

THE
INSTITUTE OF CHEMISTRY
OF
GREAT BRITAIN AND IRELAND.

FOUNDED OCTOBER, 1877.

INCORPORATED BY ROYAL CHARTER OF THE 13th DAY OF JUNE, 1885.

Regulations
for the Admission of Students,
Associates, and Fellows.

(EXAMINATION PAPERS: 1906-1907.)

Issued by Order of the Council,

RICHARD B. PILCHER,

Registrar and Secretary.

January, 1908.

All communications with reference to the Regulations should be addressed to
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THE INSTITUTE OF CHEMISTRY.

SUMMARY OF THE REGULATIONS.

THE Institute of Chemistry was founded in October, 1877, and incorporated by Royal Charter in June, 1885, to promote the better education of persons desirous of becoming professional consulting and technological chemists, public analysts and chemical advisers ; to examine Candidates, and to grant certificates of competency ; and to elevate professional Chemistry by setting up a high standard of scientific and practical proficiency, and by insisting on the observance of strict rules for professional conduct.

In pursuance of the provisions of the Charter and Bye-Laws, the Council have made Regulations for the admission of Students, Associates and Fellows.

THE STUDENTSHIP.

Annual Registration Fee, 5s.

Every Candidate for admission to the Studentship is required to produce evidence that he is upwards of 17 years of age, and that he has passed a preliminary Examination in subjects of general education, approved by the Council of the Institute (see p. 7). He must also show that, at the time of making application for registration, he is working at an institution recognised by the Council, or

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SUMMARY.

under the direction of a Fellow of the Institute, in a laboratory approved by the Council, with the object of qualifying for the practice of professional Chemistry. (See p. 11.)

THE ASSOCIATESHIP (A.I.C.)

There are three Examinations for admission to the Associateship, viz. :—I., a Preliminary Examination (see p. 7) ; II., the Intermediate Examination in general theoretical and practical Chemistry (see p. 20), or an Examination accepted by the Council in lieu of the Intermediate (see p. 24) ; and III., the Final Examination in a branch of Chemistry selected by the Candidate. (See p. 27.)

The Intermediate and Final Examinations are conducted by the Institute, and are open only to Candidates who have complied with the Regulations.

THE INTERMEDIATE EXAMINATION.

Fee, £5 5s.

Candidates for admission to the Intermediate Examination are required to produce evidence of having passed an approved Preliminary Examination, and of having regularly attended systematic *day* courses, in an institution recognised by the Council, during at least *three academic years*, in theoretical and practical Chemistry, in Physics, in Mathematics, and in one optional scientific subject. (See A pp. 14—19.)

As an alternative to the three years' training in a recognised institution, a Candidate may take two years' such training, and work systematically for two *other* years, under the direction of a Fellow of the Institute, in a laboratory approved by the Council. (See B pp. 19—20.)

SUMMARY.

Any Candidate who has taken a Degree in Science, in a University recognised by the Council, is eligible for admission to the Intermediate Examination of the Institute, provided that inorganic and organic Chemistry, and Physics were taken as subjects in the Degree, and that Mathematics were taken in either the Degree or the Intermediate University Examination.

Candidates who have passed certain examinations (see p. 24) are exempted from the Intermediate Examination provided they produce evidence, satisfactory to the Council, of having been trained in theoretical and practical Chemistry, in theoretical and practical Physics, and in one optional scientific subject, in one or more of the institutions recognised by the Council, in accordance with the Regulations of the Institute.

THE FINAL EXAMINATION FOR THE ASSOCIATESHIP (A.I.C.).

Fees : Candidates who have passed the Intermediate Examination, £5 5s. ; Candidates exempted from the Intermediate, £10 10s.

Any Candidate who has passed the Intermediate Examination of the Institute, or an Examination accepted by the Council in lieu of the Intermediate Examination, under the conditions specified above, is entitled to apply for admission to the Final Examination. (See p. 27.)

DATES OF EXAMINATIONS.

The Intermediate and Final Examinations are held each year in January, April and July, except the Final Examination in Biological Chemistry, which is held in October. The exact dates are announced, in newspapers and scientific journals, about three months before each examination.

SUMMARY.

THE FELLOWSHIP (F.I.C.).

Entrance Fee : £5 5s.

For admission to the Fellowship, an Associate is required to have been registered for three years, and to have been continuously engaged during that period in the study and practice of Chemistry in a manner satisfactory to the Council.

ADDITIONAL EXAMINATIONS.

In addition to the Examinations for admission to the Associateship, Examinations open only to Fellows and Associates are held in (i.) the Chemistry of Food and Drugs, etc. (see p. 33), (ii.) Biological Chemistry (see p. 31), and (iii.) Chemical Technology (see p. 36).

FEES.

A list of fees, subscriptions, etc., is given on pp. 38—40.

DIPLOMAS.

Under the provisions of the Royal Charter, any Fellow of the Institute is entitled to use the initials F.I.C., and any Associate of the Institute, the initials A.I.C.

THE REGULATIONS.

1.—PRELIMINARY EXAMINATION IN SUBJECTS OF GENERAL EDUCATION.

All Candidates for the Associateship, except such as are graduates of Universities recognised by the Council of the Institute, must pass an approved Preliminary Examination (see pp. 8—10), before they can be registered as Students or admitted to the Examinations held by the Institute. They must produce the certificate of having passed the Examination in the following subjects :—

COMPULSORY SUBJECTS.

- (a) English Language.
- (b) Elementary Mathematics, comprising Arithmetic, Algebra (including simple equations), Geometry (including Euclid: Books I., II., and III., or the equivalent).
- (c) At least one of the following :—Greek, Latin, French, German, Italian, Spanish, any other modern language approved by the Council,

and, if not more than one language be taken under (c), the Candidate must also pass in

- (d) Higher Mathematics,* or any other subject prescribed in the regulations for a Preliminary Examination approved by the Council.

Where the certificate does not mention the subjects in which the Candidate has passed, a statement, giving this information, must be obtained from the examining body.

* Higher Mathematics should include the Syllabus defined in par. (ii) of sub-section (d), on p. 15, or the equivalent.

APPROVED PRELIMINARY EXAMINATIONS.

Application for information concerning the Regulations of the following Examinations should be made to the respective examining bodies.

APPROVED PRELIMINARY EXAMINATIONS.

UNIVERSITIES IN GREAT BRITAIN AND IRELAND.

University of Aberdeen.—Senior Local Examination. Preliminary Examinations for Graduation in Arts or Science.†

University of Birmingham.—Matriculation Examination.

University of Cambridge.—Senior or Higher Local Examination. Previous Examination. General Examination.

University of Dublin (Trinity College).—Public Entrance Examination. Examination for the First, Second, Third, or Fourth Year in Arts.

University of Durham.—Senior Local Examination.—(To be discontinued after 1908.) Matriculation Examination of the Faculty of Science.

University of Edinburgh.—Preliminary Examinations for Graduation in Arts or Science.†

University of Glasgow.—Preliminary Examinations for Graduation in Arts or Science.†

University of Leeds.—Matriculation Examination.*

University of Liverpool.—Matriculation Examination.*

University of London.—Matriculation Examination, whether taken in its ordinary form, or in the form of the School Examination (Matriculation Standard) for the School-leaving Certificate.

† Preliminary Examination of the Joint Board of Examiners of the Scottish Universities for Graduation in Arts or Science.

* Matriculation Examination conducted by the Joint Board of the Universities of Manchester, Liverpool, Leeds, and Sheffield.

Every Candidate should produce a certificate of having passed in the compulsory subjects at *one* Examination, but where a Candidate can produce satisfactory evidence that he has passed in the compulsory subjects in *two* Examinations—and not more than *two*—the Council may, if they think fit, exempt him from passing a further Preliminary Examination.

NOTE.—In some cases a Junior or Lower Grade Examination, conducted by a recognised examining body, may be accepted, if passed in all of the compulsory subjects at one and the same Examination, *prior to 31st December, 1901.*

APPROVED PRELIMINARY EXAMINATIONS.

UNIVERSITIES IN GREAT BRITAIN AND IRELAND—*continued*.

- Victoria University of Manchester.—Matriculation Examination.*
 University of Oxford.—Senior Local Examination. Responsions.
 Royal University of Ireland.—Matriculation Examination.
 University of St. Andrews.—Preliminary Examinations for Graduation
 in Arts or Science.† Final Examination for the Diploma of
 L.L.A.
 University of Sheffield.—Matriculation Examination.*
 University of Wales.—Matriculation Examination.

OTHER EDUCATIONAL BODIES.

- College of Preceptors.—Examination for a First Class (or Senior)
 Certificate.
 Glasgow and West of Scotland Technical College.—Preliminary
 Examination for Diploma Students.
 Intermediate Educational Board of Ireland.—Senior Grade Exami-
 nation.
 Oxford and Cambridge Schools Examinations Board.—Higher
 Certificate.
 Scotch Educational Department.—Examinations for Leaving
 Certificate in all compulsory subjects on the Higher
 Standard.
 Central Welsh Board.—Senior Certificate Examination.

AUSTRALASIA.

- Adelaide University.—Senior Public Examination. First Year
 Examination in Arts.
 Melbourne University.—Matriculation Examination.
 Sydney University.—Matriculation Examination. First Year Exami-
 nation in Arts. Senior Public Examination.
 Tasmania University.—Senior Public Examination.

CANADA.

- Kingston: Queen's University.—Departmental Arts Matriculation
 Examination.
 Manitoba University.—Matriculation Examination.
 Montreal: University of Bishop's College. — Matriculation
 Examination.
 University of McGill College. — Matriculation
 Examination.

* Matriculation Examination conducted by the Joint Board of the
 Universities of Manchester, Liverpool, Leeds, and Sheffield.

† Preliminary Examination of the Joint Board of Examiners of the
 Scottish Universities for Graduation in Arts or Science.

APPROVED PRELIMINARY EXAMINATIONS.

New Brunswick: University of New Brunswick, Fredericton.—
Matriculation Examination.

College of Physicians and Surgeons.—Matriculation
Examination.

Newfoundland Medical Board.—Preliminary or Matriculation
Examination.

Nova Scotia: Dalhousie College and University, Halifax.—
Matriculation Examination.

Provincial Medical Board.—Preliminary Examination.

Ontario: Universities and Colleges of the Province.—Departmental
Arts Matriculation Examination, conducted under the
direction of the Provincial Education Department.

Quebec: College of Physicians and Surgeons of the Province.—
Matriculation Examination.

CAPE COLONY.

Cape of Good Hope University.—Matriculation Examination.

EGYPT.

The Secondary Education Certificate of the Egyptian Government.

INDIA AND CEYLON.

Allahabad University.—Intermediate Examination in Arts.

Bombay University.—Matriculation Examination.

Calcutta University.—First Examination in Arts.

Ceylon Medical College.—Preliminary Examination.

Madras University.—First Examination in Arts.

Punjab University.—Intermediate Examination in Arts.

(In the case of natives of India an Examination in a classic oriental
language may be accepted instead of an Examination in Latin.)

MALTA.

University of Malta.—Matriculation Examination.

NEW ZEALAND.

New Zealand University.—Preliminary Examination.

Otago University.—Preliminary Examination.

FOREIGN UNIVERSITIES IN EUROPE.

The German Abiturienten-Examen of the Gymnasia and Real-
gymnasia ; Examinations entitling to the French Diplomas of Bachelier
ès Lettres and Bachelier ès Sciences, and other corresponding Entrance
Examinations to the Universities.

STUDENTSHIP.

2.—REGULATIONS FOR THE ADMISSION OF STUDENTS.

1. A Candidate is eligible for registration as a Student at any period during his training, provided that he can produce evidence satisfactory to the Council—

- (a) That he is not less than 17 years of age.
- (b) That he has passed an approved Preliminary Examination in the required subjects (see pp. 7-10).
- (c) That he is, at the time of application, a student at one of the universities, colleges, or schools, approved by the Council (pp. 41—42), or a pupil of a Fellow of the Institute in a laboratory approved by the Council, and that he is *bonâ fide* in course of preparation and training with the object of qualifying for the practice of professional, consulting, technological, or analytical Chemistry.
- (d) That he has paid his registration fee of Five Shillings.

2. The registration fee is due on admission, and on the first day of January in each year. Any Student who omits to pay his annual registration fee, when due, shall on a resolution to that effect being passed by the Council, have his name removed from the Register.

3. All Students of the Institute are required to present themselves for examination within five years from the date of their admission, otherwise their names will be removed from the Register, unless an extension of time be granted by the Council.

STUDENTSHIP.

Forms of application can be obtained from the Registrar.

Although not compulsory, it is advantageous for a Candidate to register as a Student, in view of the fact that a registered Student is required to fulfil only those regulations, relating to training and examinations, which are in force at the time of his registration. Any Candidate not so registered is required to comply with the regulations in operation at the time of his application for admission to the Examinations.

Registered Students receive the "Proceedings" (containing the Reports of the Examinations with the pass lists, examination papers and particulars of the practical exercises set). They are admitted to the Library of the Institute during the same hours as Fellows and Associates.

OBLIGATORY CONDITIONS AS TO TRAINING.

No course of lectures or other instruction in the required subjects will be accepted as part of the curriculum for the Associateship which is not given *in the daytime* by the appointed professor, in a university, college or school recognised by the Council (pp. 41-42), or, in the case of laboratory work, by a duly appointed assistant, acting under the supervision of the professor; and attendance upon such instruction will not be sufficient, unless satisfactory evidence is afforded by the Candidate that the whole of his time has been given to it, either in a recognised college, or in the case of a pupil of a Fellow of the Institute (B:—pp. 19-20), partly in a recognised institution and partly under the direction of such Fellow.

STUDENTSHIP.

ADVICE AS TO TRAINING.

Chemistry, theoretical and practical, is to be regarded as the principal subject; the other subjects are subsidiary, and should occupy a relatively small proportion, as a rule not more than one-fourth, of the student's time.

A careful inspection of the syllabus of each of the Examinations held by the Institute will give the Candidate a good general idea of the extent of the knowledge of Chemistry he is expected to possess. In addition to systematic analytical practice, every Candidate should be able to use the microscope, spectroscope, polarimeter, refractometer, and other instruments commonly employed in chemical laboratories. He should also be able to draw diagrams of apparatus and of instruments.

In the Final Examination every Candidate is required to satisfy the Examiners as to his ability to translate German and French technical literature into English with the use of dictionaries.

Candidates whose aim is to practise in technological Chemistry are advised to devote particular attention to the study of Physics.

Attention is directed to the importance of Candidates keeping complete records of their practical work. When presenting themselves for examination, they are required to submit note-books, containing records of the practical work performed during the last two years of training, for inspection by the Examiners, who will take them into account in deciding the Examination.

Candidates are expected to be able to use logarithms in their chemical calculations.

TRAINING.

3.—TRAINING AND QUALIFICATIONS REQUIRED FOR THE ASSOCIATESHIP.

Every Candidate for the Examinations for the Associateship is required to produce—

1. A certificate of birth or baptism as evidence of age.

A Candidate under 21 years of age, who has complied with the Regulations, may enter for the Examinations, and, if successful, will be elected to the Associateship on attaining that age.

2. A satisfactory certificate of moral character.

3. A certificate that he has passed an approved Preliminary Examination (see p. 7).

4. Evidence that he has completed one of the following schemes of training,* **A** or **B** (p. 19):—

A.

(a) That he has passed satisfactorily through a systematic course of study extending over at least three academic years, and has passed the class Examinations, in **theoretical and practical inorganic and organic Chemistry**, in one or more of the institutions recognised by the Council (see pp. 41-42); and that the practical work has occupied, on the average, at least 15 hours per week, during the three years.

(b) That he has worked for at least 100 hours in the physical laboratory, has attended at least 50 lectures on **Physics**, and has passed the class Examinations in this subject at a recognised institution.

* See also page 20 (Section 4, Clause 2), and p. 24 (Section 5, Clause 2).

TRAINING.

(c) That he has attended lectures on **elementary Mathematics**, and has passed the class examinations in this subject at a recognised institution. The lectures and examinations must include: Euclid, Books I., II., and III., or the equivalent; Algebra to quadratic equations, ratio and proportion; Plane Trigonometry to solution of triangles, heights and distances, area of a triangle, and use of logarithms.

A certificate of having satisfactorily passed an approved examination in Mathematics covering the work indicated above will be accepted by the Council in lieu of evidence of a course in this subject having been taken.

(d) That he has also attended a course of instruction and passed the class examinations in **one optional subject** selected by himself from the following list :—

- (i) **HIGHER PHYSICS**:—Lectures and practical laboratory work as required by Candidates taking Physics in the Final or Degree Examination for B.Sc.
- (ii) **MATHEMATICS**:—Algebra, including partial fractions, binomial theorem for any rational index and exponential and logarithmic series. Trigonometry: De Moivre's theorem and the sine and cosine series. Differential and Integral Calculus treated in an elementary manner, and involving those functions only which occur in such simple physical problems as those relating to rates, correspondence of errors, maxima and minima areas, volumes, centres of gravity, moments of inertia. Geometry: the subject-matter of Euclid, Books VI., XI., and the simpler properties of the conic sections treated algebraically.

(Any Candidate who has taken Higher Mathematics in his Preliminary Examination must take some other optional subject in his training for the Associateship.)

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- (iii) **ELEMENTARY MECHANICS, STEAM AND GENERAL CHEMICAL ENGINEERING** :—Properties of constructive materials—timber, iron, steel, masonry. Principles of construction of boilers, steam engines, internal combustion engines, water-wheels, turbines, pumping engines and pumps. Dynamo machines, and secondary batteries. Furnaces. (40 to 50 lectures, or an equivalent amount of instruction.)
- (iv) **METALLURGY** :—Furnace materials and construction : Fuel (solid, liquid and gaseous), mechanical stokers, pyrometers, calorimeters, manufacture and properties of iron and steel. Manufacture of any two other metals, and their properties. Assay of the metals chosen to be learnt practically. (40 to 50 lectures, or an equivalent amount of instruction.)
- (v) **GEOLOGY AND MINERALOGY** :—About 40 to 50 lectures or an equivalent amount of other instruction, in addition to sufficient field or laboratory work once a week for a year, on general physical and stratigraphical geology, mineralogy, petrography and economic geology, with special reference to coal-fields, ore deposits, water supply, and drainage.
- (vi) **ELEMENTARY PHYSIOLOGY** :—General biology of plants and animals, illustrated by reference to the structure and life history of selected types. Histology of simple tissues. Composition of human food and its digestion. Circulation of the blood, respiration, secretion and excretion, animal heat. The functions of the nervous system. (40 to 50 lectures or an equivalent amount of instruction, in addition to practical work on

TRAINING.

the qualitative and quantitative examination of blood, urine, bile, and milk.)

(vii) **BACTERIOLOGY** :—The use of the microscope. The morphology and physiology of micro-organisms. (40 to 50 lectures, or an equivalent amount of instruction, in addition to practical work, including the recognition of microscopic specimens, with systematic instruction and practice in the preparation, staining, mounting and drawing of specimens, as well as the preparation and study of pure cultures.)

(viii) **AGRICULTURE** :—The origin, classification, and composition of agricultural soils—the supply of plant food by soil—chemical and physical properties of soils. Improvement of soil by tillage, draining, manuring and other operations. Chemical and bacterial changes going on in the soil. The constituents of plants—the sources of plant food and assimilation of the same. Rotations and the theories underlying them. The principles of manuring—manures in ordinary use—their origin, composition, uses and analysis. The principal farm crops—composition, requirements, and general characteristics. The foods of the farm—their composition and principal uses—the functions of food constituents—unexhausted manurial value of foods consumed. Milk and other dairy produce—fermentation in relation thereto. Water and water supply. Industries of the farm—special classes of farming.

(ix) **ELEMENTARY BOTANY** :—General morphology and anatomy of plants. The structure of the vegetable cell.

TRAINING.

The cell-wall and its modifications. Tissues and tissue systems, with especial reference to the characteristic cell-forms present. Elementary histology of the vegetative members of flowering plants. Elementary physiology of plants, including the sources of plant food. Salient features in the structure and life-history of *Bacterium*, *Spirogyra*, *Saccharomyces*, and *Mucor*. The essential distinctions between *Thallophyta*, *Bryophyta*, *Pteridophyta*, and *Phanerogamia*; between *Gymnospermæ* and *Angiospermæ*; and between *Dicotyledones* and *Monocotyledones*. The characteristics of the following subclasses: *Thalamifloræ*, *Discifloræ*, *Calycifloræ*, *Corollifloræ*, *Monochlamydeæ*, *Petaloideæ*, *Spadicifloræ*, and *Glumifloræ*; and of the following natural orders: *Ranunculaceæ*, *Cruciferaæ*, *Rosaceæ*, *Leguminosæ*, *Umbelliferaæ*, *Compositæ*, *Solanaceæ*, and *Liliaceæ*. (About 40 to 50 lectures, or an equivalent amount of other instruction, in addition to practical work, including the histology of the various members of flowering plants and the identification of the most important cell-forms, cell-contents and modifications of the cell-wall.)

- (x) **ELEMENTARY BIOLOGY**:—Elementary morphology and anatomy of plants. The structure of the vegetable cell. Tissues and tissue systems. Elementary physiology of nutrition. Elementary histology of the root, stem and leaf of a typical *Dicotyledon*. Salient features in the structure and life-history of *Bacterium*, *Spirogyra*, *Saccharomyces*, and *Mucor*. The essential distinctions between *Thallophyta*, *Bryophyta*, *Pteridophyta*, and *Phanerogamia*. The structure of the animal cell. The

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characteristics and functions of the chief tissues (epithelium, connective tissue, cartilage, bone, blood, muscle, nerve). The differences between plants and animals. Animal nutrition. The essential distinctions between Protozoa and Metazoa. Salient features in the structure and life-history of *Amœba*, *Paramœcium*, and *Vorticella* and in the structure of *Lumbricus*, *Scyllium* and *Rana*. (About 40 to 50 lectures, or an equivalent amount of other instruction, in addition to practical work, including the ordinary methods of staining and mounting for microscopical examination, and the identification of the chief vegetable and animal tissues.)

N.B.—After the 1st day of January, 1909, a course of instruction in Elementary Botany (as ix. above) will be compulsory to Candidates taking Branch (e), The Chemistry of Food and Drugs, etc., in the Final Examination, and a course in Elementary Biology (as x. above) will be compulsory to Candidates taking Branch (f), Biological Chemistry, in the Final Examination. The courses in such cases may be taken either before or after passing the Intermediate Examination.

B.

(a) That during at least *two academic years* he has regularly attended systematic day courses in each of the following subjects, at one or more of the institutions recognised by the Council (pp. 41-42), and has passed the Class Examinations :—

Theoretical Chemistry, including the ordinary day courses of lectures on inorganic and organic chemistry given by the professor ;

TRAINING.

Practical Chemistry, including systematic laboratory work, three days in each week, and at least five hours each day ;

Physics [as (b) on p. 14] ;

Elementary Mathematics [as (c) on p. 15] ; and

One optional subject, selected from the list (d) on pp. 15-19 ; and

(b) That he has also been systematically engaged in the study and practice of analytical chemistry for *two other years* under the direction of a Fellow of the Institute, in a laboratory approved by the Council.

4.—REGULATIONS FOR THE INTERMEDIATE EXAMINATION IN THEORETICAL AND PRACTICAL CHEMISTRY.

1. Candidates who have complied with the conditions of clauses 1, 2, 3 and 4 of Section 3 are eligible for admission to the Intermediate Examination. Forms of application can be obtained from the Registrar.

2. Candidates who have obtained the pass degree of Bachelor of Science in a recognised university, and have complied with clauses 1 and 2 of Section 3, are also eligible for admission to the Intermediate Examination, provided they produce evidence, satisfactory to the Council, that they have passed the final or degree examination in theoretical and practical inorganic and organic Chemistry and theoretical and practical Physics, and that they have

 INTERMEDIATE EXAMINATION.

passed an intermediate or final university examination in Mathematics covering the work set forth in paragraph (c) on p. 15.

3. On or before the date fixed for the closing of the List for each Intermediate Examination, every Candidate desirous of presenting himself is required to forward :—

- (a) The form of application duly filled in and accompanied by certificates containing evidence that the Candidate is entitled to present himself for examination in accordance with the Regulations.
- (b) The Examination Fee : Five Guineas (£5 5s.).
- (c) Note-books containing records of the practical chemical work of all kinds performed during training, the genuineness of the records to be attested by himself and his professors or teachers, according to the note-book form, which may be obtained on application to the Registrar. The note-books will be submitted to the Examiners, who will take their contents into consideration and will have power to submit any Candidate to a *vivâ voce* examination upon them.

 SYLLABUS OF THE INTERMEDIATE
EXAMINATION.

The Intermediate Examination occupies at least four days, from 10 a.m. to 4.30 p.m. on each day.

The Examiners are at liberty to put questions to Candidates at any time during the examination.

INTERMEDIATE EXAMINATION.

The Examination consists of :—

(A) An examination in general theoretical Chemistry.

Candidates are required to show a thorough acquaintance with the fundamental laws of chemistry ; with the methods of preparation of the more important elements and their compounds, both inorganic and organic ; with the principles of chemical classification ; and with the current theories of chemical science. At least two papers, including questions in both inorganic and organic Chemistry, will be set.

(B) An examination in practical Chemistry.

This Examination is partly qualitative and partly quantitative :

QUALITATIVE.

1. Exercises in qualitative analysis : such as the analysis of artificial mixtures of moderate complexity, of alloys, and of ores, and the detection of specified substances present in minute quantities, as impurities or otherwise, in commercial products.

2. Preparation of substances, so chosen as to elicit evidence of the Candidate's acquaintance with ordinary chemical operations, such as crystallisation, solution, distillation, etc.

3. The recognition, by practical tests, of familiar typical inorganic and organic compounds.

4. The examination of gases, and the detection of one or more of the following in a gaseous mixture : hydrogen, chlorine, hydrogen chloride, hydrogen sulphide, oxygen, ozone, carbon monoxide, carbon dioxide, sulphur dioxide,

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nitrogen, ammonia, nitric oxide, methane, ethylene, and acetylene.

5. The use of the spectroscope : recognition and diagrammatic plotting of spectra.

6. The use of the microscope : preparation, mounting and measurement of specimens.

QUANTITATIVE.

1. The gravimetric and volumetric estimation of commonly occurring substances.

2. The determination of carbon and hydrogen, nitrogen, sulphur, or halogens, in organic compounds.

3. The volumetric determination of one or more of the constituents in a mixture which may contain hydrogen, oxygen, carbon monoxide, carbon dioxide, nitrogen, methane, and ethylene.

4. Determination of boiling point, melting point, density, solubility, molecular weight.

5. The use of the calorimeter, the polarimeter and the refractometer.

The examination in quantitative analysis may include the performance of some operation selected from the Candidate's own record.

In making combustions, Candidates are required to prepare their own combustion tubes and drying apparatus.

During practical examinations, Candidates are at liberty to consult any books of reference which they may bring with them, or which are contained in the Library of the Institute.

FINAL EXAMINATION.

5.—REGULATIONS FOR THE FINAL EXAMINATION FOR THE ASSOCIATESHIP (A.I.C.).

1. Candidates who have passed the Intermediate Examination of the Institute are eligible for admission to the Final Examination.

2. Candidates who have passed any of the following examinations are exempted from the Intermediate Examination provided they produce evidence, satisfactory to the Council, of having been trained in theoretical and practical Chemistry, in theoretical and practical Physics, and in one optional scientific subject, in one or more of the institutions recognised by the Council, in accordance with the Regulations of the Institute (pp. 14-20) :

ABERDEEN: THE UNIVERSITY.

The Final Examination for the Degree of B.Sc., with special distinction in Chemistry.

BIRMINGHAM: THE UNIVERSITY.

The Final Examination for the Degree of B.Sc. in the subjects of Chemistry and Physics, the Candidate's name being placed in either of the first two divisions, with Chemistry as his principal subject, including theoretical and practical inorganic and organic Chemistry.

CAMBRIDGE: THE UNIVERSITY.

A First or Second Class in Part II. of the Natural Sciences Tripos, with Chemistry as the principal subject.*

DUBLIN: THE UNIVERSITY (TRINITY COLLEGE).

The Senior Moderatorship in Experimental Science.

THE ROYAL UNIVERSITY OF IRELAND.

The Final Examination for the Degree of B.A., with the Final Examination for B.Sc. or M.A. (involving inorganic and organic Chemistry).

ROYAL COLLEGE OF SCIENCE FOR IRELAND.†

The Examination for the Associateship of the Royal College of Science for Ireland, in the Faculty of Manufactures, passed prior to 1st October, 1902, together with a certificate from the Professor of Chemistry in the R.C.Sc., Dublin, or in some other university or college recognised by the Institute, that the Candidate has spent an additional period of six months exclusively in the chemical laboratory of such college.

* A lower Class in Honours may be accepted if the Candidate passed the examination prior to 1st October, 1902. † See note on p. 26.

FINAL EXAMINATION.

The Examination for the Associateship of the Royal College of Science for Ireland, in the Faculty of Applied Chemistry, together with evidence that the Candidate has passed an approved Preliminary Examination (pp. 7-10).

DURHAM: THE UNIVERSITY.

The Final Examination for the Degree of B.Sc. in the subjects of Chemistry and Physics, with distinction in Chemistry as chief subject, including theoretical and practical inorganic and organic Chemistry.

EDINBURGH: THE UNIVERSITY.

The Final Examination for the Degree of B.Sc., with special distinction in Chemistry.

GLASGOW: THE UNIVERSITY.

The Final Examination for the Degree of B.Sc., with special distinction in Chemistry.

LEEDS: THE UNIVERSITY.

The Final Examination for the Degree of B.Sc., with First or Second Class Honours in Chemistry.

LIVERPOOL: THE UNIVERSITY.

The Final Examination for the Degree of B.Sc., with First or Second Class Honours in Chemistry.

LONDON: THE UNIVERSITY.

The Final Examination for the Degree of B.Sc., with First or Second Class Honours in Chemistry.*

CITY AND GUILDS OF LONDON INSTITUTE (Central Technical College.)†

The Examination for the Associateship (A.C.G.I.) in the Department of Chemistry, if passed prior to 1st October, 1902.

The Examination for the Associateship of the City and Guilds Institute, in the Division of Chemistry, together with evidence that the Candidate has passed an approved Preliminary Examination (pp. 7-10).

ROYAL COLLEGE OF SCIENCE.†

The Examination for the Associateship of the Royal College of Science, London, in the Division of Chemistry, if passed prior to 1st October, 1902.

The Examination for the Associateship of the Royal College of Science, London, in the Division of Chemistry, together with evidence that the Candidate has passed an approved Preliminary Examination (pp. 7-10).

ROYAL SCHOOL OF MINES.

Associates of the Royal School of Mines in Metallurgy, who have passed an approved Preliminary Examination, and have, since obtaining the Diploma, been systematically trained in Chemistry, for six months, in the laboratories of an institution recognised by the Council, are accepted as eligible for election to the Associateship of the Institute, on passing a Final Examination in general theoretical and practical Chemistry.

* A lower Class in Honours may be accepted if the Candidate passed the examination prior to 1st October, 1902. † See note on p. 26.

FINAL EXAMINATION.

MANCHESTER: THE VICTORIA UNIVERSITY.

The Final Examination for the Degree of B.Sc., with First or Second Class Honours in Chemistry.*

OXFORD: THE UNIVERSITY.

A First or Second Class in the Final Honour School of Natural Science in the subject of Chemistry.*

ST. ANDREWS: THE UNIVERSITY.

The Final Examination for the Degree of B.Sc., with special distinction in Chemistry.

THE UNIVERSITY OF WALES.

The Final Examination for the Degree of B.Sc., with First or Second Class Honours in Chemistry.*

THE UNIVERSITY OF ADELAIDE, SOUTH AUSTRALIA.

The Final Examination for the Degree of B.Sc., with First or Second Class Honours in Chemistry.

THE UNIVERSITY OF SYDNEY, N.S.W.

The Final Examination for the Degree of B.Sc., with First or Second Class Honours in Chemistry.

No Candidate for the Associateship will, under any circumstances, be exempted from passing a Final Examination.

Candidates may forward, for the inspection of the Examiners, note-books containing duly authenticated records of practical chemical work of an advanced character done by them since passing the Intermediate Examination, or not previously inspected, and the contents will be taken into consideration in deciding the examination.

The Examination Fee must be paid at the time of making application for admission to this examination. The fee is Five Guineas (£5 5s.) for Candidates who have passed the Intermediate, and Ten Guineas (£10 10s.) for Candidates exempted from passing the Intermediate Examination.

* See p. 24.

NOTE.—The Regulation requiring Associates of the Royal Colleges of Science (London and Dublin) and Associates of the City and Guilds of London Institute to pass an approved Preliminary Examination, will not be enforced in the cases of those who produce evidence, satisfactory to the Council, that they entered on a systematic course of training in Chemistry at a recognised College prior to 1st July, 1902.

FINAL EXAMINATION.

SYLLABUS OF THE FINAL EXAMINATION.

The Final Examination occupies at least four days, from 10 a.m. to 4.30 p.m. on each day ; Branch (e) at least five days.

In cases where Candidates for the Final Examination have been exempted from passing the Intermediate Examination, the Examiners are empowered, if they deem such a course advisable, to extend the period of Examination in order to test the general knowledge of Chemistry possessed by such Candidates.

The Examiners are at liberty to apply any test which they think desirable, either vivâ voce, or by writing, or by experimental work, in order to obtain evidence as to the knowledge of theoretical and practical Chemistry possessed by the Candidate.

1. Each Candidate for the Final Examination is required to show, in addition to a general knowledge of all branches of Chemistry, a *thorough* acquaintance with at least one of the following branches, to be selected by himself:—

- (a) **Mineral Chemistry** : including general inorganic qualitative and quantitative analysis, and the preparation of pure inorganic substances.
- (b) **Metallurgical Chemistry** : Sampling, analysis and assay of metals, ores, fuel, metallurgical products, and minerals used in metallurgical processes, with reports thereon ; analysis of producer, other fuel gases, and furnace gases ; calorimetry of fuels ; the principles involved in the preparation of alloys ; practical knowledge of electrolytic methods, and of the construction and use of electrical furnaces and other apparatus employed in metallurgical investigations.

FINAL EXAMINATION.

Metallography : preparation of specimens, and recognition, under the microscope, of the characteristic structures of steel and common alloys, and of the typical structural changes produced on them by various forms of thermal and mechanical treatment. Pyrometry : calibration of pyrometers; determination of the temperatures of furnaces and the melting-points of metals and alloys; observation of critical changes in alloys, including steel.

- (c) **Physical Chemistry** : Candidates are expected to show special theoretical and practical knowledge of the methods, instruments and apparatus employed in physico-chemical processes and investigations.
- (d) **Organic Chemistry** : including ultimate organic analysis and the estimation of the proximate constituents of organic mixtures; the preparation and detailed investigation of organic compounds.
- *(e) **The Chemistry of Food and Drugs, and of Water** : including the examination and analysis of any food or drug within the scope of the Sale of Food and Drugs Acts; the assay of alkaloids; the recognition of poisonous chemicals and of crude drugs ordinarily found in commerce and having well-marked physical characters; the use of the microscope in the detection of adulterations, substitutions, commonly occurring parasites, and impurities in food, drugs, and water. Candidates in Branch (e) are required to show a general knowledge of the therapeutic effects of chemicals and

* Candidates desirous of becoming qualified as Public Analysts should take Branch (e) in the Final Examination. (See also p. 33.)

FINAL EXAMINATION.

drugs, and of the quantities which, taken internally, would be injurious or fatal to man. This part of the Examination will consist of practical work in Microscopy, a written paper in Therapeutics and Pharmacology, and an oral examination in the recognition of chemicals and drugs. Candidates will be required to produce duly authenticated note-books containing evidence of systematic instruction and practice in Microscopy. They will be expected to possess a general knowledge of the Acts relating to adulteration.

N.B.—After 1st January, 1909, all Candidates taking Branch (e) will be required to produce evidence of having taken a course in Elementary Botany, as defined on p. 17, in a recognised institution, and of having passed the Class Examinations.

†(f) **Biological Chemistry:** with special reference to fermentation and enzyme-action, the Chemistry and Bacteriology of food stuffs, water supply, and sewage disposal, and the application of Biological Chemistry to industries and manufactures.

N.B.—After the 1st of January, 1909, all Candidates taking Branch (f) will be required to produce evidence of having taken a course in Elementary Biology, as defined on p. 18, in a recognised institution, and of having passed the Class Examinations.

N.B.—After the 1st of January, 1910, Candidates for the Final Examination will be required to translate French and German technical literature into English, with the aid of dictionaries, to the satisfaction of the Examiners.

† Candidates intending to enter for the Final Examination in Branch (f), viz., Biological Chemistry, are recommended to take (after passing the Intermediate Examination, or any Examination qualifying for admission to the Final) the course of study mentioned on p. 32.

FELLOWSHIP.

2. During the practical examinations, Candidates are at liberty to consult books of reference, but not during any part of the examination conducted by the Examiner in Therapeutics, Pharmacology and Microscopy, in Branch (*e*).

3. Any Candidate is at liberty to present a thesis or dissertation upon any chemical subject to which he has given special attention, and the Examiners will take it into account in deciding the examination. The thesis must be forwarded not less than fourteen days prior to the first day of the examination, and must be accompanied by evidence as to whether the work has been carried out entirely by the Candidate, or conjointly with his professor, or with another student.

4. All Candidates must be familiar with the use of such scientific instruments as are commonly employed in chemical laboratories.

6.—THE FELLOWSHIP (F.I.C.).

1. Every Associate applying for admission to the Fellowship is required to produce evidence:—

(*a*) That he is not less than 24 years of age.

(*b*) That he has since his admission as an Associate, and for a period of three years therefrom been continuously engaged in the study and practice of Chemistry in a manner that shall be satisfactory to the Council.

2. Applications must be made to the Council, and must be accompanied by a letter of recommendation signed by some responsible person, preferably a Fellow of the Institute, testifying that the Candidate has fulfilled the foregoing conditions

BIOLOGICAL CHEMISTRY.

3. The Entrance Fee payable on election to the Fellowship is Five Guineas. No name can be transferred from the Associates' to the Fellows' list until this fee has been paid.

4. In exceptional cases non-Associates may be elected to the Fellowship. Every such Candidate is required to produce evidence of age, and a satisfactory certificate of moral character. He must also give full information as to his general and scientific education and professional career. It rests with the Council to determine in each case whether a Candidate applying for the Fellowship shall be exempted from passing any examination, or shall be required to pass either the Intermediate or Final Examination or both. If examination be imposed, or if the Candidate be exempted from passing any examination, the Examination Fee (£15 15s.) must be paid, in addition to the Entrance Fee (£5 5s.). If the Candidate be required to pass both the Intermediate and Final Examinations he shall pay £5 5s. for the Intermediate, and £10 10s. for the Final Examination.

7.—EXAMINATION IN BIOLOGICAL CHEMISTRY.

In view of the increasing application of biological methods to investigations connected with water supplies and sewage treatment, the Council consider it desirable to encourage professional chemists in the study of Bacteriology and Biological Chemistry.

Accordingly, the Council have resolved that Fellows and Associates of the Institute who desire to obtain a certificate of competency in this branch of work shall be allowed to take the Examination in Biological Chemistry. (See Branch (*f*) on p. 29.)

BIOLOGICAL CHEMISTRY.

While suited to those intending to practise their profession in its relation to the chemistry and bacteriology of water, sewage and effluents, the examination is also suited to those who are interested in the chemistry of Brewing and other industries involving both chemical and biological knowledge.

For Fellows and Associates, the fee for this examination is £5 5s.

Candidates will be required to produce evidence of having taken a course in Elementary Biology as defined on p. 18.

Candidates intending to enter for the Examination in Biological Chemistry are recommended to study the following subjects:—

1. Elementary biology.
2. The morphology, physiology, and life history of bacteria, yeasts and moulds, in their relation to food, water supply, the treatment of sewage, agriculture, and the fermentation industries. (A *special* study of pathogenic organisms is not demanded, but the Candidate should acquire a knowledge of such as are of importance in relation to food and water supply.) Practical work should include:—(a) general bacteriological methods and preparation of pure cultures; (b) microscopy: the staining and mounting of preparations, and the recognition of species; (c) fermentation changes caused by micro-organisms.
3. Enzymes and their actions.
4. Proteids and their decomposition products.
5. The methods employed in the examination and estimation of the carbohydrates.

QUALIFICATIONS FOR PUBLIC ANALYSTS.

8.—QUALIFICATIONS FOR PUBLIC ANALYSTS,
UNDER THE SALE OF FOOD AND DRUGS
ACTS.

It is open to any Fellow or Associate of the Institute who can produce evidence satisfactory to the Council that he has been continuously and systematically engaged, for at least one year, in the analysis of food and drugs in the laboratory of a Fellow of the Institute engaged in such practice, to make application for admission to the Examination in the Chemistry of Food and Drugs and of Water, provided he can also produce evidence of training in Elementary Botany (as defined on p. 17) and of systematic instruction and practice in Microscopy. (See Branch (*e*) of the Final Examination on p. 28.)

The examination is conducted on lines approved by the Local Government Board for England and Wales, and the Local Government Boards for Scotland and Ireland, who accept the Certificate of Fellowship or Associateship of the Institute of Chemistry, together with the certificate granted on passing this examination, as evidence that the holder is qualified for appointment as Public Analyst under the Sale of Food and Drugs Acts, 1875–1899.

That part of the examination which is conducted by the Examiner in Therapeutics, Pharmacology, and Microscopy may include:—The recognition of the official drugs of the British Pharmacopœia, and of such non-official drugs as are of therapeutical importance. The uses of the commoner drugs, and their prominent action as such. The commoner impurities and falsifications in drugs; their recognition, and how far such impurities affect the medicinal value of

GENERAL INSTRUCTIONS.

the drugs. The chemical changes which familiar drugs may undergo in the body, and their paths of excretion, as illustrated by the following examples:—arsenic, salts of lead, hydrocyanic acid, carbolic acid, chloral hydrate, salicin, aconitine. The reputed medicinal, deleterious and average fatal doses of such drugs as are poisonous, and the reputed effects of age, idiosyncrasy, and habituation in modifying these.

The Fee for this examination is Five Guineas (£5 5s.).

**9.—GENERAL INSTRUCTIONS TO CANDIDATES
FOR THE INTERMEDIATE AND FINAL
EXAMINATIONS.**

1. The Intermediate and Final Examinations are held each year in January, April and July, except the Final Examination in Biological Chemistry, which is held in October.

If, at the date of closing the list of Candidates for an examination, less than 35 have entered their names, the places will be allotted to the first 25 Candidates whose applications and fees are received. If there are more than 35 Candidates, a second examination will be held in the following week, but no examination period will extend over more than two weeks, and the Council cannot undertake to admit more than 25 Candidates in each week. Any remaining Candidates may be admitted to a subsequent examination.

GENERAL INSTRUCTIONS.

2. Forms of application for admission to examinations, which may be obtained from the Registrar, must be filled up and forwarded to the office of the Institute, and must be accompanied by the enclosures mentioned in these Regulations and referred to in the forms.

3. No name will be placed on the list of Candidates for examination unless the application and fee of the Candidate have been received at the office of the Institute on or before the date fixed for the closing of the list.

4. Due notice of examination will be given to each Candidate whose application has been accepted by the Council; but no notice will be forwarded to any Candidate who has not presented himself for examination within a period of two years from the date of the acceptance of his application, or of his failure at an examination.

5. The dates of the examinations will be published in daily newspapers and scientific journals.

6. Candidates who have failed in an examination are not required to fill in new forms of application for subsequent entry.

The list of names of successful Candidates will be sent, as soon as copies are available, to every Candidate and to every university, college, or school recognised by the Council, from which any Candidate has proceeded to the examination. It will also be circulated among the leading newspapers of the United Kingdom.

Unsuccessful Candidates will be informed of the subjects in which they have failed, as soon as possible after the publication of the pass list.

EXAMINATIONS IN CHEMICAL TECHNOLOGY.

10.—EXAMINATIONS IN CHEMICAL TECHNOLOGY.

1. Examinations are held in the industrial applications of chemistry, and certificates are granted to successful Candidates.

2. These Examinations are open only to Fellows, and to those Associates who have been registered as such for at least one year.

3. Any Fellow or Associate who desires to enter for the Examination in Chemical Technology is required to make application on a form obtained from the Registrar, to forward it to the Institute not less than two months prior to the date fixed for the commencement of the examination, and to mention one important branch of industry by which his knowledge of the subjects of the examination may be specially tested.

4. The conduct of these Examinations is under the control of a special Examinations Board, appointed annually by the Council.

5. The Board have the power to examine and to appoint additional Examiners as they think fit.

6. The Examinations are conducted in accordance with the scheme given below, and do not extend over more than four days.

7. The written part of the Examinations consists of at least two papers on the general principles of Chemical Technology, as indicated in the scheme, and includes questions on the calculation of working costs.

EXAMINATIONS IN CHEMICAL TECHNOLOGY.

8. In the oral part of the Examinations, Candidates are required to interpret drawings or models of plant and fittings, to show a general knowledge of the working of plant, and to have a competent knowledge of the methods of technical analysis as practised in the industries they have respectively selected.

9. Questions which might involve the disclosure of unpublished processes and details of plant in particular works will not be put.

10. Candidates will be required to produce evidence of practical technological training.

11. All Candidates will be expected to give evidence of a general knowledge of chemical technology.

12. The Examinations will comprise the following :—

- (a) The application of well-known chemical and physical laws to industrial operations.
- (b) The development, control, and transmission of power and heat.
- (c) A working knowledge of operations and plant, of which general use is made in industrial works for the treatment and handling of materials, finished products, waste products and effluents, including a practical acquaintance with fittings and stores.
- (d) The properties of materials affecting their application to the construction of plant and apparatus in chemical works.
- (e) Some ability in interpreting drawings of chemical plant and in making rough sketches.
- (f) The calculation of working costs, and a general knowledge of the clerical work connected with manufacturing operations.

LIST OF FEES.

Candidates are invited to send in records of original technical chemical work, to which the Examinations Board will give special consideration, but not so as to excuse the Candidates from any part of the Examination.

The Examination Fee is Three Guineas (£3 3s.) for each entry.

Except by special permission of the Board, a candidate who has failed shall not be allowed to enter again for the Examination until a year has elapsed.

11.—LIST OF FEES.

No application for the Fellowship, Studentship, or for admission to the examinations, will be considered by the Council unless it be accompanied by the fee payable according to the following schedule. If the application be declined the fee will be returned.

STUDENTSHIP.

	£	s.	d.
Registration Fee	0	5	0

EXAMINATIONS.

	£	s.	d.
Intermediate : for each entry	5	5	0
Final : Candidates who have passed the Intermediate : for each entry	5	5	0
Candidates exempted from passing the Intermediate : for the first entry	10	10	0
For each subsequent entry	5	5	0

LIST OF FEES.

EXAMINATIONS—*continued*.

Examination in the Chemistry of Food and Drugs, etc., for the certificate in Therapeutics, Pharmacology and Microscopy: for Fellows and Associates, each entry	...	5	5	0
Examination in Biological Chemistry: for Fellows and Associates, each entry	...	5	5	0
Examination for the Fellowship: for one Examination	... ..	15	15	0
(For Intermediate £5 5s., and Final £10 10s.)				
For each subsequent entry (each Examination)	... ..	5	5	0

When a Candidate who has signified his intention of presenting himself for an Examination withdraws his name, or fails to present himself at the Examination, the fee paid by him will not be returned, and it will rest with the Council to decide what fee, if any, he shall pay for a subsequent entry.

ANNUAL SUBSCRIPTION. £ s. d.

For Fellows and Associates	1	1	0
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ENTRANCE FEES TO THE FELLOWSHIP.

For Associates	5	5	0
For Candidates elected to the Fellowship after Examination	5	5	0
Candidates (not previously Associates) elected to the Fellowship without examination are required to pay the amount of the fee for examination for the Fellowship (£15 15s.), in addition to the Entrance Fee (£5 5s.) and Annual Subscription (£1 1s.)	... ..	22	1	0

LIST OF FEES.

LIFE COMPOSITION FEES IN LIEU OF ANNUAL
SUBSCRIPTION.

- (a) Fellows elected prior to the granting of the Charter (June, 1885), have the choice of compounding at £12 12s., or at the amount prescribed below according to age ;
- (b) Fellows elected prior to January 1st, 1890, have the choice of compounding at £14 14s., or at the amount prescribed below according to age ;
- (c) Fellows elected prior to January 1st, 1902, and Associates elected Fellows prior to December 31st, 1905, have the choice of compounding at £16 16s., or at the amount prescribed below according to age ;
- (d) Fellows (not previously Associates) elected after January 1st, 1902, and Fellows elected after December 31st, 1905, have the choice of compounding at £21, or at the amount prescribed below according to age ;

Between the ages of				£	s.	d.
50 and 52	...	...	...	12	12	0
52 „ 54	...	...	...	11	11	0
54 „ 56	...	...	...	10	10	0
56 „ 58	...	...	...	9	9	0
58 „ 60	...	...	...	8	8	0
60 „ 62	...	...	...	7	7	0
62 „ 64	...	...	...	6	6	0
64 „ over	...	...	...	5	5	0

* * Cheques and Post Office Orders (payable at the General Post Office) should be drawn to the order of the Institute of Chemistry, and crossed "London and Westminster Bank a/c The Institute of Chemistry."

UNIVERSITIES, COLLEGES, Etc.

12.—LIST OF UNIVERSITIES, COLLEGES AND INSTITUTIONS RECOGNISED FOR THE TRAINING OF CANDIDATES FOR THE EXAMINATIONS OF THE INSTITUTE OF CHEMISTRY.

Aberdeen	...	The University.
Aberystwyth	...	The University College of Wales.
Bangor	...	University College.
Belfast	...	Queen's College.
Birmingham	...	The University.
Bristol	...	Merchant Venturers' Technical College.
"	...	University College.
Cambridge	...	The University.
Cardiff	...	University College.
Cork	...	Queen's College.
Dublin	...	Royal College of Science for Ireland.
"	...	Trinity College.
Dundee	...	University College.
Edinburgh	...	The Heriot-Watt College.
"	...	The University.
Galway	...	Queen's College.
Glasgow	...	The University.
"	...	The Glasgow and West of Scotland Technical College.
Leeds	...	The University.
Liverpool	...	The University.
London	...	City and Guilds Institute, Central Institution.
"	...	City and Guilds Institute, Finsbury Technical College.
"	...	King's College.
"	...	Royal College of Science.

 UNIVERSITIES, COLLEGES, Etc.

London ...	...	*School of the Pharmaceutical Society of Great Britain.
" ...	...	University College.
Manchester	...	The Victoria University.
"	...	Municipal School of Technology (Faculty of Technology in the Victoria University).
Newcastle-on-Tyne		The Armstrong College.
Nottingham	...	University College.
Oxford ...	...	The University.
Sheffield ...	...	The University.
St. Andrews	...	The University.
Adelaide, South Australia ...	}	The University.
Montreal, Canada		McGill University.
Sydney, N.S.W....		The University.

 * For Chemistry only.

EXAMINATION PAPERS: 1906-7.**JULY, 1906.***Examiners in Chemistry:*

WALTER WILLIAM FISHER, M.A. (Oxon.), F.I.C.

GEORGE GERALD HENDERSON, M.A., D.Sc. (Glasgow), F.I.C.

*Examiner in Therapeutics, Pharmacology, and Microscopy:*FREDERICK GOWLAND HOPKINS, D.Sc., M.B. (Lond.), M.A. (Cantab.),
F.R.S., F.I.C.**Intermediate Examination.****GENERAL AND THEORETICAL CHEMISTRY.***TUESDAY, JULY 3rd, 1906: 10 a.m. to 1 p.m.*

(Four questions to be answered.)

1. How is mercury obtained on the industrial scale, and how can the commercial metal be purified? Give a full account of the uses to which mercury is put, and describe briefly its halogen compounds.

2. Describe the principal synthetic methods of preparing hydrocarbons of the paraffin and olefine series, giving an example of each method. Compare the properties of these compounds with those of the hydrocarbons of the benzene series.

3. Draw up a scheme for the detection and qualitative separation of the common metals in a solution of their salts without the employment of sulphuretted hydrogen.

4. Give as many examples as you can of the production of cyclic compounds from open chain compounds, indicating in each case the method of procedure.

5. Describe the modes of preparation and the properties of carbonyl, sulphuryl, nitrosyl, and phosphoryl chlorides. Give examples of the uses of these compounds in preparing and investigating organic substances.

6. State the laws governing the solubility of gases in liquids, and explain the methods by which the solubility of a gas can be determined.

One litre of a mixture of oxygen and carbon dioxide, in equal proportions by volume, is shaken in a closed vessel with one litre of water at 0° until equilibrium is established. The initial pressure is 760 mm. Calculate the final pressure and the composition of the residual gas. (Co-efficients of absorption at 0° , Oxygen = 0.04, carbon dioxide = 1.79.)

EXAMINATION PAPERS, 1906-7.

2 p.m. to 5 p.m.

(Four questions to be answered.)

1. Trace the several steps in the processes by which you could prepare urea from hydrocyanic acid, lactic acid from ethyl alcohol, *p*-toluidine from benzene, and *d*-glucose from formaldehyde.

2. From what source, and how, is cadmium obtained? Compare the properties of the compounds of cadmium with those of the corresponding compounds of zinc.

3. How can hypophosphorous, phosphorous, and orthophosphoric acids respectively be prepared from the element? Describe their properties and give their constitutional formulæ, stating clearly the grounds upon which each formula is assigned.

4. Give a full account of the properties and reactions of cellulose and of its principal derivatives, describing also the modes of preparation of the latter.

5. Describe in detail the methods of preparing azo, aminoazo, and hydroxyazo compounds, and illustrate the properties and uses of these substances by reference to members of each group.

6. Discuss as fully as time will permit the influence of temperature on chemical action, and state and criticise the "principle of maximum work."

PRACTICAL CHEMISTRY.

WEDNESDAY, JULY 4th, 1906 : 10 a.m. to 4.30 p.m.

1. Determine the quantities of ammonia and of hydrogen sulphide contained in one litre of the solution, A. The ammonia is to be determined by two methods. (Ammonium sulphide.)

2. Identify the substance, B, and prepare at least one derivative. (Sulphanilic acid, oxanilic acid, *p*-acetoluidide ; one to each candidate.)

THURSDAY, JULY 5th, 1906 : 10 a.m. to 4.30 p.m.

1. The solution, C, contains the sodium salts of two acids. Identify the acids and determine the quantity of one of them contained in one litre of the solution. (Solution containing sodium arsenate and phosphate.)

2. Make a full qualitative analysis of the mineral, D. (Apatite.)

FRIDAY, JULY 6th, 1906 : 10 a.m. to 4.30 p.m.

1. Prepare some silver chloride, and determine the solubility of the salt in $\frac{N}{5}$ ammonia solution at the temperature of the laboratory.

2. Demonstrate, as completely as you can, the chemical character of the compound, E, by preparing derivatives and decomposition products from it. (Hippuric acid.) Leave specimens of your preparations.

EXAMINATION PAPERS, 1906-7.

Final Examination for the Associateship.**Branch A.—Mineral Chemistry.***TUESDAY, JULY 3rd, 1906: 10 a.m. to 4.30 p.m.*

Determine the proportions of the chief constituents of the manganese ore, H. (Pyrolusite.)

Find the specific gravity of the specimen.

WEDNESDAY, JULY 4th, 1906: 10 a.m. to 4.30 p.m.

Make as complete an analysis as possible of the specimen of "white lead" powder, J. (Mixture of lead carbonate, lead sulphate, and barium sulphate.)

THURSDAY, JULY 5th, 1906: 10 a.m. to 4.30 p.m.

Identify the salt, K, and determine the percentage proportions and the molecular ratio of the base and the acid. (Calcium hypophosphite.)

FRIDAY, JULY 6th, 1906: 10 a.m. to 4.30 p.m.

Prepare a specimen of chromium oxychloride, and make an analysis of the compound.

No Candidate was examined in Branch B (Metallurgical Chemistry), or in Branch C (Physical Chemistry).

Branch D.—Organic Chemistry.*TUESDAY, JULY 3rd, 1906: 10 a.m. to 4.30 p.m.*

1. Determine the percentage of glycerol in the aqueous solution, P.

2. Ascertain what radicles are present in the substance, Q, and leave specimens of any derivatives obtained in the course of your work. (Guaiacol.)

WEDNESDAY, JULY 4th, 1906: 10 a.m. to 4.30 p.m.

1. Identify the salt, R, determine the percentage of the metallic constituent, and prepare a specimen of the acid. (Bismuth valerianate.)

2. From the *p*-toluidine supplied to you prepare a specimen of *p*-chlorotoluene.

THURSDAY, JULY 5th, 1906: 10 a.m. to 4.30 p.m.

Determine the percentage of nitrogen in the compound, X. Investigate fully the chemical character of the substance, and prepare from it as many other compounds as time will permit. (Naphthionic acid.)

FRIDAY, JULY 6th, 1906: 10 a.m. to 4.30 p.m.

1. Identify the compound, Y, determine the percentage of one of its constituent elements, and illustrate by experiment the uses to which it is put. (Benzene sulphonic chloride.)

2. Separate the ingredients of the mixture, Z, and ascertain approximately the proportions in which they are present. (Salicylic acid and resorcinol.)

EXAMINATION PAPERS, 1906-7.

Branch E.--The Analysis of Food and Drugs, and of Water.

MONDAY, JULY 2nd, 1906: 1.30 p.m. to 4.30 p.m.

1. Examine microscopically and report upon the sample of cocoa, A.
2. Identify four constituents of the suspended matter present in the water, B.
3. Identify the objects on the prepared slides, C, and D.
4. Give an account of the general physical properties, including the solubilities, of carbolic acid. Mention the pharmacopœial preparations of this substance, and give the strength in each case. State how you would detect its presence in the urine of a person who has taken a toxic dose.

5. State the composition and medicinal doses of the following; Pulvis cretæ aromaticus cum opio; tinctura camphoræ composita; tinctura nucis vomicæ; syrupus chloral; "Grey powder"; "Fowler's solution."

Candidates in this Branch were examined practically and interrogated orally as to the recognition of Chemicals and Drugs.

TUESDAY, JULY 3rd, 1906: 10 a.m. to 4.30 p.m.

Determine the fat, moisture, and total nitrogen (proteid) in the grated cheese, L. (Parmezan.)

Record the refractive index of the fat. Determine the ash and find the percentage of chlorine in the ash.

WEDNESDAY, JULY 4th, 1906: 10 a.m. to 4.30 p.m.

Identify the drugs, M, and N. Find the proportion of alkaloid in M, and ascertain whether the sample, N, agrees in composition with the formula of the British Pharmacopœia. (Caffeine and quinine salicylate; one to each candidate). (Hydrargyrum cum creta.)

Report on the chloroform, O. (Chloroform containing hydrochloric acid and alcohol.)

THURSDAY, JULY 5th, 1906: 10 a.m. to 4.30 p.m.

In the given samples of mineral manure make estimations of:—

The total phosphate as P_2O_5 and $Ca_3P_2O_8$ in the sample, P; the proportion of ammonia in Q; the percentage of sodium nitrate in R.

FRIDAY, JULY 6th, 1906: 10 a.m. to 4.30 p.m.

Examine the sample of water (recording the register number and particulars of origin) and report on its suitability for domestic use.

In addition to the other estimations, find the total hardness and determine the proportions of sulphates and carbonates.

EXAMINATION PAPERS, 1906-7.

OCTOBER, 1906.

EXAMINATIONS IN CHEMICAL TECHNOLOGY.**EXAMINATIONS BOARD (1906-07).***Chairman* : LUDWIG MOND, D.Sc., F.R.S.*Deputy-Chairman* : DAVID HOWARD, *Vice-President*.

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*Additional Examiners.**Gas Manufacture* : HAROLD G. COLMAN, Ph.D., M.Sc., F.I.C.*The Oils and Fats Industry* : JULIUS LEWKOWITSCH, M.A., Ph.D., F.I.C.

Steel Manufacture : { F. W. HARBORD, A.R.S.M., F.I.C.
 { JOHN E. STEAD, F.R.S., F.I.C.

EXAMINATIONS IN CHEMICAL TECHNOLOGY.

The first Examinations in Chemical Technology were held at the Institute from the 16th to the 18th of October, 1906. The Examinations were open only to Fellows, and to those Associates who had been registered as such for at least one year. Each Candidate was required to produce evidence of practical technological training, and to select one important industry, by which his knowledge of the subjects of the Examination might be tested. The Candidates who presented themselves on this occasion selected, respectively, Gas Manufacture, the Oils and Fats Industry, and Steel Manufacture. The papers given on the first day of the Examination referred to these industries.

First Day:—OCTOBER 16th, 1906.**GAS MANUFACTURE.**

10 a.m. to 1 p.m.

The Candidate was required to answer two questions only.

1. Discuss the construction of a setting of horizontal through retorts, indicating by sketches the essential points in design and construction, and describe fully the method of working, necessary to ensure good and even heating of the retorts, with simultaneous economy of fuel.

EXAMINATION PAPERS, 1906-7.

2. Describe the physical and chemical changes which take place during the process of condensation of coal-gas, including in this term the whole treatment of the gas from the time it leaves the retort until it enters the ammonia scrubber. Describe the impurities and the best means of carrying out such condensation in order (a) to remove all undesirable impurities to a maximum extent, and (b) to retain as far as desirable the vapours of low boiling hydrocarbons.

3. Describe and sketch the construction of a modern plant for the distillation of ammoniacal liquor and the manufacture of ammonium sulphate, including in the answer the approximate composition of and method of dealing with the waste liquor, waste gases, and "devil-liquor" to avoid nuisance arising from any of these sources. To what cause is the formation of "blue" sulphate due, and how may its production be avoided?

2 p.m. to 5 p.m.

The Candidate was required to answer two questions only.

4. Discuss the principles and practice of the determination of the illuminating and calorific power of purified illuminating gas, with especial reference in the former case to the conditions under which the gas must be burned to obtain a fair comparison of gases of different value. Describe the means you would adopt to carry out a complete analysis of purified gas, and also to determine the amount of impurities in crude gas.

5. Sketch and explain, without unnecessary detail, the general construction of the plant for the manufacture of (a) "blue" water-gas and (b) carburetted water-gas (not including condensers, purifiers, blowers, pumps, etc.). Describe the chemical and thermal changes taking place with regard to the water-gas reaction during the "blow" and the "run," and explain fully the manner in which you would carry out the manufacturing process, with your reasons for the procedure adopted.

6. Discuss the question of the most suitable quality of gas for supply, under present conditions, to a manufacturing town, having regard to the use of the gas for light, heat, and power, and the competition experienced from other sources. Give fully your reasons for the opinions expressed.

THE OILS AND FATS INDUSTRY.

10 a.m. to 1 p.m.

The Candidate was required to answer two questions only.

1. Explain the theory of saponification of oils and fats. Describe fully, with the aid of sketches, the different processes employed in practice, and point out their special advantages under given conditions.

2. Give an account of the various theories that have been propounded on the origin of petroleum. Discuss them fully, and state the views you would be inclined to adopt.

3. Describe generally the methods by which vegetable oils and fats are prepared on a large scale. Illustrate each process by sketches, choosing an oil or fat with which you are practically acquainted.

EXAMINATION PAPERS, 1906-7.

2 p.m. to 5 p.m.

The Candidate was required to answer two questions only.

4. Describe fully the physical and chemical characteristics of at least four kinds (species) of petroleum and explain by what means you would be able to identify these four species.

5. What general methods are employed for bleaching oils and fats in practice? Describe the chemical action of the bleaching agents employed, and illustrate each method of bleaching by a concrete example.

6. State the principles underlying the lubrication of running machinery? Enumerate the various lubricants employed in practice and point out their special merits and demerits.

STEEL MANUFACTURE.

10 a.m. to 1 p.m.

The Candidate was required to answer two questions only.

1. What do the following mentioned properties of blast furnace slag indicate?

- (a) Black and crystalline.
- (b) Black and vitreous.
- (c) Green.
- (d) Nearly white.
- (e) It crumbles to powder on cooling.

2. Explain why it is that the gases from a blast furnace contain the greater part of the carbon in the condition of carbon monoxide, and not as carbon dioxide.

Describe some favourable working conditions of a blast furnace for obtaining a maximum ratio of carbon dioxide to carbon monoxide in the gases.

Supposing that the air blown into a blast furnace were to be greatly enriched with oxygen, what advantage, if any, would there be? Explain the reasons for your conclusions.

3. When liquid pig iron containing $1\frac{1}{2}$ per cent. of silicon is blown in a Bessemer converter, practically all of the silicon is oxidised before the carbon is materially affected; if, however, the iron initially contains 4 per cent., sometimes 2 per cent. of silicon remains after the whole of the carbon is burnt out. Explain this.

2 p.m. to 5 p.m.

The Candidate was required to answer two questions only.

4. What furnace hearth lining would you select under the following metallurgical conditions of working, giving your reasons for the selection?

- (a) The slag must be basic and calcareous.
- (b) The slag must be basic and ferruginous.
- (c) The slag must be silicious.

5. Describe the properties of the "waste" gases from blast furnaces, and the uses to which these are put in practice. State what precautions you would take before utilising them in gas engines.

6. Explain, in detail, what occurs when steel of different grades passes gradually from the liquid to the solid state.

EXAMINATION PAPERS, 1906-7.

Second Day:—OCTOBER 17th, 1906.

Two Papers in General Chemical Technology were given.

GENERAL CHEMICAL TECHNOLOGY.

10 a.m. to 1 p.m.

The Candidate was not required to answer more than 4 questions, including question 7, which was compulsory.

1. What considerations, general and special, have to be borne in mind in selecting a site for a works? The answer is to be exemplified by an industry chosen by the Candidate, having regard to the handling of raw material and by-products, if any.

2. What are the general chemical considerations connected with the softening of water of different classes for boiler purposes?

What are the chemicals usually employed, and how are they respectively applied on the large scale?

How can the exhaust steam of an engine be utilised for softening water?

3. Steam has to be raised economically, using cheap, poor fuel. The fuel can equally well be burned under a boiler or used in a producer. What are the considerations which would lead you to adopt one or the other.

4. You have to transmit steam, of 75 lbs. pressure, through a pipe of $1\frac{1}{2}$ in. diameter, from the boiler house to a building at a distance of 600 ft. Describe how you would arrange it, and what precautions you would take.

5. State reasons for selecting any particular kind of firebrick for lining (a) a cement furnace, (b) a sulphite pulp boiler.

6. Enumerate the materials of which vessels are constructed for the concentration of sulphuric acid from the strength of chamber acid up to C.O.V. strength. Discuss their merits and demerits.

7. (*Compulsory*.) A wrought-iron boiler 20 ft. long, 6 ft. diameter, filled with a liquid of 1.8 sp. gr., is to be supported on brick pillars 5 ft. high in the open air. A 2 in. flanged tap is to be fixed at the bottom, and from it, by means of a 2 in. pipe, two tanks, standing respectively 20 ft. and 30 ft. away, one behind the other, are to be supplied permanently. The first tank is to hold 1 ton, and has a $\frac{1}{2}$ in. flanged tap on the top; the second one is to hold 3 tons, and has a $1\frac{1}{2}$ in. flanged tap on the top. Make simple sketches, with dimensions of the boiler with its pillars and foundations, the tanks and the pipe connections. Make a list of all the piping and all the fittings you would put on the boiler and tanks.

2 p.m. to 5 p.m.

The Candidate was not required to answer more than 4 questions, including question 13, which was compulsory.

8. Describe any process in commercial use for the manufacture of alkali and bleach electrolytically.

EXAMINATION PAPERS, 1906-7.

9. Describe the rationale of a refrigerating plant, and illustrate your answer by reference to the respective employment of any of the following:—Ammonia, ether, air, sulphurous acid, carbonic acid.

How would you apply the cold produced by an efficient refrigerating plant to the cooling below zero C. of chemical solutions requiring such treatment upon the large scale?

10. A substance whose melting point is 60° C., but which cannot be heated above 130° C. without decomposition, has to be filtered on a large scale. Make a sketch of a simple warm filter, and write out your instructions for the fitter and a list of materials required. The means of heating are left to your choice. The substance does not attack metals.

11. What are the ordinary impurities of commercial pig lead, and in what quantity are they commonly present? What specification would you adopt for lead (a) for accumulators, (b) for sulphuric acid chambers?

12. A hydraulic accumulator with a 9 in. ram is acted upon by a 2 in. pump. The accumulator is weighted with 5,000 lbs. all told. It acts upon a hydraulic press having a ram of 24 in. diameter. The table of the press carries 6 square dies for pressing cakes of 4 in. \times 3 in. What is the pressure per square inch acting on the cakes? Suppose you had to make another press, exerting double the amount of pressure on the same number of cakes, what means would you employ to obtain it (a) when the number of cakes per hour is not specified, (b) when the same number of cakes should be pressed per hour.

13. (*Compulsory.*) 50 per cent. pyrites cost $4\frac{1}{2}$ d. per unit. The efficiency of a certain vitriol chamber plant is 296 lbs. of H_2SO_4 per 100 lbs. of sulphur charged. It produces in 24 hours, 28 tons of chamber acid containing 76 per cent. H_2SO_4 . The consumption of HNO_3 is 1.0 lb. for 100 lbs. of H_2SO_4 , nitric acid of 55 per cent. HNO_3 , costing £12 per ton, being used. The consumption of fuel for steam and power is 3 tons per day at 7/- per ton. There are 6 men and 1 foreman employed night and day, their wages being 4/- for labourers, and 6/- for the foreman. Repairs and renewals amount to £2 per day. A sum of £3 3s. is to be set aside per day for the sinking fund. For general expenses an amount equal to the sum of the wages is assumed. Make an account showing the cost per ton of monohydrate, and per ton of chamber acid, and also for each item separately per ton of chamber acid.

Third Day:—OCTOBER 18th, 1906.

Each Candidate was examined *vivâ voce* by the Board with the assistance of the Additional Examiners. Questions were put on general chemical technology and on the technology of the industry selected by the Candidate. This part of the Examinations included the interpretation of plans of plant and machinery.

EXAMINATION PAPERS, 1906-7.

OCTOBER, 1906.

Final Examination for the Associateship,

In the Branch of Biological Chemistry.

Examiner in Biological Chemistry:

ARTHUR HARDEN, D.Sc. (Vict.), Ph.D. (Erlangen), F.I.C.

Examiners in Chemistry:

WALTER WILLIAM FISHER, M.A. (Oxon.), F.I.C.

GEORGE GERALD HENDERSON, M.A., D.Sc. (Glasgow), F.I.C.

TUESDAY, OCTOBER 23rd, 1906: 10 a.m. to 4.30 p.m.

1. Determine the carbolic co-efficient of the sample of disinfectant supplied. Use the culture of *B. Coli Communis* provided and incubate the experimental tubes for 24 hours.

2. Make a chemical and bacteriological examination of the sample of water and report on its quality as a drinking water.

The necessary concluding work may be continued during the following days of the examination, but the Candidate must describe in his notes to-day what he proposes to do to complete the exercises.

WEDNESDAY, OCTOBER 24th, 1906: 10 a.m. to 4.30 p.m.

1. Examine the material supplied for the enzymes lipase and diastase, making your experiments, as far as possible, quantitative. (Castor Oil seeds.)

2. Examine the organism of which a pure culture is supplied and report on its general character. Make experiments with the object of ascertaining the chief chemical functions of the organism. Leave any stained preparations of it which you may make for the inspection of the Examiner. (*Bacillus Mesentericus Vulgatus*.)

The necessary concluding work may be continued during the following days of the examination, but the Candidate must describe in his notes to-day what he proposes to do to complete the exercises.

THURSDAY, OCTOBER 25th, 1906: 10 a.m. to 4.30 p.m.

Estimate the total nitrogen and the nitrogen as protein in the solution given. Ascertain, as far as possible, the nature of the protein material which is present. (A solution of albumoses containing an ammonium salt.)

This work may be concluded to-morrow, but the Candidate must describe in his notes to-day what he proposes to do.

FRIDAY, OCTOBER 26th, 1906: 10 a.m. to 4.30 p.m.

Prepare 500 c.c. of nutrient gelatine of reaction + 10.

EXAMINATION PAPERS, 1906-7.

JANUARY, 1907.

Examiners in Chemistry:

WALTER WILLIAM FISHER, M.A. (Oxon.), F.I.C.

GEORGE GERALD HENDERSON, M.A., D.Sc. (Glasgow), F.I.C.

*Examiner in Therapeutics, Pharmacology and Microscopy:*FREDERICK GOWLAND HOPKINS, D.Sc., M.B. (Lond.), M.A. (Cantab.),
F.R.S., F.I.C.

Intermediate Examination.

GENERAL AND THEORETICAL CHEMISTRY.

TUESDAY, JANUARY 1st, 1907: 10 a.m. to 1 p.m.

(Four questions to be answered.)

1. State the principal chemical changes which take place in the blast furnace. How can pure iron be obtained, and how are its properties affected by the presence of carbon, silicon, sulphur, and phosphorus respectively? Give some account of recent investigations on the rusting of iron.

2. Give an account of the method of preparation and the properties of ozone, and state fully the grounds upon which the formula O_3 is assigned to it. How can the presence of ozone in air be detected, and how would you determine quantitatively the percentage of ozone in a mixture of oxygen and that substance?

3. From what sources, and how, is selenium obtained? Tabulate the resemblances and differences between sulphur and selenium, and between their principal compounds.

4. Describe the methods of obtaining the alkali hyponitrites, hypsulphites, and hypophosphites, and the respective acids. What are the characteristic properties of these substances, and for what purposes are they used? Give the constitutional formulæ of the acids and show how they have been determined.

5. How would you propose to purify a specimen of cobaltous oxide which contains a small admixture of nickelous oxide? Point out the chief differences in chemical character between nickel and cobalt as illustrated by their compounds.

6. Describe the methods of determining (1) the extent of dissociation of a compound in the gaseous state, (2) the extent of ionisation of an electrolyte in aqueous solution, and (3) the extent of hydrolysis of a salt in aqueous solution.

2 p.m. to 5 p.m.

(Four questions to be answered.)

1. Describe in detail the preparation of lactic acid by the fermentation process, and indicate the possible synthetic methods of obtaining it. What is the behaviour of the acid when heated alone, and when heated with sulphuric, hydrobromic, and hydriodic acids respectively? How can the inactive acid be resolved into its optically active components?

EXAMINATION PAPERS, 1906-7.

2. From what natural sources can (1) benzyl alcohol, and (2) the cresols be obtained, and by what methods can they be prepared from toluene? Make a full comparison of the properties and reactions of these compounds. How could you obtain benzene from each of them?

3. Describe the methods of preparing nitro compounds, amino acids and sulphonic acids of the fatty series, and compare the chemical character of each group with that of the corresponding group of aromatic compounds.

4. Give examples of the uses of sodium, sodamide, sodium ethoxide, and magnesium ethyl iodide, in the synthesis or investigation of organic substances. How are the three latter compounds prepared, and what are their properties?

5. How are benzoquinone, α -naphthaquinone, and anthraquinone respectively prepared? Give a full account of the chemical character of these compounds, and show how the constitutional formula of each has been established.

6. Give a detailed description of the methods of determining the relative strengths of acids, and summarise the principal results which have been obtained.

PRACTICAL CHEMISTRY.

WEDNESDAY, JANUARY 2nd, 1907: 10 a.m. to 4.30 p.m.

1. Identify the salt, A, and determine the proportion of each constituent radicle. (Manganous oxalate.)

2. Determine the solubility of the salt in water at 20° and at 100°.

THURSDAY, JANUARY 3rd, 1907: 10 a.m. to 4.30 p.m.

1. The solution, B, contains grape sugar and cane sugar. Determine polarimetrically the quantity of each contained in 1 litre of the solution.

2. Make a full qualitative analysis of the mineral, C. (Muscovite.)

FRIDAY, JANUARY 4th, 1907: 10 a.m. to 4.30 p.m.

1. Determine the proportion of (1) magnesium oxide and of (2) magnesium peroxide in the powder, D.

2. Identify the compound, E, and prepare two derivatives. (Resorcinol, hydroquinone, β -naphthol; one to each candidate.)

Final Examination for the Associateship.

Branch A.—Mineral Chemistry.

TUESDAY & WEDNESDAY, JANUARY 8th and 9th, 1907:
10 a.m. to 4.30 p.m.

1. Determine the amount of arsenic in the arsenical pyrites.

2. Make a quantitative analysis of the limestone. The alkalis need not be estimated.

(This exercise can be completed to-morrow.)

EXAMINATION PAPERS, 1906-7.

THURSDAY, JANUARY 10th, 1907: 10 a.m. to 4.30 p.m.

1. Make a qualitative and quantitative analysis of the given compound (Sodium hydrosulphite.)
2. Give some account of its character and reactions.

FRIDAY, JANUARY 11th, 1907: 10 a.m. to 4.30 p.m.

1. Find the percentage composition of the given compound and determine the molecular ratio of the constituents. (Iodine monobromide.)
2. Identify the given mineral. (Scheelite.)

Branch B.—Metallurgical Chemistry.

(At the ROYAL COLLEGE OF SCIENCE, LONDON.)

TUESDAY, JANUARY 1st, 1907: 10 a.m. to 4.30 p.m.

Determine the gold and silver contents of the given complex ore ;
or,
Calibrate a thermo-couple pyrometer.

WEDNESDAY, JANUARY 2nd, 1907: 10 a.m. to 4.30 p.m.

Estimate the iron and chromium in the given sample of ferro-chrome ;
or,
Prepare a high and low power photomicrograph from the given sample of steel, and report on the final heat treatment it has received.

THURSDAY, JANUARY 3rd, 1907: 10 a.m. to 4.30 p.m.

Make an examination of the given sample of coal and state for what purposes it is suitable.
(Phosphorus need not be determined as it is not present in injurious quantities.)

(At the INSTITUTE.)

FRIDAY, January 4th, 1907: 10 a.m. to 4.30 p.m.

Make a complete analysis of the given alloy. (Copper and nickel.)

No Candidate was examined in Branch C (Physical Chemistry).

Branch D.—Organic Chemistry.

TUESDAY, JANUARY 1st, 1907: 10 a.m. to 4.30 p.m.

1. The aqueous solution, G, contains two compounds. Identify them, and determine approximately the quantity of each contained in 1 litre of the solution. (Sodium phenoxide and sodium salicylate.)
2. Determine the percentage of halogen in the compound, H. Use a method which does not involve the use of sealed tubes. (Monobromocamphor.)

EXAMINATION PAPERS, 1906-7.

WEDNESDAY, JANUARY 2nd, 1907: 10 a.m. to 4.30 p.m.

1. Determine the percentage of methoxyl in the compound, I. (Anisol.)
2. Ascertain what radicles are present in the substance K, and leave specimens of any derivatives obtained in the course of your work. (Methyl-acetanilide.)

THURSDAY, JANUARY 3rd, 1907: 10 a.m. to 4.30 p.m.

1. From the olive oil supplied, prepare specimens of (a) lead oleate, and (b) elaidic acid.
2. Determine the percentage of lead in the salt which you have prepared.

FRIDAY, JANUARY 4th, 1907: 10 a.m. to 4.30 p.m.

1. Determine, by the cryoscopic method, the molecular weight of the substance, L. (Phthalimide.)
2. Identify the substance, and *after submitting a scheme of work to the Examiners*, demonstrate its character and reactions as fully as you can.

Branch E.—The Analysis of Food and Drugs, and of Water.

MONDAY, JANUARY 7th, 1907: 1.30 p.m. to 4.30 p.m.

1. Examine microscopically and report upon the sample of rhubarb "A."
2. Examine microscopically the sample of ground rice, "B." Identify, if possible, any abnormal material which may be present, and leave upon your bench any preparation which may have led to your conclusions with regard to it.
3. Identify, by microscopical examination alone, the crystals which have separated from the sample of urine, "C."
4. Give a list of the official preparations of nux vomica and state the medicinal dose of each. Discuss in connection with this drug, and also with reference to digitalis, the relative gain to pharmacology which has followed from the separation and use of pure active principles.
5. Discuss, briefly and without detail, the practical uses of chloral hydrate. What evidence might be obtained on chemical analysis of the urine to show that chloral hydrate had been taken in a given case?

Candidates in this Branch were examined practically and interrogated orally as to the recognition of Chemicals and Drugs.

TUESDAY, JANUARY 8th, 1907: 10 a.m. to 4.30 p.m.

1. Find the molecular weight of the given acid by an analysis of the silver or barium salt; and by a neutralization method. (Palmitic acid.)
2. Determine its melting point.

EXAMINATION PAPERS, 1906-7.

WEDNESDAY, JANUARY 9th, 1907 : 10 a.m. to 4.30 p.m.

1. Report on the composition of the ammoniated tincture of quinine, and state whether it agrees with the formula of the B.P.
2. Identify the alkaloid in the given solution. (Brucine, atropine ; one to each Candidate.)
3. Determine the percentage of iodine in the preparation of iodoform ; and the amounts of the constituents in the mixture.

THURSDAY, JANUARY 10th, 1907 : 10 a.m. to 4.30 p.m.

1. In the sample of brewing sugar determine the moisture, ash, optical rotation and copper reducing power.
2. Find the alcoholic strength of the liqueur, and determine the total acidity and the acidity of the distillate. (Sloe gin.)

FRIDAY, JANUARY 11th, 1907 : 10 a.m. to 4.30 p.m.

1. Make a quantitative analysis of the boiler crust.
2. Ascertain the nature and amount of poison in the given liquid Potassium cyanide, oxalic acid ; one to each Candidate.)

APRIL, 1907.

BOARD OF EXAMINERS.

Chairman : Percy Faraday Frankland, LL.D., F.R.S., *President*.

For the Intermediate Examination :

Bertram Blount, F.I.C.

George Gerald Henderson, M.A., D.Sc. (Glasgow), F.I.C.

For the Final Examination :

- | | |
|---------------------------------------------------------------|--------------------------------------------------------------------------------------|
| (a) Mineral Chemistry ... | Bertram Blount, F.I.C. |
| (b) Metallurgical Chemistry ... | Frank William Harbord, A.R.S.M.,
F.I.C. |
| (c) Physical Chemistry ... | Thomas Slater Price, D.Sc. (Lond. and
Birm.), Ph.D. (Leipzig), F.I.C. |
| (d) Organic Chemistry ... | George Gerald Henderson, M.A., D.Sc.
(Glasgow), F.I.C. |
| (e) Analysis of Food and
Drugs, and of Water | Cecil Howard Cribb, B.Sc. (Lond.),
F.I.C. |
| (f) Biological Chemistry ... | Arthur Harden, D.Sc. (Vict.), Ph.D.
(Erlangen), F.I.C. |
| (i.p.m.) Therapeutics, Phar-
macology, and Micros-
copy | Frederick Gowland Hopkins, D.Sc.,
M.B. (Lond.), M.A. (Cantab.), F.I.C.,
F.R.S. |

EXAMINATION PAPERS, 1906-7.

Intermediate Examination.

GENERAL AND THEORETICAL CHEMISTRY.

TUESDAY, APRIL 9th, 1907: 10 a.m. to 1 p.m.

(Four questions to be answered.)

1. What are the chief substances present in caliche (Chili saltpetre earth) other than sodium nitrate. Which of these substances is industrially prepared; what is the method of preparation, and for what purposes is the substance used?

2. Contrast and compare sulphur and tellurium and the most characteristic compounds of these elements. Mention a commercial source of tellurium, and state why the atomic weight of that element, as experimentally determined, has been disputed.

3. Describe all the metallic hydrides with which you are acquainted, and state how they are prepared.

4. A solution of lead nitrate acidified with nitric acid is electrolysed between platinum electrodes. Describe the reactions which occur in the electrolyte and state the composition of any deposit which may form on either electrode.

5. What are the principles which underlie the various methods of molecular weight determination?

6. Name the principal ore of tin, and state how the metal is extracted and purified. Compare and contrast the oxides, and also the sulphides, of silicon, tin, and lead.

2 p.m. to 5 p.m.

(Four questions to be answered.)

1. From what sources, and by what methods, is starch usually obtained? How can glucose, maltose, and dextrin respectively be obtained from starch? Describe the properties of these substances, and the reactions by which they can be distinguished from each other.

2. What is the nature of the substances included in the uric acid group? Give an account of the occurrence and properties of the more important of these compounds, and show how the constitution of any one of them has been established.

3. How is naphthalene obtained on the manufacturing scale, and how can the naphthylamines and the naphthols be prepared from it? State the principal properties of naphthalene, and indicate the methods by which its constitution has been determined.

4. By what methods can phthalic acid be obtained, and how can it be distinguished from its isomerides? Give a full account of the properties and uses of the acid and of its principal derivatives.

5. Describe the chief source of glycerol, and the methods of obtaining and purifying it. How can it be proved that glycerol is a saturated trihydric alcohol? For what purposes is it chiefly used in manufactures and in the laboratory?

EXAMINATION PAPERS, 1906-7.

6. Is there a natural, as distinct from a practical, limitation to the temperature attainable by the combustion of carbon in oxygen? Give full reasons for your answer, and state which (if any) of these reasons limit the temperature of the electric furnace.

PRACTICAL CHEMISTRY.

WEDNESDAY, APRIL 10th, 1907: 10 a.m. to 4.30 p.m.

1. Determine the strontia and sulphuric anhydride in the given substance. (Celestine containing silica.)

THURSDAY, APRIL 11th, 1907: 10 a.m. to 4.30 p.m.

1. Determine the quantity of material, other than water, contained in 1 litre of the solution, B. (Hydrogen peroxide.)

2. Identify the ingredients of the mixture, C. (Cane sugar, benzoic acid, and ferric phosphate; cane sugar, salicylic acid, and aluminium phosphate. One mixture to each candidate.)

FRIDAY, APRIL 12th, 1907: 10 a.m. to 4.30 p.m.

1. Investigate the nature and constitution of the compound, D, and prepare two crystalline decomposition products. (Hippuric acid.)

2. Determine the specific gravity of the sample of coal (*a*) in lump, and (*b*) in powder.

Final Examinations for the Associateship.

Branch A.—Mineral Chemistry.

TUESDAY and WEDNESDAY, APRIL 9th and 10th, 1907:
10 a.m. to 4.30 p.m.

1. Determine the percentage of arsenic in the sample of commercial copper.

(This exercise to be finished on the first day.)

2. Analyse the sample of bauxite determining insoluble siliceous matter, soluble silica, alumina, ferric oxide and titanate acid.

THURSDAY and FRIDAY, APRIL 11th and 12th, 1907:
10 a.m. to 4.30 p.m.

1. Analyse the water, as fully as time permits, and report on its suitability for boiler use.

(This exercise to be completed to-day.)

2. Analyse the sample of red oxide ground in oil, determining the iron by a volumetric method.

EXAMINATION PAPERS, 1906-7.

Branch B.—Metallurgical Chemistry.

(At the ROYAL COLLEGE OF SCIENCE, LONDON.)

TUESDAY and WEDNESDAY, APRIL 9th and 10th, 1907 :
10 a.m. to 4.30 p.m.

1. Determine the percentage of tin and tungsten in the given sample of tin ore,

or,

Take a cooling curve of the given alloy, and determine its melting point. *(If this exercise be chosen, it must be finished on the first day.)*

2. Examine the given sample of manganese ore and report as to its suitability for the manufacture of 80 per cent. of ferro-manganese,

or,

Examine microscopically the two samples of steel submitted to you and describe in detail their structure; report as to the heat treatment each sample has received, and prepare a high and low power photo-micrograph of No. 2.

THURSDAY and FRIDAY, APRIL 11th and 12th, 1907 :
10 a.m. to 4.30 p.m.

1. Determine the percentage of phosphorus and of copper in the given alloy.

2. Determine the percentage of nickel and manganese in the given sample of steel.

No Candidate was examined in Branch C (Physical Chemistry).

Branch D.—Organic Chemistry.

TUESDAY, APRIL 9th, 1907: 10 a.m. to 4.30 p.m.

1. Identify the radicles present in the compound, W, and make a quantitative estimation of one of them. *(Para-nitroacetanilide.)*

2. Prepare specimens of derivatives or decomposition products of the substance.

WEDNESDAY, APRIL 10th, 1907: 10 a.m. to 4.30 p.m.

Estimate the percentage of sodium nitrite in the sample provided. With the sodium nitrite diazotise the amino compound, X, and prepare specimens of the corresponding hydroxy compound and of its tribromo derivative. Take the melting points of your products. *(Para-toluidine.)*

THURSDAY, APRIL 11th, 1907: 10 a.m. to 4.30 p.m.

Determine the molecular weight of the acid, Y, by analysis of its silver salt. Investigate the constitution of the acid as fully as time will permit, and leave specimens of any derivatives obtained in the course of your work. *(Malic acid.)*

FRIDAY, APRIL 12th, 1907: 10 a.m. to 4.30 p.m.

Determine as completely as possible the physical constants of the ester, Z. *(Ethyl tartrate.)*

Investigate the action of ammonia on the ester under different conditions.

EXAMINATION PAPERS, 1906-7.

Branch E.—The Analysis of Food and Drugs, and of Water.*MONDAY, APRIL 8th, 1907: 1.30 p.m. to 4.30 p.m.***THERAPEUTICS, PHARMACOLOGY AND MICROSCOPY.**

1. Examine microscopically, and report upon, the suspended matter present in the effluent, A.
2. Determine, by microscopical examination, the probable nature of the fibre in the samples of paper marked B, C, and D.
3. From the dried blood-stains on the cloth, E, prepare slides of a crystalline hæmoglobin derivative which will serve for microscopic identification of the stains.
4. Mention the nature of the active principles present, respectively, in the roots of *Ipecacuanha*, *Rhubarb*, *Aconite*, and *Podophyllin*; and in the leaves of *Stramonium*, *Senna*, *Laurocerasus*, and *Hyoscyamus*.
5. Give the strength and full medicinal dose of the following: *Infusum digitalis*, *Infusum ergotæ*; *Tinctura nucis vomicæ*, *Tinctura opii ammoniata*, *Tinctura camphoræ composita*; *Syrupus scillæ*, and *Syrupus Chloral*.
6. Write a short account of alcohol with reference to its use as a drug, its claims as a food, and its effects as a chronic poison.

*Oral and practical Examination in the recognition of Chemicals and Drugs.**TUESDAY, APRIL 9th, 1907: 10 a.m. to 4.30 p.m.*

1. Examine the sample of water (as fully as time permits) with a view to forming an opinion as to the source from which it is most likely to have been derived. (Water from stagnant pond.)
2. Examine the sample of butter fat and report as to its purity.

WEDNESDAY, APRIL 10th, 1907: 10 a.m. to 4.30 p.m.

1. Examine and report on the sample of olive oil
(*This exercise to be completed to-morrow. The Candidate must state in his note-book what further work he proposes to undertake.*)
2. Determine the proportion of copper in the sample of peas.

THURSDAY, APRIL 11th, 1907: 10 a.m. to 4.30 p.m.

1. Complete the examination of the oil.
2. Examine the sample of pepper and report on the official form supplied. *Write the details of work in the note-book.*

FRIDAY, APRIL 12th, 1907: 10 a.m. to 4.30 p.m.

1. Estimate the boric acid in the sample of cream.
2. Ascertain the organic poison in the sample of wine. (*Chloral hydrate.*)
3. Identify the three drugs. (*Ferrum redactum*, *bismuth salicylate*, *antimonium nigrum purif.*)

EXAMINATION PAPERS, 1906-7.

JULY, 1907.

BOARD OF EXAMINERS.

(As on page 57.)

The Intermediate Examination held at Glasgow from July 2nd to 5th, 1907, was conducted under the superintendence of Professor John Millar Thomson, LL.D., F.R.S., F.I.C.

Intermediate Examination.

(LONDON AND GLASGOW.)

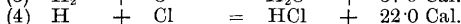
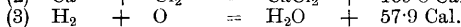
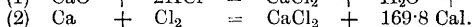
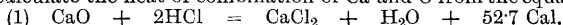
GENERAL AND THEORETICAL CHEMISTRY.

TUESDAY, JULY 2nd, 1907: 10 a.m. to 1 p.m.

(Four questions to be answered.)

1. Give the formula of every "per" acid which you know and of a salt of each acid, indicating modes of preparation and properties in each case.

2. Calculate the heat of combination of Ca and O from the equations:



Mention a condition which must be identical in equations (1) and (3) in order that the calculation may give a correct result.

3. How is fluorine prepared? In what chemical characteristics does it differ from other members of the halogen group?

4. What is the ordinary source of cadmium? Compare its chemical and physical properties with those of lead and zinc.

5. Mention any substances which can be obtained in the electric (not electrolytic) furnace and by no other means. What are the characteristics which these substances have in common?

6. What reactions take place when a solution of sodium chloride is electrolysed between unattackable electrodes (a) with and (b) without a diaphragm. In the latter case, what effect (if any) is due to the temperature of the electrolyte? Give equations, as far as possible.

2 p.m. to 5 p.m.

(Four questions to be answered.)

1. State the principal methods of preparing amines of both the fatty and the aromatic series. Describe the actions of nitrous acid on those compounds, or their salts, and indicate the uses of the products thus obtained from primary aromatic amines.

EXAMINATION PAPERS, 1906-7.

2. Describe the characteristic properties of beryllium and its compounds, and compare and contrast these with the corresponding compounds of aluminium.

3. From what natural sources can cinnamic acid be obtained, and how is it prepared synthetically? Explain fully how you would proceed to elucidate the constitution of the acid. Trace the steps in the process by which cinnamic acid can be converted into indigotin.

4. Describe the various applications of the chlorides of phosphorus, aluminium, iron, and tin respectively in the preparation or investigation of carbon compounds.

5. Give a full description of the principal fermentation processes which are of technical importance for the preparation of organic substances.

6. Write a brief account (*a*) of the principal methods of liquefying refractory gases, stating clearly the principles upon which they are based, and (*b*) of the investigations which have been made on chemical action at low temperatures.

PRACTICAL CHEMISTRY.

WEDNESDAY, JULY 3rd, 1907: 10 *a.m.* to 4.30 *p.m.*

1. Determine the total chlorine and the free hydrochloric acid in the sample, A, which is a solution of sodium chloride in dilute hydrochloric acid.

2. Fully identify the given compound, B, and leave a purified specimen of at least one derivative obtained in the course of the investigation. (Ethyl benzoate, ethyl succinate, methyl salicylate; one to each candidate.)

THURSDAY, JULY 4th, 1907: 10 *a.m.* to 4.30 *p.m.*

1. Determine the percentage of nitrogen in the given compound by Kjeldahl's process. Investigate the manner in which the nitrogen is combined, and leave specimens of any derivatives which you can obtain. (Oxamide, oxanilide, oxamethane; one to each candidate.)

2. Identify by the spectroscope the two metals in the given mixture. (Lithium and calcium carbonates, lithium and strontium carbonates, lithium and barium carbonates; one to each candidate.)

FRIDAY, JULY 5th, 1907: 10 *a.m.* to 4.30 *p.m.*

1. Make a complete qualitative analysis of the given alloy. (Copper, lead, tin, and nickel.)

2. Estimate the weight of copper in 100 c.c. of the given solution: (i.) by a gravimetric method, and (ii.) volumetrically, by the thiosulphate method.

Final Examinations for the Associateship.

Branch A.—Mineral Chemistry.

TUESDAY, JULY 9th, 1907: 10 *a.m.* to 4.30 *p.m.*

Analyse the sample of carborundum.

EXAMINATION PAPERS, 1906-7.

WEDNESDAY, JULY 10th, 1907: 10 a.m. to 4.30 p.m.

From the lead nitrate provided, prepare specimens of (a) pure oxygen, (b) pure nitrogen peroxide, and (c) pure nitrogen.

THURSDAY, JULY 11th, 1907: 10 a.m. to 4.30 p.m.

Determine the silica and lead oxide in the sample of glass.

FRIDAY, JULY 12th, 1907: 10 a.m. to 4.30 p.m.

Determine the phosphorus in the sample of phosphor tin.

Branch B.—Metallurgical Chemistry.

(At the ROYAL COLLEGE OF SCIENCE, LONDON.)

TUESDAY and WEDNESDAY, JULY 9th and 10th, 1907:

10 a.m. to 4.30 p.m.

1. Determine the percentage of copper and silver in the given sample of copper antimony silver ore.

or,

Take a cooling curve of the given alloy and determine its solidifying point. (*If this exercise be chosen it must be finished on the first day.*)

2. Examine and report upon the sample of pig iron submitted to you with reference to its suitability for manufacture of steel in the acid open hearth process.

THURSDAY and FRIDAY, JULY 11th and 12th, 1907:

10 a.m. to 4.30 p.m.

1. Examine and report upon the sample of coal submitted to you as to its suitability for the manufacture of coke for blast furnace purposes.

2. Determine the percentage of tin, antimony, and copper in the given sample of white metal,

or,

Examine microscopically the samples of copper tin alloy, and steel submitted to you, and describe in detail their structure. Heat the sample of steel for 20 minutes at a temperature of 780°C. , and cool slowly. Prepare a low and high power photomicrograph of the steel after heating and slow cooling.

No Candidate was examined in Branch C (Physical Chemistry).

Branch D.—Organic Chemistry.

TUESDAY, JULY 9th, 1907: 10 a.m. to 4.30 p.m.

1. Determine by Kjeldahl's process the percentage of nitrogen in the given substance. (Succinimide.)

2. Investigate the character of the substance as fully as possible, and prepare specimens of at least two crystalline derivatives.

EXAMINATION PAPERS, 1906-7.

WEDNESDAY, JULY 10th, 1907: 10 a.m. to 4.30 p.m.

1. Examine the methyl alcohol, A, determine the proportion of any impurity found, and prepare a specimen of the pure alcohol.
2. Identify the ingredients of the mixture, B, and ascertain approximately the proportions in which they are present. (Methyl oxalate and oxanilide.)

THURSDAY, JULY 11th, 1907: 10 a.m. to 4.30 p.m.

1. Prepare from the given salt a specimen of its base, and determine its solubility in water at 100°.
2. Prepare from the base specimens of characteristic derivatives, other than salts.
3. Identify the salt, and estimate the percentage of the acid radicle. (Benzidine sulphate.)

FRIDAY, JULY 12th, 1907: 10 a.m. to 4.30 p.m.

1. Determine, by the cryoscopic method, the molecular weight of the given substance. (Amygdalin.)
2. Investigate the substance as fully as time will permit. Leave on your bench specimens of any products which you obtain.

Branch "E."—The Analysis of Food and Drugs, and of Water.

MONDAY, JULY 1st, 1907: 10.30 a.m. to 12.30 p.m.

THERAPEUTICS AND PHARMACOLOGY.

1. Write a full description of the chief active substance present in belladonna leaves, and give the pharmacopœal method for its extraction. Enumerate its official preparations and their full medicinal doses.
2. Compare the pharmacological characters of the perchloride and subchloride of mercury. Discuss the practical therapeutic employment of these salts.
3. Enumerate the drugs which are commonly administered by injection under the skin. Give the strength of the solutions so used, and mention in each case the full dose for injection.
4. What indications pointing to the consumption of the following drugs can be obtained by an examination of the urine:—chloral hydrate, salicin, phenol.

Oral and practical Examination in the recognition of Chemicals and Drugs.

EXAMINATION PAPERS, 1906-7.

2 p.m. to 4.30 p.m.

MICROSCOPY.

1. The fabric, A, is seen to be smeared with adherent matter. Examine this microscopically and report upon it. Leave upon your bench the prepared slides you obtain from it.

2. B and C are food substances in powdered form. Make a microscopic examination of each and report upon the result.

3. Make a clean permanent preparation of starch granules from the potato provided. Leave the prepared slide upon your bench.

4. Identify the objects on the slides 1 to 6.

TUESDAY, JULY 2nd, 1907 : 10 a.m. to 4.30 p.m.

1. Examine the sample of milk as if submitted to you under the Sale of Food and Drugs Acts, using the official form supplied to you. Determine the fat by at least two different methods.

2. Examine the sample of crude carbolic acid with a view to ascertaining if it complies with the requirements of the following specification :

“The sample shall be free from tar oils, contain not less than 95 per cent., by volume, of tar acids and not more than 5 per cent. of water. It shall be wholly soluble in caustic soda of sp. gr. 1.07.”

WEDNESDAY, JULY 3rd, 1907 : 10 a.m. to 4.30 p.m.

1. Examine and report upon the sample of jam with reference to the proportions of cane and invert sugar respectively, and to the presence of foreign fruits.

2. Ascertain if the sample of Pil. Hydrarg. complies with the requirements of the British Pharmacopœia.

THURSDAY, JULY 4th, 1907 : 10 a.m. to 4.30 p.m.

1. Determine the poison in the given specimen of stomach contents. (Phosphorus.)

2. Make such determinations (higher alcohols excepted) on the sample of brandy as will enable you to express an opinion as to its genuineness. (*This exercise to be completed to-morrow.*)

FRIDAY, JULY 5th, 1907 : 10 a.m. to 4.30 p.m.

1. Complete the examination of the brandy.

2. Make a qualitative examination of the sample of baking powder, and estimate the amount of available carbonic acid. (*The Candidate is required to construct the apparatus necessary for this determination.*)

3. Examine and report on the genuineness, or otherwise, of the sample of powdered drug. (Gentian root.)

EXAMINATION PAPERS, 1906-7.

OCTOBER, 1907.

Final Examination for the Associateship,**In the Branch of Biological Chemistry.***Examiner in Biological Chemistry :*

ARTHUR HARDEN, D.Sc. (Vict.), Ph.D. (Erlangen), F.I.C.

Examiners in Chemistry :

BERTRAM BLOUNT, F.I.C.

GEORGE GERALD HENDERSON, M.A., D.Sc. (Glasgow), F.I.C.

TUESDAY, OCTOBER 22nd, 1907 : 10 a.m. to 4.30 p.m.

1. Examine the sample of milk chemically and bacteriologically, and report on its quality.

2. Examine the zymon provided for the presence of (a) invertase ; (b) maltase ; (c) a proteoclastic enzyme ; making your experiments as far as possible quantitative.

The work may be continued during the following days of the examination, but the Candidate must describe in his notes to-day what he proposes to do to complete the exercise.

WEDNESDAY, OCTOBER, 23rd, 1907 : 10 a.m. to 4.30 p.m.

Examine and characterise, as far as possible, the organisms of which pure cultures are supplied.

The work may be continued during the following days of the examination, but the Candidate must describe in his notes to-day what he proposes to do to complete the exercise.

THURSDAY, OCTOBER 24th, 1907 : 10 a.m. to 4.30 p.m.

Examine and report on the sample of sewage effluent.

FRIDAY, OCTOBER 25th, 1907 ; 10 a.m. to 4.30 p.m.

Submit the carbohydrate, A, to acid hydrolysis. Ascertain the proportion of reducing sugar produced from it, and characterise the products of hydrolysis as completely as you can.

EXERCISES IN PHYSICAL CHEMISTRY.

Set in JANUARY, 1903, and JULY, 1904.

Find the specific gravity of the given liquid at two temperatures, one of them being its own boiling point.

Determine also the molecular weight of the substance by Dumas' method. (Chloroform.)

1. Construct a temperature regulator, and employ it to regulate the temperature of a water bath to 30° .

2. Investigate with the help of the freezing point method the molecular condition of phenol and phenetol in benzene solution, determining the influence, if any, of the concentration.

Prepare a solution of diazobenzene chloride as follows:—

Dissolve 6.64 grams of aniline in 21.4 c.c. of HCl (sp. gr. = 1.16); cool in ice water and add gradually a solution of 4.9 grams of NaNO_2 in 75 c.c. of water; make the solution up to a litre, and place 35 c.c. in a small flask.

Determine the rate of decomposition of the diazobenzene chloride at 30° by measuring from time to time the nitrogen that has been evolved. (The gas should be collected in a jacketed Hempel's burette.)

Find how far the experimental data warrant you in regarding the reaction as unimolecular.

Determine the resistance capacity of the given electrolytic cell and find the degree of dissociation of acetic acid in $\frac{N}{10}$, $\frac{N}{100}$ and $\frac{N}{1000}$ solution at 25° , having given $\Delta\phi$ for acetic acid at $25^{\circ} = 388$.

Investigate the relative accelerating influences of formic, oxalic, and succinic acids on the inversion of cane sugar.

In the case of any one of these acids study the relation between the velocity of the hydrolysis of the cane sugar and the concentration of the acid.

Investigate the action of iodine on potassium ferrocyanide, with a view to determining the velocity of the reaction. Study the influence of extra added potassium ferricyanide on the reaction and from your results draw conclusions as to the nature and extent of the reversible reaction.

The liquid A is thiophene. Make as complete a study of its physical properties as you can in the time at your disposal, paying special attention to determinations of its vapour density, molecular elevation constant, specific volume and refractive index. From the results which you obtain for the two last constants and from accepted data for atomic volumes and atomic refractive energies compare the probable values of the two formulæ.

