Works

Candidates are also required to submit a folio of work (including sketch-books) representative of their course of study. The studies must be entirely the individual work of the candidates. Candidates offering Craftwork should include with their folios of personal work examples of the craftwork completed by them during their period of study. Candidates **should submit not more than eight finished works which should be executed on paper not larger than 22 in. by 15 in. and sent in a portfolio measuring not more than 25 in. by 20 in.** Instructions about the submission of the finished works will be sent to the schools before the examination.

The school number and the number of the candidate should be clearly shown on the cover of the folio, and on the back of each drawing and on sketch-books included in the folio.

Special paper

A composition in *colour*, in any medium other than oil paint, including not less than three figures and based on a subject specified by the Examiner.

35 CRAFTS

Ordinary level

The following is a list of the crafts in which examination papers will be provided :—

O a Embroidery
O b Pottery
O c Modelling and Carving
O d Lettering and Script Writing
O e Pictorial Crafts
O f Fabric Printing
O g Bookbinding
O h Weaving

The examination in each craft will comprise a two-hour paper on *History and Methods* and a Practical Examination. Not more than two crafts may be offered by a candidate.

Schools wishing to present candidates for any one of the above crafts are asked to inform the office not later than September 30 in the year preceding the examination.

Ordinary level—*continued*

The paper set at the written examination will be devoted to the history and methods of the selected craft. The practical examination will consist of two sessions, of two hours each, exclusive of any additional time that may be allowed in certain crafts for special processes. Candidates must satisfy the examiners in the practical examination.

Candidates' note-books should be available at the practical examination.

O a Embroidery

1. Simple outline of the historical background from Saxon to modern times.
2. Materials and equipment.
3. Stitches and their application to various types of embroidery and suitability for use in various materials.
4. Finishing and presentation.
5. Design and colour.

Practical examination

A design, to be worked on material, to be prescribed by the examiner at the time of the examination. The design will be based on the stitches learned in class, with the addition of other stitches if desired.

O b Pottery

1. Simple outline of the historical background of English pottery.
2. *Materials.* Clay—its nature and characteristics. Source of supply and varieties. Preparation of clay. Glazes.
3. *Shaping processes.* Pinch pottery, slab pottery, coil pottery, thrown pottery. Turning. Making of plaster moulds.
4. *Decoration.* Raw ware decoration—incising, scraffito, thumbing, embossing and applied ornament. Slip training, brushing, combing. Wax resist and tin glaze. Majolica and underglaze.

Practical examination

The test will consist of making and decorating a simple pot, to the examiner's specifications. The first of the two sessions is to be spent in making, the other in decorating, the pot. Firing may be carried out at some other suitable time.

O c Modelling and Carving

1. A general historical background and appraisal of English sculpture.

Ordinary level—*continued*

2. Materials used in modelling and carving—their nature and use in various forms of sculptural work, e.g. clay, wood, stone, plaster, chalk.

3. Tools and equipment—making of armatures.

4. Methods of casting—the nature of plaster in casting.

Practical examination

The execution in pliable or hard material of small modelled or carved forms, e.g. figures (singly or in groups), animals or birds. The subject and specifications of the test will be set by the examiner. The period allowed for the practical examination does not include any time that may be required for casting.

O d Lettering and Script Writing

1. The historical development of letter forms from Greek and Roman times to the printed letter forms of today. The important historical letter forms: Roman capitals, uncials and half-uncials, tenth-century English writing, simple Gothic forms, versals, the Roman small letter and italic letter as developed from fifteenth-century Italian forms.

2. *Materials.* Pens, quills, inks, pigments, etc.; paper and skins.

3. *Design.* Lay-out of panels or pages. Margins and spacing. Decoration and colouring of panels and pages. Ruling out for writing.

Practical examination

Candidates will be required to produce a panel (or page) in either drawn letters or script letters and to include appropriate decoration.

O e Pictorial Crafts

1. An outline history of English book illustration to the present day.

2. *Methods and materials.* Wood engraving, lino-block cutting or lithography. Nature of the materials, paper, and inks. Tools and their care and maintenance. Preparation of blocks, stones, or plates for printing. Proofing processes.

Practical examination.

The practical test will include the preparation of blocks and the printing in black or colour of a final proof by one of the above processes. Only in the case of lino-block cutting and lithography will more than one colour be asked for. The subject of the illustration and other specifications will be set by the examiner.

Ordinary level—*continued*

O f Fabric Printing

1. Outline of the traditional development of printed fabrics.

2. Design—basic repeating patterns, half-drop, stripe, interchange and counterchange.

3. Materials suitable for making blocks : potato, cork, sticks, lino, rubber.

4. Inks and dyes suitable for block printing.

5. Simple stencil and screens suitable for developing all-over patterns on fabric.

6. Printing and registering patterns.

7. Free-hand painting on fabric.

Practical examination.

The test will consist of designing a suitable block, and printing in one or more colours a short length of material. The type of pattern and material to be used will be specified by the examiner.

O g Bookbinding

1. A simple outline of the historical background of bookbinding.

2. Equipment and materials. Tools : care and maintenance. Materials : papers, boards, cloth, adhesives.

3. Pattern making suitable for the craft : marbling, paste graining, paper staining, patterns printed by lino, potato, stick, and other methods.

4. Constructions, single section books, quarter and half bound, portfolios, magazine covers, albums.

Practical examination

The test will consist of designing and making a book of one or more sections, with suitable decorations, to the specifications of the examiner.

O h Weaving

1. Outline background of the historical development of weaving.

2. *Materials.* Silk, wool, cotton, flax, and man-made fibres.

3. *Methods.* Simple spinning, preparation of the loom, warping, beaming, and denting. Simple weaves : plain or tabby, twill, basket, etc.

4. *Equipment.* Types of simple looms.

Ordinary level—*continued*

Practical examination

The test will consist of weaving a short length of material in accordance with the examiner's specifications. The examiner may provide detailed instructions for the setting of the warp before the time specified for the test.

36 WOODWORK

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours, and a practical examination of three hours.*

Drawing and Theory

*Drawing**

The preparation of accurate working drawings, including plans, elevations, and horizontal and vertical sections. Elementary geometrical constructions, including the ellipse, as applied to working drawings. Conventional isometric and oblique projections involving simple curves. Free-hand sketching, including pictorial and orthographic views.

The designing of articles that could be made in the woodwork room.

Theory

A knowledge of the common hand woodworking tools, their uses, maintenance, and construction.

Growth, conversion, and seasoning of timber. Working characteristics of hardwoods and softwoods in general use. Manufacture and uses of plywood.

Questions may be asked on any of the materials and processes involved in the practical work.

Practical

The fundamental uses of the common hand woodworking tools. The following joints and simple variations of them: halving, housing, mortise and tenon, and dovetail joints; their application in frame, carcase, and stool construction. (The secret dovetail and the long and short shouldered mortise and tenon joints are excluded.)

* First angle projection should be used in all working drawings; these should be in accordance with "Engineering Drawing Practice" B.S. No. 308: 1953.

Ordinary level—*continued*

Edge jointing—Butt, groove with loose tongue, and dowel joints.

Curved work—The use of bowsaw, coping saw, spokeshaves, and gouges.

Assembling—Gluing, screwing, nailing, and hinging.

Decorative processes—Simple shaping, chamfering, gouge-cut ornamentation.

Wood finishing—to improve the appearance; to preserve the wood.

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination of four hours.*

A1 Technology

Materials

Timber; growth and geographical distribution of timber trees; characteristics of timbers in common use; conversion; seasoning; market forms; methods of preservation. Manufacture, characteristics and uses of plywood, laminated board, and veneer.

Common types of glue and their uses; screws, nails; simple fittings used in cabinet work. Abrasives, and the materials necessary for wood finishing.

Tools

The common hand woodworking tools, their evolution, construction, and manipulation. Upkeep of workshop equipment. The wood-turning lathe.

Construction and Processes.

Construction of frames (plain, grooved, and rebated). Carcase, drawer, and table construction, excluding secret dovetail joints. Surface decoration: inlaying; tooled decoration; veneering. Finishing processes. Wood-turning.

History

Historical development of the common articles of furniture. The principal styles of furniture in England and Wales with a more detailed study of a special period. In 1966 the special period will be "From the Great Exhibition of 1851 to Modern Times".

Advanced level—*continued*

A2 *Design and Drawing**

The design and preparation of working drawings of a small piece of furniture, a fitment for the home or workshop, a piece of apparatus or equipment, or any other article in wood that can suitably be made by boys in the school workshop, with special reference to fitness for purpose, good proportion, sound construction, and the restrained use of decoration. The setting out of both full-size and scale drawings in orthographic projection.

The use of free-hand sketches for suggesting and designing craftwork and as a means of illustrating practical details of construction.

Plane Geometry

The construction of circles and the common rectilinear figures, including regular polygons. The construction of plain and diagonal scales. Methods of enlargement and reduction of figures, and profiles of mouldings. Circles and lines in contact, with special application to "setting out".

The ellipse, tangents and normals.

Solid Geometry

Drawing (to scale) in orthographic projection from dimensioned sketches. Plans, elevations, sections, sectional plans and elevations. Auxiliary plans and elevations of rectilineal and cylindrical solids. Conventional isometric and oblique projection. True lengths and shapes.

Practical

Working from sketches and full-size or scale drawings.

Frame, carcase, box and drawer constructions, excluding secret dovetail joints.

Stool and table constructions.

Fitting of hinges and other simple cabinet fittings ; the making and fixing of wooden handles.

The making of simple mouldings ; simple veneering, inlaying, carving, and wood-turning.

* All drawings should conform to the recommendations of "Engineering Drawing Practice", B.S. No. 308 : 1953. First *or* third angle projection may be used, but a knowledge of both will not be expected.

Advanced level—*continued*

Course Work

Examples of the work, including drawings, made by the candidate during the course should be available for inspection by the Examiner at the Practical Examination.

37 METALWORK

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours, and a practical examination of three hours.*

Drawing and Theory

*Drawing**

The preparation of accurate working drawings, including plans, elevations, and horizontal and vertical sections. Elementary geometrical constructions, including the ellipse, as applied to working drawings. Conventional isometric and oblique projections involving simple curves. Free-hand sketching, including pictorial and orthographic views.

The designing of articles that could be made in the metalwork room. Easy developments suitable for sheet metalwork.

Theory

A knowledge of the common bench tools, their uses, maintenance, and construction.

An understanding of the principles of the plain lathe, drilling machine, and grinder.

An elementary knowledge of the production and uses of the common metals and alloys generally found in the school metalwork room.

Questions may be asked on any of the materials and processes involved in the practical work.

* First angle projection should be used in all working drawings; these should be in accordance with "Engineering Drawing Practice", B.S. No. 308 : 1953.

Ordinary level—*continued*

Practical

The following basic processes: setting out, cutting, filing, drilling, riveting, the cutting of screw threads by hand; soft soldering, silver soldering, brazing; simple forging, hardening and tempering, annealing and case hardening. Elementary beaten metalwork involving hollowing, simple raising, and planishing. Sheet metalwork—lapped and grooved seams, turned and wired edges.

Simple lathe work. (At the Practical Examination, the Examiner will set an alternative test which will permit a limited number of candidates to use the lathe.)

Advanced level

Candidates will be required to take two basic papers, **A 1** *and* **A 2,** *each of three hours, and a practical examination of four hours.*

A1 Technology

Machine Tools

The lathe: its parts and accessories, including lathe carriers, chucks, face plates, stays (steadies), plain mandrels, and lathe tools; simple and compound trains of gears; speeds and feeds.

Grinders: selection and maintenance of grinding wheels.

Drilling machines: drill chucks, drills, and the machine vice; speeds and feeds.

The use of coolants and lubricants.

Hand Tools

The construction and use of the common hand metalwork tools, together with the following:—

Vices; surface plate and surface gauge; micrometer; vernier caliper; depth gauge; feeler, radius, and thread gauges; dial test indicator; combination tool. Forging tools. Stakes, hammers, and other tools used in sheet metalwork and beaten metalwork.

Materials: the production and the characteristics of the common metals and their principal alloys. The treatment of metals to prevent corrosion.

Advanced level—*continued*

Processes

Fitting, including riveting, screwing, chipping, and scraping. Forging. Sheet metalwork. Beaten metalwork. Casting. Workshop methods of hardening, tempering, annealing, and case hardening. Soft and hard soldering. Brazing. The nature and uses of the different kinds of solders and fluxes and spelter. Rolling and wire drawing.

History

Evolution of the common tools, including the plain lathe, together with a more detailed study of one aspect of the metalworking crafts.

For 1966 the subject for special study will be British Blacksmithing through the ages.

A2 Design and Drawing*

The design and preparation of working drawings of craftwork that could be made in the school metalwork room. The setting out of both full-size and scale drawings in orthographic projection.

The use of free-hand sketches for suggesting and designing craftwork and as a means of illustrating practical details of construction.

Emphasis should be laid upon the types of geometrical problems likely to arise in workshop drawing and setting out. The questions set in the examination will, as far as possible, be closely related to actual workshop practice.

Plane Geometry

The construction of the common rectilineal figures, including regular polygons ; the construction of plain and diagonal scales, methods of enlargement and reduction of rectilineal figures in given proportions. The construction of circles touching lines and circles. The ellipse, tangents, and normals.

* **All drawings should conform to the recommendations of "Engineering Drawing Practice", B.S. No. 308 : 1953. First *or* third angle projection may be used, but a knowledge of both will not be expected.**

Advanced level—*continued*

Solid Geometry

The drawing of plans, elevations, and sections of rectilineal and cylindrical solids projected in their correct relative positions on planes parallel to the main axes of the objects ; auxiliary plans and elevations. The determination of true lengths of lines, of true shapes, and of the magnitude of angles, from plans and elevations of objects of pyramidal form in so far as such data may be necessary for the construction of such objects in metal. Developments based upon the prism, cylinder, pyramid, and cone.

Conventional isometric and oblique projections.

Projections of square and hexagonal nuts and bolts ; the conventional methods of representing screw threads ; the projection of helical curves.

Practical

The processes should include :—

Forging, including the single-handed operations of bending, twisting, drawing down, flattening, and upsetting.

Hardening, tempering, annealing, and case hardening.

Fitting, including riveting and hand threading.

The use of the lathe in plain turning between centres, the use of three-jaw and four-jaw chucks, surfacing, simple taper turning, and boring.

Sheet metalwork: bending, seaming, and the wiring of straight and curved edges, using hand methods only.

Elementary beaten metalwork involving hollowing, raising, and planishing.

Hard and soft soldering. Brazing.

In the Practical Examination, the test will mainly involve the use of hand tools. An alternative test involving the use of the lathe and other machine tools will be set.

Course Work

Examples of the work, including drawings, made by the candidate during the course should be available for inspection by the Examiner at the Practical Examination.

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours, and a practical examination of three hours.*

Theory

An elementary knowledge of

Safety measures.—General precautions including the care of tools, machines, and workshops. Personal safety.

Materials.—The composition, physical properties, and engineering uses of the more common metals and their alloys: cast iron, low and medium carbon steels, copper, brass, bronze, gun metal, light alloys.

Bench work and hand tools.—Selection, care, and uses of hand tools including files, hammers, chisels, punches, hack saws, scrapers, screwdrivers, pliers, wrenches, spanners. The vice. Screw thread production by hand tools. The principles underlying the fitting of parts using rivets, screws, bolts and nuts, studs, dowels.

Marking out.—Use of marking out table, vee block, angle plate, surface gauge, square, rule, centre square, dividers, and scribing tools. The preparation of surfaces for marking out.

Cutting tools.—High carbon and high-speed steels, heat treatment. Single point tools for turning, boring, shaping. Shapes, rake and clearance angles for various materials and operations. Speeds and feeds. Grinding methods for single point tools. Cutting fluids; types, methods of application, and effects.

Machine tools.

(i) Centre lathe—

General features of design and construction, functions. Chucks and other common accessories. Elementary centre, chuck and faceplate work. Taper turning.

(ii) Pillar and sensitive drilling machine—

General features of design, action, methods of holding tools, drills, reamers, countersink, counterbore.

Setting up and holding work; machine vice.

Drills; twist, flat, methods of grinding, angles, effects of faulty grinding.

Ordinary level—*continued*

(iii) Shaping machine—

General description of the shaping machine. Quick return action, clapper box, feeding mechanism.

Types of work carried out and methods used.

(iv) Pedestal or bench grinding machine—

Description of machine, types of wheel, wheel mounting, special precautions to be taken.

The lubrication and care of the machines.

Measurement and inspection.—Micrometer, vernier caliper, types and methods of reading. Simple protractor. Limit gauges, plug, ring, gap (fixed and adjustable). Metric conversions.

Processes.—Soft and hard solders, brazing spelter, compositions and application. Methods of use, temperatures. Fluxes, types and functions. Heat treatment of plain carbon steels including casehardening.

Practice

The following work should be carried out on both ferrous and non-ferrous metals where applicable :—

(*a*) Basic constructional processes. The preparation, marking out, and fitting of two or more mating parts requiring the use of chisels, files, scrapers, drills, reamers, hand taps and dies. All important dimensions to within good class limits.

(*b*) Plain turning between centres and in three- or four-jaw chuck. Drilling, boring, and reaming of work held in the chuck. All work to be to specified limits (fractional and/or decimal) and of good finish. Knurling and parting off. The shaping of flat surfaces, parallel to and/or square to other surfaces. (Candidates will be expected to have used shaping machines during the course but the practical examination will not involve their use.)

(*c*) The production of riveted, soldered, brazed joints using ferrous or non-ferrous metals. Heat treatment of plain carbon steels ; hardening and tempering. The forging of simple hand tools.

During the practical examination candidates' course work should be available for inspection.

39

GEOMETRICAL AND ENGINEERING DRAWING

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

Section A

(i) *Plane Geometry*

Division of a line into equal parts and in a given ratio. Scales. Enlarging and reducing plane figures. Setting out triangles, quadrilaterals, and polygons. Circles and lines in contact; applications to "setting out". Areas of plane rectilinear figures determined graphically and divided into equal areas. Simple problems on loci and paths of points in elementary link work. The ellipse; tangents and normals.

(ii) *Solid Geometry*

Projections of points, lines, and planes excluding oblique planes. Plans and elevations of prisms, pyramids, cylinders, cones, and spheres, and of their sections; true shapes of sections of the above. Development of the surface of pyramids, cylinders, prisms, and right cones. Simple examples of the interpenetration of prisms, pyramids, cylinders, and cones, with development showing lines of interpenetration. Projections of the simple helix and the square-threaded screw. Isometric and oblique drawings of simple plane surfaces and solids without using "isometric scale".

Section B

Engineering Drawing

The making of scale drawings, two or more views, with simple sections of elementary machine parts, e.g. brackets, simple bearings, flanged couplings, pipe joints, valves, etc., from partly dimensioned or incomplete sketches. A knowledge will be expected of simple machine construction such as the proportions of bolts, rivets, keys, riveted joints, etc., to enable pupils to complete a drawing. Free-hand sketching to illustrate machine parts and simple mechanisms.

(Drawings should be in accordance with "Engineering Drawing Practice", B.S. No. 308 : 1953.)

In the examination half-imperial paper will be used.

Advanced level

Candidates will be required to take two papers, **A 1** *of three hours, and* **A 2** *of four hours.*

A1 (i) *Plane Geometry*

Plane figures and the determination of their areas; similar figures. Circles and lines in contact together

Advanced level—*continued*

with applications to problems of "setting out". The construction of the ellipse, the hyperbola, the parabola, the cycloid, the epicycloid, the hypocycloid, and their evolutes; tangents and normals to the curves. Loci of points in mechanisms—Cams.

(ii) *Solid Geometry*

The projections of points, lines, and planes (including the oblique plane); their traces, inclination, and intersection. Development of the surfaces of prisms, pyramids, cylinders, and cones, including the oblique cases. Sections of solids by planes, perpendicular to one of the planes of projection. Interpenetration of any two simple solids, such as prisms, pyramids, cylinders, and cones. The helix and its applications.

Isometric (including the isometric scale) and oblique drawings.

(iii) *Engineering Graphics*

The polygon of forces and the link polygon. Determination of the position of the centroids of plane areas. Force diagrams applied to simple frameworks in two or three dimensions.

Bending moment and shearing force diagrams for loaded horizontal beams (including distributed loads).

A2

*Engineering Drawing**

Conventional methods of representing small engineering parts, e.g. screw threads, nuts, bolts, rivets, etc. Fully dimensioned drawings of simple engineering parts used in mechanical, electrical, or constructional engineering. Free-hand sketching of technical details. Preparing working drawings from sketches and pictorial projections. The drawing of additional views to those given; the conversion of external views to sections and *vice versa*; rearranging views and assembling separate parts into one unit.

40 GEOMETRICAL AND BUILDING DRAWING

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

Section A. As for **Section A** of Geometrical and Engineering Drawing **O** (page 131).

* All drawings should conform to the recommendations of "Engineering Drawing Practice", B.S. No. 308: 1953. Candidates will be expected to be familiar with both first and third angle projection.

Ordinary level—*continued*

Section B

Building Drawing

Practical plane and solid geometry as applied to building problems such as intersections of roofs, ceilings, and other surfaces together with their development. Arch problems, including segmental, elliptical and flat arches, and drawing of mouldings. Working drawings of simple building construction details with plane surfaces, e.g. simple footings, bonding in brickwork, simple details in carpentry, joinery, and plumbing.

(Drawings should be in accordance with "Drawing Office Practice for Architects and Builders", B.S. No. 1192: 1953.)

In the examination half-imperial paper will be used.

41 PRACTICAL PLANE AND SOLID GEOMETRY

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours.*

Plane Geometry

Division of a line into equal parts and in a given ratio. Scales. Enlarging and reducing plane figures. Setting out triangles, quadrilaterals, and polygons. Circles and lines in contact; applications to "setting out". Areas of plane rectilinear figures determined graphically and divided into equal areas. Simple problems on loci. Cycloids and cams and paths of points in elementary link work. The ellipse and involute of a circle with tangents and normals. The Archimedean spiral.

Solid Geometry

Projections of points, lines, and planes (excluding oblique planes), their traces, inclination, and intersection. Plans and elevations of prisms, pyramids, cylinders, cones, and spheres, and of their sections; true shapes of sections of the above. Development of the surface of right and oblique prisms, pyramids, and cylinders; the development of the surface of the right cone. Simple examples involving interpenetration of prisms, pyramids, cylinders, and cones, with development showing the lines of interpenetration. Projections of the simple helix and the square-threaded screw. Isometric and oblique drawings of simple plane surfaces and solids. The making of scale drawings, two or more views, with simple sections of elementary solids, from rough, partly-dimemsioned sketches.

In the examination quarter-imperial paper will be used.

Ordinary Level

Candidates will be required to take one paper, **O,** *of two and a half hours, and a practical examination of three hours.*

During the course attention should be paid to the following :—

The nature and dietary value of different foodstuffs.

The changes taking place in food during cooking.

The planning of meals for a variety of families and for various occasions, taking into consideration different nutritional needs, including those of invalids and convalescents, vegetarians, young children and old people, and persons living alone. Packed meals and the use of commercially prepared foods.

The choice and care of kitchen equipment.

The choice and cost of the foodstuffs used.

The laying of tables and service of meals.

Food hygiene as it affects the production, storage, and sale of food.

Practical work should include the following :—

Soups.—Fresh and dried vegetable soups ; simple meat soups.

Meat.—Boiling, baking, stewing, frying, and grilling.

Fish.—Steaming, baking, frying, and grilling.

Vegetables.—The usual root and green vegetables, including raw and cooked salads with a simple dressing. Various ways of cooking potatoes should be taught.

Casserole Cookery.

Sauces and Gravies.—Simple miscellaneous sauces, savoury and sweet ; thick and thin gravies.

Batters.

Puddings.—Steamed and baked puddings of the suet and sponge varieties.

Milk Puddings.—Whole grain, crushed grain, and moulds. Egg custards.

Bread.—Bread and rolls made with yeast.

Cakes, Biscuits, and Scones.—A variety of cakes made from simple foundation recipes using rubbed, creamed, and melted fat, and including plain biscuits.

Pastry Making.—Suet crust as applied to meat, fruit, and jam puddings. Short crust for jam and fruit tarts and pies. Flaky pastry for sausage rolls.

Ordinary Level—*continued*

Breakfast and Supper Dishes.—The cooking and serving of porridge, simple egg dishes, and such dishes as bacon, haddock, sausages, and kidneys.

Meatless Dishes.—Cheese dishes and salads.

Beverages.—The making and serving of tea, coffee, and cocoa.

Practical Examination

The practical test will be of three hours' duration. Candidates will be required to prepare and serve specified dishes or meals. Recipe books may be referred to during the practical test.

43 DRESSMAKING

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours, and a practical examination of two and a quarter hours.*

The study of the needs of the individual with particular attention to clothes in relation to colour, style, and occasion.

Materials.

A knowledge of the properties and prices of materials.

Cutting Out

The adaptation and use of commercial patterns.

The various stitches and processes used in needlework for the construction and decoration of modern garments for children and girls.

Stitches

Running, tacking, hemming, seaming, herring-bone, machine-stitching, loopstitch, buttonhole stitch, and decorative stitches.

Processes

Methods of neatening edges.

Methods of joining edges.

Methods of taking in fullness—pleats, tucks, gathers, and darts.

Ordinary level—*continued*

Sewing on of tapes and buttons; eyelet holes; loops; worked button-holes; cutting "on the cross" and facing and binding with crossway strips; openings, including slide fasteners.

The use, care and cleaning of the sewing machine.

Repair Work

Good grooming—care and maintenance of clothes. Machine darning applied to household articles. Use of commercial aids for repairs. Patching, including a patch on plain or figured material.

Practical Examination

At the practical examination, candidates will be required to use commercial paper patterns, and to cut out and make up a specified section of a garment.

Candidates will be required to show the following work done during the course :—

(*a*) Two garments showing a reasonable amount of handwork and machine work; one of these should include a set-in sleeve.

(*b*) One example of repair work done on a garment.

44 HOMECRAFT

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours.*

Candidates must satisfy the Examiners in the Physiology Section as well as in the Paper as a whole, and the treatment of the subject should be based, as far as possible, on observation and experiment.

A. *The Body.*—The general structure of the human body; the boundaries and contents of the various body cavities; bones, muscle, skin, hair, teeth. An elementary knowledge of the chief organs and processes concerned with respiration, circulation and digestion. Excretion by means of lungs and skin.

Ordinary level—*continued*

B. *Personal Hygiene.*—Healthy and unhealthy habits. Exercise. Fresh air. Deep breathing. Rest. Sleep. Bathing. Care of eyes, skin, hair and teeth. Importance of cleanliness in person and clothing. Evils of tight clothing.

C. *Food.*—Classification of foods according to their chief constituents; their respective effects on the body. Theory of cooking; changes produced in different types of food by varying degrees of heat; effects on digestion. Suitable foods, natural and artificial, for infants. Adulteration of foods; how it can be detected in certain cases. The larder and preservation of food. Importance of precautions against infection; care of vessels; temperature; flies. Functions of various beverages and dangers from misuse.

D. *Lighting, Ventilation, and Heating.*—The importance of sunlight in dwelling houses. Different forms of artificial light and their respective merits and defects. The composition of the air shown by simple experiments. How air becomes foul. Movement of air caused by unequal temperatures. Natural and mechanical ventilation. Relative advantages of different methods of heating rooms.

E. *Water.*—Sources of water supply; hard and soft waters and their action on pipes. Nature of dangerous impurities. Filters and other means of purifying water for drinking purposes. Materials added to water for washing clothes; explanation of the action of each.

F. *The Home.*—Ways by which the home can be kept in a sanitary condition. Measures for securing cleanliness. Disposal of refuse. Drainage; safe and unsafe systems; testing of drains. Avoidance of waste. Labour-saving devices. Advantages of a garden in the household economy. Importance of neatness and taste in the general arrangements of the home; suitable decorations; orderly service of meals; flowers.

G. *Diseases.*—Simple ways of combating tuberculosis. Prevention of spread of epidemic diseases, such as scarlet fever, measles, whooping cough and diphtheria. Common disinfectants and antiseptics and the methods of applying them.

Ordinary level—*contiuued*

H. *Accidents.*—Immediate measures to be taken in case of clothes catching fire, burns or scalds, cuts, fainting fits, fractures.

45 DOMESTIC SUBJECTS

Advanced level

Candidates must offer paper **A 1** *together with one or both of the following* :—

(1) *Paper* **A 2** *and a practical examination in Cookery* ;

(2) *Paper* **A 3** *and a practical examination in Needlework and Dressmaking.*

Each of the written and practical examinations will be of three hours' duration. The certificate awarded to a successful candidate will indicate whether she has satisfied the examiners in Cookery and/or Needlework and Dressmaking.

A 1. *General Paper*

1. *The Home*

Environment. Rent or purchase of accommodation, mortgages. Insurance ; household, personal, and third party risk. Use of bank account. The home budget ; advantages and disadvantages of hire purchase ; simple household accounts.

Lighting, heating, ventilation, importance of pure water supply. Hard and soft water, hot-water systems. Soap and detergents. Disposal of refuse.

Design, furnishing, and equipment in the home. Selection and care of surfaces.

2. *Welfare of the Family.*

Outline study of common infectious diseases, prevention of infection. Inoculation and immunity. Control of household pests.

Accidents in the home and how to deal with them ; main causes of accidents, and preventive measures.

Legislation concerning bacterial contamination, food sales and service in public places. Clean milk production. Labelling orders.

3. *Home and its relation with the community including the development of the present-day statutory and voluntary services.*

(*a*) Central and Local Government departments concerned with social services.

(*b*) National Health Service. Specialist and hospital services, district nurse, health visitor, home help.

(*c*) National Insurance contributions and benefits. National Assistance.

(*d*) Maternity and Child Welfare.

(*e*) The School Health Service.

(*f*) Voluntary Social Services.

A 2. *Cookery and Nutrition*

It will be assumed that candidates possess an adequate knowledge of the subject matter of the schedule in Cookery at the Ordinary level.

(1) Essential constituents of a balanced diet. Diets in relation to age, work, health, and seasons. Effects of enzymes, acids, alkalis, and cooking processes on the nutritional value of foods.

(2) Choice and purchase of foods in season. Use of fresh and dried foods, frozen and tinned foods, prepacked foods, their advantages and disadvantages. Importance and general principles of food and kitchen hygiene including food storage. Principles and practice of home preservation of food.

(3) Modern cooking appliances and equipment, including pressure and automatic cookers. Suitability for purpose, control, and care. A brief reference should be made to infra-red grills and electronic cooking. Safety precautions in the kitchen.

Practical work should include the following :—

Simple hors d'oeuvres, simple fish entrées, poultry, use of less common vegetables, e.g. celery, artichokes, and leeks, and interesting methods of serving potatoes, e.g. croquettes and duchesse. Variety in salads and salad dressings, sweet and savoury flans, meringue topped sweets, choux pastry, Genoese sponge, yeast mixtures.

Practical Examination

Candidates will be expected, within the scope of the test set, to choose, plan, cook, and serve an attractive well-balanced meal.

A 3. *Needlework and Dressmaking*

It will be assumed that candidates possess an adequate knowledge of the subject matter of the schedule in Dressmaking at the Ordinary level.

(1) The study of fabrics and the fibres from which they are woven. The identification of natural and man-made fibres. Reactions to heat, to washing, and to reagents used for cleaning and removing stains. Properties of fabrics, due to fibres, weave or finish, affecting their suitability for clothing and household uses.

(2) Choice and care of equipment used in needlework and dressmaking, including (*a*) the sewing machine (with simple attachments), and (*b*) pressing equipment.

(3) The use and adaptation of commercial patterns for under and outer garments for infants, children, and the candidate.

(4) Cutting out, preparing, fitting, and making up of garments mentioned in (3). All processes used in dressmaking (excluding tailoring). Suitable methods of decorating (*a*) infants' and children's garments, and (*b*) underwear.

(5) The study of clothes. Budgeting. Relative values of home-made and ready-made clothes. Selection of colour schemes, accessories, and footwear suitable to the individual and to the occasion.

(6) Simple soft furnishings for the home; curtains, pelmets, and cushion covers.

Practical Examination

During the three-hour practical examination the candidate will be required to make up part of a garment. Candidates must show the following made during the course :—

(i) A woollen dress or blouse and skirt or simple suit to fit the candidate and to be modelled at the examination.

(ii) An undergarment for the candidate, or a baby's gown or a child's dress or a small boy's suit, showing handwork.

(iii) A simple piece of soft furnishing.

46 COMMERCE

Ordinary level

Candidates will be required to take one paper, **O,** *of two and a half hours.*

The paper will test the candidates' general knowledge of the structure and function of commerce associated with home and foreign trade. It is realized that the candidates' own

Ordinary level—*continued*

experience is limited, but candidates are expected to have had the kind of experience involved in the carrying out of carefully selected projects, in organized visits to business houses, and in the use of standard works of reference, Government publications, trade reports, etc. Candidates are expected to have acquired the habit of verification and guarded statement and to understand the extent to which business structure depends on the good faith of all concerned. Where questions which involve calculation are set, the arithmetical work is subordinate to the commercial principles involved.

1. *Introduction*

The complexity of the processes by which human wants are satisfied. The interdependence of individuals and communities ; the effects of transport and invention upon the distribution of industry.

2. *Commerce*

Those activities concerned with distribution so that goods and services are obtained economically. The classification of such activities under Trade, Communications, Transport, Finance, Insurance ; the interdependence of these activities.

3. *Trade*

The outcome of specialization ; the limitations of barter and the introduction of media of exchange. The purpose and subdivisions of trade.

(*a*) *Home and foreign trade.* Purposes of each ; similarities and differences between them.

(*b*) *Home trade* as trade between members of the same customs area. The channels of distribution—direct selling by producer to consumer, the services of middlemen : retailers, wholesale merchants and agents ; the commercial aspects of industry (including in the term "industry" agriculture, mining, fisheries).

(i) *Retail trade.* Functions of the retailer ; the main characteristics and the reasons for the existence of the different forms of retailers : the independent retailer, manufacturers' retail agents, department stores, chain stores and multiple shops, consumers' co-operative societies, mail order ; the local market : its organization and function. The emergence of, and reasons for, modern trends such as branding and packaging of proprietary articles, price maintenance, self-service,

Ordinary level—*continued*

after-sales service ; the effects of such trends. The growth of credit sales and of hire purchase, the nature, advantages, and disadvantages of hire purchase. Elementary treatment of retail traders' associations : their emergence and functions.

(ii) *Wholesale trade.* Functions of the wholesale merchant, brokers, and factors. The forces making for their elimination and survival. The Co-operative Wholesale Society. Organization of a wholesale warehouse. Function and operation of organized wholesale markets. Manufacturers' depots.

(iii) *Transactions between wholesalers and retailers.* Their development and record ; the function of the main documents—price list or quotation, order, invoice, debit note, credit note, receipt, statement of account ; the importance of trade discount and cash discount.

(*c*) *Foreign trade* as trade between members of different customs areas. The work of H.M. Customs and of the Board of Trade (Export Services Branch, Export Credits Guarantee Department). The middlemen of foreign trade ; the importance of warehousing in general and of bonded warehouses in particular ; the main documents, including documents of title : their functions. Methods of promoting exports.

4. *Communications and Transport*

(*a*) The necessity for rapid and accurate communications.

(*b*) The Post Office as a means of communication : the introduction and effects of cheap postage, the telegraph, telephone, cable, wireless.

(*c*) Development of transport by road, canal, sea, rail, air; the characteristics of each method and the circumstances under which it is to be preferred. The functions of the main documents in the transport of goods.

5. *Finance*

(*a*) *Means of payment.* Cash, postal orders, money orders, offsettings, cheques. The emergence of modern banking and the growth in the use of cheques ; the form and characteristics of cheques ; crossings and endorsements ; the operations of bankers' clearing houses ; the path of the cheque in a simple transaction.

(*b*) *Necessity for finance.* Growth of credit and of large-scale operations, the lengthening of the chain of processes between the primary producer and final consumer.

Ordinary level—*continued*

(*c*) *Provision of finance by the different forms of the business unit.* The sole trader, partnership, private and public limited liability companies, the co-operative society, public utility corporations. The distinguishing features of each of these with special reference to ownership and allocation of profits or surplus.

(*d*) *Provision of finance by banks.* Current accounts and deposit accounts ; finance of trade by bank advances (loans and overdrafts) ; the importance of documentary credits in the finance of foreign trade. The finance of hire purchase by banks and special finance corporations.

(*e*) *The function of the Stock Exchange.* As a market for the transfer of ownership of capital rights in securities (stocks and shares) and in facilitating the raising of new capital.

(*f*) *The main financial aspects of the individual business unit.* Capital owned by the unit and the capital employed by it ; fixed assets, current assets, short-term and long-term liabilities ; working capital : its meaning and importance ; gross and net profits and their relation to turnover and rate of stock turn ; relation of net profits to capital invested.

6. *Insurance*

Risks of business and the distinction between those which are insurable and non-insurable, the insurable being those which may be pooled, spread, and, as a result of statistical calculation, classified. Essentials of a contract of insurance —indemnity, insurable interest, utmost good faith. Comparison of the organization of Lloyd's and of insurance companies ; the functions of brokers, underwriters, and agents.

7. *Advertising*

Purpose ; devices ; dangers.

47 ACCOUNTS

Ordinary level

Candidates will be required to take one paper, **O,** *of three hours.*

The purpose of accounting : recording and calculating assets and liabilities and the results of transactions over a period, in making provision for the future, and serving as a means of control—a general aid to efficiency.

Recording of transactions. Sources of information for the compilation of accounts ; the original documents which are the basis of subsidiary books and of their modern equivalents ; columnar books.

Ordinary level—*continued*

Cash books ; analysis columns ; bank current account, bank deposit account, overdraft and bank loan, bank statement and bank reconciliation statement ; receipts and payments account.

The ledger as the main book of account : posting, folios, balancing ; the statement of account ; interpretation of ledger accounts. The trial balance : its compilation, uses, and limitations. Division of the ledger ; sectional balancing ; control accounts.

Results of transactions over a period. Income and expenditure ; distinction between capital and revenue income and expenditure. The nature, measurement, and allocation of profit ; profit as an increase in the net value of assets (and loss as a decrease in such value) ; bases of valuation of assets (including goodwill) and liabilities ; effect of the bases chosen on profit (or loss). Reserves and provisions : distinction between them ; general reserve, provision for bad debts and for discounts ; accrued and prepaid expenses ; the problem of, and provision for, depreciation. Availability of profit for distribution to proprietors or for increasing capital. Simple problems in the preparation of accounts from incomplete records.

Accounting as an instrument of control. Preparation, interpretation, and comparisons of trading and profit and loss accounts (and of income and expenditure accounts) and balance sheets. The use of percentages in such comparisons. The structure and inter-relationship of the parts of a balance sheet and its connections with items in the trading and profit and loss (and income and expenditure) accounts. Interpretation of balance sheet to ascertain capital owned, capital employed, current and fixed assets, short-term and long-term liabilities, working capital, solvency.

Application of the foregoing to the affairs of a household and of non-trading associations, and to those of commercial and manufacturing enterprises, including those of sole traders, partnerships, and, in a simplified form, of joint stock companies. Attention should be paid to the allocation of profit and in the case of joint stock companies, to the various forms of capital.

Questions will not be set on bills of exchange (other than cheques), consignments, joint ventures, or, except in an elementary form, on joint stock companies. Candidates should be able to deal with the admission of new partners,

Ordinary level—*continued*

and with the purchase and sale of a business by a sole trader or partnership, but they will not be required to deal with the dissolution of a partnership. In dealing with joint stock companies in a simplified form, the questions will be restricted to the Appropriation Account in an elementary form, the analysis of a simple balance sheet, the distinction between Nominal, Authorized, and Paid-up Capital, and between Debentures, Preference, Ordinary, and Deferred Shares.

GENERAL CERTIFICATE OF EDUCATION, 1967

Advanced level

1. Lists of books prescribed in **English, Welsh** (**Home Language**), **Welsh** (**Modern Language**), **Greek, Latin, French, German,** and **Spanish.**
2. Schedule in **Scripture Knowledge.**
3. Prescribed works in **Music.**

ENGLISH

A 1

Set Books

Chaucer : *The Prologue to the Canterbury Tales* and *The Nun's Priest's Tale.*

Shakespeare : *The Winter's Tale* and *King Lear.*

Milton : *Paradise Lost,* Book I and *Comus.*

Wordsworth : *Selections* (ed. B. I. Evans).

A 2

Candidates will be required to study four books, **one** from each of the sections A, B, C, D given below. In the examination, candidates will be asked to answer a compulsory question on practical criticism together with three other questions of which not more than **one** may be taken from any section.

Section A, Poetry

(1) *Eight Metaphysical Poets* (ed. Dalglish ; Heinemann).

(2) Dryden : *Absalom and Achitophel,* Part I.

(3) Browning : *Men and Women,* Vol. I.

(4) Hopkins : *Selected Poems* (ed. Reeves ; Heinemann).

Section B, Drama

(1) Marlowe : *Doctor Faustus.*

(2) Sheridan : *The Rivals* and *The School for Scandal.*

(3) Sean O'Casey : *Juno and the Paycock.*

(4) T. S. Eliot : *Murder in the Cathedral.*

Section C, Fiction (Novel form)

(1) Jane Austen : *Pride and Prejudice.*

(2) Dickens : *Great Expectations.*

(3) Hardy : *The Mayor of Casterbridge.*

(4) Forster : *A Passage to India.*

Section D, Discursive Prose

(1) *English Critical Essays* (selected by E. D. Jones ; World's Classics, O.U.P.), Vol. 1—Sixteenth to Eighteenth Centuries ; the following essays only :—
Sir Philip Sidney : *An Apologie for Poetry.*
Sir Francis Bacon : *The Nature of Poetry.*

(2) *English Critical Essays* (selected by E. D. Jones ; World's Classics, O.U.P.), Vol. 1—Sixteenth to Eighteenth Centuries ; the following essays only :—
Dryden : *Preface to the Fables.*
Johnson : *Dryden as Critic and Poet.*

(3) Hazlitt : *The Spirit of the Age* (Everyman Library).

(4) *A Book of Modern Prose* (ed. D. Brown ; Harrap).

WELSH (Home Language)

A 1

(1) *Chwedlau Odo* (gol. Syr Ifor Williams : Gwasg Prifysgol Cymru).

(2) Ellis Wynne : *Gweledigaeth Uffern.*

(3) D. J. Williams : *Hen Dŷ Ffarm* (Gwasg Aberystwyth), tt. 13–99.

(4) *Blodeugerdd o'r Ddeunawfed Ganrif* (gol. D. Gwenallt Jones : Gwasg Prifysgol Cymru), rhifau XII, XIII, XIV, XVI, XVIII.

(5) T. H. Parry-Williams : *Cerddi* (Gwasg Aberystwyth).

A 2

(1) *Erthyglau a Llythyrau Emrys ap Iwan*, II (gol. D. M. Lloyd ; Clwb Llyfrau Cymreig, Gwasg Aberystwyth), tt. 45–169.

(2) W. J. Gruffydd : *Hen Atgofion* (Gwasg Aberystwyth).

(3) Huw Lloyd Edwards : *Y Gŵr o Wlad Us* (Gwasg Gee).

(4) E. Tegla Davies : *Gŵr Penybryn* (Gwasg Gee).

(5) Islwyn Ffowc Ellis : *Cyn Oeri'r Gwaed* (Gwasg Aberystwyth).

(6) D. Gwenallt Jones : *Ysgubau'r Awen* (Gwasg Aberystwyth).

(7) T. S. Eliot : *Lladd wrth yr Allor* (cyf. Thomas Parry : Llyfrau'r Dryw).

(8) Daniel Owen : *Enoc Huws* (argraffiad gwreiddiol neu ddiwygiedig).

WELSH (Modern Language)

Set Books

(1) W. J. Gruffydd : *Hen Atgofion* (Gwasg Aberystwyth).

(2) Islwyn Ffowc Ellis : *Cyn Deri'r Gwaed* (Gwasg Aberystwyth).

(3) T. H. Parry-Williams : *Cerddi* (Gwasg Aberystwyth).

(4) Daniel Owen : *Enoc Huws* (argraffiad gwreiddiol neu ddiwygiedig).

GREEK

A 1

Set Books

(1) *Either* Homer, *Odyssey* XIX–XX,

or Euripides, *Troiades*.

(2) *Either* Herodotus, Book II (ed. W. G. Waddell : Methuen), 1–5, 33–98, and 112–20.

or Plato, *Republic* I.

A 3

Greek Literature

List of works for reading partly in the original and partly in translation :—

Homer, *Iliad* XI and XII
Aeschylus, *Seven against Thebes*
Aristophanes, *Frogs*
Thucydides, Book I.
Lysias, *Orationes* (ed. E. S. Shuckburgh : Macmillan) : V and X.
Menander, *Dyskolos*.

LATIN

A 1

Set Books

(1) *Either* Sallust, *Catiline* (ed. W. C. Summers : Pitt Press),
or Pliny, *Selected Letters* (ed. G. B. Allen : Clarendon Press).

(2) *Either* Virgil, *Aeneid* I (passages for comment will not be set from lines 643 to end),
or Horace, *Epistle I*, Nos. 1, 2, 5, 6, 7, 10, 11, 14, 16, 17, and 18 (passages for comment will not be set from Nos. 10 and 14).

A 3

Latin Literature

The following authors :—

Cicero, Tacitus, Virgil, Lucretius, and Terence ; with special reference to Cicero, *Pro Milone* ; Tacitus, *Annals* I (Chapters 16–71) ; Virgil, *Eclogues I, V and IX* and *Georgics IV* ; Lucretius, Book V ; Terence, *Adelphi* and *Andria*.

FRENCH

(1) *Twelve French Poets* (ed. D. Parmée ; Longmans, Green and Co.). The poems of Vigny, Hugo, Leconte de Lisle, Baudelaire.

(2) *Either* Molière : *L'Avare*
or Beaumarchais : *Barbier de Séville*.
Any complete edition.

(3) *Either* Mauriac : *Le Mystère Frontenac* (ed. A. M. C. Wilcox : Harrap),
or H. Troyat : *La tête sur les épaules* (ed. J. S. Wood, U.L.P.).

(4) *Either* Anouilh : *Becket* (ed. W. D. Howarth ; Harrap),
or Pagnol : *La gloire de mon père* (ed. J. Marks ; Harrap).

GERMAN

(1) *Either* Goethe : *Torquato Tasso,*
or Schiller : *Maria Stuart.*

(2) *The Harrap Anthology of German Poetry* (ed. Closs and Williams).

The following poems :—

Goethe : *Heidenröslein, Mailied, Der König in Thule, Prometheus, Ganymed, Auf dem See, Wanderers Nachtlied, An den Mond, Grenzen der Menschheit, Erlkönig, Mignon I and II, Trilogie der Leidenschaft* (An Werther, Marienbader Elegie, Aussöhnung),

together with those of Platen, Morike (omitting *Peregrina,* and *Erinna an Sappho*), Hebbel, Liliencron (omitting *Pidder Lüng*), Trakl, and Weinheber.

(3) *Either* Grillparzer : *Der arme Spielmann,*
or Mörike : *Mozart auf der Reise nach Prag.*

(4) *Either* Fritz Hochwälder : *Das heilige Experiment,*
or Thomas Mann : *Tonio Kröger.*

SPANISH

(1) Quevedo : *Historia de la vida del buscón.*

(2) *Either* Gil Vicente, *Obras dramáticas castellanas* (Clásicos Castellanos) : *La Sibila Casandra* and *Los Cuatro Tiempos ;*

or García Lorca, *La Zapatera prodigiosa* (Harrap).

(3) *Either Antología de la poesía española contemporánea* (ed. Clásicos Ebro), the poems by : Antonio Machado, Juan Ramón Jiménez, Jorge Guillén, Dámaso Alonso, Federico García Lorca, Rafael Alberti, Luis Cernuda, and Miguel Hernández,

or The Harrap Anthology of Spanish Poetry : Villasandino, *Cantiga* (pp. 145–47) ; Santillana (omitting *Canción* and *La comediéta de Ponza*); Jorge Manrique, *Coplas* ; and poems by Garcilaso de la Vega, Fray Luis de León, Fernando de Herrera, San Juan de la Cruz, Luis de Góngora, Lope de Vega, Francisco de Quevedo.

(4) *Either* C. J. Cela : *Viaje a la Alcarria* (Harrap),

or J. L. Borges : *Ficciones* (Emecé, Buenos Aires) : *Tlön, Uqbar . . ., La lotería en Babilonia,* and the stories in the section *Artificios,* omitting *El fin* and *La secta del Fénix.*

SCRIPTURE KNOWLEDGE

A 1

Old Testament (as for 1965 and 1966).

A 2

New Testament

The history, religion, and literature of the New Testament with special reference to :—

Either (*a*) (i) the Gospel according to St. John,

(ii) I Corinthians, chapters viii–xv ; Galatians ; and Hebrews, chapters i–v,

or (*b*) I Corinthians, chapters viii–xv; Galatians; and Hebrews, chapters i–v ; with a study of the Greek text of St. John ix–xxi.

MUSIC

A 2	*Set Work*	*Associated Topic*
J. S. Bach	Jesu meine Freude	The Church cantatas and motets of J. S. Bach.
Beethoven	String Quartet in E flat major, Op. 74, "The Harp"	String quartets of the Viennese period (1755–1810).
Brahms . .	Symphony No. 2 in D, Op. 73	The symphonies of Brahms and Schumann.
Bartók . .	Music for Strings, Percussion and Celesta	The instrumental music of Bela Bartók.

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