



OXFORD AND CAMBRIDGE
SCHOOLS EXAMINATION BOARD

REGULATIONS FOR
CERTIFICATE
EXAMINATIONS

FOR THE YEAR

1966

Internationales Schulbuchinstitut

Braunschweig

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Oxford and Cambridge Schools Examination Board

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SUBJECTS OF THE GENERAL CERTIFICATE EXAMINATION

In the following table **A** indicates an **A** level subject for which a Special paper is set, **A†** an **A** level subject for which there is no Special paper, **O** an **O** level subject, and **O*** a subject at Alternative Ordinary level. The page numbers indicate where the syllabuses may be found.

<i>Subject</i>				<i>Pages</i>
Latin of Classical Studies	A			14
Greek	A	O		14, 81
Ancient History	A†	O		15, 78
Latin of Modern Studies	A			16
Latin Translation and Roman History	A†			16
Latin		O	O*	80, 60
General Classics		O		82
French	A	O	O*	16, 82, 60
German	A	O	O*	16, 82, 60
Spanish	A	O	O*	16, 82, 60
Italian	A†	O		16, 82
Russian	A†	O		19, 82
Arabic (July only)	A†	O		20, 83
Welsh (July only)		O		82
Irish (July only)		O		82
English (Literature)	A	O	O*	20, 77, 61
English Language		O		76
History	A	O		21, 77
History with Foreign Texts	A			23
English History			O*	61
European History			O*	62
Geography	A	O	O*	24, 78, 62
Economic and Political Studies	A			25
British Constitution			O*	62
British Economic Organization			O*	62
Music	A	O		27, 105
Art	A†	O		30, 108
Divinity	A†			32
Scripture Knowledge		O	O*	75, 73
Mathematics and Higher Mathematics	A			34
Mathematics for Science	A			37
Mathematics with Statistics	A†			39

4 *Subjects of the General Certificate Examination*

<i>Subject</i>			<i>Pages</i>
Statistics		0*	63
Elementary Mathematics	0		85
Additional Mathematics	0		87
General Mathematics		0*	63
Applied Mechanics	A		57
Physics	A	0	40, 89
Chemistry	A	0	43, 93
Physics-with-Chemistry		0	95
General Science		0	97
Zoology	A		47
Botany	A	0	47, 103
Biology	A	0	0* 47, 101, 64
Geology	A†		55
Physical Geography and Elementary Geology		0*	72
History of Science		0*	65
Geometrical and Mechanical Drawing	0		108
Handicraft	0		109
Domestic Subjects (July only)	0		111
Navigation		0*	73
General Paper	0		59

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10 Trumpington Street,
Cambridge.

ARTICLE OF AGREEMENT made 8 Nov. 1873 between
the Schools Examination Delegacy of the UNIVERSITY
OF OXFORD and the Schools Examination Syndicate of
the UNIVERSITY OF CAMBRIDGE as amended 21 Feb.
1914:

In accordance with the provisions hereinafter contained the Schools Examination Delegacy of the University of Oxford and the Schools Examination Syndicate of the University of Cambridge shall act in concert.

- (1) A Board shall be formed consisting of all the members of the Delegacy (except the Proctors) and of the Syndicate, and shall be called 'the Oxford and Cambridge Schools Examination Board'.
- (2) The Board shall have power,
 - (A) To make regulations respecting its own proceedings; the time and place of its first meeting being settled by arrangement between the Vice-Chancellors of the two Universities.
 - (B) To appoint a standing Committee composed of not less than four of its members, an equal number being nominated by the Delegacy and the Syndicate respectively, and to assign to the Committee such duties as it may think fit.
 - (C) To assign to the Secretaries who are to be appointed by the Delegacy and the Syndicate respectively such duties and salaries as it may think fit.
 - (D) To make regulations respecting the examination of Schools and the duties and remuneration of Examiners: and to appoint Examiners upon the nomination of the Delegacy and the Syndicate respectively; provided that as far as possible an equal number of Examiners shall be appointed from each University.
 - (E) To make regulations respecting the granting of Certificates to persons examined under its authority, such Certificates to be granted under such conditions, as regards the persons who are to be admitted as Candidates, as may be approved by the Delegacy and the Syndicate; provided that, so long as the Board grants Certificates only to boys at school, it shall be competent either to the Delegacy or to the Syndicate, acting separately, to examine and grant Certificates to other Candidates.
- (3) The Board shall every year draw up a report of its proceedings, which shall be presented by the Delegacy and the Syndicate to their respective Universities.
- (4) Either the Delegacy or the Syndicate shall be at liberty at any time to withdraw from the Board after giving a year's notice.

(Signed) H. G. LIDDELL,

Vice-Chancellor of the University of Oxford.

H. W. COOKSON,

Vice-Chancellor of the University of Cambridge.

INTRODUCTORY

THE Joint Board of the Universities of Oxford and Cambridge was established in 1873 to inspect and examine schools preparing pupils for those Universities and to grant Certificates on the results of the Examination.

APPLICATION to the Board for the holding of an examination at a school may be made by any school that has a regularly constituted Governing Body, or prepares a fair proportion of its scholars for the Universities, or has been approved by the Board for this purpose.

All letters should be addressed to **The Secretary**, either at **Elsfield Way, Oxford**; or at **10 Trumpington Street, Cambridge**.

REGULATIONS FOR THE GENERAL CERTIFICATE EXAMINATION

The Board conducts the General Certificate Examination at two levels, Advanced (**A**) level and Ordinary (**O**) level. **A** level is normally taken by candidates after two years in the sixth form and **O** level by candidates at the age of about 16, prior to entering the sixth form.

In most subjects at **A** level, optional Special (**S**) papers, designed to provide additional information about the abler candidates for the benefit of those universities which may wish to make use of it, are also set. *In any one examination **S** papers may be offered in not more than two subjects.*

Subjects at Alternative Ordinary (**AO**) level, of the same standard and status as the **O** level, are primarily intended to meet the needs of sixth formers but are not confined to them.

1. *Dates of Examinations*

The examinations will be arranged to end as follows: Advanced level—the Saturday next but two before the first Monday in August; Ordinary levels—the Wednesday next

but one before the first Monday in August, and the Thursday falling on one of the days between the 10th and 16th December inclusive.

For 1966:

A level.

Monday, 4 July–Saturday, 16 July 1966.

AO and **O** levels.

Monday, 4 July–Wednesday, 20 July 1966.

O level only.

Thursday, 1 December–Thursday, 15 December 1966.

2. *Application and Entry for the G.C.E.*

Application must be made to one of the Secretaries before 1 February for the Summer examinations, and before 1 October for the December examination.

The names of candidates shall be sent in, on forms supplied by the Secretaries, not later than 12 March for the Summer examinations, and 21 October for the December examination, accompanied by the fees payable by the candidates.

The Board reserves the right of declining to entertain any application.

Additional entries or alterations to existing entries, which should be kept to a minimum, can be accepted until 1 May, when the lists of candidates go to press. Changes after that date can be accepted only in exceptional circumstances, with the approval of one of the Secretaries, and will be liable to an additional late fee of £2.

3. *External Candidates*

Applications from External candidates **will not be accepted after 1 March** for the Summer examinations, and **1 October** for the December examination.

Candidates who have previously attended for not less than two years a school examined by the Board should make arrangements with the Head Master or Head Mistress of their former school to be allowed to return for the examinations. If this is not possible, the permission of the Head Master or Head Mistress of another school taking the Board's Examinations must be obtained.

A pupil still in attendance at one of the Board's approved schools will not be accepted as an External candidate.

4. Alternative Syllabuses and Papers

Applications for the approval of the Board of papers on alternative books, periods, or syllabuses, in any subject in the General Certificate Examination, must reach one of the Secretaries by 1 October 1965 for the 1966 Examinations. When, however, a choice of prescribed books is provided in the Regulations, it is hoped that alternatives will not be submitted, except for cogent reasons, in view of the burden placed on the Awarders in setting additional papers. Requests for alternative papers on the regular syllabuses to be set at different times from those specified in the time-table must also be sent by the same dates. The extra expense of alternative papers shall be defrayed by the school authorities, and the copyright thereof shall be reserved to the Board.

Alternative papers shall not be of an easier character than the corresponding regular papers.

5. Literacy and Legibility

Every candidate is required to answer the questions in such a manner as to satisfy the examiners that he has an adequate knowledge of English Grammar and Orthography, and is also required to write a good and legible hand.

Candidates may be penalized for bad presentation and for illiteracy or illegibility, in extreme cases to the extent of failing in the subject.

6. Conduct of Examinations

The Head Master shall be responsible for the proper conduct of the examination. A declaration that the regulations have been duly kept shall be signed by all who take part in the supervision of an examination.

A time-table will be sent to the Head Master and all papers shall be set on the dates specified. Any paper taken by more than one group of candidates must be set to all at the same hour.

No candidate shall be permitted to enter the examination room more than half an hour after a paper has been given out; and no candidate shall be permitted to leave the room until half an hour has elapsed from the time at which the paper has been given out.

Candidates shall be required to sit in the order of their index-numbers.

It is the duty of the Head Master to report to the Board all cases of irregularity or misconduct in the examination and he shall have power to discontinue the examination of any candidate who may misconduct himself.

A candidate found guilty of dishonesty in connexion with the examination will be disqualified in the entire examination.

Exceptional circumstances, considered likely to prejudice a candidate's performance, should be notified to the Board without delay.

Further instructions on matters of detail will be sent to each school shortly before the examination.

7. *Results*

Results in **A** level subjects will be issued in grades: A, B, C, D, or E, representing an **A** level pass in decreasing order of merit, O an **O** level pass, and F failure. The **S** papers will be graded separately: 1. Distinction, 2. Merit, U. Unclassified. A candidate will qualify for grades 1 or 2 only if he has reached one of the three grades A, B, or C on the **A** papers in that subject and in the same examination. With the exception of F and U these grades will be recorded on Certificates. No marks for the **A** and **S** papers will be issued.

For the **O** level subjects the lists sent to schools will show the result, pass or fail, for each subject. At a later stage, a list of marks for the separate **O** level papers will follow.

8. *Reports*

Provided that application is made before 1 May, the Board will supply reports on individual papers.

The fee for each report will be 10s.

9. <i>Fees</i>	£	s.	d.
Entrance Fee		10	0
For each subject at A level	1	10	0
For each subject at A level with Special paper	2	5	0
For each subject at O or AO level (including the General Paper).		10	0
For each report, per paper		10	0

External candidates who have received permission to take a Certificate Examination may be charged by the authorities

of a school an additional fee to cover the expenses involved.

If a candidate withdraws from the entire examination before the lists of names are sent to press, on 1 May, the whole fee will be refunded.

If complete withdrawal is notified later, the entrance fee only will be retained.

If a candidate withdraws from part of the examination after the lists have gone to press, no refund can be made.

The travelling expenses of an examiner sent to a school shall, in general, be paid by the school, and the school shall provide for his entertainment. No charge will be made for the travelling expenses of an examiner visiting a school in England for the practical examinations in Science at **A** level, or for an oral examination in a modern language, at which at least ten candidates are presented.

A fee of 2s. will be charged for each statement (other than the Certificate itself) of a candidate's performance in a Certificate Examination, such as may be required by bodies granting exemption. The fee should be sent to the Secretary when the application for the statement is made. The applicant should give his name in full, the date of the examination, and the name of the school at which it was taken.

10. *Recommendations for Prizes*

The Board is prepared, if requested to do so by the authorities of a school, to make recommendations for the award of Prizes on the results of its examinations. Any request to the Board for recommendations must be made before the beginning of the examination.

USE OF ENGLISH EXAMINATION

The Board holds examinations in March and June in Use of English, a pass in which fulfils a requirement for entry to the universities of Oxford, Cambridge, and some other universities, although it is not part of the G.C.E.

The provisional dates for the examinations in 1965 are:

Thursday, 10 March 1966,

Thursday, 2 June 1966.

The examination in June is confined to those who have failed in the previous March. All entries should be restricted to bona fide candidates for admission to a university.

Applications for the March examination, giving provisional numbers of candidates, must be made by **31 October** and entry forms must be returned before **1 February**.

Entries for the June examination must be made at the beginning of the school summer term, no later than **10 May**.

The fee for the examination is £1.

The results of the June Use of English Examination will not be announced until the end of August. In those cases in which candidates have failed narrowly on the June paper but obtained A or B gradings on their **A** level papers a re-assessment will be made based on the quality of the English in the **A** level scripts together with the performances in both the March and the June Use of English papers.

INSPECTION OF SCHOOLS

The Board is prepared to undertake the inspection of schools at any time during the school year, except when examinations are being held.

It will be the duty of the inspectors:

- (1) To acquaint themselves with the circumstances and aims of the school, and to consider its arrangements in relation to these, especially in regard to the curriculum, the grading and size of classes, and the distribution of subjects in the time-table.

- (2) To inspect the school buildings and apparatus of all kinds, including boarding-houses, playground, laboratories, workshops, gymnasium, &c.
- (3) To inspect the actual working of the school. For this purpose they will hear lessons given by the staff, and inspect classes. Their report will bear upon the general tone and discipline of the classes, as well as upon the teaching.

The report of the inspectors, like the reports of school examiners, will be sent to the Board, and the Board will then make its report to the Governing Body of the school.

This report is to be regarded as for the use of the authorities of the school alone, and NOT for publication.

ADVANCED LEVEL SUBJECTS

I. CLASSICAL STUDIES

Latin, Greek

The following papers will be set:

(a) for candidates at **A** level

I. Prose Composition	1¼ hrs.
II. Unprepared Translation	2 "
III. Set Books	3 "

(b) if Special papers are offered

I. Prose Composition	3 hrs.
II. Unprepared Translation	2½ "
IV. General Paper.	2 "
V. Verse Composition (optional)	3 "

The two papers in Prose Composition have passages in common and must be set at the same time. The same is true for the two papers in Unprepared Translation.

Candidates offering Special papers will not be allowed to take the Set Book papers.

Verse Composition in either language is optional, but good work in these papers may compensate for less good work in Prose Composition.

General Paper. In each language the paper will include a compulsory question requiring linguistic comment. The rest of the paper will offer a wide choice of questions on literature and civilization, with special reference to the authors prescribed for Paper III; questions on these authors will be optional, and will not include translation, but opportunity will be given for comment on passages of particular interest in the portions of text prescribed for comment at **A** level.

The award of **A** level grades to candidates offering the Special papers will be based on the passages set for Prose Composition and Unprepared Translation which comprise the **A** level papers, together with the General Paper.

Paper III. Set Books for 1966

Candidates must select two half-portions from the following list. Passages for comment will not be set from the portions of books indicated by an asterisk. Papers will be set from the latest editions of the Oxford Classical Texts unless another text is specified.

Latin

Half-portions

- | | |
|------------------------------|-----------|
| 1. Plautus, <i>Rudens</i> . | *1281-end |
| 2. Virgil, <i>Aeneid</i> vi. | |

3. Cicero, *Philippic* ii.
4. Horace, *Odes* ii and iv. *ii 13-20 and iv 10-13
5. Livy xxx, 1-37. *27-37
6. Tacitus, *Histories* i, 1-73.
7. Juvenal, *Satires* 1, 3, 10.

Greek

Half-portions

1. Homer, *Iliad* xvii, 188-end and xviii.
2. Aeschylus, *Prometheus Vincetus*.
3. Euripides, *Iphigenia in Tauris*. *1234-end
4. Aristophanes, *Clouds*. *1214-end
5. Thucydides i, 1-54.
6. Plato, *Republic* x.
7. Demosthenes, *de Corona* 1-163. *all decrees, &c., cited

Ancient History

The following papers will be set:

I. Greek History Outlines	3 hrs.
II. Roman History Outlines	3 „
III. Greek Subject	3 „
IV. Roman Subject	3 „

Candidates offering Ancient History at **A** level must take two papers, one of which must be an Outlines paper.

History Outlines. In both Greek and Roman Outlines one paper will be set which covers the whole period, viz. from earliest times to 323 B.C. for Greek, and from 510 B.C. to A.D. 180 for Roman. It will be possible to satisfy the examiners if the periods studied have been limited to:

- Greek: Earliest times to 435 B.C., or 510-371 B.C., or 478-323 B.C.
 Roman: 510-44 B.C., or 133 B.C.-A.D. 69, or 44 B.C.-A.D. 180.

Subjects for 1966

Greek

- Either** Persia and Greece, 500-465 B.C.
Or Periclean Athens.

Roman

- Either** The Roman Occupation of Britain—the main emphasis will fall in the period ending A.D. 180.
Or Roman Provincial Government to A.D. 14.

II. MODERN STUDIES

Latin of Modern Studies. The following papers will be set:

- | | |
|---|--------|
| I. Unprepared Translation (one prose passage) and
Prose Composition | 2 hrs. |
| II. Set Books (two) | 2 " |
| III. Roman History Outlines | 3 " |
| IV. Unprepared Translation (one prose passage and one
verse passage) | 2 " |

Paper IV is the Special paper.

Paper II. Set Books for 1966

Candidates must select any **two** books from the following list:

- (a) Virgil, *Aeneid* vi, 1-547.
- (b) Caesar, *Bellum Gallicum* i, ii.
- (c) Horace, *Odes* ii.
- (d) Livy xxx, 1-25.
- (e) Tacitus, *Histories* i, 1-49.
- (f) Juvenal, *Satires*, 1, 3.

Alternatively candidates may offer Paper III set for candidates offering Latin of Classical Studies at **A** level.

Latin Translation and Roman History. The following papers will be set:

- | | |
|--|--------|
| I. Unprepared Translation (the prose passage from
Paper I of Latin of Modern Studies, with another
prose passage of similar standard but from a dif-
ferent author) | 2 hrs. |
| II. Set Books (three) from the list given for Latin of
Modern Studies | 2½ " |
| III. Roman History Outlines | 3 " |

The paper on Roman History Outlines, in both subjects, will be the same as that set in Classical Studies.

Candidates who fail to reach the standard for an A level pass in this subject will not be able to qualify for an O level pass in Latin.

Latin Translation and Roman History may not be offered together with Latin of Modern Studies.

Candidates offering Ancient History at **A** level with either Latin of Modern Studies or Latin Translation and Roman History may not include the paper common to all three syllabuses, viz.: Roman History Outlines, as one of the two offered for Ancient History.

French, German, Spanish, and Italian

The following papers will be set:

- | | |
|--------------------------------|---------|
| I. Prose Composition | 1½ hrs. |
| II. Essay | 2 " |

An approved length is 300–400 words, but no limit is prescribed.

III. Unprepared Translation	2 hrs.
IV. Literature	3 „
V. Dictation	½ hr.
VI. Special Paper (excluding Italian)	3 hrs.

Candidates offering any of these languages at **A** level must take Papers I–V.

Candidates offering French, German, or Spanish with the Special paper must take Papers I–VI.

FRENCH, GERMAN, AND SPANISH

Paper IV. *Literature*. The list of prescribed books is printed in *two* sections.

Section A

Questions on each of these books will require compulsory translation of a passage, together with a short essay-type answer.

Section B

Questions on these books will require comment on passages and/or essay-type answers, but not translation.

The question paper will include, in addition, a third section C consisting of questions of a more general character on the authors of the prescribed texts. Candidates will be required to answer four questions dealing with four different authors. Two questions *must* be chosen from section A and the other two may be taken from any section or sections of the paper.

Paper VI. *Special Paper*. The special paper will require answers to *two* questions.

- i. Prose Composition.
- ii. Comment and appreciation:

Two passages will be set, one to be attempted:

- (a) a passage of prose in the language, to test comprehension and analysis of argument.
- (b) a verse passage for critical comment.

An Oral examination in reading and conversation, conducted by a visiting examiner, before the written papers are taken, will be compulsory. The marks obtained in the Oral test will be added to the total for the written papers, and included in the pass mark.

If the number of candidates offering a language is insufficient to justify the expense of sending a visiting Examiner, the Board may require those candidates to travel to a neighbouring school.

Candidates who offer German may use the English or the German characters.

All question papers in the German language will be printed in Roman type.

In Spanish either the old or the new system of written accent will be accepted, but not a mixture of the two.

Passages in Spanish in the question papers will follow the old rules.

French Literature (Paper IV) prescribed for 1966

Section A

- Mérimée, *Carmen et autres nouvelles* (Harrap).
 Becque, *Les Corbeaux* (Harrap).
 Saint-Exupéry, *Vol de nuit*.
 Anouilh, *Becket* (Harrap).

Section B

- Corneille, *Horace*.
 Molière, *Le Malade imaginaire*.
 Racine, *Mithridate*.
 Prévost, *Manon Lescaut*.
 Chénier, *Poésies* (Classiques Larousse, Selection).
 Hugo, *Hernani*.
 Balzac, *La Rabouilleuse*.
 Mauriac, *Le Mystère Frontenac* (Harrap).
 Voltaire, *Histoire de Charles XII* (Classiques Larousse).

German Literature (Paper IV) prescribed for 1966

Section A

- Lessing, *Emilia Galotti*.
 Droste-Hülshoff, *Die Judenbuche*.
 Meyer, *Das Amulett*.
 Goes, *Das Brandopfer*.
 Dürrenmatt, *Der Richter und sein Henker* (Harrap).

Section B

- Goethe, *Egmont*.
 Schiller, *Wallensteins Tod*.
 Grillparzer, *Des Meeres und des Liebe Wellen*.
 Hebbel, *Agnes Bernauer*.
 Hauptmann, *Bahnwärter Thiel* and *Fasching*.
 Ernst, *Selected Short Stories* (Blackwell).
 Böll, *Doktor Murkes gesammeltes Schweigen* (Harrap).
Modern German Lyric Verse, ed. Rose, School Edition, pp. 175-271 (Clarendon Press).
 *Ranke, *Geschichte Wallensteins*, Chapters I, 5-8, 14, 15 (Agris-pina, Köln).
 *Fichte, *Reden an die deutsche Nation*, Nos. 1, 4, 5, 8, 12, 13, 14.

* Questions on the books marked with an asterisk will not be set unless notice has been received by 1 October 1965.

Spanish Literature (Paper IV) prescribed for 1966

Section A

- Cadalso, *Cartas marruecas* (Bell).
 Miguel Delibes, *El camino* (Harrap).
 A. Casona, *Los árboles mueren de pie* (Harrap).
Antología de ensayos españoles (Harrap).
 Azorín, *Lecturas españolas* (Nelson).

Section B

- Lecturas clásicas españolas* (Harrap).
Spanish Ballads, ed. Le Strange (C.U.P.).
 Lope de Vega, *El Caballero de Olmedo* (C.U.P.).
 Calderón, *La vida es sueño* (Manchester University Press).
 Galdós, *Doña Perfecta* (Biblioteca contemporánea Losada, or any complete text).
 Joaquín Calvo-Sotelo, *La muralla* (Harrap).
 Baroja, *La ciudad de la niebla* (Nelson).
Oxford Book of Spanish Verse, 1st or 2nd ed., Nos. 160-85.

Italian Literature (Paper IV) prescribed for 1966

Candidates must offer four of the following:

- Dante, *Inferno*, Cantos x-xix.
 Manzoni, *I Promessi Sposi*, chaps. i-viii (Feltrinelli U.E., or B.U.R.).
 Leopardi, *I Canti*, chaps. i-iii, vi, ix, xi-xvi, xviii, xx-xxvi, xxviii, xxx-xxxiv (Scalabrini, Naples, with an English verse translation, or B.U.R., or B.M.M.).
 Verga, *Nedda, Vita dei Campi, Novelle Rusticane* (in *Novelle*, vol. I., B.M.M.).
 Emilio de Marchi, *Il Cappello del Prete* (ed. Speight, Manchester University Press).
 Pirandello, *Così è se vi pare* (B.M.M.).
 Pirandello, *Enrico IV* (B.M.M.).
 Carlo Levi, *Cristo si è fermato a Eboli* (B.M.M.).

Russian. The following papers will be set:

- | | |
|--------------------------------------|-------------------|
| I. Prose and Essay | 2 hrs. |
| II. Unprepared Translation | 2 " |
| III. Set Books | 3 " |
| IV. Dictation | $\frac{1}{2}$ hr. |

Candidates must take all four papers. An Oral examination in reading and conversation, conducted by a visiting Examiner, before the written papers are taken, will be compulsory.

Russian Literature (Paper III) prescribed for 1966

- A Pushkin verse reader*, ed. I. P. Foote (George Allen & Unwin), No. 2, 5, 20, 22, 23, 41, 48, 50.
 Leo Tolstoy, *Selections*, ed. N. Duddington and N. Gorodetzky (O.U.P.).
 Turgenev, *Pervaya lyubov* (O.C.S.E.B., Elsfield Way, Oxford).

Chekhov, *Tri sestry*, ed. J. M. C. Davidson (Bradda Books).

Panova, *Serezha* (Pergamon Press).

Lermontov, *Geroi nashego vremeni*, ed. D. J. Richards (Bradda Books).

Arabic

The subjects of the examination will be: (a) Grammar, including questions on Arabic Literature. (b) Unprepared Translation. (c) Composition. (d) Dictation. (e) One of the following selections of Arabic authors, to be specially prepared: (1) Ḥarīrī, *Maqāmas*, I, XII, I; with *Hamāsah* of Abū Tammām, sections II and III, Elegies and Moralities. (2) *Al-Fakhrī* (Cairo ed., A.H. 1317), pp. 132–226, i.e. History of 'Abbāsīd Caliphate down to the end of Muḥtadī; with Bahā-ed-Dīn Zuhair, *Poems* (in Cairo ed. of A.H. 1345, poems rhyming in *sin* to *kaf*). (3) *Muqaddamah* of Ibn Khaldūn (Beyrūt ed. 1900), pp. 531–88 (end) omitting the poetry; with *Majānī al-Adab*, Part 6, pp. 142–270. Notice of a candidate's desire to offer Arabic, and of the books offered, must be sent with the application form before **1 February**.

English. The following papers will be set:

I. Two Plays of Shakespeare	2½ hrs.
II. Chaucer and Milton	2½ "
III. English Literature from the sixteenth century to about 1926. A wide choice of questions will be given; candidates can satisfy the Examiners by an adequate knowledge of two of the prescribed groups of books.	2½ "
IV. A definite literary form	2½ "
V. Dealing mainly with comment and appreciation	3 "

Candidates offering English at **A** level must take Papers I, II, and either III or IV.

Paper V is the Special paper.

Prescribed for 1966

Paper I

Hamlet or *Othello* and **either** *King John* **or** *Much Ado about Nothing*.

Paper II

Chaucer, *The Knight's Tale* and Milton, *Paradise Lost*, I, II.

Paper III

*Group i: Wordsworth, ed. J. Butt (New Oxford English Series, O.U.P.).

Keats, ed. R. Sharrock (New Oxford English Series, O.U.P.).

*Group ii: Newman, *The Idea of a Liberal Education*, ed. H. Tristram. (Harrap).
J. S. Mill, *On Liberty*.

- Group iii: Dickens, *Little Dorrit*.
 Conrad, *Chance*.
- Group iv: Robert Browning, *Selected Poems*, ed. J. Reeves
 (Heinemann).
 W. B. Yeats, *Poems*, ed. A. N. Jeffares (Macmillan).
- Group v: Shaw, *Major Barbara*.
 T. S. Eliot, *The Cocktail Party*.
- Group vi: H. G. Wells, *Kipps*.
 D. H. Lawrence, *Sons and Lovers*.

Paper IV. Satire.

- Jonson, *Every Man in his Humour*.
 Dryden, *Absalom and Achitophel*, Pt. I.
 Swift, *Gulliver's Travels*, Pts. I and II.
 Pope, *Epistle to Dr. Arbuthnot* and *To Augustus*.
 Byron, *Satirical and Critical Poems*, ed. J. Bennett (C.U.P.).
 Butler, *Erewhon*.
 Shaw, *Major Barbara*.
 Aldous Huxley, *Brave New World*.
 George Orwell, *Animal Farm*.
 Evelyn Waugh, *The Loved One*.

N.B. In 1967 the subject of this paper will be Prose Fiction.

History. The following papers will be set:

I. Special Subject	2½ hrs.
II. English History Outlines, 878-1939	2½ "
III. European History Outlines, 800-1939	2½ "
IV. History of the U.S.A., 1760-1941	2½ "
V. British Imperial History, 1783-1947	2½ "
VI. History General Paper	2½ "

Candidates offering History at **A** level must take Paper I, and *two* of the Papers II, III, IV, or V, with the following restrictions:

If IV is taken the third paper must be II.

If V is taken the third paper must be either II or III.

Paper VI is the Special paper. The Special paper is designed to test the ability of a candidate to use in an informed and intelligent way the historical knowledge and the historical ways of thought which he should have acquired from his work for the Outlines and Special Subject papers and from his general historical reading.

In each of the papers English History and European History Outlines one paper will be set with a wide choice of questions. Candidates will not be expected to have studied the whole period, and it will be possible to satisfy the Examiners if an adequate knowledge is shown of a substantial portion. Candidates will suffer, however, if their answers are confined to an unduly narrow field within the whole period.

Paper I. Special Subjects for 1966

The alternatives are lettered A to D.

There will be no prescribed books for these papers, but the following lists are intended to suggest some books, the relevant parts of which are suitable for inclusion in a course of reading. Candidates may be given an opportunity of showing their knowledge of these books.

A. *The Reign of King John, 1199-1216*

- A. Lane Poole, *From Domesday Book to Magna Carta* (O.U.P.), pp. 347-486.
 W. L. Warren, *King John* (Eyre and Spottiswoode).
 F. M. Powicke, *The Loss of Normandy* (Manchester U.P.), pp. 95-169, 209-20, 232-40, 290-307.
 F. Barlow, *The Feudal Kingdom of England, 1042-1216* (Longmans), pp. 394-435.
 C. R. Cheney and W. H. Semple, *Selected Letters of Pope Innocent III* (Nelson), nos. 17, 20, 21, 29, 30, 32, 39, 45, 53, 55, 67, 74, 75, 77, 82, 83.
 J. C. Dickinson, *The Great Charter* (Historical Association 1955), (this includes translated text of Magna Carta; a translation is also printed in Warren).

B. *The Reign of Queen Elizabeth I, 1558-1603*

- R. Hakluyt, *Voyages and Documents* (World's Classics) Nos. xiv-xl.
 G. W. Prothero, *Select Statutes and Other Constitutional Documents* (O.U.P.), pp. 1-20, 41-54, 64-65, 93-105, 107-24, 158-72, 176-82, 202-10, 211-14, 219-24, 245-9, 448-55.
 J. E. Neale, *Queen Elizabeth* (Jonathan Cape).
 A. L. Rowse, *The England of Elizabeth* (Macmillan).

C. *The French Revolution, 1787-1799*

- A. Goodwin, *The French Revolution* (Hutchinson).
 G. Lefebvre (trans. E. M. Evanson), *The French Revolution* (Routledge and Kegan Paul).
 J. M. Thompson, *The French Revolution* (Blackwell).
 J. M. Thompson, *Leaders of the French Revolution* (Blackwell).
 E. Burke, *Reflections on the Revolution in France*.
 A. Young, *Travels in France*, ed. Constantia Maxwell (C.U.P.).

D. *The Age of the Chartists, 1832-52*

- T. Carlyle, *Past and Present*.
 B. Disraeli, *Sybil*.
 A. Briggs (ed.), *Chartist Studies* (Macmillan).
 M. Howell, *The Chartist Movement* (Manchester U.P.).
 N. McCord, *The Anti-Corn Law League* (Allen & Unwin).
 G. M. Young and W. D. Handcock (edd.), *English Historical Documents* (Eyre & Spottiswoode), vol. xii (1) (1833-74), pp. 413-78, 506-25, 697-736, 765-813, 933-92.

History with Foreign Texts

This double subject consists of two sections, History and Foreign Texts. A candidate will not be considered for a pass in Foreign Texts unless he also satisfies the Examiners in History.

History with Foreign Texts will count as two subjects at **A** level if the additional papers listed below, which involve a knowledge of Latin and of either French or German, are taken together with the three papers in History prescribed on p. 21.

If the History General Paper is taken as well, the entry will rank as one **A** subject with Special paper plus one **A** subject.

Notice must be given by **1 October 1965** of the intention to enter candidates offering German.

The following papers will be set:

- | | |
|---|--------|
| I. Translation from prescribed books (four) | 2 hrs. |
| II. Subject-matter of the books (five questions to be answered) | 3 " |
| III. Latin Unprepared Translation | 2 " |
| IV. French or German Unprepared Translation | 2 " |
| V. Latin Prose Composition | 1 hr. |
| VI. French or German Prose Composition | 1 " |

A candidate will be excused Paper V if he has passed in Latin at **O** level; he will be excused Paper VI if he has passed in French or German at **O** level.

Set Books. Candidates must offer both Set Books in Latin and two in either French or German. In French they may choose any two of the three alternatives provided. They will be required to translate passages, and to answer questions on the subject-matter and its historical background. The short lists of recommended books are intended to give some guidance as to what is required.

Prescribed for 1966

- | | |
|--------|--|
| Latin | 1. Tacitus, <i>Annals</i> i, cc. 1-15, 31-52, 72-end. |
| | 2. <i>The Historia Pontificalis (1148-52) of John of Salisbury</i> (Nelson's Medieval Classics), excluding cc. XIII, XIV, pp. 28-41. |
| French | 1. Joinville, <i>Histoire de S. Louis</i> (Classiques Illustrés Varbourdelle, Librairie Hachette). |
| | 2. Saint-Simon, <i>Mémoires</i> (Classiques Larousse). |
| | 3. Voltaire, <i>Histoire de Charles XII</i> (Classiques Larousse). |
| German | 1. Ranke, <i>Geschichte Wallensteins</i> , chaps. 1, 5-8, 14-15 (Agrippina, Köln). |
| | 2. F. Meinecke, <i>Die deutsche Katastrophe</i> , chaps. 1-8 (Eberhard Brockhaus, Wiesbaden). |

Recommended for 1966

- | | |
|-------|--|
| Latin | 1. H. H. Scullard, <i>From the Gracchi to Nero, Cambridge Ancient History</i> , vol. x, chaps. 5, 7, 18.
Introductions to Furneaux, <i>The Annals of Tacitus</i> (2nd ed.). |
|-------|--|

2. C. C. J. Webb, *John of Salisbury*.
 R. L. Poole, *Illustrations of the History of Medieval Thought and Learning*, chaps. 6 and 7.
 Z. N. Brooks, *The English Church and the Papacy*, chap. 12.
 Sir Steven Runciman, *A History of the Crusades*, vol. ii, book 3.
 David Knowles, *The Evolution of Medieval Thought*, chaps. 10, 11, 12.
- French
1. R. Fawtier, *The Capetian Kings of France*.
 Petit-Dutaillis, *The Feudal Monarchy in France*.
 2. D. Ogg, *Louis XIV*.
 J. Lough, *Introduction to Seventeenth-century France*.
 3. F. G. Bengtsson, *The Life of Charles XII*.
 I. Anderson, *History of Sweden* (relevant chapters).
- German
1. C. V. Wedgwood, *The Thirty Years War*.
 G. P. Gooch, *History and Historians in the Nineteenth Century*, chap. 6 (on Ranke).
 2. E. J. Passant, *A Short History of Germany, 1815-1945*.
 A. J. P. Taylor, *The Course of German History*.
 D. Thomson, *Europe since 1815*.

Unprepared Translation. Papers III and IV will contain passages of historical interest at the standard of **A** level.

Prose Composition. The passages set will be at the standard of **O** level.

This subject may not be offered with any of the following **A** level subjects: Latin of Classical Studies, Latin of Modern Studies, Latin Translation and Roman History and the modern language, French or German, offered in this subject.

Geography. The following papers will be set:

I.	.	.	.	.	.	.	.	.	2½ hrs.
II.	.	.	.	.	.	.	.	.	2½ "
III.	.	.	.	.	.	.	.	.	2½ "
III. S	.	.	.	.	.	.	.	.	2½ "

Candidates offering Geography at **A** level must take Papers I, II, and III; those offering the Special paper must take Papers I, II, and III **S**.

In the award of **A** level passes to candidates offering the Special paper, account will be taken of all the work submitted.

Candidates will be expected to have made observations in the field.

Paper I. Physical and Human Geography

Map reading with special reference to the 1/63,360 and 1/25,000 Ordnance Survey maps. The Daily Weather Report as published

by the Meteorological Office. General principles of map making. Properties of the simpler atlas projections (excluding their construction). A map reading question will be compulsory.

The characteristics and distribution of major landforms; the nature and evolution of landscapes under humid, arid, and glacial conditions; the effects on scenery of the main types of rocks; the formation of soils; soil erosion and conservation. Submarine relief: salinity, temperature, and movement of sea water. The climatic regions of the world and their vegetation.

The growth and distribution of population; types of settlement; land use, mining and manufacturing industry, transport and communications.

Paper II. Regional Geography

Candidates will be required to study Western Europe and *one* of the regions in Section B.

Section A

Western Europe (Norway, Sweden, Finland and Denmark, the Netherlands, Belgium, Luxemburg, France, the Federal Republic of Germany, Switzerland).

Section B

Prescribed for 1966

1. India, Pakistan, Ceylon.
2. Australasia.
3. Canada.

Papers III and III S

These papers will emphasize the relationships of physical and human geography with special reference to the British Isles, Western Europe, and the other region studied for Paper II. They may include questions dealing with the geographical background of economic, social, and political problems. Paper III S will contain questions of a more searching type than Paper III.

Local Geography and Field Work

A candidate may submit a study of Local Geography in the form of an essay (between three and four thousand words is suggested) illustrated with maps, diagrams, and photographs, not later than the third day of the school summer term in which the examination is held. The candidate will be given an Oral examination, if at all possible, in the course of which he will be required to present such evidence of actual Field Work as field notebooks, sketches, and specimens.

Participation in the scheme is optional; a candidate may gain, but no candidate will lose, by submitting a local study for examination.

Candidates are no longer required to submit titles in advance. Entries must be made on the normal entry form in March.

Economic and Political Studies. The following papers will be set:

- | | | |
|-----|------------------------------------|---------|
| I. | The British Constitution | 2½ hrs. |
| II. | Principles of Economics | 2½ „ |

III.	British Economic Organization	2½ hrs.
IV.	British Economic History since about 1700.	2½ „
V.S	Political and Economic Theory	2½ „

Candidates offering this subject at **A** level must take Paper I and any two of Papers II, III, and IV.

Candidates offering this subject with the Special paper must take Paper V in addition.

Paper I. The British Constitution

The Constitution of Britain and its Administration. Legislature—King, Lords, Commons. Executive—King, Cabinet, Civil Service. Judiciary—Law Courts, Police. The Party System. Control of public finance.

The Local Government of England and Wales. Authorities; Members; Committees. Relations with Central Government, Powers and Duties. Financial Control.

Papers II and III

These two papers are designed to test the candidates' ability to use elementary principles of economic reasoning in the analysis of the main institutions and problems of the British economy. Paper II (Principles of Economics) will stress in particular the more theoretical and analytical aspects of the subject. Paper III (British Economic Organization) will give an opportunity to use a more descriptive and historical approach; but, despite this difference of emphasis, it is hoped that in preparing for either of these papers, candidates will acquire some elements of both the analytical and the descriptive approach to economics.

Paper II. Principles of Economics

The principles of income, employment, and price determination, including questions on (i) national income and its distribution; (ii) employment and money; (iii) price competition and monopoly; (iv) international trade. A sufficient choice of questions will be provided to enable a candidate, if he so wishes, to confine his attention to not less than three of the four sections.

Paper III. British Economic Organization

Specialization and division of labour: the occupational, industrial, and geographical distribution of the occupied population. Forms of economic organization: joint-stock companies; cartels and combinations; co-operation; public corporations. Financing of economic activity: types of credit; the banking system; stock exchanges and new issue market. Marketing: wholesale and retail distribution; organized commodity markets. Organization of labour: trade unions; employers' organizations; government intervention in industrial relations. International position of the United Kingdom: exports and imports; international investment; the balance of payments.

Paper IV. British Economic History since about 1700

The study of economic development and social conditions in the United Kingdom since about 1700.

Paper V S. Political and Economic Theory

Political Theory: The theory underlying the principal types of political institutions in the modern world (since 1945).

Economic Theory: The same syllabus as for Paper II but at a more advanced level. A sufficient choice of questions will be provided to enable a candidate, if he so wishes, to confine his attention to either Politics or Economics.

Music. The following papers will be set:

Aural Tests

I.	Counterpoint and Harmony	. . . . .	3 hrs.
II.	History of Music	. . . . .	3 „
III.	Analysis and Criticism	. . . . .	3 „
	Practical Examination		

Candidates offering Music at **A** level must take the Aural Tests, the Practical Examination, and Papers I and II.

Paper III is the Special paper.

Any candidate may submit an original composition, which should consist of a single work, e.g. a movement, a sketch, or a song (*not* a song cycle); no orchestral score should be submitted. The composition should be sent to one of the Secretaries not later than 31 May in the year of the examination, accompanied by a signed statement from his music master that it is the candidate's own work.

Candidates are not allowed to take copies of musical works into the examination room. Any printed music which is necessary will be sent with the examination papers.

Aural Tests (not exceeding 40 minutes)

These will be administered by means of a gramophone record, which will be sent to the school before the examination. The examination will be held on a specified date in June, as given on the time-table.

1 (three minutes). Candidates will be required to write on a monotone, prefixing the necessary time-signature, a rhythmical passage which will not necessarily begin on the first beat of a bar. After indicating the speed at which the pulse of the music moves, the Examiner will play the passage *twice*. After a short interval, he will play it a third and a fourth time.

2 (five minutes). Candidates will be required to write from dictation a short melodic phrase (not necessarily beginning on the first beat of a bar) in either a major or a minor key. Before playing the passage, the examiner will indicate the speed at which the pulse of the music moves. The key will be named, and the key-note and tonic chord sounded. The phrase will then be played once throughout. It

will then be played *twice in sections* (as indicated by the slurs) at short intervals of time, and finally the phrase will be repeated in its entirety.

3 (two minutes). Candidates will be required to describe and name intervals which are diatonic in a major or minor key, the key-note being sounded on the pianoforte by the Examiner before the playing of each pair of notes constituting an interval. The test will consist of the naming of two such intervals. Each interval will be played *twice*.

4 (five minutes). Candidates will be required to recognize and name any of the following cadences—perfect, imperfect (half-close), plagal, interrupted—occurring in a musical example in a major or a minor key played by the Examiner. After the tonic chord has been sounded, the whole musical sentence will be played through *four* times, with due deliberation, at short intervals.

5 (five minutes). Candidates will be required to recognize major and minor common chords and their inversions as played by the Examiner in a continuous musical phrase in a definite key. Candidates will be expected to recognize each chord in its relation to the key (e.g. submediant) and also to state whether it is in root position or in first or second inversion. The phrase containing the given chords will be played *four* times at a reasonably slow pace, and before each of these the tonic chord will be sounded.

6 (four minutes). Candidates will be required to recognize and name changes of key in a harmonized passage played by the Examiner. Modulations will be limited to nearly related keys of the given tonic and not more than three modulations away from the tonic will be given. After the key has been named and the tonic chord has been sounded, the passage will be played through *four* times.

7 (five minutes). Candidates will be required to write down from dictation a short and easy two-part phrase in the treble clef (for treble and alto voices). The Examiner will state the key and will play the whole phrase through twice. Subsequently it will be played in two sections (each *twice*) with slight intervals and, finally, once more in its entirety.

Paper I. Counterpoint and Harmony

Candidates will be required to answer one question on each of the following three sections, there being a choice in each section.

1. **Either** The completing of an instrumental melody, the opening of which will be given, adding phrasing and dynamics.
Or The writing of a melody to a short given stanza of poetry.
2. **Either** Two-part sixteenth-century counterpoint (e.g. sacred in the style of Lassus or Palestrina; secular in the style of Morley).
Or Two-part invention in eighteenth-century contrapuntal style.

3. **Either** Harmonization in four parts of a J. S. Bach chorale melody.

Or Completion of a passage from a simple string quartet in classical eighteenth-century style.

Candidates may be required to work examples using alto and tenor C clefs.

In 2 and in the second alternative of 3 the opening bars and the whole of the top or bottom part will be given.

Paper II. History of Music. The paper will include:

(a) Alternative subjects for an essay requiring some knowledge of the outlines of musical history, beginning in A.D. 1500.

(b) Special Period of Musical History with prescribed works. Questions will be set on these selected works and will include musical quotations to be referred to their contexts. Candidates will be expected to have an extensive rather than an intensive knowledge of the music and its composers.

(c) Analysis of one unprepared piece of pianoforte or chamber music.

Prescribed for 1966

1864–1964

Tchaikowsky, *Romeo and Juliet—Fantasy Overture.*

Verdi, *Rigoletto.*

Mahler, *Symphony No. 1 in D.*

Ravel, *Introduction and Allegro.*

Britten, *War Requiem.*

and

Either Palestrina, *Missa Papae Marcelli.*

Or Bartok, *Concerto for Orchestra.*

Paper III S. Analysis and Criticism. The paper will include:

(a) The identification of well-known melodies or phrases (candidates may be required to give the name of the composer, the title of the work, the position of the theme in the work, and to provide any other relevant information which may be required).

(b) Analysis and criticism, including harmonic analysis, of an un-prescribed work.

(c) An essay, from a wide choice, on a musical topic.

Practical Examination

The examination will be Grade VI (Intermediate) of the Associated Board of the Royal Schools of Music. A candidate who has already passed this examination, or the corresponding examination in a higher grade, will not be required to take it again, provided that a certified statement is submitted to the effect that practical study has been continued in the meantime. There is no exemption from the Aural Tests of the Oxford and Cambridge Schools Examination Board.

Candidates must take the Practical Examination (unless they are exempt) in the March–April period. Application for entry to the Practical Examination must be made direct to the Associated Board of the Royal Schools of Music by the date prescribed (before the end of January). A list of all candidates offering music at **A** level must be sent to either the Oxford or Cambridge Office, and *not* to the Associated Board, by 16 January on forms which will be sent to Schools in December.

Art. The following papers will be set:

I. Object Drawing	2 hrs.
II. Imaginative Drawing	3 „
III. Design	3 „
IV. Plant Drawing	2 „
V. Drawing from Life	1½ „
VI. Detail Drawing from Life	1½ „
VII. History of Art:	
A. European Architecture	2 „
B. European Painting	2 „

Candidates offering Art at **A** level must offer three of the Drawing Papers I–VI together with Paper VII, History of Art, both sections.

Quarter-imperial paper (15" × 11") should be used by candidates for all drawing papers except that, in the case of Imaginative Drawing and Drawing from Life, they are given the option of using half-imperial paper (15" × 22"). Half-imperial sheets should be folded when dispatched to Examiners.

Any candidate may submit an original work to be considered at the award. It should be sent to the Examiner with the examination drawings but packed separately, accompanied by a signed statement from his art master that it is the candidate's own work and a stamped addressed label if its return is desired. The original work should not be large, but about the same size as the examination drawings. It should not be too similar to what is required in the examination and should be of sufficiently high quality to benefit the candidate. The Board cannot take responsibility for the safety of any drawing that may be submitted.

In the drawing papers candidates will be given a wide choice in their method of treatment, as explained below. It is expected, however, that they will include in their choice at least one type of 'objective drawing'.

I. *Object Drawing*

A group of common objects placed before the candidates. The subject may be treated either as a 'picture' or 'still life', or as a straight drawing. If the former is chosen, colour should be used and the background, which need not necessarily be plain, should be treated as an integral part of the picture. If the latter is chosen, the drawing may be in pencil, crayon, or pen and ink with or without wash; in this case colour should not be used.

II. *Imaginative Drawing*

Any imaginative rendering of a set subject. Pencil, pen and ink, crayon, water-colour, or gouache may be used. Three alternative subjects will be set.

III. *Design*

The following three alternatives will be set:

(a) A layout, primarily of lettering, e.g. a number of words such as a title-page or a notice.

(b) A design to be used for some commercial purpose such as (i) an advertisement, description of the contents of a tin, or poster, or (ii) some form of book production, e.g. an illustration, dust-cover, or decorated text.

(c) A design for (i) some form of stage-set or decor, costume, &c., or (ii) some scheme of interior decoration of a shop, ballroom, living-room, office, &c.

Pen, pencil, water-colour, crayon, gouache, or coloured paper may be used.

IV. *Plant Drawing*

Candidates will be supplied with a natural specimen of which a drawing in pencil or pen and ink will be required; colour may be introduced.

V. *Drawing from Life* in pencil, crayon, or pen and ink, with or without wash.

VI. *Detail Drawing from Life*

Candidates will be asked to make from the living model a drawing in pencil, crayon, pen and ink, or pen and ink and wash, of some detail such as a hand, a foot, shod or unshod, a part of a face, folds of a dress or trouser, &c.

VII. *History of Art*

A. European Architecture

The following book is prescribed: N. Pevsner, *An Outline of European Architecture* (Penguin). Plates for identification will be taken from the 1963 Penguin edition of this book.

The following is recommended as a book of reference: Banister Fletcher, *A History of Architecture* (Batsford). Questions of a general nature will be set. Greek and Roman architecture are excluded from the syllabus except in so far as a knowledge of them is required to understand Renaissance Architecture.

B. European Painting

Questions of a general nature will be set on the main schools of European Painting, including only the principal masters, from Giotto onwards. A wide choice of questions will be given. No plates for identification will be set.

Divinity

The following papers will be set:

- | | |
|---|---------|
| I. Old Testament | 2½ hrs. |
| II. The Life and Teaching of Jesus Christ as recorded in the Gospels | 2½ „ |
| III. The Life and Teaching of St. Paul as recorded in the Acts and the Epistles | 2½ „ |
| IV. Church History | 2½ „ |

Three papers must be offered.

*Prescribed for 1966*Paper I. *Old Testament*

- Either** (1) The Early Traditions of Israel as recorded in Genesis and Exodus, with special reference to:
Genesis i-ix, xi. 1-9, xii, xxiv, xxvii, xxviii, xxxii, xxxiii, xxxix-1;
Exodus i-vi. 13, xii. 1-36, xix, xx, xxxii-xxxiv;
from which alone passages for comment will be set.
- Or** (2) Prophetic Leaders at the time of the Exile and the Return with special reference to:
Isaiah xl-lv; Ezekiel i-vi, xviii, xxxvii, xlvi; Haggai;
from which alone passages for comment will be set.

(1) will be prescribed for 1967, (2) will be changed.

The following books are suggested for reference:

- (1) S. H. Hooke, *In the Beginning* (Clarendon Bible, O.T. vi) supplemented (for Genesis i-xi) by E. B. Redlich, *The Early Traditions of Genesis* (Duckworth).
S. R. Driver, *Exodus* (Cambridge Bible).
- (2) A. W. F. Blunt, *The Prophets of Israel* (Clarendon Press).
W. F. Lofthouse, *Israel after the Exile* (Clarendon Bible, O.T. iv).
J. Skinner, *Isaiah* (vol. ii, Cambridge Bible).

Paper II. The Life and Teaching of Jesus Christ as recorded in the Gospels

For 1966 the subject should be studied in the Gospel according to St. Mark and the Gospel according to St. John. Both Gospels may be offered in the Greek Text.

Paper III. The Life and Teaching of St. Paul as recorded in the Acts and the Epistles

Special attention should be given to:

- 1 & 2 Thessalonians.
*Galatians.
Colossians.

* May be offered in the Greek Text.

Different Epistles will be prescribed for 1967.

Questions may be asked on St. Paul's original circumstances and outlook, the significance of his conversion, the development of his teaching, his evangelistic methods, his relation to Judaism and contemporary systems of thought, his personal character, and his place in the history of Christianity.

Paper IV. Church History

Either (1) Modern Church History from 1792 to the present day.

Questions may be set on the following topics: The Evangelical Revival, the pioneer missionaries, the challenge of social conditions, the Oxford Movement, the growth of toleration, interpretation of the Bible, Christian Socialists, growth of 'native' churches, the ecumenical movement, South India, developments in the Roman Catholic Church.

Or (2) Medieval Church History, especially in England, from A.D. 800 to A.D. 1500.

The following books are suggested for reference:

- (1) and (2) E. Bevan, *Christianity*, H.U.L. (O.U.P.).
 Carpenter, *Christianity* (Pelican Books).
 Moore, *Furtherance of the Gospel* (O.U.P.).
Documents of the Christian Church, ed. Bettenson (World's Classics).
- (1) Payne, *The Free Church Tradition in the Life of England* (S.C.M.).
 Williams, *The Anglican Tradition in the Life of England* (S.C.M.).
 Payne, *The Growth of the World Church* (Edinburgh House Press, Macmillan).
 Wand, *History of the Modern Church* (Methuen).
- (2) Deanesley, *History of the Medieval Church* (Methuen).
 Workman, *Evolution of the Monastic Ideal* (Epworth).

The Institute of Christian Education has prepared a list of books suitable for Divinity at A level, details of which may be obtained on application to the Secretary of the Institute, 46 Gordon Square, London, W.C. 1.

III. MATHEMATICS AND HIGHER MATHEMATICS

The following papers will be set:

I. Pure Mathematics	2½ hrs.
II. Pure Mathematics	2½ „
III. Applied Mathematics	2½ „
IV. Applied Mathematics	2½ „
V. Special Paper (Pure)	3 „
VI. Special Paper (Applied)	3 „

All candidates must take Papers I–IV. In addition they may take one or both of the Special papers V–VI. (Thus a candidate offering Physics and Mathematics and Higher Mathematics may take the Special paper in Physics and Paper V or Paper VI above.)

An **A** level pass may be awarded in Pure Mathematics on Papers I and II and in Applied Mathematics in Papers III and IV, Papers I–IV comprising a double subject.

A printed list of formulae will be provided for use in the examination. Additional copies of this list may be purchased from the Secretaries. The issue of this list does not preclude the Examiners from asking for proofs of these or other formulae, within the limits of the syllabus.

It will be assumed that candidates have a knowledge of the following standard topics, for the purpose of routine manipulation; the topics will not be made the subjects of artificially complicated questions:

Routine algebraic manipulation, including partial fractions, logarithms, binomial theorem for positive index, elementary inequalities.

Elementary trigonometry including sine and cosine formulae, solution of triangles, sum and product formulae, formulae involving $\tan \frac{1}{2}x$, solution of simple trigonometrical equations.

Elementary geometry of the circle and triangle, including centroid, circumcentre, orthocentre, and incentre.

Differentiation and integration of standard forms, and forms depending on them.

Those parts of the following syllabus which are *in italic* will be made the subject of straightforward questions in the first four papers, but more searching questions may be set on them in the special papers.

PURE MATHEMATICS

Proof by induction. Finite series. *Recurrence relations*. Theory of equations. *Complex numbers and their geometrical representation; de Moivre's theorem for integral index; simple equations*.

Coaxial circles. Elementary coordinate geometry, including conics in their standard forms; focus and directrix. *Parallel translation and rotation of axes; general equation of the second degree. Pencils of conics*. Parameters for simple curves. Elementary pure geometry of three dimensions, including the sphere.

Derived functions from definition. Behaviour of functions explicitly defined and the sketching of their graphs (to include criteria of reality, symmetry, simple asymptotes, maxima, minima, inflexions); use of polar coordinates. Application to discussion of solubility of equations (e.g. $\log x = kx$); approximate numerical solution by, for example, Newton's method. Behaviour of simple functions implicitly or parametrically defined; graph sketching.

Logarithmic and exponential functions, trigonometrical functions, including $a \cos x + b \sin x$ and $e^{ax} \cos bx$, and their behaviour. Simple approximations; use of Taylor's and Maclaurin's series. The idea of an integral as the limit of a sum; *inequalities associated with definite integrals*. Integration by parts and by substitution (the substitution to be given in difficult cases).

Differential equations; separable variables, first order linear; the differential equation $\frac{d^2y}{dx^2} + n^2y = f(x)$, such that a particular integral can be found by inspection. *Sketches of the family of solutions in first order cases, and derivation of equations characteristic of a family of curves.*

APPLIED MATHEMATICS

The whole range of the syllabus in Pure Mathematics may be tested in physical problems, in which it is expected that candidates will show their ability to express mathematically problems stated in physical terms; in certain simple questions candidates may also be expected to make a selection of the data, and to make reasonable approximations.

The idea of an integral as the limit of a sum, applied to areas, volumes, lengths, averages, &c.

Simple plane differential geometry: s, ψ , curvature $\frac{d\psi}{ds}$, all in terms of cartesian coordinates.

The method of small changes to form a differential equation.

Vectors: addition and subtraction, components and resolved parts; with applications to relative velocity, force, momentum, &c. Position vector; velocity and acceleration and their expressions in cartesian form in two dimensions and, for circular motion only, in polar form.

Statics of particles and rigid bodies in two and three dimensions. Dynamics of a particle in one and two dimensions, including simple harmonic motion. Dynamics of a rigid body rotating in two dimensions about a fixed axis (excluding reactions at the axis). Work, energy, power, momentum, angular momentum.

Knowledge will be expected of friction, Hooke's law, and Newton's law of impact.

SPECIAL PAPERS

One paper will be set on the syllabus for Pure Mathematics and the other paper on the syllabus for Applied Mathematics. In each paper sufficient questions will be set on the above syllabus for full marks to be obtainable on them. In addition, four alternative questions will be set involving some of the following topics.

Pure Mathematics. Infinite series, summation, convergence (excluding formal tests); determinants; harder inequalities; hyperbolic functions; functions of two independent variables and their geometrical representation, partial differentiation; incidence in three dimensions, triangles in perspective.

Applied Mathematics. Reduction of a general system of coplanar forces; stability of equilibrium, including the potential energy test; dynamics of a rigid body in two dimensions (excluding impulsive motion); components of velocity and acceleration in polar coordinates,

with simple applications; use of $\delta f \doteq \frac{\partial f}{\partial x} \delta x + \frac{\partial f}{\partial y} \delta y$.

IV. NATURAL SCIENCE

Mathematics for Science

The following papers will be set:

I. Pure Mathematics	3 hrs.
II. Applied Mathematics	3 "
III. Special Paper	3 "

Candidates offering this subject at **A** level must take Paper I and Paper II. Paper III is the Special paper. The chief aim will be to test ability in *using* mathematics, but not always in familiar ways. The emphasis will be on ideas and the use of principles, and the deductions will involve relatively straightforward mathematics.

It will be assumed that candidates have a knowledge of the following standard topics, for the purpose of routine manipulation; the topics will not be made the subjects of artificially complicated questions.

Routine algebraic manipulation including easy partial fractions, linear and quadratic equations, elementary inequalities, easy graphs, logarithms.

Circular measure, trigonometrical ratios of any angles, solution of triangles.

Coordinate geometry of the straight line.

A printed list of formulae will be provided for use in the examination. Additional copies of this list may be purchased from the Secretaries. The issue of this list does not preclude the Examiners from asking for proofs of these or other formulae, within the limits of the syllabus.

PURE MATHEMATICS

Familiarity with the following functions will be presumed: polynomials, simple rational functions, the six trigonometric functions, the logarithmic function, the exponential function.

Binomial theorem for a positive integral index (questions on the greatest term and on sums and properties of the coefficients will not be asked). Use of the series for $(1+x)^n$ when n is not a positive integer.

Use of the formulae for $\sin(x \pm y)$, $\cos(x \pm y)$, $\tan(x \pm y)$; double angle formulae; $\sin x = \frac{2t}{1+t^2}$, $\cos x = \frac{1-t^2}{1+t^2}$; expressions for $\sin x \pm \sin y$ and $\cos x \pm \cos y$ in factors; $a \cos x + b \sin x$ in the forms $r \cos(x \pm \alpha)$, $r \sin(x \pm \alpha)$.

Solution of simple trigonometric equations within the range 0 to 360° . Periodicity of the trigonometric functions. Knowledge of the notation $\sin^{-1}x$, &c.

Complex numbers: geometrical representation; modulus and argument; sum and difference; product and quotient of two complex numbers expressed in the form $a+ib$ or $r(\cos \theta + i \sin \theta)$. Elementary

examples of conjugate complex roots of equations with real coefficients. The use of de Moivre's theorem will be allowed.

Numerical evaluations.

Use in simple cases of cartesian and parametric equations including recognition of the forms: $y^2 = 4ax$, $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, $xy = c^2$, $(at^2, 2at)$, $(ct, \frac{c}{t})$.

Parallel translation of axes.

Use of polar coordinates.

Differentiation; use in approximations of the first few terms of a Taylor's or Maclaurin's series. Integration; idea of the integral as the limit of a sum; integration by substitution and by parts in simple cases.

Simple differential equations requiring separation of the variables; the differential equation $\frac{d^2y}{dx^2} + n^2y = \text{constant}$. (The form of the solution may be quoted.)

APPLIED MATHEMATICS

Application of mathematics to simple physical situations, e.g. setting up differential equations, making suitable approximations.

Application of differentiation to tangents, rates of change, small errors, maxima and minima.

Application of integration to the calculation, with respect to rectangular cartesian coordinates, of areas, volumes, centres of mass, moments of inertia.

Approximate integration by estimation of area. Use of Simpson's rule.

The idea of a vector; the sum $a + b$ and difference $a - b$ of two vectors a and b ; unit vectors; components in the case of two dimensions only.

Displacement, velocity, acceleration, force, momentum, impulse, with treatment by vectors where appropriate; relative velocity; graphical methods applied to motion.

Equilibrium: simple force diagrams; moments; properties of centres of gravity.

Motion in a straight line: work, energy, power, impulse, momentum; impact.

The conservation of momentum and of energy.

Simple extensions to two dimensions; parabolic motion (projectiles), circular motion. Simple cases of rotation of a rigid body about a fixed axis (reactions on the axis will not be expected).

Simple harmonic motion.

Knowledge will be expected of friction, Hooke's law, and Newton's law of impact.

SPECIAL PAPER

There will be a wide choice of questions, some of which will be set on the syllabus of Papers I and II and others on the extensions of the syllabus to the following topics:

Hyperbolic functions; inverse circular and hyperbolic functions. Use of Newton's approximation to a root of an equation.

The differential equation $\frac{d^2y}{dx^2} + n^2y = f(x)$.

Functions of two independent variables and their geometrical representation; first order partial differentiation; the formula

$$\delta f \simeq \frac{\partial f}{\partial x} \delta x + \frac{\partial f}{\partial y} \delta y.$$

Length of arc; area of surface of revolution. Simple applications of integration using polar coordinates.

Simple inequalities by considerations of area.

Moves towards better approximations to reality, e.g. simple cases of two-dimensional motion in a resisting medium or damped forced oscillations. The general treatment of the resulting differential equation will not be expected.

The potential energy criterion of stability.

Mathematics with Statistics

I. Pure Mathematics	3 hrs.
II. Statistics	3 "

The syllabus for Paper I will be the same as that for Pure Mathematics of Mathematics for Science, see pp. 37-38. Mathematics with Statistics may not be offered with Mathematics for Science.

STATISTICS

Statistical inquiries, questionnaires, tabulation and representation of data. The histogram, frequency curve, and cumulative frequency diagram.

Averages; arithmetic and geometric means, mode, median.

Moving averages.

Weighted averages (index numbers).

Measures of dispersion; quartiles, mean deviation, standard deviation.

Permutations and Combinations.

Probability and sampling, the addition and multiplication laws of probability.

The binomial probability distribution. Proof and use of np , \sqrt{npq} , $\sqrt{\frac{pq}{n}}$.

Introduction to the Normal and Poisson distributions.

Applications of $\frac{\sigma}{\sqrt{n}}$ for testing the significance of a mean in large samples.

Correlation: scatter diagrams, calculation of correlation coefficient and regression lines, rank correlation.

[The Annual Abstract of Statistics (H.M.S.O.) should be examined and used as a source of data for problems, particularly the sections on unemployment, imports and exports, and prices.]

Physics

The following papers will be set:

I.	.	.	.	.	.	.	.	.	.	.	.	2 $\frac{3}{4}$	hrs.
II.	.	.	.	.	.	.	.	.	.	.	.	2 $\frac{3}{4}$	„
III.	.	.	.	.	.	.	.	.	.	.	.	3	„
Practical	.	.	.	.	.	.	.	.	.	.	.	3	„

Candidates must take Papers I, II, and the Practical examination. Paper III is the Special paper.

Papers I and II may be set on the whole of the following syllabus but there will be sufficient questions on those parts not underlined to enable a candidate who has not studied the underlined parts to answer each paper. Paper III may be set on the whole of the syllabus with the exception of those parts in *italic* and will require a higher standard of knowledge than Papers I and II.

Where no particular method is specified, as in the case of the mechanical equivalent of heat or the velocity of light, questions will be framed to allow any suitable method. This does not preclude problems from being set on a particular method, provided they contain information sufficient for candidates not familiar with that method.

Two practical papers will be set, an **A** and an **S** paper. Schools will be given the option of entering candidates either for the **A** paper or for the **S** paper. The **A** paper will consist of three experiments, of which candidates must do two in 3 hours. The **S** paper can be taken only at schools where it is possible to provide a visiting examiner. It is intended primarily for candidates who have studied Physics in the sixth form for three years, and will consist of one experiment, with no choice, to be done in 3 hours.

A knowledge of the physics in the syllabus for Physics at **O** level will be assumed.

MECHANICS AND PROPERTIES OF MATTER

Units and dimensions of common physical quantities. Method of dimensions. Methods of measuring mass, force, length, volume, and time, and the accuracy of the methods.

Uniform motion in a circle, circular orbits in a central field of force.

Conservation of linear momentum and of angular momentum.
Moment of inertia and its application in physical problems.

Newton's law of gravitation.

The effects of stress on a deformable body, types of strain. Hooke's law. Young's modulus and simple methods for its determination. Description of phenomena beyond the elastic limit. Work done in elastic stretching.

Surface tension and simple methods for its determination. The descriptive aspects of the flow of fluids; laminar and turbulent flow;

the consequences of Bernoulli's theorem; Poiseuille's and Stokes's laws (dimensional proofs only). Elementary concept of intermolecular forces and its application to the phenomena associated with capillarity, elasticity, and viscosity.

OSCILLATIONS AND WAVES

Simple harmonic motion. Free, damped, and forced oscillations treated experimentally. Resonance.

Waves: experimental treatment of diffraction.

Superposition: harmonics, interference, beats. Stationary waves, vibration of strings and air columns. Sound waves in a gas, and the factors which determine velocity of sound in a gas. Doppler effect.

HEAT

The elementary molecular theory of solids, liquids, and gases. Electrical methods of determining specific heat and latent heat. Atomic heat. Saturated and unsaturated vapours. Dalton's law of partial pressures. Properties of gases, perfect gas laws. Temperature and temperature scales. *Thermometry, including the gas thermometer and electrical methods.* The derivation of the equation $p = \frac{1}{3}\rho c^2$ and its correlation with the perfect gas laws. Real gases. Critical point. Descriptive treatment of van der Waals's equation. The principal molar specific heats of a gas, their difference and ratio. Isothermal and adiabatic changes. Internal energy; the first law of thermodynamics.

The measurement of the thermal conductivity of solids of high and low conductivity. Qualitative explanation of thermal conductivity.

Radiation and Prévost's theory of exchanges. Black bodies. Stefan's law. Distribution of energy in black body spectrum treated descriptively.

LIGHT

Formulae for thin spherical lenses and spherical mirrors. Qualitative treatment of aberrations. Prisms of small and large refracting angles; minimum deviation; dispersion. Construction and use of the prism spectrometer. Emission and absorption spectra.

The astronomical telescope using refracting and reflecting objectives and a simple eyepiece. The simple refracting microscope. Magnifying power of a telescope with the image at infinity and of a microscope with the image at the least distance of distinct vision.

The wave nature and properties of light and other electromagnetic radiations (including X-rays). Demonstration of the diffraction, interference and polarization of light, and their elementary explanation. Interference phenomena involving two slits; Newton's rings. Colours of thin films. Elementary treatment of the diffraction grating. Measurement of the wavelength of light, and of the velocity of light. Relation of velocities to refractive index.

ELECTRICITY AND MAGNETISM (in terms of c.g.s. units)

Quantities in all problems will be expressed in practical units, i.e. amp., volt, ohm, &c. and conversion factors to the electrostatic and electromagnet systems will be given where necessary.

The elementary phenomena of electrostatics; electrons and ions. The inverse-square law. Unit charge, electric field strength, potential. Simple applications of Gauss's theorem. Capacitance: the capacitance of two concentric spheres, and of two parallel plates. Dielectrics and permittivity. Capacitors in series and in parallel. Energy of a charged capacitor. The principle of the attracted-disc electrometer.

Magnetic field, magnetic field strength, magnetic moment. Magnetic properties of materials treated qualitatively. Couple on a magnetic dipole in a uniform magnetic field. The force acting on a current-carrying wire and on a moving charge in a magnetic field. The magnetic field strength at the centre of a circular coil, and in a solenoid, and their derivation. The moving-coil galvanometer. Absolute measurement of current by means of a simple current balance or dynamometer.

Electromagnetic induction. Self and mutual induction; the coefficients of self and mutual induction; the standard mutual inductance. *Simple a.c. and d.c. generators and d.c. motors; back e.m.f.* Absolute measurement of resistance by an electromagnetic method.

The nature of electric current and resistance. Conservation of charge, Kirchhoff's first law. Variation of resistance with temperature. Ammeter and voltmeter. Heating effect of electric current.

The Wheatstone bridge; the potentiometer and its use for measuring large and small potential differences, current and resistance. Use of standard resistances and standard cells.

Alternating current of sinusoidal form; r.m.s. and mean values. The heating effect of a.c. The a.c. transformer. Descriptive treatment of flow of a.c. through resistors, capacitors, and inductors taken separately. Simple quantitative treatment of a resistor in series with either an inductor or a capacitor. Moving-iron and rectifier-type a.c. instruments for measuring current and potential difference.

The high-vacuum diode and thermionic emission. Characteristics of diode, including description of space-charge limitation and saturation. The diode as a rectifier, practical methods of the rectification of the a.c. supply. The triode and its use as a voltage amplifier. Simple treatment and use of the cathode-ray tube.

Deflexion methods of determining e/m and the velocity of electrons. Millikan's oil-drop experiment. The photoelectric effect.

Nature of simple atoms and molecules. Atomic number and atomic mass. Elementary treatment of radioactivity, both natural and artificial.

ALTERNATIVE SYLLABUS IN ELECTRICITY AND MAGNETISM (in terms of M.K.S. units)

Magnetizing force in a solenoid, around a long straight wire, and at the centre of a circular coil. Magnetic flux and the use of a ballistic galvanometer for comparing quantities of flux (questions on the

theory of the ballistic galvanometer will not be asked). Flux density and its relation to magnetizing force. The force on a current-carrying wire in a magnetic field. Force between long parallel current-carrying wires and the definition of the ampere. Measurement of current by a simple dynamometer. Moving-coil galvanometer.

The nature of electric current. Conservation of charge, Kirchhoff's first law. Heating effect of electric current. Variation of resistance with temperature. Definition of the coulomb, the volt, and the ohm. Ammeter and voltmeter.

Electromagnetic induction. Self and mutual induction; the coefficients of self and mutual induction; the standard mutual inductance. *Simple a.c. and d.c. generators and d.c. motors; back e.m.f.* Absolute measurement of resistance by an electromagnetic method.

The electric field, electric intensity and potential. The force on a charge in an electric field. Electric flux density, permittivity of free space, relative permittivity of a dielectric. Simple applications of Gauss's theorem. Force between point charges. Capacitance of two parallel plates and two concentric spheres. Capacitors in series and parallel. Energy of a charged capacitor. The principle of the attracted-disc electrometer.

The remainder of the syllabus is the same as the normal syllabus beginning 'The Wheatstone bridge' and continuing to the end.

Chemistry

The following papers will be set:

I.	.	.	.	.	.	.	.	.	.	2 $\frac{3}{4}$ hrs.
II.	.	.	.	.	.	.	.	.	.	2 $\frac{3}{4}$ "
III.	.	.	.	.	.	.	.	.	.	3 "
Practical	.	.	.	.	.	.	.	.	.	3 "

Candidates must take Papers I, II, and the Practical examination. Paper III is the Special paper.

Paper I will be based on the general principles given in Part I of the syllabus. Examples and illustrations required in the answers will in general be drawn from the material in Part II of the syllabus, but questions will be set in such a way that candidates will not need to be familiar with the whole of Part II in order to answer them satisfactorily. There will be a very limited choice of questions in this paper, the purpose of which is to ensure that the candidates have an adequate understanding of basic principles.

Paper II. This paper will be set on Part II of the syllabus, although application of facts to the general principles in Part I will not necessarily be excluded from the questions. The paper will be set in sections corresponding approximately to the fields of Physical, Inorganic, and Organic Chemistry. Candidates will have a wide choice of questions, but will be required to answer questions in all three sections.

Paper III will be set on both Parts of the syllabus and *will carry a wide choice of questions*. It will be set in sections and candidates will be required to answer questions from each of the sections. The sections will again correspond approximately to each of the three branches, Physical, Inorganic, and Organic Chemistry, but the essential difference between questions in this paper and those in Papers I and II will be the treatment of principles in greater depth and the greater demand on the intelligence of the candidate.

Questions set in Papers I, II, and III may involve the subjects of the syllabus for the Practical Examination.

Candidates will not be expected to have covered more than sixty per cent. of the material included in Part II of the syllabus.

A knowledge of the syllabus for Chemistry at O level will be assumed.

PART I

Laws of chemical combination. Equivalents of elements and compounds. Concept of atoms; principles of atomic weight determination by chemical equivalents, limiting density and mass spectrometry; concept of isotopes. Elementary treatment of radioactivity. Simple treatment of the Periodic Table from the point of view of atomic structure: existence of periods, groups and 'transitional' characteristics; their explanation by a simple qualitative treatment of the electronic theory of valency. (A knowledge of orbital nomenclature will not be required.)

Molecular concept based on the work of Gay-Lussac and Avogadro. Gram-molecular volume. Avogadro Number. The forces of cohesion which bind atoms, ions, and molecules; the physical and chemical properties associated with such forces. Allotropy. Principles of the determination of empirical, molecular, and structural formulae. Isomerism, including optical and geometric isomerism. Chemical properties as functions of groups and radicals.

A simple treatment of elementary kinetic theory as applied to changes of state and chemical reaction. The Law of Mass Action; order and molecularity of reactions; energy of activation; simple chain reactions. Equilibrium constants. Effects of temperature, pressure, and concentration on reaction velocity and equilibrium. Catalysis. Phase equilibria between the solid, liquid, and vapour phases of a single substance and the effect on these of a volatile and non-volatile solute. Qualitative relation of freezing-points, boiling-points, and osmotic pressure to vapour pressure. Solubility as a phase equilibrium.

Electrolysis. Faraday's laws. Evidence for the ionic theory. Specific and equivalent conductivity. Ionic mobilities. (Measurement of transport number not required.) Distinction between weak and strong electrolytes. Concept of pH. Acids, bases, salts.

Changes of energy accompanying physical, chemical, and electrochemical changes. Heats of combustion, formation, and reaction. Hess's law. Concept of free energy. Oxidation and reduction. Oxidation and reduction potentials.

PART II

SECTION A

Practical methods for the determination of equivalents of elements (by conversion ratio or electrolysis), of acids and bases, and of common volumetric reagents. Normal and molar solutions. Determination of molecular weights in solution and in the vapour phase (one method only for each). Experimental determination of reaction velocity constants and equilibrium constants. Purification of substances by crystallization and distillation. Fractional distillation. Steam distillation. Constant boiling mixtures. Simple eutectics. Partition of a solute between two immiscible solvents. Chromatography. Ion exchange. Elementary qualitative treatment of osmosis. Measurement of conductivities of solutions. Dissociation constants of weak acids and bases. Acid-base titration curves. Hydrolysis of salts. Buffer solutions. Solubility product. Elementary treatment of the colloidal state.

SECTION B

The principal features of the Periodic Table as shown by a *general* survey of:

(a) the short periods (hydrogen and helium, lithium to neon, and sodium to argon),

(b) the first long period (potassium to krypton), and

(c) the groups II_A (beryllium to radium), and II_B (zinc, cadmium, and mercury), IV_B (carbon to lead), V_B (nitrogen to bismuth), and VII_B (fluorine to iodine).

A more detailed study of ten elements and their more important compounds, including hydrogen, nitrogen, phosphorus, oxygen, sulphur, iron, *either* chlorine *or* iodine, *two* from magnesium, calcium, aluminium, and zinc, and *one* from chromium, manganese, nickel, and copper.

Outlines of the manufacture and uses of two substances from group (a) and one substance from each of groups (b), (c), and (d): (a) iron (including steel), aluminium, nickel, copper, zinc, and titanium; (b) hydrogen, chlorine, sodium hydroxide, sodium carbonate; (c) ammonia, nitric acid, sulphuric acid; (d) producer gas, water gas, coal gas.

Standard laboratory methods of preparing inorganic substances including collection of gaseous compounds; manipulation of volatile compounds; methods of salt formation; simple methods of oxidation and reduction; preparation and handling of insoluble substances.

SECTION C

The production of important organic chemicals: industrial processes associated with coal (including coal-tar, coke, and calcium carbide), petroleum, animal, and vegetable products (fats, proteins, and carbohydrates). Production and uses of methanol, ethanol, and acetone; man-made fibres, plastics.

The special features of carbon chemistry: formation of chains and rings; homologous series (including the anomalous behaviour of first members), isomerism, synthesis of complex compounds.

The dependence of the chemical properties and reactions of organic compounds on functional groups (including cases where two such groups occur in one molecule). Functional groups to be considered should include C—OH, C=O, —COOH, —CN, C≡C (and —C≡C—, —CH₃, C—hal., C—NO₂ (aromatic), C—NH₂, C₆H₅).

Functional character should be illustrated by a study of the methods of preparation and of the properties of such compounds as methane, ethane, ethylene, propylene, acetylene, ethyl bromide, ethylene dibromide, methyl, ethyl, and secondary propyl alcohols, formaldehyde, acetaldehyde, acetone, formic acid, acetic acid, lactic acid, acetyl chloride, acetic anhydride, acetamide, the esters of simple carboxylic acids, the simple primary amines, alkyl cyanides, chloroacetic acid, glycine, and urea. Diethyl malonate and its uses in synthesis.

Elementary chemistry of simple aromatic compounds such as benzene, phenol, aniline, benzene diazonium chloride, toluene, benzaldehyde, benzoic acid, and benzoyl chloride. (Questions on the structure of benzene will not be asked.)

Practical details of the following laboratory processes:

- (a) Oxidation of an alcohol (e.g. ethanol to acetaldehyde and acetic acid; benzyl alcohol to benzoic acid).
- (b) Reduction (e.g. nitrobenzene to aniline).
- (c) Replacement of an —OH group by chlorine.
- (d) Acetylation (e.g. aniline to acetanilide).
- (e) Benzoylation (e.g. aniline to benzanilide, phenol to phenyl benzoate).
- (f) Esterification (e.g. acetic acid to ethyl acetate).
- (g) Hydrolysis of an ester.
- (h) Nitration (e.g. benzene to nitrobenzene and m-dinitrobenzene).
- (i) Detection of C, H, N, and halogens in organic compounds.

PRACTICAL EXAMINATION

It is expected that candidates will have encountered and carried out, personally, a variety of practical operations, including:

1. Titration exercises involving acid-alkali, redox, and silver nitrate reactions.
2. Identification of the single substances listed below based on a logical scheme (i.e. not merely by a series of spot-tests).
Candidates will not be permitted the use of books in the examination.

The following metals and their principal oxides:

sodium, potassium, magnesium, calcium, barium, aluminium, chromium, manganese, iron, nickel, copper, silver, zinc, mercury, tin, lead, antimony, bismuth.

Salts containing not more than one of these metals or an ammonium radical, and not more than one of the following acid radicals: chloride, bromide, iodide, sulphide, sulphite, sulphate, thiosulphate, nitrite, nitrate, orthophosphate, carbonate, acetate, oxalate.

3. Determination of melting-point, boiling-point, vapour density, molecular weight, rate of reaction, solubility, partition-coefficient, &c.
4. Preparation, purification, and observations on a variety of organic and inorganic compounds, referred to in the theoretical section of this syllabus.

Exercises will be set which, while giving adequate directions to the candidate, will test competence in and understanding of these techniques and operations.

Zoology, Botany, Biology.

The following papers will be set:

I.	2½ hrs.
II.	2½ „
III.	3 „
Practical	3 „

Candidates offering a subject at **A** level must take Papers I and II and the Practical.

Paper III is the Special paper.

A combined Special Paper in Zoology and Botany will be set as an alternative to the Special Paper in Zoology or in Botany. It is intended to meet the needs of candidates who are offering, say, Chemistry, Zoology, and Botany, and who wish to offer the Special Paper in Chemistry, but do not wish to concentrate on one Biological subject more than on the other.

Biology may not be offered with either Zoology or Botany. The work of a candidate who has just failed to secure a pass at Advanced level in Zoology, or in Botany, or in both, will be reviewed and, if the combined performance in Zoology and Botany is deemed to have been equivalent to that required for a pass in Biology at Advanced level, a note to this effect will be made on the certificate issued to the candidate. (This composite pass in Biology is unlikely to be recognized by certain universities.)

PERSONAL WORK

Candidates may submit brief accounts of personal field or practical work, done individually or in pairs. These should be sent, if possible, to the Examiner before his visit to the school. He will conduct a brief *viva voce* examination, during which notebooks, sketches, specimens, &c. may be presented. In the cases of those schools that are not visited accounts may be submitted to one of the Awarders before the beginning of the main examination.

Participation in the scheme is optional; a candidate may gain, but no candidate will lose, by submitting a study for examination.

Zoology. (This may not be offered with Biology.)

All papers may include questions on the whole of the following syllabus, but those in Paper III will in general require a more thorough knowledge than those in Papers I and II.

Where the detailed syllabus is identical with that of the subject Biology, the standard of knowledge assumed will also be identical.

1. **Mammalia.** The elements of the structure and physiology of a mammal exemplified by the study of the rabbit (or rat, or guinea-pig), and with reference to man:

(a) The skeleton (without details of the skull) and the general relation of muscles to the skeleton in producing movement. Names of muscles and details of the chemistry of muscle action will not be required. The histology of connective tissue, cartilage, bone, and striated muscle.

(b) The main features of the omnivorous, carnivorous, and herbivorous dentitions. The digestive system, the constituents of a balanced diet, action of digestive enzymes. The histology of the small intestine, liver, and pancreas.

(c) The vascular system and the circulation, composition, and functions of blood. The histology of blood. Temperature control.

(d) The respiratory organs. The mechanism of inspiration and expiration. Oxygen and carbon dioxide exchanges. Internal (tissue) respiration. An outline of the mechanism by means of which energy is made available in tissues.

(e) The excretory system with a simple account of action of the urinary tubules. The histology of the kidney.

(f) The function of the endocrine system, as exemplified by the thyroid, adrenals, pituitary, islets of Langerhans, gonads. (Details of histology and biochemistry will not be required.)

(g) The nervous system, limited to the main regions of the brain, the spinal cord, nerves, and the sense organs. A simple study of the reflexes and behaviour patterns. Elements of the histology of nervous tissue.

(h) The reproductive system and histology of the gonads.

A simple account of the development of the rabbit, including functions of the placenta (but not a detailed account of its embryological origin). The care of the young.

(i) Cytology. An outline of cell structure, the composition of protoplasm, the nucleus, the cell surface.

The importance of mammals as pests of agriculture illustrated **either** by (a) the rabbit **or** by (b) the brown rat. Their mode of life, diet, and natural enemies. Methods of control.

2. A general study of the following organisms, including living organisms (except dogfish); special attention should be given to the points indicated after each. The types that are to be dissected should be studied in detail, including external features, movement and behaviour, feeding, respiration, excretion, and reproduction.

(a) Protozoa. The comparison of animals with plants, modes of

nutrition, locomotion, and reproduction. *Euglena*, *Chlamydomonas*, *Volvox*, *Amoeba*, *Paramecium*, *Monocystis*, Malarial parasite.

(b) Coelenterata. *Hydra*: differentiation and specialization of cells. Reproduction (asexual and sexual). Behaviour.

(c) Platyhelminia. A turbellarian worm: nervous system and behaviour. Characteristics of parasites and their control as illustrated by *Fasciola*.

(d) Annelida. *Nereis*: external features, free larval stage.

Earthworm (by dissection): locomotion and behaviour, respiration, excretion, reproduction, economic importance.

(e) Arthropoda.

Crustacea. Crayfish (by dissection): details of the limb segments will not be required.

Insecta. Cockroach (by dissection). Movement, respiration, excretion, and ecdysis in insects.

(f) The following insects (omitting internal structure). Their mode of feeding, life-history, economic importance, and methods of control, natural and artificial.

Aphis.

Butterfly and clothes moth.

Honey-bee: social life and behaviour.

Mosquito.

(g) Mollusca. The snail (by dissection).

(h) Chordata. Pisces. The dogfish (by dissection): vertebrate organization, external features.

A teleostean fish: external features, respiration, swim-bladder.

(i) Amphibia. The frog (by dissection). Development: external features such as can be seen by a hand-lens (cleavage, gastrulation, formation of neural tube, gills, limbs); outlines of development of gut, heart, eye, ear, and myotomes. Metamorphosis, transition from aquatic to terrestrial life.

(j) Aves. A bird: adaptation to flight. An outline of the development during the first three days. The formation and function of the embryonic membranes. Nesting and care of the young.

3. Natural History.

The natural history in some detail either of a common group of animals or of the animals of some well-defined habitat. The food relations, habits, and life-histories of the animals observed. Their relations and adaptations to the physical environment and to other organisms about them. No restriction will be placed on the groups of animals or habitat chosen. (Examples of habitats are freshwater ponds, streams, marshy ground, the sea-shore, the open sea, the soil, an oak tree, pasture land, woodland, rubbish heaps.)

The examination will test:

(a) ability to draw conclusions by direct personal observation from facts observed in the field;

(b) the student's appreciation of the concept of species;

- (c) knowledge of the influence of environment on animals;
- (d) the extent of the student's interest in field studies.

Questions of a general character may be set in the theory papers which can be answered by candidates who have followed special field interests.

4. A. Outline of the concept of evolution and the evidence for it. The outstanding features of the palaeontological succession. Introduction to the theory of natural selection with reference to variation, mutation, inheritance, isolation, and the struggle for existence.

B. An outline of the main phyla of the animal kingdom, illustrated especially by the phyla mentioned in sections 1 and 2 and including also elementary knowledge of the following: Nematoda, Arachnida, Echinodermata, and Reptilia.

C. Mitosis. A simple outline of the behaviour of the nucleus in maturation of the germ cells and in fertilization. The importance of the pairing and subsequent separation of homologous chromosomes. The evidence connecting inheritance with chromosomes. Outlines of Mendelian inheritance for not more than two pairs of characters. Linkage, sex chromosomes, and sex-linkage.

PRACTICAL EXAMINATION

The candidate may be asked to dissect any of the animals specified; to make simple temporary and permanent microscopical preparations; to carry out simple experiments; to identify or comment on specimens.

Botany. (This may not be offered with Biology.)

All papers may include questions on the whole of the following syllabus, but those in Paper III will in general require a higher standard of knowledge than those in Papers I and II.

The syllabus is intended to cover a study of botany at the sixth form level. Importance is attached to the following: the relation of structure to function; observation of plants and their development in their natural environment and under cultivation (not necessarily limited to those mentioned in the syllabus); importance of plants in food production and the general economy of nature. Candidates will be expected to show familiarity with simple physiological experiments including some of a quantitative kind. It is recognized that in some schools not all parts of the syllabus can be studied with equal thoroughness and the choice of questions set will allow for this.

1. The morphology of flowering plants. The external morphology of typical British dicotyledons and monocotyledons. The main anatomical features of the roots, stems, and leaves of a herbaceous dicotyledon and a monocotyledon such as maize. Primary and secondary growth. Differentiation and formation of tissues. Arborescent plants; the external morphology and the main anatomical features of a common angiospermous tree; bark; leaf-fall. Perennation; storage organs; vegetative reproduction. Protoplasm (cytoplasm and nucleus); the plant cell and its contents. Mitosis and cell-division.

2. Physiology. The water relations of the cell and the absorption of solutes. Soil composition, manuring, and crop rotation. Culture solutions. Photosynthesis. Translocation and storage of food. Transpiration and water movement. Respiration, aerobic and anaerobic. Growth. Response to stimuli; geotropism, phototropism, and hydrotropism. An elementary study of enzymes and their role in plant metabolism. Sufficient knowledge of the following to permit appreciation of the physiological processes: salts, solutions, colloids, diffusion, permeability of membranes, osmotic pressure, the elementary chemistry of carbohydrates, fats, and proteins including simple qualitative tests for common reserve foods, rate of chemical change, catalysis.

3. Reproduction of flowering plants. The morphology of inflorescences and flowers considered in relation to pollination; anthers and ovules including their microscopic structure. Fertilization and its results. Fruit and seed formation and dispersal. Germination.

4. Flowerless plants and *Pinus*. The structure, nutrition, and life-history of *Chlamydomonas*, *Pandorina*, *Eudorina*, *Volvox*, *Spirogyra*, *Fucus*, bacteria, yeast, *Mucor*, *Pythium*, *Peronospora*, *Agaricus*, *Pellia* or *Funaria*, and *Dryopteris* (detailed anatomy of moss and fern is not required). The external morphology and life-history of *Pinus*, including the detailed structure of the reproductive organs.

5. The natural history of flowering plants. Annuals, biennials, and perennials. Water plants, xerophytes, climbing plants, parasitic plants, and insectivorous plants. The principles of ecology as demonstrated by the study of a woodland if possible or of other suitable tracts of vegetation, stressing the nature of plant communities and the interaction of plants with each other and with edaphic, biotic, and climatic factors within their habitat. Observations and records to be made throughout the year.

6. Systematic botany. Principles underlying the classification of plants; the meaning of the terms species, variety, genus, family. Study of the characters used in classification as illustrated by the commoner members of the Ranunculaceae, Rosaceae, Leguminosae, Compositae, and one species of grass. Candidates should be able to identify British plants by means of a Flora.

7. Evolution and Heredity. Variation. Outlines of Mendelian inheritance for not more than two pairs of characters. Meiosis and the evidence connecting inheritance with chromosomes. Linkage and crossing-over. Introduction to the theory of natural selection with reference to variation, mutation, inheritance, isolation, and the struggle for existence; the evidence for evolution.

PRACTICAL EXAMINATION

The main object of the practical examination will be to test the powers of the candidates in making accurate observations, in recording them clearly, and in drawing reasoned conclusions from their observations.

Candidates may be required to perform simple experiments bearing on plant physiology, including tests for reserve materials.

A question will usually be set involving the cutting of sections of plant material in different planes for microscopic examination. Candidates should be able to use simple micro-chemical tests and simple and rapid methods of staining to differentiate anatomical features, but double staining and the mounting of permanent preparations will not be required in the examination. Special attention should be paid to the preparation of diagrams illustrating the general distribution of tissues, and to drawings showing the exact form of constituent cells or cell groups.

Candidates will be expected to be able to give short descriptions of the important features of the vegetative and reproductive parts of plants and to recognize features of special biological interest, but an extensive knowledge of technical terms will not be required. They should be able to construct floral diagrams and to show the structure of flowers as seen in longitudinal sections.

Tests may be set on the use of a Flora approved by the Board and provided by the candidate. The following have been approved:

Concise Flora of Britain. Makins (O.U.P.).

Flora of the British Isles. Clapham, Tutin & Warburg (C.U.P.).

Excursion Flora of the British Isles. Clapham, Tutin & Warburg (C.U.P.).

Applications for permission to use any other Flora should be made before **1 October** in the year preceding the examination. Approval will not be given to any which is extensively illustrated.

Biology. (This may not be offered with Zoology or Botany.)

All papers may include questions on the whole of the following syllabus, but those in Paper III will be more difficult than those in Papers I and II.

The papers will include questions of a general biological nature.

The examination will require that the candidate shall have examined living organisms, as far as possible under natural conditions.

Where the detailed syllabus is identical with that of the subjects Botany and Zoology, the standard of knowledge assumed will also be identical.

(1) ELEMENTS OF STRUCTURE AND PHYSIOLOGY

Sufficient knowledge of the following topics to permit appreciation of physiological processes. Acids, bases, salts, carbohydrates, fats, proteins. Solutions and colloidal systems. Diffusion, and the elements of membrane permeability. Rates of chemical change, catalysis, enzyme action.

The cell: the chemical and physical nature of the cytoplasm and cell membranes. The nucleus. Cell-division and differentiation.

Differences between living and non-living matter. Similarities and differences between plants and animals. Holophytic, holozoic, saprophytic, and parasitic nutrition.

(2) THE MAMMAL

The elements of the structure and physiology of a mammal exemplified where possible by the study and dissection of the rabbit (or rat or guinea-pig) and with reference to man.

(a) The skeleton (without details of the skull); the general relation of muscles to the skeleton in producing movement. Names of muscles and details of the chemistry of muscle action are not required. The elements of the histology of cartilage, bone, and striated muscle.

(b) The digestive system, the constituents of a balanced diet, digestion.

(c) The vascular system. Composition, histology, and functions of the blood.

(d) The respiratory organs. The mechanism of inspiration and expiration. Gaseous interchange in the lungs and tissues. The general nature of internal (tissue) respiration.

(e) The excretory system, with a simple account of the action of urinary tubules.

(f) Temperature control.

(g) The nervous system, limited to the main regions of the brain and spinal cord, the main nerves of the neck and arms. Special sense organs. The principles of nervous co-ordination. Elements of the histology of nerve. Thyroxin and adrenalin as examples of hormones; the endocrine system (details of histology and biochemistry will not be required).

(h) The reproductive system and an outline of the development and care of the young, including some knowledge of the amnion and placenta but not a detailed account of their embryological origin.

(i) The defences of the body against infection.

(3) THE FLOWERING PLANT

(a) The structure of a flowering plant such as sunflower or wall-flower with sufficient detail to make clear the development and functions of the root system, the stem, and the leaf.

(b) The elements of the physiology of the green plant.

Photosynthesis: essential factors, formation of carbohydrates, removal of carbohydrates.

Respiration: absorption of oxygen and production of carbon dioxide. Aerobic and anaerobic respiration.

Uptake conduction and loss of water: effect of external factors on rate of water-loss. Use of cobalt chloride paper. Use of potometer.

Water relations of cell: suction-tension, turgor pressure. Plasmolysis and recovery. Wilting.

Uptake of inorganic substances.

Growth and tropisms: geotropism in root and stem. Phototropism in stem and leaf. Reception and transmission of stimuli. Response to stimuli.

Knowledge of these points should be based as far as possible on experimental demonstration.

(c) Seasonal changes in herbs and woody shoots, including changes during secondary growth.

(d) Vegetative reproduction. Importance in nature and in cultivation. Food storage in perennating organs.

(e) Reproduction by seed.

Structure of two simple flowers, e.g. buttercup and bean.

Pollination, differences between wind- and insect-pollinated flowers. No details of development of the stamens or of the unfertilized ovary and embryo-sac will be required.

Fertilization: an outline of the formation of fruits and seeds and their dispersal.

Germination of sunflower and wheat seeds: conditions required.

Changes taking place in the food stores.

(4) THE VARIETY OF ORGANISMS

A general study of the following organisms, involving observation of living specimens where possible and dissection where appropriate.

(a) *Euglena*: structure, nutrition, movement.

(b) *Amoeba*: structure, nutrition, osmo-regulation, movement, life-history.

(c) *Spirogyra*: the green plant cell contrasted with the animal cell; asexual and sexual reproduction.

(d) *Mucor*: structure, nutrition, asexual and sexual reproduction.

(e) Yeast: nutrition, aerobic and anaerobic respiration; economic importance.

(f) *Fucus*: differentiation, adaptation, reproduction.

(g) *Pellia* (or *Funaria*): general structure, life-history, and adaptations to conditions of life in both generations.

(h) *Dryopteris*: general structure and life-history.

(i) *Hydra*: differentiation and specialization of cells, reproduction.

(j) Earthworm: the body-cavity, vascular system, locomotion, reproduction, economic importance.

(k) Insects (omitting internal structure). Cockroach: respiration, life-history. Butterfly: life-history. Honey-bee: social life and economic importance. Mosquito: life-history and economic importance. Mouth parts and feeding in the above types.

(l) The dogfish: external features; heart and arterial system; brain, and cranial nerves.

(m) The frog: general anatomy without details of the skeleton, brain or cranial nerves. A sufficient knowledge of the tadpole for the appreciation of the changes involved in the transition from aquatic to terrestrial life.

(5) ORGANISMS IN RELATION TO HABITAT

The natural history in some detail of the plants and animals within one well-defined habitat (e.g. woodlands, moorlands, heath or chalk

down, grassland, swampy land—marsh, fen, or bog—hedgerow, streams, freshwater ponds, sea-shore). Candidates will be expected to have observed and recorded the interrelations between the plants and animals and to have some knowledge of methods of assessment of the relative importance of climatic, edaphic, and biotic factors.

Relations of organisms to disease and decay. The life-history of one plant and one animal parasite of economic importance (e.g. *Phytophthora infestans* (potato blight); *Heterodera* (eel worm)). The effects of the parasite on its host and the general features of parasitism.

A general knowledge of bacteria, viruses, and Protozoa in relation to the circulation of substances in nature and to the control of disease by personal hygiene and public-health measures.

(6) THE SOIL

The soil in relation to plant and animal life. Its origin and structure; humus, mineral, and water content; soil organisms; carbon and nitrogen cycles.

Maintenance of soil fertility. Natural and artificial manures. Rotation of crops.

(7) HEREDITY AND EVOLUTION

A simple outline of the behaviour of the nucleus in the maturation of the germ-cells and in fertilization. The importance of meiosis.

Outlines of Mendelian inheritance for not more than two pairs of factors. A detailed study of meiosis is not required, but students should realize the importance of the pairing and subsequent separation of homologous chromosomes.

Variation within the species. Outline of the concepts of evolution and natural selection and of the nature of the evidence for them.

PRACTICAL EXAMINATION

This is intended to test not merely the extent of the candidate's knowledge, but his ability to perform manual operations, including dissection, with neatness and dexterity, to observe accurately, to record the observations by means of accurate drawings or diagrams, and to use judgement in their interpretation.

The candidate may be required to perform simple experiments upon plant or animal material, including dissections and the cutting of sections of plant material and simple staining. Detailed study of the microscopic anatomy of flowering plants will not be required, except in so far as is indicated in section (3) 'The Flowering Plant'.

Geology

The following papers will be set:

I.	.	.	.	.	.	.	.	.	.	2½ hrs.
II.	.	.	.	.	.	.	.	.	.	2½ "
Practical	.	.	.	.	.	.	.	.	.	3 "

Weathering and soil-formation in different climates. Denudation. River erosion; drainage systems and their development. The work

of ice and frost; glaciation and its effects upon topography. Marine erosion; development of coastlines. Wind action and desert geomorphology. Special features of limestone regions.

The development of land forms in relation to rock-structure and to climate. Mountains, plateaux and plains; escarpments. Origin of lakes. Islands and their origin. Coral reefs and atolls.

Movements of the earth's crust. Earthquakes. Mountain-building movements and the structure of mountain ranges. Evidence of elevation and depression. Types of folds and faults; their effects upon outcrops and topography.

The physical properties of minerals, including refractive index (but not its determination) and double refraction. Chemical composition. The general nature of crystals. Crystal symmetry, and Miller's notation as applied to a few simple forms. Mode of occurrence of the more important minerals.

Igneous rocks; their mineral composition, structure, and classification.

Sedimentary rocks; composition and mode of formation of the principal types. Transportation and deposition. Stratification, lamination, cleavage. Modern marine sediments; beaches; shallow-water and deep-sea deposits. Marine, estuarine, deltaic, lacustrine and desert deposits among British strata.

The common metamorphic rocks. Thermal and stress metamorphism. Pneumatolysis.

Igneous activity. Distribution of volcanoes and the structure of different types. Ashes and lavas. Form and structural relationships of igneous intrusions. Distribution of igneous rocks in the British Isles.

The preservation of fossils; their distribution in rocks of different ages. The characters of Foraminifera, Sponges, Graptolites, Corals, Crinoids, Echinoids, Brachiopods, Lamellibranchs, Gasteropods, Cephalopods, and Trilobites. A general study of the evolution of Fishes, Reptiles, and Mammals. The distinctive features of Palaeozoic, Mesozoic, and Tertiary fossil floras.

The principles of stratigraphy (Historical Geology). Nature and distribution of the geological systems in Great Britain; their fossils, and the conditions under which they were deposited. The geological structure of Great Britain. The influence of different formations upon scenery.

Economic geology. Coal, oil-shale, petroleum. Rock-salt and gypsum. Ores of the metals and their mode of occurrence. Water supply. Building materials.

Local geology; the geology of the school district, or some other area studied by the candidate in the field. Special aspects of field-work, such as collection of fossils, measurement of sections, study of local economic geology.

Practical Test

The identification of common rocks and minerals in hand specimens.

The description of common forms of crystals.

The identification of fossils, and the reference of each to its biological group and geological age.

The description of specimens selected from the main groups of fossil invertebrates, either in writing or by means of labelled drawings.

The description and discussion of specimens that could be found within easy reach of the school or local centre.

The description of photographs illustrating land-forms and the effects of various geological processes.

The interpretation of simple geological maps, and the drawing of sections. The use of graphical methods for finding the strike, dip, and thickness of beds, and their underground extension.

List of Minerals and Rocks

The following list of minerals and rocks is regarded as a minimum requirement for the practical test.

Quartz, the Felspars, the Micas, Augite, Hornblende, Olivine, Tourmaline, Apatite, Garnet, Iron Pyrites, Copper Pyrites, Galena, Zinc Blende, Haematite, Malachite, Barytes, Fluorspar, Gypsum, Anhydrite, Rock-Salt, Calcite.

Granite, Syenite, Diorite, Gabbro, Peridotite, Serpentine, Pegmatite, Quartz-porphry, Pitchstone, Porphyrite, Dolerite, Rhyolite, Obsidian, Pumice, Trachyte, Andesite, Basalt.

Gneiss, Schist, Phyllite, Chiastolite-Slate, Hornfels, Marble.

Conglomerate*, Breccia, Sandstone*, Mudstone, Clay, Marl, Shale, Slate*, Limestone*, Dolomite-Rock, Chalk, Flint and Chert, Lignite, Bituminous Coal, Anthracite, Oil Shale.

Applied Mechanics

The following papers will be set:

I. Applied Mechanics	3 hrs.
II. Graphical Statics	3 „
III. Mechanical Drawing	3 „
IV. S Applied Mechanics	3 „

Candidates offering Applied Mechanics at **A** level must take Papers I, II, and III; those offering the Special paper must take Papers II, III, and IV.

In the award of **A** level passes to candidates offering the Special Paper, account will be taken of all the work submitted.

There will be no practical Examination, but the examiners may inspect the practical notebooks of the candidates. A choice of questions will be given in the Graphical Statics and theoretical papers.

Answers to Paper III must be on half-imperial (15" × 22") drawing-paper.

APPLIED MECHANICS (I)

Statics. Coplanar forces, statics of a rigid lamina, equilibrium of simple framework. Bending moment and shearing force diagrams. Centre of gravity. Laws of friction and their application to simple cases of equilibrium. Method of sections.

* It would be an advantage if several varieties of each of these were available for study.

Kinematics. Vector quantities, their resolution and composition. Relative motion, angular velocity, and acceleration. Uniform motion in a circle. Free motion under gravity, projectiles.

Dynamics. Newton's laws of motion. Mass, momentum, force, impulse, work, energy, power. Motion due to constant and variable forces. Friction. Simple machines. Simple harmonic motion. Simple and compound pendulums. Elementary rotational dynamics. Conical pendulum.

Strength of Materials. Stress, strain, Hooke's law. Young's modulus. Extensometer. Tensile testing machine. Torsion of shafts of circular cross-section. Rigidity modulus. Horse-power transmitted by thin tubes, and by solid and hollow shafts.

GRAPHICAL STATICS (II)

Funicular polygon for a system of coplanar parallel forces. Bending moment and shearing force diagrams. Link polygons used as bending moment diagrams. Force diagrams for Warren- and N-girders, and for simple frameworks.

Questions may be set on the graphical solution of problems on the subject-matter of Applied Mechanics (I). A choice of questions will be given.

MECHANICAL DRAWING (III)

The principles of Orthographic Projection applied in the setting out of details of engines and machines. Questions may be set in which:

(1) An object is provided and the candidate has to make and dimension freehand sketches and then produce a mechanical drawing from his sketches.

(2) A dimensioned perspective or isometric sketch is provided and orthographic views are to be drawn.

(3) Two or more views are given, and another is to be projected or to be completed, if partly given.

(4) Sketches of component parts are given, from which an 'assembly' drawing has to be made.

(5) Given external views, simple horizontal or vertical sections are to be drawn, or vice versa.

APPLIED MECHANICS (IV S)

The syllabus for Graphical Statics, together with:

Statics. Simple roof principles, subject to dead loads and wind pressure.

Strength of Materials. Elementary theory of bending of beams under concentrated loads and uniformly distributed loads. Deflexion under pure bending.

Dynamics. Second moment of areas. Moment of inertia of simple solids. Parallel and perpendicular axes theorems. Governors, rotation about a fixed axis, torque, angular acceleration, kinetic energy of

rotation. Simple harmonic motion treated more fully than in Paper I. Elementary theory of balancing of engines. Velocity diagrams for simple mechanisms.

Hydraulics. Flotation, centre of pressure and total pressure on plane surfaces. Laws of fluid friction, Bernouilli's theorem, Venturimeter. Flow of water through pipes and over 'V' notches.

GENERAL PAPER

The General Paper will consist of a comprehension test and about 20 questions, grouped in five sections, relating to (i) the Arts, (ii) Science, including Natural History, (iii) Literature (probably including a passage for comment and appreciation), (iv) History, including Current Affairs, (v) other subjects. Answers to the comprehension test and to three other questions, each selected from a different section, will be required in three hours.

The results for this paper, expressed in grades, will be included in the printed lists of **A** level results circulated to universities.

For Certificate purposes, the General Paper is recognized as a subject at Ordinary level.

ALTERNATIVE O SUBJECTS

The subjects of the Examinations are arranged as follows:

Latin, French, German, Spanish, English Literature, English History, European History, Geography, British Constitution, British Economic Organization, General Mathematics, Statistics, Biology, History of Science, Physical Geography and Elementary Geology, Scripture Knowledge, Navigation.

Latin

The following papers will be set:

- | | |
|--|--------|
| I. One passage of Unprepared Prose Translation and
one of Prose Composition | 2 hrs. |
| II. Unprepared Prose and Verse Translation | 2 „ |
| III. Set Book | 2 „ |

Candidates must offer Paper I and either II or III. The passage set for Prose Composition will be the same as at O level; the corresponding papers at O and Alternative O levels must be set at the same time.

Set Books for 1966. One book will be required, selected from:

1. Virgil, *Aeneid* vi. 1-547.
2. Caesar, *Bellum Gallicum* i, ii.
3. Horace, *Odes* ii.
4. Livy xxx, 1-25.

French, German, Spanish

The following papers will be set:

- | | |
|--|--------|
| I. One passage of Unprepared Prose Translation and
one of Prose Composition | 2 hrs. |
| II. One Set Book | 2 „ |

In Paper I the passage for Prose Composition will be the same as at O level; the corresponding papers at O and Alternative O levels must be set at the same time. In Paper II two short passages for translation will be set, both to be required; there will also be one question on contexts and one discussion question.

An Oral examination in reading and conversation, before the written papers are taken, is compulsory (see also p. 17).

Candidates who offer German may use the English or the German characters.

All question papers in the German language will be printed in Roman type.

In Spanish, either the old or the new system of written accent will be accepted, but not a mixture of the two.

Passages in Spanish in the question papers will follow the old rules.

Set Books for 1966. One book will be required, to be selected from:

French:

Mérimée, *Carmen et autres nouvelles* (Harrap).

Saint-Exupéry, *Vol de nuit*.

Mauriac, *Le Mystère Frontenac* (Harrap).

German:

Bergengruen, *Die drei Falken*.

Meyer, *Das Amulett*.

Huch, *Weisse Nächte*.

Spanish:

Galdós, *Doña Perfecta* (Biblioteca contemporánea Losada, or any complete text).

A. Buero Vallejo, *Historia de una escalera* (University of London Press).

Quintero Brothers, *Los Galeotes* (University of London Press).

English Literature

There will be a single paper (3 hrs.) on set books; a wide choice of questions will be given so that a candidate may pass on an adequate knowledge of five books.

Prescribed for 1966:

Shakespeare, *King John*.

*Keats, ed. R. Sharrock (New Oxford English Series. O.U.P.).

Dickens, *Little Dorrit*.

*J. S. Mill, *On Liberty*.

Robert Browning, *Selected Poems*, ed. J. Reeves (Heinemann).

Shaw, *Major Barbara*.

H. G. Wells, *Kipps*.

*D. H. Lawrence, *Sons and Lovers*.

Graham Greene, *The Power and the Glory*.

Ten Twentieth Century Poets, ed. M. Wollman (Harrap).

English History

One paper of 2½ hours.

The Outlines of English History from the Roman Conquest onwards.

Candidates will be required to answer any four questions out of the thirty-six set, with complete freedom of choice as to how the selection is made.

European History

One paper of 2½ hours.

The Outlines of European History from the reign of Constantine onwards.

Candidates will be required to answer four questions out of the thirty-six set, with complete freedom of choice as to how the selection is made.

Geography

There will be one paper of 3 hours, in which a map-reading question will be compulsory. The paper may include questions on the relationships of aspects of physical and human geography and may give candidates an opportunity of using knowledge of local geography and fieldwork.

Map reading with special reference to the 1/63,360, and 1/25,000 Ordnance Survey maps. The Daily Weather Report as published by the Meteorological Office; temperature, pressure, winds, humidity, precipitation, clouds. The principal climatic regions of the world and their natural vegetation. The characteristics and distribution of major landforms; the nature and evolution of landscapes under humid, arid, and glacial conditions; the effects on scenery of the main types of rocks. Submarine relief; salinity, temperature, and movement of sea water.

The growth and distribution of population; types of settlement.

Characteristics of soils, soil erosion, and conservation. Land use; mining and manufacturing industries. Transport and communications.

British Constitution

There will be one paper of 2½ hours.

The Constitution of Britain and its Administration. Legislature—King, Lords, Commons. Executive—King, Cabinet, Civil Service. Judiciary—Law Courts, Police. The Party System. Control of Public Finance.

The Local Government of England and Wales. Authorities; Members; Committees. Relations with Central Government. Powers and Duties. Financial Control.

British Economic Organization

There will be one paper of 2½ hours.

Specialization and division of labour: the occupational, industrial, and geographical distribution of the occupied population. Forms of economic organization: joint-stock companies; cartels and combinations; co-operation; public corporations. Financing of economic activity: types of credit; the banking system; the stock exchange and new issue market. Marketing: wholesale and retail distribution; organized commodity markets. Organization of labour: trade unions; employers' organizations; government intervention in industrial relations. International position of United Kingdom: exports and imports; international investment; the balance of payments.

No questions will be asked either of a directly theoretical or historical nature, but it is considered that some knowledge both of simple economic theory and of historical development is necessary before a satisfactory understanding of economic structure can be acquired.

General Mathematics

Two papers will be set:

- I. Algebra, Trigonometry, and Analytical Geometry. $2\frac{1}{2}$ hrs.
- II. Differential and Integral Calculus, Statics, and Dynamics. $2\frac{1}{2}$ hrs.

ALGEBRA

Up to and including the Binomial Theorem for a positive integral exponent; the properties and use of logarithms; graphs and their application to the solution of equations.

TRIGONOMETRY

Up to and including the addition theorems and the solution of triangles; graphs of the sine and cosine; use of four-figure tables; simple problems in three dimensions.

ANALYTICAL GEOMETRY

The straight line and circle; equations of loci.

CALCULUS

Differentiation and integration of the simpler standard forms; applications to areas, volumes of revolution, and centres of gravity; velocity, acceleration; maxima and minima.

STATICS AND DYNAMICS

The composition and resolution of forces, velocities, and accelerations in one plane (proofs of the parallelogram law will not be required); graphical methods applied to motion; moments; simple cases of equilibrium; centres of gravity; friction; rectilinear motion under uniform acceleration; Newton's laws of motion; force, work, and energy; conservation of linear momentum and of energy; simple cases of the motion of projectiles.

The pass mark in Alternative **O** Mathematics will be an aggregate for the two papers offered: there will be no minimum in respect of the separate papers.

Statistics

There will be one paper of 3 hours.

The syllabus will be the same as for the **A** level section of Mathematics with Statistics (p. 39). The subject may not be offered with Mathematics with Statistics.

Biology. (This may not be offered with Botany, p. 103.)

There will be one paper of 2½ hours.

There may be one or two questions of a practical nature which will not be compulsory, and there will be a choice of other questions.

(1) **THE CHIEF CHARACTERISTICS OF LIVING ORGANISMS** illustrated by the study of Man and of a flowering plant.

A. MAN

This section should be illustrated by the study of other mammals where necessary.

(i) **Food.** The constituents of a balanced diet and common deficiencies. Digestion, including enzyme action, and assimilation.

(ii) **Transport in the body.** The blood; its functions, composition, and circulation.

(iii) **Respiration and excretion.** Gaseous exchange at the lungs and in tissues. The mechanism of respiratory movement. The elimination of waste products via lungs and kidneys, including an elementary account of the kidney tubule.

(iv) **Movement.** The general structure of the skeleton and muscular system and their mechanical functions.

(v) **Co-ordination.** The nervous system; main regions of the brain, the spinal cord and peripheral nerves; sense organs. The reflex arc. Control by hormones, illustrated by an elementary account of the action of the following: islets of Langerhans, thyroid, pituitary, adrenal body, gonads.

(vi) **Reproduction and development.** The reproductive system, fertilization, nutrition, and respiration of the embryo, care of the young. The embryonic cell and its division (no details of the course of nuclear division). Cell specialization and division of labour by reference to a nerve cell, striped muscle, cartilage, and stratified epithelium.

B. THE FLOWERING PLANT

(i) **Elementary physiology.** Photosynthesis; the intake of mineral salts, and the intake, passage, and loss of water by the plant. Water relations of the plant-cell, plasmolysis. Respiration; absorption of oxygen and production of carbon dioxide and heat. Growth; tropistic responses and an elementary account of their mechanism.

(ii) **Reproduction by seed.** Pollination; the development of the seed by reference to a plant with a simple flower, excluding nuclear changes; germination of one type of seed, conditions necessary and physiology of process.

(iii) **The general form and structure of the flowering plant** considered in relation to the above functions.

(2) **THE VARIETY OF LIVING ORGANISMS** and the relations which may exist between them.

(i) **An outline of the classification of Animal and Plant kingdoms,** as systematizing an immense body of material. A short treatment of the

following organisms from the point of view of their morphology and relation to environment, illustrating various degrees of specialization; *Euglena*; *Paramecium*; *Spirogyra*; a liverwort; *Hydra*; earthworm; hive-bee; herring or other fish. Questions will not be set on the detailed anatomy of these organisms.

(ii) Predatism. Food chains. The main sources of man's food supplies; insects and rodents as his principal competitors for these.

(iii) Parasitism. Bacteria and disease; the defences of the body and methods of immunization. Malaria (details of life-history of *Plasmodium* not required) and the importance of mosquito control. Potato blight.

(iv) Saprophytism. Yeast and fermentation. A mould, such as *Mucor*. Decay and the circulation of carbon and nitrogen in nature.

(v) Symbiosis. Root nodules of Leguminosae; yeasts in insects.

(3) EVOLUTION AND HEREDITY

The concept of evolution as applied to all living organisms. Evidence for evolution. Natural selection. Types of variation. Outlines of Mendelian inheritance for not more than two pairs of characters. Linkage and sex-linkage. (No knowledge of chromosomes will be required.) The application of Mendel's work to the improvement of crop plants.

(4) ASPECTS OF BEHAVIOUR

An elementary consideration of the following: Taxes; conditioned responses; instinctive behaviour illustrated by insects and birds; social behaviour in bees; territory in birds and the behaviour associated with it; learning processes and their importance in the behaviour of mammals and man.

History of Science

A single paper of 2 hours will be set.

The syllabus is intended to illustrate the methods, influence, and social consequences of science and to cover the historical development of some of the most important scientific generalizations. It is not expected that candidates will have studied all the topics; a generous choice of questions will be given and answers to not more than four questions will be asked for, one of which must be taken from Section I (General). A minimum of quantitative work and only the simplest mathematics will be required. It is assumed that candidates will have a foundation at least equivalent to General Science at Ordinary level, studied in the middle school.

The syllabus is set out below in the column on the left; the notes on the right suggest selected interpretations of the syllabus.

1. General

The questions in this section will be based on general topics, some of which will have been studied in connexion with the other sections. Scientific methods.

The roles of experiment, observation, intuition, hypothesis, induction, deduction, and mathematics.

Contrast between nineteenth-century view of scientific method as collection of facts, derivation of laws from facts by induction, and explanation of laws by deduction from the theory, with the modern idea of a freely invented theory and verification of deductions from it.

The exploitation of chance in scientific discovery.

Difference between a scientific and a value judgement.

Importance of the scientific societies in the seventeenth century.

Social control of science: the development from individual research to modern, planned, team research.

Interrelation between science and technology.

History of the interrelationship between religion and science since the seventeenth century.

The following books are suggestions for this section; there may be others equally suitable:

Beveridge, W. I. B., *The Art of Scientific Investigation* (London, 1950).

Popper, K. R., *The Logic of Scientific Discovery* (London, 1959).

Taton, R., *Reason and Chance in Scientific Discovery* (London, 1957).

Toulmin, S., *The Philosophy of Science* (London, 1953).

Russell, Bertrand, *Religion and Science* (London, 1935).

Russell, E. J., *Science and Modern Life* (London, 1955).

Graham, A. C., *The Problem of Value* (London, 1961).

2. Measurement of Time and Space

Historical development of the measurement of time. Definition of the unit of time in terms of the apparent movements of the sun and stars. Mechanical clocks; modern devices for the measurement of time.

The measurement of the size of the earth and of solar, stellar, and nebular distances.

The expanding universe.

Single—and continuous—creation theories.

Eratosthenes, William Herschel, Shapley, Hubble.

Einstein's finite universe.

Lemaitre, Bondi, and Gold.

3. Motion and Gravitation

Aristotle's cosmology and views on motion.

Aristotle's presentation of the homocentric spheres of Eudoxus as a physical system. Motion as 'the actualization of a potentiality'. Natural and violent motion.

Ptolemaic system.

An alternative geometrical approach in terms of epicycles.

Medieval criticism of Aristotle's theory of motion.	Impetus theory. Revival of independent thought in physical science.
Copernican system.	Heliocentric system but circular motion preserved, retaining the physics of Aristotle.
Galileo's cosmology and dynamics.	Influence of Galileo's predecessors. Jupiter's moons, sunspots, phases of Venus. Studies on falling bodies. Galileo's scientific philosophy.
Tycho Brahe.	New precision in measurement.
Kepler's laws.	Search for true orbit of Mars. Influence of Gilbert and magnetic attraction.
Newton's laws of motion and his <i>Principia</i> .	Unification of terrestrial and celestial physics.
The law of gravitation and its explanation of Kepler's laws.	Simple derivation of Kepler's third law for circular orbits.
Influence of Newton's work.	Newton's work popularized on the Continent by Voltaire and its development by Laplace.
Discovery of Neptune and Pluto.	The former as an early example of prediction from theory.
Einstein's criticism of Newton's gravitational theory. Relativity.	The influence of the existence of two alternative theories on philosophical views of the nature of physical theories.

4. Atmospheric Pressure, Energy, and Power

Atmospheric pressure.	Torricelli, Pascal, von Guericke, Boyle.
The nature of heat.	Heat as a form of motion suggested by Francis Bacon. The work of Black, distinguishing heat and temperature and leading to the caloric theory. The relationship between heat and mechanical energy shown by Rumford and Davy.
Conservation of energy.	The work of Meyer and Joule leading to the formulation of the 1st Law of Thermodynamics. The equivalence of mass and energy.

The Second Law of Thermodynamics.

Carnot's theory derived from his work on steam engines leading to the formulation of the law by Clausius and Kelvin. The statistical nature of the law given by Maxwell and Boltzmann.

The harnessing of power.

Early machines illustrated by the work of Archimedes and by medieval machines. Water power harnessed in Roman times. Wind power harnessed in the tenth century. The harnessing of steam power by Newcomen and Watt. The introduction of the electric motor, the internal combustion engine and the steam turbine in the nineteenth century. The harnessing of atomic power. Solar batteries.

5. *The Wave Aspect of Radiation and Matter*

The history of the corpuscular and wave theories of light.

Newton and Huygens. Young and Fresnel.

Maxwell's electromagnetic theory of light.

Importance of electromagnetic waves: radio, television, radar, &c. The complete electromagnetic spectrum.

Hertz's production of electromagnetic waves.

The rise of the quantum theory.

Planck, Einstein (photoelectric effect) and Bohr.

The wave aspect of matter.

Wave-particle dualism.

Bohr's theory of complementarity.

6. *Magnetism and Electricity*

Gilbert.

Magnetism. Electricity. Idea of 'electrical atmosphere'.

Electrostatics in the eighteenth century.

Conduction (Gray). Resinous and vitreous electricity, and law of poles (du Fay). Conservation of charge (Watson, Franklin). One-fluid theory (Franklin). Inverse square law.

Outline of the early history of current electricity.

Galvani, Volta, Oersted, Ohm, and Ampère.

Faraday's discovery of electromagnetic induction.

Significance of electricity in the development of communications and industry.

Invention of the telephone.
Influence of electric power on the nature and distribution of industry.

7. *The Foundations of Chemistry*

The phlogiston theory.

Stahl.

The nature of combustion and the discovery of oxygen.

Seventeenth-century experiments on the part played by air in combustion. Black's experiments on calcium carbonate. Priestley, Cavendish, and Lavoisier.

The chemical elements.

Boyle and Lavoisier.

Concept of atomism.

Greeks. Atomism in seventeenth and eighteenth centuries.

Atomic and molecular weights.

Dalton, Avogadro, Cannizzaro.

The Periodic Table.

Mendeléef. Enough of the structure of the Periodic Table to enable the prediction of elements to be appreciated.

Valency and atomic structure.

8. *Organic Chemistry*

Early ideas on substances occurring in living materials. Break-down of the barrier between organic and inorganic chemistry.

Vital force theory (Berzelius).
Wöhler and Kolbe.

Constancy of bonding capacity of the carbon atom.

Kekulé and Couper.

Stereochemistry. The necessity of a three-dimensional approach to structure.

Evidence for the tetrahedral structure of carbon compounds to include an elementary discussion of structural isomerism and stereoisomerism. Pasteur, Le Bel, Van't Hoff.

Structure of new compounds.

Use of analysis, reactions and final proof by synthesis.

Organic chemistry in the chemical industry and its economic influence.

The growth of the petroleum chemical industry. Synthetic materials, *either* plastics *or* dyes. Properties depend on structure.

9. *The Structure of the Atom*

Discovery of the electron.

J. J. Thomson.

Measurement of the charge and mass of the electron.

Millikan's oil-drop experiment.
Determination of e/m .

X-rays: their discovery, nature, properties, and applications.

Radioactivity and the Rutherford-Soddy theory of atomic disintegration.

Rutherford's nuclear atom.

The discovery and uses of isotopes.

Discovery of the neutron.

Induced nuclear transmutation.

Becquerel, the Curies.

Scattering experiments.

Soddy, J. J. Thomson.

Chadwick.

Rutherford's (1919) experiment. Cockcroft-Walton experiment. Discovery of artificial radioactivity. Neutron-induced reactions. Discovery and uses of nuclear fission.

10. *The Nature and Continuance of Life*

Contributions of the Greeks.

The great systematists of the sixteenth, seventeenth, and eighteenth centuries.

Buffon, Lamarck, and Cuvier. The dawn of the idea of evolution.

The biological revolution of the nineteenth century resulting from studies of the cell, advances in geology and the theory of natural selection. The change from a static to a dynamic outlook.

Work of Aristotle with particular reference to his attempts at classification based on arbitrary criteria ('artificial' classification).

Sixteenth-century herbalists. Work of Ray and Linnaeus, and the development of the binomial system of nomenclature. The static outlook resulting from the acceptance of the fixity of species.

Ideas of change among living organisms. Adaptive radiation. Influence of the environment on inherited variations. The inheritance of the effects of use and disuse. Conflict between the new scientific outlook and religious beliefs based on Divine Creation.

Rise of the cell theory. Weismann; the distinction between sex and soma. Contributions of Hutton and Lyell; the theory of uniformity and its impact on the study of evolution. Darwin and Wallace; natural selection.

Mendel. The particulate theory of inheritance. The behaviour of genes in accordance with Mendel's laws. Morgan and linkage. Roles of DNA and RNA. Mutation—natural and artificial. The work of Muller. Elements of population genetics with particular reference to eugenics.

The present status of evolutionary theory. Evidence for evolution in the past and now. The modern theory of the mechanism of evolution; neo-Darwinism. Classes of evidence should include palaeontology, anatomy, embryology, geographical distribution, physiology, domestication (as an example of artificial evolution). At least one example of recent work on the action of natural selection, e.g. Kettlewell (Peppered Moth), Cain and Sheppard (Snails), Dobzhansky (*Drosophila*), Bodmer and Crosby (Primrose).

11. *Man and his Environment*

Circulation of the blood.

Galen; vital spirits. Servetus, Harvey, Hales.

Respiration.

Priestley; Lavoisier. Modern concept of tissue respiration; the Krebs cycle. Breathing; influence of atmospheric pollution.

Co-ordination — nervous and hormonal.

Haller; doctrine of irritability. Galvani and the electrical nature of the nerve impulse. Sherrington; the integration of the nervous system. Hill; nerve action in relation to muscular movement. Adrian; the measurement of nervous activity. Bayliss and Starling; secretin (discovery of the first hormone). Modern views on the action of one ductless gland, e.g. thyroid, pituitary, adrenals, &c.

Nutrition.

Liebig; fats, carbohydrates, proteins. Bernard; the glycogenic function of the liver. Hopkins; accessory food factors.

Reproduction.

Aristotle. Nutritive principle in female—formative principle in male. Preformation versus epigenesis. De Graaf; investigation of the egg.

Man's food and its dependence on green plants.	Priestley; Ingen-Housz; de Saussure; sunlight and gas exchange in the green plant. Liebig; CO ₂ and mineral salts in plant nutrition. Crop rotation and soil fertility; Rothamsted Experimental Station. Malthus; tendency of populations to out-run food supplies.
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12. *Medicine*

The four humours.	Hippocrates.
The revival of anatomy and physiology.	Vesalius and Harvey.
Spontaneous generation. Inoculation and immunity.	Jenner, Pasteur, Koch.
Antisepsis and asepsis.	Lister.
Chemotherapy.	Ehrlich; salvarsan and the sulphonomides. Fleming; antibiotics.
Major diseases and their control.	Malaria, yellow fever, plague, sleeping sickness.
Anaesthesia.	Simpson.
Insulin treatment in sugar diabetes.	Banting and Best.

Selected Bibliography

The following are a small selection of general works on the history of science. Books on the history of the individual sciences and on more specialized topics are given in the report of the Science Masters' Association, *Science in Sixth Form General Education*, and in several of the books below:

- Butterfield, H., *The Origins of Modern Science* (London, 1949).
 Conant, J. B. (ed.), *Harvard Case Histories in Experimental Science* (Harvard, 1957).
 Crombie, A. C., *Augustine to Galileo* (London, 1952).
 Hall, A. R., *The Scientific Revolution 1500-1800* (London, 1954).
 Mason, S. F., *A Short History of the Sciences* (London, 1953).
 McKenzie, A. E. E., *The Major Achievements of Science*, vols. 1 and 2 (Cambridge, 1960).
 Singer, C. F., *A Short History of Scientific Ideas to 1900* (Oxford, 1959).

Physical Geography and Elementary Geology

There will be one paper of 2½ hours.

The paper will be divided into three sections: (1) Physical Geography, (2) Climatology and Meteorology, (3) Geology.

The Examiners will assume that candidates possess a knowledge of Elementary Physics and Chemistry, and may set questions in any section which involve such knowledge.

The subjects of the examination will be:

(i) The outlines of *Physical Geography*, viz. the form of the Earth and variations in the Earth's surface; gravitation; the ocean, tides, seas, lakes and rivers, glaciers and icebergs, volcanoes and earthquakes.

(ii) The outlines of *Geology*, viz. the principal igneous, aqueous, and metamorphic rocks, including recognition of specimens; denudation; deposition of stratified rocks; dip, strike, joints, cleavage, faults, dykes; unconformable stratification; the principles on which the relative ages of rocks are determined; the outlines of stratigraphical geology; the recognition of the fossil genera found in the principal formations.

(iii) The outlines of *Climatology* and *Meteorology*, viz. the seasons; the atmosphere and climate, winds, clouds, rain and dew.

Candidates must satisfy the Examiners in (i), (ii), and (iii) taken together.

Candidates will be required to answer a compulsory practical question and four others including at least one from each section.

Scripture Knowledge

Candidates must offer **one** of the following three papers.

I. Old Testament	2½ hrs.
II. The Life and Teaching of Jesus Christ as recorded in the Gospels	2½ "
III. The Life and Teaching of St. Paul as recorded in the Acts and the Epistles	2½ "

The syllabuses will be the same as for the first three papers at Advanced level (pages 32 and 33) but separate papers of an easier standard will be set.

Navigation

A single paper of 2½ hours will be set.

The paper is intended to test a knowledge of the general principles of navigation (including the elements of astro-navigation); it will be divided into two sections, the second being chiefly concerned with elementary astronomy and its application to navigation. The syllabus is framed to be, in the main, a suitable introductory course in sea navigation or in air navigation.

Candidates will be expected to be familiar with the simpler graphical and arithmetical processes; calculations should be made, where necessary, with the usual four-figure tables. A liberal choice of questions will be allowed.

SECTION I

Geometry of the sphere. Great circle. Small circle. Application to the Earth. Departure. 'Parallel-sailing'; proof and use of the formula $Dep. = Dlong. \cos(lat.)$. Direction on the Earth's surface.

The magnetic compass. Variation. Deviation. Use of a deviation table or curve. Relative bearings. Rhumb lines. Construction and properties of the Mercator chart. Dead reckoning. Finding the position of a ship or aircraft from observations of terrestrial objects and W/T bearings. Running fix. Application of triangle of velocities to the simple problems. Rhumb-line formulae and their use. Use of the cosine-formula of spherical trigonometry (proof not required) in finding great circle distances and in Section II below.

SECTION II

The celestial sphere. Altitude and azimuth. Hour Angle and declination. The First Point of Aries. Sidereal Time. Mean Time. Zone (or Standard) Time. Right Ascension and Sidereal Hour Angle. Relation between G.H.A. and Local H.A. Almanacs. Finding the Local Hour Angle of a heavenly body. Correction of observed altitudes for refraction, parallax, and semi-diameter (descriptive only); the theory of the sextant will not be required. Theory of the astronomical position line. Determination of position at sea and in the air. (Candidates will not be expected in the paper to work out a position line in detail, but it will be assumed that they are familiar with the general principles.) Sunrise and sunset. Twilight. The moon's phases. General description of the sun, moon, and planets. Constellations and the magnitudes of the stars (descriptive only).

ORDINARY LEVEL SUBJECTS

The subjects of the Examinations are arranged as follows:

- I. Scripture Knowledge; English Language; English Literature; History; Ancient History; Geography.
- II. Latin; Greek; General Classics; French; German; Spanish; Italian; Russian; Welsh; Irish; Arabic.
- III. Elementary Mathematics; Additional Mathematics; Physics; Chemistry; Physics-with-Chemistry; General Science; Biology; Botany.
- IV. Music; Art; Geometrical and Mechanical Drawing; Handicraft; Domestic Subjects.

I

Scripture Knowledge

For an experimental period of three years a single paper of 2½ hours will be set on an alternative syllabus on the text of the New English Bible. Details are given below.

1. Regular Syllabus.

There will be two papers of 2 hours each.

- I. A Synoptic Gospel (Greek or English Text).
- II. One of the following:
 - (a) A selected subject from Old Testament History.
 - (b) A special portion of the Old Testament.
 - (c) A portion of the Acts of the Apostles in English.

Candidates must offer Paper I and one of the alternatives in Paper II.

Candidates whose parents object on religious grounds to their taking one of the New Testament books may take both II (a) and II (b), omitting I.

In papers on Scripture Knowledge the Revised Version will be used.

Greek Text

When the Gospel prescribed is St. Matthew or St. Luke the passage set for translation will be taken from the sections of the Gospel reserved for comment.

Prescribed for 1966:

Paper I. The Gospel according to St. Luke. Passages will be set for comment from chapters iii. 1-v. 11, vi. 17-viii. 3, ix. 51-xxiv. 53.

Paper II. (a) The beginning of the Monarchy and the history of the Undivided Monarchy. Candidates will be expected to know something of the religious ideas of the period. Passages for comment will be set from 1 Samuel ix-xi, xiii, xiv, xxvi; 2 Samuel i-iii, vi, xii, xvi-xix; 1 Kings xii.

(b) Isaiah xl-lxvi, Jonah.

(c) Acts xiii-end.

2. Alternative Syllabus. The Life and Teaching of Jesus Christ.

There will be one paper of 2½ hours.

Prescribed for 1966:

New English Bible:

The Gospel according to St. Mark.

The Gospel according to St. Matthew, v, vi, vii, xiii.

The Gospel according to St. Luke, xiv. 15-xvi. 31.

In all papers questions will be set which will demand some general knowledge of elementary commentaries and some evidence of the candidates' ability to appreciate the religious and historical significance of the set texts, as well as accurate factual knowledge of their contents.

The paper on the Gospel will contain a choice of questions, and the questions will be varied in character. In the question requiring comment on set passages, specific questions may be asked on their subject-matter. These are intended to be a guide to the candidates in making their comments, but candidates will be free, if they wish, to select other significant points in these passages on which to comment instead of the set questions.

English Language

All candidates must take two papers as follows:

I. English Language	2 hrs.
II. English Composition	2 „

Paper I. One passage will be set for précis and two for comprehension. In the second passage for comprehension a choice may be offered between, for example, a poem, a piece of scientific prose, or a piece of prose involving dishonesties of argument, tone and attitude, or lack of clarity in thought and expression, which the candidate would be asked to expose.

Paper II. Two questions will be set, one demanding formal expository prose, the other providing opportunities for freer writing with a wider choice of tone and subject. A choice will be given in both questions. Candidates will be advised to spend at least fifteen minutes correcting their work and will be warned that length is not necessarily regarded as a virtue.

Candidates will no longer be invited to write stories.

English Literature

All candidates must take two papers as follows:

- I. Shakespeare 1½ hrs.
 and **Either** II. Set Book 1½ „
Or III. Two or three related Set Books . . . 1½ „

Prescribed for 1966:

Paper I. *Macbeth* or *The Merchant of Venice* or *King Henry IV, Pt. I.*

Paper II: One book to be selected from:

- A. Chaucer, *The Prologue*.
 B. Dickens, *David Copperfield*.
 C. Kinglake, *Eothen*.
 D. Shaw, *The Devil's Disciple*.
 E. *The Poet's World*, ed. J. Reeves (Heinemann) pp. 1-31, 141-261.

Paper III. Kipling, *Kim*.

- Richard Hughes, *High Wind in Jamaica*.
 William Golding, *Lord of the Flies*.

History

Candidates must take *two* papers each of 1½ hours. In each paper they will be instructed to answer *three* questions; one of them will be in the form 'Write short notes on *x* of the following'. This question will not be compulsory. One of the two papers must be a period of English Outlines (1-7 below) and the other may be another period of English Outlines or any one of the options 8-18.

Outlines of English History:

1. 55 B.C. to A.D. 1216.
2. 1216-1485.
3. 1485-1660.
4. 1660-1763.
5. 1763-1846.
6. 1846-1914.
7. 1914-1951.

Outlines of European History:

8. A.D. 284-1216.
9. 1216-1494.
10. 1494-1660.
11. 1660-1763.
12. 1763-1850.
13. 1850-1914.
14. 1914-1951.
15. The History of the British Empire and Commonwealth, 1783-1951.
16. The History of the U.S.A., 1783-1865.
17. The History of the U.S.A., 1865-1941.
18. The Expansion of Europe, c. 1400 to c. 1660.

The Expansion of Europe, c. 1400 to c. 1660:

The beginnings of Portuguese exploration as a crusade against the Moslems—Portuguese settlements in Africa, India, and the Spice Islands—Prince Henry, Albuquerque.

South America and the West Indies: Columbus, Vespucci, Magellan, Cabral. The conquistadors—principles of Spanish colonization.

The North American fisheries—search for a north-west passage—the fur trade. The north-east passage—trade with Russia.

The East India Companies—decline of Portuguese power in the Indies, and subsequent activities of the Dutch—the Dutch and the spice trade, Dutch settlements. Dutch monopoly of the carrying trade—Dutch commercial methods. English beginnings in India: Surat, Madras.

English settlements in America—the chartered companies, Puritan settlements, colonial self-government. The French in North America, Cartier, Champlain. Settlements, commercial rivalries, and privateering in the West Indies. The development of slavery and the slave trade.

Improvements in navigation throughout the period—developments in the design of ships—the compass, map-making, naval gunnery.

Ancient History

The following papers will be set:

- | | | |
|--------------------------------------|-----------|---------|
| I. Greek Outlines, 750–323 B.C. | | 2½ hrs. |
| II. Roman Outlines, 264 B.C.–A.D. 68 | | 2½ „ |

Candidates will offer either Paper I or Paper II.

Geography

The following papers will be set:

- | | |
|----------------------------------|---------|
| I. General Geography | 2¼ hrs. |
| II. Regional Geography | 2 „ |

Map work may be tested in both papers. In both papers candidates are expected to draw sketch-maps and diagrams to illustrate their answers.

I. General Geography

(a) *Practical.* A compulsory question on the interpretation of contour maps and the drawing of such maps from verbal descriptions. For candidates from schools in the British Isles the question set may involve the use of an Ordnance Survey map, either 1:63,360 or 1:25,000. Maps set in the examination may be purchased by schools from the Ordnance Survey at an inexpensive rate.

(b) *Physical.* The Earth as a planet; latitude and longitude (but not the methods of their determination): time. Important landforms and topographical features such as mountains, plateaux, valleys, plains, shorelines; the effects of erosion and deposition. Elementary knowledge of the oceans—depth, salinity, currents (but not the theory of tides). The general nature and causes of the seasonal distributions

of temperature, atmospheric pressure, wind systems, and rainfall. Climatic and vegetation regions. Exercises on world outline maps and on weather maps of Western Europe. The construction and interpretation of simple climatic and statistical graphs. (At least five questions will be set.)

(c) *Human*. An outline of the relief, climates, vegetation, and resources of the continents, together with their human utilization. Distribution of population and modes of living in relation to natural vegetation and cultivated crops, mineral wealth, and industrial development; lines of communication and transport; the bearing of these on world problems. (At least five questions will be set.)

In Paper I candidates will be required to answer four questions, viz. the compulsory practical question, one question from each of the sections (b) and (c), and one other question.

II. *Regional Geography*

Detailed geographical study of the British Isles together with another area in less detail.

Prescribed for 1966:

North America (Canada and U.S.A.).

II

Latin

The following papers will be set:

I. Composition and Unprepared Translation . . .	2 hrs.
II. Unprepared Translation and Questions . . .	2 "
III. Set Books	2 "
IV. Unprepared Prose Translation and Verse Book . . .	2 "

Candidates must take Paper I and **either** Paper II **or** Paper III **or** Paper IV. In all papers they must show a satisfactory knowledge of the grammar of the language.

Paper I. Translation into Latin (*a*) of English sentences involving only simple constructions and (*b*) of a simple passage of continuous English, together with Unprepared translation into English of a short and easy passage of Latin prose.*

The Sentences will require knowledge only of constructions such as:

Cases governed by the commoner verbs—modal verbs—impersonal verbs—regular use of the moods.

Direct and indirect statement; prohibition, question, and command.

Adjectival and adverbial clauses in direct and indirect speech.

Knowledge of the use of conditional clauses in indirect speech will not be required.

A knowledge of rare words and uncommon grammatical forms will not be required.

The Continuous Prose will differ from the Sentences mainly in affording an opportunity for recasting the structure in a form appropriate to Latin.

Paper II. Two passages will be set, one of prose, from a historian, and one of verse, in either dactylic hexameters or elegiac couplets.

Candidates will be required to give English words containing the roots of certain Latin words taken from the prose passage, and to scan a few lines from the verse passage.

Questions will also be set to test candidates' knowledge and understanding of such matters as are essential for the intelligent reading of Latin. These questions will deal with such subjects as:

- (1) Outlines of Roman History, especially of such periods as are covered by the authors most commonly read in schools.
- (2) The main features of Roman domestic life, and military, political, and constitutional organization.
- (3) The main features of Roman religion, mythology, and legend.

* The prose will not bear any relation in vocabulary and construction to the Unprepared passage.

Paper III. Both books must be offered. On each book, *four* questions will be set, all to be attempted:

Passages for translation.

Derivations (on the prose book). A passage for scansion (on the verse book).

Questions on the subject-matter and grammar of four short passages.

A choice of questions (factual, not critical) on the subject-matter of the book.

Paper IV will consist of the unprepared prose passage from Paper II, together with the verse set book section of Paper III.

Papers will be set, unless otherwise stated, from the latest editions of the Oxford Classical Texts. If a school has used any other text, a note to that effect should be appended to the candidates' scripts, drawing attention to any important discrepancies.

Prescribed for 1966:

Caesar, *Bellum Gallicum* i, c. 1-41.

Virgil, *Aeneid* xii, 383-952.

Greek

The following papers will be set:

I. Composition and Unprepared Translation	2 hrs.
II. Unprepared Translation	2 „
III. Set Books	2 „

Candidates must take Paper I and **either** Paper II **or** Paper III.

Paper I. A short and simple piece of Greek prose for unprepared translation, followed by a choice of **either** sentences to be translated into Greek, each involving only one syntactical construction other than the ordinary concords, **or** a short piece for continuous prose composition.

Paper II. The paper will contain one prose passage and two alternative verse passages, one from tragedy and one from comedy. The use of lexicons will not be allowed.

Paper III. Both books must be offered. On each book, *four* questions will be set, all to be attempted:

Passages for translation.

Simple questions on accidence (on the prose book). A passage for scansion (on the verse book).

Questions on the subject-matter and grammar of four short passages.

A choice of questions (factual, not critical) on the subject-matter of the book.

Papers will be set, unless otherwise stated, from the latest editions of the Oxford Classical Texts. If a school has used any other text, a note to that effect should be appended to the candidates' scripts, drawing attention to any important discrepancies.

Prescribed for 1966:

Euripides, *Alcestis*, 1-76, 136-212, 244-746.

Thucydides, iv, 1-41.

General Classics. (This subject may not be offered with O Level Latin.)

All candidates must take two papers, as follows:

Paper I. Translation into English of Latin sentences and of a short continuous passage similar to that in Latin I (1 hour), together with a half-paper (1 hour) on *one* of the following:

- A Classical Latin Prose set book.
- A Classical Latin Verse set book.
- A Medieval or Renaissance Latin set book.

Each set book half-paper will include passages for translation and questions on subject-matter and language.

Paper II. Any *two* of the following three half-papers, each 1 hour:

A part of the *Odyssey* or *Aeneid* or a selection of Greek plays in translation.

A selection of Herodotus, Thucydides, or Plato in translation (two authors prescribed each year).

Latin composition (sentences only).

Each set book half-paper will include passages for reference to their context and questions on subject-matter.

Prescribed for 1966:

Paper I. Caesar, *Bellum Gallicum*, i, c. 1-41.
Virgil, *Aeneid* xii, 383-952.
Erasmus and his Times, ed. Facet (Bell).

Paper II. **Either** Aeschylus, *The Oresteian Trilogy*, trans. Vellacott (Penguin Classics).
Or Homer, *Odyssey* xvii-xxiv, trans. Rouse (Nelson).

With **Either** Thucydides ii and iii, trans. Livingstone (World's Classics).
Or Plato, *Apology, Crito, Phaedo*, 1-13, 64-66, trans. Jowett (Livingstone, *Portrait of Socrates*, Clarendon Press).

French, German, Spanish, Italian, Russian, Welsh,* and Irish*

The following papers will be set in each language:

I. Unprepared Translation	1 $\frac{3}{4}$ hrs.
II. Dictation	$\frac{1}{2}$ hr.
III. Composition and Story	2 hrs.

exclusive of the time occupied in reading the story to the candidates.

The Composition and Story paper will require easy continuous composition in the foreign language and the reproduction in the foreign language of a story read in the foreign language.

* Welsh and Irish not examined in December.

An Oral examination in reading and conversation, before the written papers are taken, is compulsory. The marks obtained in the Oral test will be added to the total for the written papers, and included in the pass mark.

If the number of candidates offering a language is insufficient to justify the expense of sending a visiting Examiner, the Board may require those candidates to travel to a neighbouring school or centre.

For the December examination, candidates offering a modern language which they have taken in the summer examination will have the Oral marks carried over and recorded. There will be an Oral examination for candidates sitting for the first time, and a visiting Examiner will be sent in those cases in which the numbers justify a visit. If the number of candidates offering a language is insufficient to justify the expense of sending a visiting Examiner, the Board may require those candidates to travel to a neighbouring school, or, alternatively, ask the Head Master to delegate the test to a colleague.

A separate pass in written and oral will not be recorded on certificates.

Candidates who offer German may use the English or the German characters.

All question papers in the German language will be printed in Roman type.

In Spanish either the old or the new system of written accent will be accepted, but not a mixture of the two.

Passages in Spanish in the question papers will follow the old rules.

Arabic. (Not examined in December.)

The following papers will be set:

I. Translation	2 hrs.
II. Prose and Sentences	2 „
III. Literature	2 „

Paper I will consist of unseen passages, and also a passage from the set books, for translation from Arabic into English.

Prescribed for 1966:

Paper I. Kitāb al-muṭāla‘a al-tawjīhiya, ed. Aḥmad Amīn, &c., chapters *Al-Nawādir wa’l-mulāḥ*, *Al-Rasā’il wa’l-maqālāt* (part 2, *thāniyan fī’l-ḥadīth* only), and *Al-qīṣaṣ*, pp. 92–111 and 171–233 in the edition of 1947; also to be found in *Mukhtārāt min al-adab al-‘Arabi*, ed. Muḥammad Fawzi Ḥasan Jalil.

Paper II will consist of a prose passage, and also of sentences, for translation from English into Arabic.

Paper III will be in two parts: (i) short passages in Arabic selected from *Min ḥadīth al-shi‘r wa’l-nathr*, by Ṭaha Ḥusain Beg, chapters 5–7 (chapters 6–8 in some editions) under the headings *Al-shi‘r: al-ḥayāt al-adabiya al-‘Arabiya fī’l-qarn al-thālith lil-Hijra*, *Abū Tammām wa-shi‘ruhu* *Al-Buḥturī wa-shi‘ruhu*, for translation and comment; (ii) questions in English on Literature up to A.D. 1050, for answering in Arabic or English, a choice of questions being allowed.

The books named below should be in the school library and students should be encouraged to consult them:

Al-Mujmal fi Ta'riḫ al-Adab al-'Arabī, by Ṭaha Ḥusain Beg, &c.
Fajr al-Islām. Aḥmad Amin.

Duḥā'l-Islām.

Ta'riḫ al-Adab al-'Arabī, pts. 3 and 4. Aḥmad al-Iskandarī, &c.
Nicholson, *Literary History of the Arabs*.

Gibb, *Arabic Literature*.

The Board is prepared to consider applications from schools for an examination in languages other than those enumerated above, provided that they are part of the curriculum of the school. Such applications must reach the Secretaries not later than **1 February** for the July Examination, and **1 October** for the December Examination.

III

Elementary Mathematics

Two papers of 2 hours each will be set. All candidates must take both papers.

Each paper will contain questions on Arithmetic, Algebra, Geometry, and Trigonometry, and a choice of questions will be given.

The following instruments and tables will be required:

(a) A ruler graduated in inches and tenths of an inch and in centimetres and millimetres, two small set squares, a protractor, compasses furnished with a hard pencil point, and a hard pencil. In particular questions the use of the set square or of the protractor may be forbidden.

(b) Four-figure tables, including logarithms, natural sines, cosines, and tangents.

Questions may be set involving the use of squared paper.

Candidates may use slide-rules and tables of logarithms, squares, square roots, and reciprocals in answering any mathematical papers except in any question in which their use is specifically forbidden. The use of five-figure tables will be allowed.

ARITHMETIC

The ordinary processes of arithmetic; the commoner units in the tables of measurement of length, area, volume (including pints, quarts, gallons), and weight (avoirdupois); the metre, gramme, and litre with their commoner multiples and submultiples; franc and centime, dollar and cent. The use of indices to express such numbers as 3.74×10^8 or 1.35×10^{-6} . The use of logarithms and of graphs applied to arithmetical problems.

A knowledge of recurring decimals and the process of extracting the square root will not be required. Questions will not be set on 'present worth' or 'true discount'. The use of contracted methods is permissible but will not be required.

Mensuration: the rectangle, triangle, and figures derived from them, including the cube, the rectangular block, the wedge; the circle, cylinder, cone, and sphere (formulae for the last two need not be memorized). Meaning of density and specific gravity.

The use of algebraic symbols and processes will be allowed.

ALGEBRA

The expression of an arithmetical generalization in a formula: easy questions on the simplification of algebraical expressions, such as might arise in dealing with practical problems; evaluation of a formula for numerical values of its variables; simple equations, quadratic equations, solution of two linear simultaneous equations, and the solving of easy problems involving any of these; easy factors (knowledge of the remainder theorem will not be assumed); easy graphs; change of the subject of a formula.

GEOMETRY

A sound appreciation of the properties set out below will be expected. Proofs of the items in *italics* may be required; where a general enunciation is given in the question paper, candidates should state the particular enunciation appropriate to their figure. Proofs of the other properties will not be required, but riders may be set which can be solved by the use of these properties. In solving riders candidates may use any knowledge they possess. Candidates will be expected to understand the relation between a theorem and its converse.

Properties of angles at a point and angles made with parallel lines.

The exterior angle property and angle-sum of a triangle.

Angle-sum properties of polygons.

Congruence of triangles; similarity of triangles.

Symmetry about a point or line.

The isosceles triangle; the parallelogram, rectangle, square.

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

Area of parallelogram = bh ; area of triangle = $\frac{1}{2}bh$.

Other area properties of rectangles, parallelograms, triangles, and trapezia.

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

(By congruence or areas or similarity.)

The Theorem of Pythagoras.

The symmetrical properties of chords of a circle.

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.

The angle in a semicircle is a right angle.

The opposite angles of any quadrilateral inscribed in a circle are supplementary.

The perpendicularity of tangent and radius; the distance between centres of circles in contact; the equality of tangents from an external point.

The 'alternate segment' theorem.

The 'intersecting chord' theorem for an external point ($OP \cdot OQ = OR \cdot OS = OT^2$).

The analogous property for an internal point.

The relationship between the areas of similar triangles. Corresponding results for similar figures and extension to volumes of similar solids.

The bisector of any angle of a triangle divides the opposite side in the ratio of the sides containing the angle.

The analogous property for an exterior angle.

Knowledge of simple loci, with easy extensions to three dimensions.

Knowledge and use of the following 'ruler and compass' constructions.

Bisection of angles and straight lines.

Construction of perpendiculars to a given line and of angles equal to a given angle.

Construction of angles of 30° , 45° , 60° .

Construction of triangles, quadrilaterals, and circles from simple data, including the inscribed and circumscribed circles of a triangle.

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

Construction of a triangle equal in area to a quadrilateral and of a square equal in area to a given rectangle.

Construction of tangents from an external point.

Construction of a segment containing a given angle.

Candidates must leave lines of construction sufficient to show how the solution is arrived at; they may be asked to state in words how the problem is solved and to give reasons for their construction. Set squares will be allowed for the construction of parallel lines.

Candidates will be expected to be acquainted with the forms of the simpler solid bodies, namely, the cube, the rectangular block, the sphere, the cylinder, the wedge, the right pyramid, and the cone.

TRIGONOMETRY

Definitions of sine, cosine, and tangent for acute angles and their supplements; graphs of these functions; applications to easy problems on heights and distances (knowledge of circular measure and of ratios other than sine, cosine, and tangent will not be necessary). Applications to elementary mensuration of plane and solid figures. Area of triangle = $\frac{1}{2}bc \sin A$. The sine rule and the extension of the theorem of Pythagoras in the form $a^2 = b^2 + c^2 - 2bc \cos A$, for any triangle. Such problems in the solution of triangles as may be solved simply, e.g. by dividing into right-angled triangles.

Additional Mathematics

Two papers of 2 hours each will be set. All candidates must take both papers.

Each paper will be divided into three sections:

- (a) Algebra, Geometry, and Trigonometry.
- (b) Calculus and Coordinate Geometry.
- (c) Statics and Dynamics.

Four questions will be set in each section, and candidates will be asked to answer in each paper not more than seven questions, which may be selected from two or three sections.

The syllabus will include that prescribed for Elementary Mathematics together with the following:

ALGEBRA

Solution of two simultaneous equations, one linear and one quadratic; knowledge of the remainder theorem and easy examples; translation into symbols of relations such as 'y is inversely proportional to x' and 'V varies as x^3 '; use of negative and fractional

indices and of logarithmic notation (no formal proofs); arithmetic progression, finite geometric progression.

GEOMETRY AND TRIGONOMETRY

The six ratios for angles of any magnitude; $\sin^2 A + \cos^2 A = 1$; graphs of trigonometric functions; the sine and cosine rules (the ambiguous case of the solution of triangles is excluded); simple three-dimensional examples on heights and distances. Simple trigonometric equations (excluding $a \cos x + b \sin x = c$). Circular measure, length of arc, and area of sector.

Elementary ideas in solid geometry treated informally (angle between planes, angle between line and plane, great and small circles of sphere).

CALCULUS AND COORDINATE GEOMETRY

Differentiation and integration of powers of x (proofs and the integration of $\frac{1}{x}$ excluded).

Applications to gradients, maxima and minima, rates of increase, small increases, velocity and acceleration, area and volume.

Distance between points, mid-point.

Equation of straight line in the form $y = mx + c$; line through given point with given gradient; line joining two points. Conditions of parallelism and perpendicularity of two lines.

Equation of tangent at given point to the curves $y = \frac{k}{x}$ and $y = f(x)$, where $f(x)$ is a polynomial in x .

Equation of circle and of the tangent at a given point.

Equations of loci derived from simple geometrical properties. Symmetry about axes.

STATICS AND DYNAMICS

Moments; parallel forces; parallelogram and triangle of forces, velocities and accelerations; composition and resolution of forces, velocities and accelerations in one plane (proofs excluded). Questions on relative velocity will not be set.

Simple graphical methods; simple cases of equilibrium; properties of centre of gravity; friction.

Uniformly accelerated rectilinear motion. Newton's laws of motion; the conservation of linear momentum; work and energy; the principle of the conservation of energy. The time of flight, greatest height, and horizontal range of a projectile.

Questions will be mainly numerical and will not be asked on abstract topics, e.g. on a system of coplanar forces.

The regulations for the use of instruments and tables are the same as for Elementary Mathematics.

Science

Examinations will be set in the following science subjects: **Physics, Chemistry, Physics-with-Chemistry, General Science, Biology, and Botany.**

Physics-with-Chemistry may **not** be offered with *General Science* or *Chemistry* or *Physics*, and *General Science* may **not** be offered with more than one of the subjects *Physics*, *Chemistry*, and *Biology*. *Botany* may **not** be offered with *Biology*.

Candidates who offer both *Physics* and *Chemistry* but do not reach the required standard will be considered for a Pass in *Physics-with-Chemistry*. (This composite pass in *Physics-with-Chemistry* is unlikely to be recognized by certain universities.)

Physics

The following papers will be set:

Physics I	2 hrs.
Physics II	2 "
Practical Physics	2½ "

Candidates may take papers on either the New Syllabus or the Old Syllabus.

NEW SYLLABUS

Paper I will be set, largely, on the Thermal Properties of Matter and on Wave Motion, Light and Sound; Paper II on the Mechanical Properties of Matter and on Electricity and Atomic Structure.

In all appropriate topics emphasis will be placed upon interpretation of the phenomena in terms of simple kinetic theory and of inter-atomic and inter-molecular forces.

MECHANICAL AND THERMAL PROPERTIES OF MATTER

Mass, length, time and their units. Density. Scalar and vector quantities. Treatment of vectors illustrated by the composition and resolution of forces and velocities in simple cases. Moments and couples. Simple machines. Relation between mass, acceleration, and force. *Definition of dyne from $F = ma$ or $F = \text{rate of change of momentum}$. Conservation of momentum.* Gravitational units of force. Work and energy; *erg, joule, kilowatt-hour*. Power; horse-power, *watt, kilowatt*. *Qualitative treatment of circular motion and gravitational attraction. Satellites and planets.* Fluid pressure; application to simple hydraulic machines. Principle of Archimedes; flotation. Hydrometer. U-tube manometer. Pressure of the atmosphere and its measurement.

Thermal expansion of solids and liquids, coefficient of linear expansion. Liquid-in-glass thermometers. Elementary calorimetry, with emphasis on methods based on constant rate of supply of heat. Specific heat. Pressure-volume-temperature relationships for gases. *Brownian movement*. Perfect gas scale of temperature. Latent heat associated with change of state, vapour pressure, evaporation, boiling, *humidity and dewpoint*. Energy and its conservation. The conversion of mechanical energy into heat; mechanical equivalent of heat by a simple mechanical method. *Surface tension treated qualitatively. Upper limit of molecular size by surface film method.* Heat transfer by convection and conduction.

WAVE MOTION, LIGHT AND SOUND

Characteristics of progressive waves illustrated experimentally. Longitudinal and transverse waves. *Superposition of wave-trains, interference patterns; stationary waves as special case of interference. Measurement of frequency; wavelength of sound in a gas deduced from stationary waves.* Wave-forms of complex sounds and relationship to quality, pitch, and loudness. *Vibration of stretched strings treated qualitatively: harmonics.* Qualitative explanation of reflection and refraction of plane and spherical wave-fronts incident at plane and spherical surfaces; image formation, illustrated by ripple tank or similar technique. Reflection of sound, echoes, velocity of sound by echo. Reflection and refraction of light. Rectilinear propagation and use of ray concept for treatment of reflection and refraction. Snell's law (numerical examples not required). Total reflection illustrated experimentally. Simple converging lenses and *concave mirrors*; focal length; graphical treatment of image formation of small objects on the axis (the use of formulae will not be required). Simple questions may be asked on such applications as the camera, the eye (as an optical instrument), the projector, the simple magnifying lens. *Diffraction grating (treated as interference system) used as evidence for the wave nature of light and for approximate determination of wave-length. Spectra produced by grating; wave-length and colour. Infra-red and ultra-violet. Simple descriptive treatment of the electromagnetic spectrum.*

ELECTRICITY AND ATOMIC STRUCTURE

Simple properties of magnets and magnetic fields associated with them. The electric current and simple sources of d.c. supply (candidates should be familiar with the practical use of primary and secondary cells, rectifier units, &c., but will not be required to know their theory). Magnetic, thermal, and chemical effects of the current. *Principle of measurement of current by current balance.* The ampere. The coulomb. *Faraday's laws of electrolysis; the faraday.* The volt. Rate of conversion of energy in watts and kilowatts. The kilowatt-hour and simple problems on cost of energy. Resistance, the ohm, resistivity. *Characteristics of various types of conducting materials, e.g. pure metals, alloys, semi-conductors, rectifiers.* E.m.f., internal resistance, p.d. Calculations of current-voltage-resistance relationships for simple circuits. Simple calculations on shunts and multipliers for use of galvanometers as ammeters or voltmeters. Magnetic flux pattern associated with a straight wire, plane coil, and solenoid. The continuity or circuital nature of magnetic flux. Electromagnets and simple applications. The motor effect and its application to galvanometers and d.c. motors. Electromagnetic induction treated descriptively. Simple a.c. and d.c. generators. The transformer. *Power losses in transmission.*

Static electric charges and forces between them (non-quantitatively). Identification of flow of charge with electric current. Thermionic emission, cathode rays as demonstrated in a cathode-ray tube. Identification of negative charge of cathode rays, e.g. by electric or magnetic field. Simple description of nuclear atom. Radioactivity: alpha, beta,

and gamma radiations, their nature and simple means for their detection; half-life. Isotopes and radioactive transformations.

Practical examination

Candidates will be expected to carry out ordinary physical measurements, to present their measurements graphically and to draw simple deductions.

The experiments set will, in general, be within the syllabus for the theory papers but, should they go beyond this, full instructions will be given to the candidates.

OLD SYLLABUS

Paper I

Section A will consist of six questions on Heat, Light, and Sound.

Section B will consist of three questions on Mechanics and Hydrostatics.

Paper II

Section A will consist of six questions on Electricity and Magnetism.

Section B will consist of three questions on Mechanics and Hydrostatics.

Candidates will be required to answer at least one question from Section B in each paper.

EXPERIMENTAL MECHANICS AND HYDROSTATICS

Fundamental properties of the three states of matter. Density and its determination by direct measurement of weight and volume. Specific gravity. Measurement of density and specific gravity of a liquid and of an insoluble solid. Fluid pressure. Pressure at a point. Thrust on a horizontal surface. Water-supply, hydraulic press, and other simple practical applications of fluid pressure. Principle of Archimedes; flotation, the common hydrometer, and other simple applications. Determination of the specific gravity and density of solids and liquids by the principle of Archimedes. The pressure of the atmosphere. Simple, Fortin, and aneroid barometers. Boyle's law. Bicycle pump, force pump, and lift pump. *The siphon*. The spring balance and its use in the measurement of force. Moments of forces and simple practical applications. Couple. Centre of gravity of a rod. Simple pulley systems, wheel and axle. Work. Mechanical advantage. velocity ratio, and efficiency. Principle of simple gears. Power, horsepower. Kinetic and potential energy treated qualitatively. Conservation of energy. Vector and scalar quantities. The parallelograms of velocity and force. *Equilibrium of three non-parallel coplanar forces*. *Uniform and uniformly accelerated motion in a straight line*. *Falling bodies*. *Mass*. *Newton's laws of motion*. *Conservation of momentum*. *Simple quantitative examples involving force, energy, and momentum*.

HEAT, LIGHT, AND SOUND

Mercury and alcohol thermometers. Centigrade and Fahrenheit scales. Clinical thermometers. Maximum and minimum thermometers. Qualitative treatment of the thermal expansion of solids, liquids, and gases; simple applications. Anomalous expansion of

water. Determination by a simple method of the coefficient of linear expansion; simple calculations. Expansion of a gas at constant pressure. Absolute temperature. Conversion of gas volumes to S.T.P. Measurement of heat generated by a source; calorie, B.Th.U., and therm. Calorific value of fuels and foodstuffs, and its determination for coal. Determination of the specific heats of solids and liquids (excluding the method of cooling). Change of state, latent heats and their determination by boiling away water and melting ice. *Determination of latent heats by the method of mixtures.* Boiling- and melting-points and influence of pressure and dissolved substances on them. Cooling by evaporation and its practical applications. Meaning of dew-point and humidity; formation of mist and clouds. *Determination of vapour pressure. Relation of vapour pressure to boiling-point.* Conduction, convection, and radiation, and simple practical examples of them. Heat as a form of energy. *The joule. Determination of the mechanical equivalent of heat by any one simple method.*

Rectilinear propagation of light, shadows, eclipses, and pinhole camera. Reflection and refraction of light at plane surfaces. Laws of refraction. Critical angle and total internal reflection. Converging and diverging lenses. Definition of focal length. Determination by graphical methods of the position and nature of images formed by converging lenses. Formulae for the position and magnification of the image formed by a converging lens. The camera. The eye as an optical instrument; correction of long and short sight treated qualitatively. Magnifying glass, *compound microscope. Simple astronomical refracting telescope.* Dispersion illustrated by passage of white light by a prism. Simple treatment of colour by addition and absorption. *The production of a pure spectrum.* Infra-red and ultra-violet radiation. *Descriptive treatment of wave motion.* Relation between frequency, wavelength, and velocity.

Production of sound by vibration; material medium necessary for transmission. Velocity of sound in air. Echoes. Pitch and loudness of a musical note. Measurement of frequency by simple methods. Resonance.

ELECTRICITY AND MAGNETISM

Simple phenomena of magnetism, and their explanation by theory of elementary magnets. The magnetic compass. The earth as a magnet. *Meaning of declination and dip and their variation over the Earth's surface.*

Electrification by friction. Positive and negative charges. Conductors and insulators. Electrostatic induction. Magnetic, thermal, and electrolytic effects of an electric current. Electromagnet, electric bell. Electrolysis of dilute sulphuric acid with platinum electrodes and of copper sulphate solution with copper electrodes. Electroplating. *Simple ionic theory.* Laws of electrolysis. Determination of electrochemical equivalent. Potential differences. *Definition of the volt. Ohm's law.* Resistances in series and in parallel. Resistivity. The e.m.f. and internal resistance of a cell; cells in series; *measurement of internal resistance by ammeter and voltmeter.* The watt and kilowatt-hour. *The heating effect of an electric current treated quantita-*

tively. Moving-coil galvanometer and its adaptation for use as an ammeter or a voltmeter. *Calculations on shunts and series resistances.* The metre bridge and potentiometer. Electromagnetic induction. The principle of the electric motor and the dynamo. *Transformer.* The telephone receiver and transmitter.

Practical Examination

Candidates will be expected to carry out ordinary physical measurements such as weighing, measuring length (including the use of the vernier and screw gauge), measuring angles, areas, volumes, and timing vibrations. They will be expected to be able to present their measurements graphically and to draw simple deductions from their measurements.

Mechanics and Hydrostatics. Density and specific gravity of a liquid and of an insoluble solid with a specific gravity bottle. Simple experiments on fluid pressure and on the application of the principle of Archimedes. Boyle's law. Simple experiments illustrating the use of moments and of the triangle of forces.

Heat and Optics. Determination of melting-point of a solid: simple experiments in calorimetry, including the determination of the specific heats of solids and liquids, and of the latent heats of water and steam. Experiments illustrating reflection and refraction of light at plane surfaces, including tracing rays through a parallel glass block and determining the refractive index; tracing rays through a prism and measuring angles of incidence, emergence, and deviation. Determination of focal lengths of converging lenses, including use of simple graphical methods.

Electricity and Magnetism. Plotting magnetic fields: location of neutral points. Simple experiments with ammeters and voltmeters illustrating the measurement of current, p.d., and resistance; *internal resistance of a cell*; measurement of resistivity by a metre bridge. Electrolysis of copper sulphate solution and measurement of electrochemical equivalent of copper. *Comparison of e.m.f.s by potentiometer.*

Chemistry

The following papers will be set:

Chemistry	.	.	.	.	.	.	.	2½	hrs.
Practical Chemistry	.	.	.	.	.	.	.	2½	„

The action of heat on matter. The range of substances investigated should include elements, compounds and mixtures; solids, liquids and gases. Experiments should bring out the broad distinctions between (a) physical change and chemical change; (b) elements, compounds and mixtures.

Elements, compounds and mixtures. An evaluation of data accumulated, supplemented by further experiments on the separation of mixtures and demonstration of the differences between (a) elements and their compounds, (b) compounds and mixtures. Simple chromatographic separations.

The atomic nature of matter. The significance of the laws of chemical combination, particularly the laws of constant and of multiple proportion, as evidence for the atomic nature of matter. The concept of the gram-molecule (Avogadro).

Synthesis and decomposition. The investigation, on a practical basis, of these processes. The combination of elements and the decomposition of compounds; evolution of gases and of water of hydration. The gain or loss of energy frequently associated with these processes.

The action of electricity on matter. Conductors and non-conductors. Decomposition of fused salts and aqueous solutions by electricity. Faraday's laws.

The bonds between atoms. The simple structure of atoms in terms of nuclei and electrons. The significance and the role of the valency electrons. The ionic bond and the covalent bond. Ions and molecules. Crystals; simple lattices containing ions, atoms or molecules, e.g. sodium chloride, diamond, copper and solid carbon dioxide. Alternative arrangements of the same atoms (allotropy) and of more than one sort of atom (isomerism).

The two main types of chemical compound. The influence of bonds on the chemical and physical properties of compounds, with reference to (a) ionic or ionisable compounds; acidic and basic compounds; salts; (b) non-ionic compounds.

The study of some typical metals and their compounds. Physical and chemical properties of metals in terms of electrons. A study of the elementary chemistry of sodium, calcium, iron and copper; a more limited treatment of potassium, magnesium, aluminium, lead and zinc; the more important uses of these metals and their compounds. The correlation of the general chemistry of these nine elements with their positions in the electrochemical series. The chemical principles underlying the extraction of iron and aluminium.

The study of some typical non-metals and their compounds. Physical and chemical properties of non-metals in terms of electrons. A study of the elementary chemistry of carbon, sulphur, nitrogen and chlorine; a more limited treatment of phosphorus, bromine and iodine; the more important uses of these elements and their compounds. Hydrogen and oxygen, with special reference to the composition of water and air.

Periodicity. Families of elements. The relation between atomic structure and periodicity.

Formulae, formulae-weights and reacting-weights. The experimental determination of equivalent weights of elements. The determination of empirical formulae. The relationship between empirical and molecular formulae. (Knowledge of the determination of molecular weights is not required.)

The unique features of the chemistry of carbon. The properties and typical reactions (but not the laboratory preparation) of ethanol, ethylene, acetic acid, ethylamine (as a base) and glycine; compounds showing important inter-relationships. Outline of the large-scale production of the first three. The predominance of covalency. Carbon chains (exemplified by paraffins) and rings (benzene). Degradation

exemplified by the pyrolysis of petroleum (yielding important chain-compounds such as ethylene); the hydrolysis of a fat and of a protein; alcoholic fermentation. Elementary aspects of coal processing. Synthesis exemplified by the preparation of an ester such as ethyl acetate; the synthesis, in outline, of polyethylene and terylene; photosynthesis.

Combustion, fuels, photosynthesis, respiration. Fuels as typical energy sources; their origins and uses; biological fuels. Photosynthesis as an important endothermic reaction; its relationship to respiration.

Oxidation and reduction. Elementary examples of the following conversions: metals to ions, ions to metals, oxides to metals, metals to oxides, changes of valency, chlorine atoms to ions and vice versa, hydrogen atoms to ions and vice versa, sulphite to sulphate, nitrite to nitrate. Hydrogen peroxide as an oxidising agent.

The rate of chemical change. The effect of concentration, temperature, pressure, light and catalysts on the rate of reaction. The application of these principles to (a) laboratory experiments on the liberation of iodine from potassium iodide and of sulphur from sodium thio-sulphate; the combination of hydrogen and chlorine, the action of light on silver halides, the catalysed decomposition of hydrogen peroxide; (b) the manufacture of ammonia, nitric acid and sulphuric acid.

Energy changes in chemical reaction. Examples of exothermic and endothermic reaction. Generation of electric current by chemical action. Galvanic couples. Electrolytic methods for the manufacture of aluminium, chlorine and sodium hydroxide. The electrothermal manufacture of calcium carbide.

Solvents and solubility. The determination of solubility; its variation with temperature; purification by recrystallisation. Natural waters; hard water and its treatment; purification by ion-exchange. Salt-hydrates and their water content. Solvents other than water.

Relationship between laws and theories. Exemplified by (a) the laws of chemical combination and the laws of electrolysis; (b) Dalton's atomic theory and Faraday's ionic theory.

Practical Examination

Simple practical operations and exercises including (a) qualitative tests for the recognition of the following elements and their simple compounds: (sections 8 and 9 of the theory syllabus) sodium, calcium, iron, copper, potassium, magnesium, aluminium, lead, zinc, carbon, sulphur, nitrogen, chlorine, phosphorus, bromine, iodine, hydrogen, oxygen; (b) observations on the effect of conditions on the rate of a reaction; (c) measurement of (i) solubilities, (ii) loss in weight on heating, (iii) reacting weights, (iv) reacting volumes of aqueous solutions (questions will not be framed in such a way that understanding of normality will be required); (d) recognition of oxidising and reducing reagents.

Physics-with-Chemistry

The following papers will be set:

Physics	2 hrs.
Chemistry	1½ „

Practical Physics	2½ hrs.
Practical Chemistry	2½ ,,

For the physics part of the subject the syllabus will be that for the Subject Physics, either the New Syllabus or the Old Syllabus, on pp. 89–93 excluding those portions in *italic*.

For the chemistry part of the subject the syllabus will be as follows:

The action of heat on matter. The range of substances investigated should include elements, compounds and mixtures; solids, liquids and gases. Experiments should bring out the broad distinctions between (a) physical change and chemical change; (b) elements, compounds and mixtures.

Elements, compounds and mixtures. An evaluation of data accumulated, supplemented by further experiments on the separation of mixtures and demonstration of the differences between (a) elements and their compounds, (b) compounds and mixtures. Simple chromatographic separations.

The atomic nature of matter. The significance of the laws of chemical combination, particularly the laws of constant and of multiple proportion, as evidence for the atomic nature of matter. The concept of the gram-molecule (Avogadro).

Synthesis and decomposition. The investigation, on a practical basis, of these processes. The combination of elements and the decomposition of compounds; evolution of gases and of water of hydration. The gain or loss of energy frequently associated with these processes.

The action of electricity on matter. Conductors and non-conductors. Decomposition of fused salts and aqueous solutions by electricity.

The bonds between atoms. The simple structure of atoms in terms of nuclei and electrons. The significance and the role of the valency electrons. The ionic bond and the covalent bond. Ions and molecules. Crystals; simple lattices containing ions, atoms or molecules, e.g. sodium chloride, diamond, copper and solid carbon dioxide.

The two main types of chemical compound. The influence of bonds on the chemical and physical properties of compounds, with reference to (a) ionic or ionisable compounds; acidic and basic compounds; salts; (b) non-ionic compounds.

The study of some typical metals and their compounds. A simple treatment based on the electrochemical series of sodium, calcium, zinc, iron, copper, lead and aluminium.

The study of some typical non-metals and their compounds. A simple study of hydrogen, oxygen, carbon, sulphur, nitrogen and chlorine.

Formulae, formulae-weights and reacting-weights. The experimental determination of equivalent weights of elements. The determination of empirical formulae. The relationship between empirical and molecular formulae. (Knowledge of the determination of molecular weights is not required.)

The unique features of the chemistry of carbon. The properties of ethanol, ethylene and acetic acid. Paraffins as examples of carbon

chain compounds. Alcoholic fermentation and the hydrolysis of a fat as examples of degradation. The preparation of ethyl acetate and polyethylene as examples of synthesis.

Combustion and fuels. Fuels as typical energy sources; their origins and uses.

Oxidation and reduction. Elementary examples of the following conversions: metals to ions, ions to metals, oxides to metals, metals to oxides, changes of valency, chlorine atoms to ions and vice versa, hydrogen atoms to ions and vice versa, sulphite to sulphate. Hydrogen peroxide as an oxidising agent.

The rate of chemical change. The effect of concentration, temperature and catalysts on the rate of reaction as exemplified by laboratory experiments on the liberation of sulphur from sodium thiosulphate, the decomposition of hydrogen peroxide.

Energy changes in chemical reaction. Examples of exothermic and endothermic reaction. Generation of electric current by chemical change. Galvanic couples.

Solvents and solubility. The determination of solubility; its variation with temperature; purification by recrystallisation. Natural waters; hard water and its treatment; purification by ion-exchange.

Practical Examination

Simple practical operations and exercises including (a) qualitative tests for the recognition of the following elements and their simple compounds: (sections 8 and 9 of the theory syllabus) sodium, calcium, zinc, iron, copper, lead, aluminium, hydrogen, oxygen, carbon, sulphur, nitrogen and chlorine; (b) measurement of (i) solubilities, (ii) loss in weight on heating, (iii) reacting weights, (iv) reacting volumes of aqueous solutions (questions will not be framed in such a way that understanding of normality will be required); (c) recognition of oxidising and reducing reagents.

General Science

The following papers will be set:

Physics	1½ hrs.
Chemistry	1½ „
Biology	1½ „

PHYSICS

Fundamental properties of the three states of matter. Measurement of volume by displacement. Density and its determination by direct measurement of weight and volume. Specific gravity. Measurement of density and specific gravity of a liquid. Fluid pressure. Water-supply, hydraulic press, and other simple practical applications of fluid pressure. Principle of Archimedes; flotation, the common hydrometer, and other simple applications. The pressure of the atmosphere. Simple and aneroid barometers. Bicycle pump, force pump, and lift pump. The spring balance and its use in the

measurement of force. Moments of forces and simple practical applications. Centre of gravity of a rod. Simple pulley systems, wheel, and axle. Work. Mechanical advantage, velocity ratio, and efficiency. Principle of simple gears. Power, horse-power. Kinetic and potential energy treated qualitatively. Conservation of energy.

Mercury and alcohol thermometers. Centigrade and Fahrenheit scales. Clinical thermometers. Qualitative treatment of the thermal expansion of solids, liquids, and gases; simple applications. Anomalous expansion of water. Measurement of heat generated by a source; calorie, B.Th.U., and therm. Change of state, latent heats and their determination by boiling away water and melting ice. Cooling by evaporation and its practical applications. Meaning of dew-point and humidity; formation of mist, clouds. Conduction, convection, and radiation, and simple practical examples of them. Heat as a form of energy.

Rectilinear propagation of light, shadows, and eclipses. Reflection and refraction of light at plane surfaces. Converging and diverging lenses. Definition of focal length. Determination by graphical methods of the position and nature of images formed by converging lenses. The camera. The eye as an optical instrument; correction of long and short sight treated qualitatively. Magnifying glass. Dispersion of white light by a prism. Simple treatment of colour by addition and absorption.

Production of sound by vibration; material medium necessary for transmission. Relation between frequency, wavelength, and velocity. Velocity of sound in air. Echoes. Pitch and loudness of a musical note. Measurement of frequency by simple methods. Resonance.

Simple phenomena of magnetism, and their explanation by theory of elementary magnets. The magnetic compass. The Earth as a magnet.

Electrification by friction. Positive and negative charges. Conductors and insulators. Magnetic, thermal, and electrolytic effects of an electric current. Electromagnet, electric bell. Domestic electric lighting circuit including lamps, fuses, and electric heating appliances. Electrolysis of dilute sulphuric acid with platinum electrodes and of copper sulphate solution with copper electrodes. Electroplating. Simple cell, polarization, Leclanché cell, dry cell. Potential difference. Ohm's law. Resistances in series. The watt and kilowatt-hour. Moving-coil galvanometer and its adaptation for use as an ammeter or a voltmeter. Electromagnetic induction. The principle of the electric motor and the dynamo. The telephone receiver and transmitter.

CHEMISTRY

Where the name of a substance is given without any indication of the limits of treatment, it should be understood that an elementary descriptive account of the substance and its properties is required.

(i) General Theory and Principles (to be illustrated by reference to the subject-matter of (ii)).

Matter: solids, liquids, gases. Fusion, sublimation, evaporation, boiling, distillation, diffusion of gases and solutes. Solution of solids, liquids, and gases in water. Suspension, precipitation, filtration. Crystallization from fused solids and from solutions. Chemical change. Catalysis.

Elements, compounds. Allotropy.

Atoms, molecules, symbols, formulae. Valency for use in simple formulae; calculation of percentage composition of compounds from formulae; equations.

Laws of Conservation of Mass and Constant Composition.

Oxidation and reduction (addition or subtraction of oxygen and hydrogen only).

Relative abundance of common elements (oxygen, silicon, aluminium, iron, calcium, sodium, potassium) in the Earth's crust.

Electrolysis, ions.

Acids, alkalis, bases, salts. Preparation of salts by acid on base and acid on metal.

(ii) Air. Priestley's and Lavoisier's experiments. One laboratory preparation of oxygen and its manufacture from air without technical details. Rusting. Nitrogen, carbon dioxide, water, solids and living organisms, and argon as constituents of air.

Hydrogen prepared from acids and water. Properties and uses of hydrogen. Hydrogen as a reducing agent for copper and lead oxides. Water as an oxide of hydrogen. Composition of water by weight.

Carbon: diamond, graphite, charcoal. Combustion of carbon. Carbon dioxide, calcium carbonate and bicarbonate, hardness of water, elementary treatment of natural waters, drinking-water. Reduction of carbon dioxide by carbon; carbon monoxide, its reducing power and poisonous nature. Properties of sodium carbonate and bicarbonate. Fuels: coal, coke, coal gas, producer and water gas, petrol, and oil. The Bunsen burner and the nature of flame. Smoke. The carbon cycle; wood and coal.

Nitric acid. Potassium, ammonium, and sodium nitrates.

Ammonia: its synthesis (conditions of reaction but not technical details) and catalytic oxidation. Reaction with acids, displacement from salts by bases. Laboratory preparation. Uses of chloride, sulphate, and nitrate. Nitrogenous fertilizers.

Sulphur: principal uses. Sulphur dioxide. Sulphuric acid: uses, preparation by contact process, action as acid and dehydrating agent. Calcium and copper sulphates. Zinc sulphate (preparation only).

Sodium chloride. Hydrochloric acid, chlorine. A brief consideration of the occurrence, physical properties, uses of, and action of air, water, and dilute hydrochloric acid on: magnesium, aluminium, zinc, iron and steel, lead, copper, and mercury. The uses of these metals, including electroplating for copper.

Basic character and uses of sodium hydroxide, calcium oxide, and hydroxide.

BIOLOGY

Candidates will be expected to show knowledge of the main features of living organisms and their mode of life; it will be assumed that such studies have been based as far as possible on observation of living plants and animals both in the field and in the laboratory. Candidates will be expected to be able to perform simple experiments,

to draw conclusions therefrom, and to understand the necessity for control experiments. Questions may be asked that are designed to test the powers of observation and reasoning of the candidates. They may be asked to make practical observations of animals or plants and to describe specimens that they may not have seen before. Although no direct question will be set on evolution, candidates will be expected to understand the concept of the evolution of organisms.

Candidates will be expected to have studied organisms with the aid of a hand-lens and, where necessary, a compound microscope or a microprojector.

The characters of living organisms ; differences between plants and animals.

The cell. Cytoplasm and nucleus illustrated by animal and plant cells. Elementary facts about the composition of protoplasm, proteins, carbohydrates, fats, salts. Growth, cell multiplication (details of mitosis not required). Unicellular and multicellular organization.

The elementary structure and physiology of a mammal, including simple experimental treatment :

(a) General arrangement of internal organs and skeleton (excluding details of the skull).

(b) Nutrition. Constituents of an adequate human diet. Human teeth. Simple account of digestion and assimilation. Experiments to illustrate the action of ptyalin and pepsin.

(c) Circulatory system. Composition and functions of blood. The heart, arteries, veins and capillaries (naming only the main vessels entering and leaving the heart).

(d) Respiration and breathing. Energy changes.

(e) Excretion. The function of liver and kidneys (omitting structural details).

(f) Nervous co-ordination. An elementary account of the nervous system and the eye. The reflex arc.

(g) Muscular movement as exemplified by biceps and triceps muscles and the bones of the fore limb.

(h) The reproductive organs. Essentials of sexual reproduction and parental care.

The elementary structure and physiology of a herbaceous flowering plant, including simple experimental treatment :

(a) The main vegetative organs. A general account of the structure of the root and stem. The leaf, including a histological account (details of stomatal mechanism not required).

(b) Nutrition. A simple account of photosynthesis. The carbon cycle. Inorganic materials taken in by the root.

(c) Transpiration and water uptake. The potometer. Translocation.

(d) Respiration.

(e) Tropisms, using geotropism and phototropism as examples.

(f) The flower. The buttercup in detail. Pollination: differences between wind- and insect-pollinated flowers. Essentials of fertilization.

(g) Seeds and fruits. Dispersal by wind and by animals, with two examples of each method. The seed of the broad bean, and conditions necessary for its germination.

(h) Vegetative reproduction. The potato tuber.

The soil: living and non-living components. The nitrogen cycle (omitting the names of bacteria).

Agents of disease and decay; bacteria, viruses, and fungi. Sterilization, and methods of food preservation. Yeast in breadmaking and brewing. The life-history of the house-fly or blow-fly.

The life-history of the frog, as far as can be studied with the aid of a hand-lens.

Biology. (This may not be offered with Botany, p. 103.)

The following papers will be set:

Biology I	. . . . .	2 hrs.
Biology II	. . . . .	2 "

Candidates will be expected to show knowledge of the main features of living organisms and their mode of life; it will be assumed that such studies have been based as far as possible on observation of living plants and animals both in the field and in the laboratory. Candidates will be expected to be able to perform simple experiments, to draw conclusions therefrom, and to understand the necessity for control experiments. Questions may be asked that are designed to test the powers of observation and reasoning of the candidates. They may be asked to make practical observations of animals or plants and to describe specimens that they may not have seen before. Although no direct question will be set on evolution, candidates will be expected to understand the concept of the evolution of organisms.

Candidates will be expected to have studied organisms with the aid of a hand-lens and, where necessary, a compound microscope or a microprojector.

The characters of living organisms; differences between higher animals, micro-organisms, and higher plants. The relations between organisms.

The cell. Cytoplasm and nucleus illustrated by animal and plant cells. Elementary facts about the composition of protoplasm, proteins, carbohydrates, fats, salts. Growth, cell multiplication (details of mitosis not required).

Conditions necessary for life. Biological effects of high and low temperatures. Refrigeration and sterilization.

Micro-organisms. The life-history and general morphology of *Amoeba* and *Spirogyra*. Fungi, viruses, and bacteria, as agents of disease and decay. Yeast: nutrition, aerobic and anaerobic respiration; economic importance. *Mucor*: life-history and general morphology.

Flowering plants. Structure and function of the parts of a herbaceous flowering plant. Knowledge of anatomical detail will be required sufficient only to enable candidates to understand the physiological significance of the plant organs.

Carbon cycle. An elementary account of photosynthesis and respiration studied experimentally.

Transpiration. The root system and water uptake. Quantitative experiments on the uptake of water. Translocation.

Flower structure. Wind- and insect-pollinated flowers, actinomorphic and zygomorphic flowers. Pollination and sexual reproduction (omitting details of embryo sac).

The morphology throughout the year of a deciduous tree and a herbaceous plant. Perennation: storage of food, food reserves, and storage organs. Elementary knowledge of the metabolic changes involved. Vegetative reproduction by rhizomes, tubers, and bulbs.

Seeds: the structure and germination of the broad bean. Dispersal of fruits and seeds by wind and animals, with two examples of each method.

An experimental study of tropisms in plants.

A mammal. The general macroscopic structure and elementary physiology. The skeleton (excluding details of the skull). The position of the main organs in the body.

The constituents of an adequate human diet. Teeth, their relation to function and diet in man, in a carnivorous animal, and in a herbivorous animal. Digestion, parts of the alimentary canal and their functions; experiments illustrating enzyme action, using ptyalin and pepsin as examples. Assimilation and the uses of food.

Respiration, including experiments on the intake of oxygen and the production of carbon dioxide.

Composition and functions of the blood. A simple account of the heart and blood system and their actions. Excretion.

Co-ordination, hormonal and nervous. An elementary account of the nervous system and sense organs. The reflex arc.

Muscular movement as exemplified by biceps and triceps muscles and the bones of the fore limb.

Skin: defence against infection. Temperature control.

The reproductive system. The significance of sexual reproduction (omitting details of meiosis). An outline of early development, omitting details of embryo and placenta other than those necessary to illustrate the physical protection and nutrition afforded by the parent. Parental care after birth.

The life-history of the frog as far as can be studied with the aid of a hand-lens.

Insects. Outline of the external structure, life-cycle, food and habits of the butterfly, bee, mosquito, and house-fly. (Details of the mouth parts will not be required.)

The soil. Formation and structure of soil. Living and non-living components. The nitrogen cycle (omitting the names of bacteria).

Natural History. The candidates will be expected to show knowledge from personal observation in the field of some of the commoner animals and plants of the British Isles; also of the animals

and plants of any one suitable habitat from the point of view of the interrelations of the species found there and their adaptations to the conditions of their environment.

The life-histories and habits of at least five animals (other than domestic animals, the frog, and the four insects specified above) and five plants should be known. The questions on this section will be such as can be answered by those living in towns, but will require that the candidates shall have made observations out of doors.

Botany. (This may not be offered with Biology, pp. 64, 101.)

Candidates will take *one* paper of 2½ hours.

It is expected that the subject will be taught with due regard to the economic and aesthetic importance of plants to Man.

The general external and internal structure of flowering plants, including microscopical details only in so far as they serve to elucidate the function of the parts. The main anatomical features of the stems, leaves, and roots of a typical herbaceous plant. Woody plants; growth of a twig in length and thickness; annual rings in wood; leaf fall. Perennation; storage organs; vegetative reproduction.

Effects of compacted, well aerated, and waterlogged soils on plants; light and heavy soils; presence of organic debris in soil and its origin; soils in relation to rotation of crops and other agricultural practices; Carbon cycle; nitrogen cycle; effect of lack of elements Fe, K, N, and P as shown by water or sand cultures. Germination of seeds and conditions necessary for this.

Experiments on tropistic responses of stems and roots. Demonstration of osmosis, the movement of water through stems, and of the evaporation of water from leaves. Measurement of water absorption by a cut leafy shoot, and of water loss. Photosynthesis as the ultimate source of food material; experiments illustrative of the conditions under which starch formation takes place in leaves; translocation and storage of food; use made by plant of food. Aerobic and anaerobic respiration; demonstration of the evolution of CO₂ and of rise in temperature. Parasitism, symbiosis, and saprophytism compared with holophytic and holozoic nutrition.

The appearance, without anatomical detail, and natural history of a fern, a moss, a green alga such as *Spirogyra*, yeast, a mould fungus such as *Mucor*, and a parasitic fungus such as *Peronospora*.

The structure of some common types of flower such as buttercup, primrose, pea, and a grass; the functions of the parts of a flower; inflorescences, without details of types. Mechanism of insect-, wind-, and self-pollination, fertilization, without details of nuclear behaviour: fruit and seed formation; structure of a typical seed; dispersal.

The principles of classification illustrated by common flowering plants; the meaning of the terms species, variety, genus, and family; characters used in classification in the commoner members of two suitable families such as Rosaceae and Ranunculaceae. The use of a Flora as an aid to the identification of British flowering plants.

A study of the flowering plants, including trees, of some easily accessible district, and some consideration of the factors influencing

their distribution within it. More detailed plant ecology of at least one well-defined habitat such as woodland, grassland, hedgerow, waste ground, moor, fen, seashore, pond, or stream. Weeds of cultivation and of grassland.

A considerable choice of questions will be offered. Weight will be attached to evidence of actual observation in the field and practical questions on plant description or identification will be set.

Tests may be set on the use of a Flora approved by the Board and provided by the candidate. The following have been approved:

Concise Flora of Britain. Makins (O.U.P.).

Flora of the British Isles. Clapham, Tutin & Warburg (C.U.P.).

Excursion Flora of the British Isles. Clapham, Tutin & Warburg (C.U.P.).

Applications for permission to use any other Flora should be made before **1 October** in the year preceding the examination. Approval will not be given to any which is extensively illustrated.

IV

Music

The following papers will be set:

Aural Tests.

- | | | |
|-------------------------|-----------|---------|
| I. History and Analysis | | 2½ hrs. |
| II. Harmony. | | 2½ „ |

Practical Examination (except as indicated below).

Candidates must take Aural Tests, History and Analysis, and **either** Harmony or the Practical Examination (unless exempt as explained on p. 107).

Candidates may, if they wish, take both Harmony and the Practical Examination, in which case their better performance, in one of these, will be counted towards a pass in the subject.

Candidates are not allowed to take copies of musical works into the examination room. Any printed music which is necessary will be sent with the examination papers.

AURAL TESTS (not to exceed 30 minutes: candidates will be required to write all six Tests).

These will be administered by means of a gramophone record, which will be sent to the school before the examination. The examination will be held on a specified date in June for the July Examination and in November for the December Examination.

A candidate repeating the examination in December may elect to have the July Aural mark carried forward.

1 (five minutes). Candidates will be required to write on a monotone, prefixing the necessary time-signature, a short rhythmical passage beginning on the first beat of a bar. After indicating the speed at which the pulse of the music moves, the Examiner will play the passage twice. After a short interval, he will play it a third and a fourth time.

2 (five minutes). Candidates will be required to write from dictation a short melodic phrase, beginning on the first beat of a bar, in either a major or a minor key. Before playing the passage, the Examiner will indicate the speed at which the pulse of the music moves. The key will be named, and the key-note and tonic chord sounded. The phrase will then be played once throughout. It will then be played twice in sections at short intervals of time, and finally the phrase will be repeated in its entirety.

3 (three minutes). Candidates will be required to describe and name (e.g. 'perfect 5th') intervals which are diatonic in major keys. Two such intervals will be given without the sounding of the key-note. Each interval will be played twice.

4 (five minutes). Candidates will be required to recognize and name any of the following cadences—perfect, imperfect (half-close), plagal, interrupted—occurring in a musical example in a major or a minor key played by the Examiner. After the tonic chord has been sounded, the whole musical sentence will be played through three times, with due deliberation, at short intervals.

5 (five minutes). Candidates will be required to recognize the three principal chords of a major or a minor key (tonic, or I in root position or inverted, sub-dominant or IV and dominant or V in root position only) as played by the examiner in a continuous musical phrase in a definite key. The phrase containing the given chords will begin with a chord in root position. It will be played *four* times at a reasonably slow pace, and before each playing the tonic chord will be sounded.

6 (five minutes). Candidates will be required to recognize and name simple changes of key. Three examples will be given, each starting from the same tonic key, and containing one modulation only. Modulations will be limited to the dominant, sub-dominant, and relative major or minor keys. After the key has been named and the tonic chord has been sounded, each of the three examples will be played through twice.

I. HISTORY AND ANALYSIS

1. (a) The completing of a melody, the opening of which will be given.

(b) The transposition of a given tune.

2. Musical History: the life and work of selected composers.

Five works will be prescribed for study, each by a different composer. A question will be set on the life and/or prescribed work of each of the five composers. Candidates will be expected to answer two of the five questions.

Only an outline knowledge will be expected of the lives of the composers. The questions on the selected works will include the identification and contexts of themes, and, in some cases, their completion. An elementary knowledge of the more usual instruments may be required.

Prescribed for 1966 (Musical History):

Gluck, *Orfeo*.

Mozart, *Clarinet Quintet*.

together with one of the following:

Bach, *Suite No. 2 in B minor*.

Schubert, *Symphony No. 5*.

Berlioz, *L'Enfance du Christ*.

3. Analysis of a prepared work. Candidates will be required to show some knowledge of the structure of one work selected from a list of four (at the candidate's option). Simple questions on design, on the use of thematic material where this is easily discerned, and on changes of key, will be set. Some knowledge of the circumstances and purpose of the composition may also be required.

Prescribed for 1966 (Analysis):

- Either** (a) Purcell, *Three anthems—Hear my prayer; Jehova quam multi sunt hostes; Praise the Lord, O Jerusalem.*
- Or** (b) Beethoven, *Piano Sonata No. 23 in F minor (Appassionata).*
- Or** (c) Elgar, *Serenade for Strings.*
- Or** (d) Britten, *A Ceremony of Carols.*

4. An unprepared movement, brief in length and simple in design, will be placed before the candidates who will be required to comment on rhythmic, harmonic, and structural aspects. The work will be played to the candidate by a master or mistress at the school. Copies (with bars numbered where necessary) will be provided in the examination room.

II. HARMONY

The paper will include:

1. The writing of a tune to given words, adding phrasing and dynamics.
2. The addition of a melody, including unaccented passing-notes, *above* a simple given part.
3. Tests designed to show a knowledge of the use (in three or four vocal parts, or in simple pianoforte style) of the primary triads and the supertonic and submediant triads and their inversions, in all major or minor keys; also of the use of unaccented passing notes and auxiliary notes. Any of the tests may include instances of modulation (a) between a major key and its dominant major and 'relative' minor; and (b) between a minor key and its dominant minor and 'relative' major.

PRACTICAL EXAMINATION

Candidates may offer any keyboard or orchestral instrument, or singing, in Grade V or a higher grade of the Examination of the Associated Board of the Royal Schools of Music. A candidate who has already passed this examination, or the corresponding examination in a higher grade, need not take it again, provided that a certified statement is submitted to the effect that practical study has been continued in the meantime.

Entries for the Practical Examination must be made direct to the Associated Board by the last day of January, April, or September.

A list of all candidates offering Music at O level must be sent to either the Oxford or Cambridge office, and *not* to the Associated Board, by 12 March, on forms which will be sent to schools in January.

Art

The following papers will be set:

I. Object Drawing	2 hrs.	} as defined for A level on pp. 30-31.
II. Imaginative Drawing	3 "	
III. Design	3 "	
IV. Plant Drawing	2 "	
V. Drawing from Life	1½ "	
VI. Detail Drawing from Life	1½ "	
VII. History of Art	2 hrs.	

Candidates must offer History of Art and any three of the other papers.

HISTORY OF ART**Either I. *Painting.***

A general knowledge paper will be set on British Painting from Tudor Times to 1890. 'Painting' should be taken to embrace outstanding draughtsmen and engravers such as William Blake, Alexander Cozens, Charles Keene, &c. Only important figures or movements will be touched on in the questions set. Two books particularly recommended are *An Introduction to English Painting*, by John Rothenstein (Cassell, new edition, 1952), and *A Century of British Painters*, by S. and R. Redgrave (Phaidon).

Or II. *Architecture.*

English Architecture from the Saxon to the Regency Periods inclusive

The prescribed book will be *The Observer's Book of Architecture*, by J. Penoyre and M. Ryan (Warne, 5s., 1958 or later edition): with *The Architecture of England*, by F. Gibberd (Architectural Press, 15s., 4 edn., 1962) recommended for further reading.

Illustrations of buildings, which may be taken from any source, will be set for comment on style and period.

Candidates may be required to sketch from memory architectural features illustrated in the prescribed book.

Geometrical and Mechanical Drawing

Two papers of 2 hours each will be set. All candidates must take both of them.

Candidates should be provided with good quality drawing-paper of size not less than 11 inches by 15 inches (quarto imperial).

Plane Geometrical Drawing. Construction of simple geometrical figures, problems on circles and tangents, scales and graphic arithmetic. Loci including the paths of points in elementary mechanisms. Problems on areas.

Solid Geometrical Drawing. Elementary projections of points, lines and planes, including surfaces, simple sections and developments.

Auxiliary projections. Projections and simple sections of solids, including the sphere, the cylinder, and the cone.

Elementary examples of isometric or oblique projection, without using isometric scale, of plane surfaces and simple solids.

Machine Drawing. Scale drawing, with two or more views, and simple sections, of simple machine parts from given dimensioned sketches.

Handicraft

The following papers will be set:

I A. Drawing, Design, and Theory, Woodwork	3 hrs.
I B. Drawing, Design, and Theory, Metalwork	3 „
II A. Practical Woodwork	3 „
II B. Practical Metalwork	3 „

All candidates must take IA and IIA or IB and IIB and must satisfy the Examiners in both parts of the examination.

Paper I. *Section A*

DRAWING (Woodwork and Metalwork)

Candidates will be expected to achieve a high standard of draughtsmanship. First or Third angle Orthographic Projection, complying with the British Standard Specification 308 of 1953, will be used. Questions may include the need for Elevations and Plans, simple Sections, and Sectional Elevations and Plans. Isometric and freehand drawing, including 'exploded' drawings may also be required. The geometrical constructions necessary for the making of working drawings and the construction of simple plain scales must be understood.

DESIGN (Woodwork and Metalwork)

Candidates must have an understanding of the factors affecting the design of work in wood and metal which could be undertaken in the school workshop, and the ability to use the techniques of drawing (detailed above), to answer simple design problems, including lathe work, set as outline drawings or written descriptions.

Section B

In Section B, annotated freehand sketching will be expected in clarification of written answers.

APPRECIATION AND HISTORY OF CRAFT (Woodwork and Metalwork)

Candidates should be given the opportunity of gaining knowledge of traditional and contemporary design and designers and an understanding of the historical development of work in wood and metal. In order to define the nature of this study for purposes of the Examination, a limited subject, period or selection of reading will be given each year (see below).

THEORY (Woodwork)

Setting out, determining the proportions of, and making joints used in, the basic constructions such as frame, stool, carcass, and

drawer, including lapped dovetails but not secret dovetails. The construction, use, and maintenance of hand tools and equipment. Timber; the characteristics of the common hardwoods and softwoods, the effects of its structure on methods of construction. Manufactured boards. Common woodworking techniques. Natural and synthetic glues and adhesives. Decoration, veneering, and simple carving. Surface finishes and the use of laminates. The woodturning lathe: its construction, tools, and use. Preparation of Cutting Lists.

THEORY (Metalwork)

Setting out, measuring, and testing. Workshop processes in bench fitting, sheet metalwork, forgework, simple casting and hammered metalwork including hard and soft soldering, brazing. The construction, use, and maintenance of bench tools and equipment. Selection of methods of construction appropriate to tools and materials. The properties of ferrous and non-ferrous metals and alloys. Knowledge of surface finishes. The construction and use of the lathe for turning between centres and in the chuck, including the selection of the correct lathe tools for materials and processes.

Paper II

PRACTICAL (Woodwork and Metalwork)

Each candidate will be required to work from a drawing provided. He may be expected to decide for himself the proportions of, or type of joint or construction to be used in, a part of the test, and may be required to complete simple shaping and decoration from suggested outlines. It may be that time for preparation will be allowed before the actual test. The practical tests will follow the content of the Theory syllabus, except that no machine work will be required during the Woodwork test; and the Metalwork test will be confined to general fitting, benchwork and forgework without the use of machines other than the drilling machine, although simple lathework may be included, with alternative arrangement not requiring the use of the lathe. No questions will be set on Hammered Metalwork without prior notice being given. Where turning or other work is required in either Woodwork or Metalwork, to make a more realistic test, details of this, for preparation before the examination, will be issued with the Instructions to Supervisors.

Prescribed for 1966:

Paper I, Section B, *Appreciation and History of Craft.*

WOODWORK

Comparison of the William and Mary period with the work of Thomas Sheraton.

METALWORK

The work of the blacksmith, including ironwork for doors and chests.

Candidates should be conversant with safety precautions in the workshop.

Domestic Subjects (Theory and Practice) (*Not examined in December.*)

The examination comprises three sections, (a) being compulsory:

(a) Cookery, (b) Needlework, and (c) Housecraft, with Household and Personal Hygiene.

There will be one theoretical paper (2 hrs.), candidates being expected to answer questions from the two sections in which they are being examined, one of which must be Cookery. They will also take the two corresponding practical examinations: Cookery (2½ hrs.), Needlework (2 hrs.), and Housecraft, with Household and Personal Hygiene (2 hrs.).

The work should have a scientific basis following a preliminary course in Physics and Chemistry. A knowledge of Hygiene is essential for (c) Housecraft.

Cookery. Food values and dietetics. Choice and cost of food. Management of refrigerator, larder, and store room. Planning of menus for the home, with particular attention to children's requirements. Emphasis on (a) cooking of balanced meals with correct timing of accompaniments and vegetables, (b) economy in dealing with food and fuel, and (c) cleanliness.

Different methods of cooking, including boiling, steaming, stewing, baking, frying, grilling, and conservative methods of cooking vegetables.

Bone stock and soup-making. Baking, steaming, and grilling fish with accompaniments. Sauce making. Vegetarian cooking with a variety of cheese and egg dishes.

Suet, shortcrust, and flaky pastry. Economical cakes and biscuits.

Simple invalid cookery: suitable foods and beverages. Attention and care required in cooking and serving for convalescents.

Needlework. The hygienic value, type, and suitability of clothing material. Choice, cost, and amount of material required for different garments. The use and adaptation of paper patterns.

The work should include a knowledge of cutting out and making modern underwear, housecoats, blouses, and plain cotton frocks; the use, care, and cleaning of the sewing-machine.

Repairs: darning, all types of patching by hand and machine.

One garment made during the examination year illustrating a number of processes should be shown at the practical examination, also a repair which may be carried out on a garment or household article needing attention, or as a specimen.

Housecraft, with Household and Personal Hygiene.

Household Hygiene, the effect of environment, site, aspect, building materials, sanitation, water-supply, methods of heating, lighting, and ventilation. Personal Hygiene, the laws of health. General rules of diet.

Experimental work to illustrate the use of common cleansing agents. Daily and thorough cleaning of all rooms, with special attention to method. Care of labour-saving appliances. Storage of clothing, bedding, and household equipment. Laying of tables, clearing, and washing-up. Shopping and storage of foods. Repairs, darning, all types of patching by hand and machine.

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1966 REGULATIONS

Supplement No. 1
(Issued December 1964)

1. RESULTS

Page 10, paragraph 7.

Delete: A candidate will qualify for grades 1 or 2 only if he has reached one of the three grades A, B, or C on the A papers in that subject and in the same examination.

2. RUSSIAN – A LEVEL

Page 19, *Russian Literature (Paper III) prescribed for 1966:*

Insert: Candidates must offer four of the following:

3. ENGLISH – A LEVEL

Page 20, Paper I:

For '*King John* or *Much Ado About Nothing*'

substitute '*Henry IV, Part 2, or King John* or *Much Ado About Nothing.*'

4. HISTORY WITH FOREIGN TEXTS – A LEVEL

Page 23, *Prescribed Books:*

German 1. Ranke, *Geschichte Wallensteins* (Agrippina Köln) out of print.

Alternative – Schiller, *Wallensteins Tod.*

5. MUSIC – A LEVEL

Page 28. *Paper I. Counterpoint and Harmony*

Delete: '2. Either Two-part sixteenth-century counterpoint (e.g. sacred in the style of Lassus or Palestrina; secular in the style of Morley),'

and substitute: '2. Either Two-part sixteenth-century counterpoint (which may involve the underlay of words): e.g. sacred in the style of Lassus; secular in the style of Morley.'

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21815

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2-29(1,66)

6. ART – A LEVEL

Page 30: I. Object Drawing – for 2 hrs. read 2½ hrs.
IV. Plant Drawing – for 2 hrs. read 2½ hrs.

7. PHYSICS – A LEVEL

Page 42, line 24:

Delete: 'Kirchhoff's first law'
and substitute: 'Kirchhoff's laws.'

line 41:

Delete: '*The photoelectric effect*'
and substitute: '*Photoelectricity: photoelectric emission. Einstein's equation and its significance. The photon.*'

line 43:

Delete: '*Elementary treatment of radioactivity, both natural and artificial*'

and substitute: '*Radioactivity: radioactive substances and the radiations from them. Distinction between α , β and γ rays by effects of electric and magnetic fields and by selective absorption. Nature of α and β particles and of γ rays. Simple radioactive changes, law of radioactive decay. Isotopes. The curie.*'

8. APPLIED MECHANICS – A LEVEL

Pages 57–58.

Delete line 25 on page 57 to line 12 on page 58, and substitute:

The following papers will be set:

I. Applied Mechanics	3 hrs.
II. Graphical Statics	3 hrs.
III. Mechanical Drawing	3 hrs.

A choice of questions will be given in the Graphical Statics and theoretical papers. There will be no practical examination.

Answers to Paper III must be on half-imperial (15" × 22") drawing-paper.

Applied Mechanics (I)

Statics. Coplanar forces, statics of a rigid lamina, forces in simple frameworks, equilibrium of simple framework. Bending and shearing force diagrams. Centre of gravity. Laws of friction and their application to simple cases of equilibrium. Method of sections.

Kinematics. Vector quantities, their resolution and composition. Velocity diagrams for simple mechanisms. Relative motion, angular velocity, and acceleration. Uniform motion in a circle. Free motion under gravity, projectiles.

Dynamics. Newton's laws of motion. Mass, momentum, force, impulse, work, energy, power. Motion due to constant and variable forces. Friction. Simple machines. Simple harmonic motion. Simple and compound pendulums. Moments of inertia of simple solids. Parallel and perpendicular axes theorems. Elementary rotational dynamics.

Strength of Materials. Stress, strain, Hooke's law. Young's modulus. Extensometer. Tensile testing machine. Torsion of shafts of circular cross-section. Rigidity modulus.

Hydraulics. Flotation, centre of pressure and total pressure on plane surfaces. Laws of fluid friction, Bernouilli's theorem, Venturimeter. Flow of water through pipes and over 'V' notches.

Graphical Statics (II) – stet.

Mechanical Drawing (III) – stet.

Applied Mechanics (IV 5) – delete.

9. GENERAL CLASSICS – O LEVEL

Page 82, *Prescribed Books:* Homer, *Odyssey* xvii–xxiv.

After: 'trans. Rouse (Nelson)'

add: 'or trans. Rieu (Penguin).'

10. CHEMISTRY – O LEVEL

Page 94, lines 3–4:

For: 'The concept of the gram-molecule (Avogadro)'

read: 'Avogadro's Law and the concept of the gram-molecule.'

11. MUSIC – O LEVEL

Page 106, History and Analysis.

Delete: 1 (a) and (b)

and substitute: 1. The transposition of a given tune for clarinet, cor anglais, trumpet or horn.

12. ART – O LEVEL

Page 108, line 15:

Delete: '1890'

and substitute: 'the present day.'

13. GEOMETRICAL AND MECHANICAL DRAWING –
O LEVEL

Pages 108–109:

Delete: from *Plane Geometrical Drawing* to the end,
and substitute: Paper I will be restricted to questions on
Mechanical Drawing and Isometric
Projections and Paper II will include
a choice of geometrical questions.

14. HANDICRAFT – O LEVEL

Page 109, line 20:

Delete: 'British Standard Specification 308 of 1953'
and substitute: 'British Standard Specification 308 A of
1958.'

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