



International Examinations

INTERNATIONAL BASIC SCIENCE  
EXAMINATION FOR OPHTHALMOLOGISTS

Instructions for Candidates

Basic Science





## **Introduction**

The International Council of Ophthalmology is the executive body of the International Federation of Ophthalmological Societies. One of the objectives of the Council is to advance ophthalmic education. The International Basic Science Examination is part of that initiative.

## **Objectives of the International Basic Science Examination**

The members of the International Council of Ophthalmology are of the opinion that every ophthalmologist, wherever they are working, are required to have a good knowledge of basic science in order to understand the principles underlying their clinical practice.

### *Testing Knowledge:*

The primary objective of the Examination is to discover whether a candidate has acquired the breadth and depth of knowledge necessary to understand the scientific basis of ophthalmology. The aim is to achieve a uniformly high standard throughout the world.

### *Effect on Training Programmes:*

The existence of an international examination provides the possibility for eye departments with residents in training, or for the candidates themselves, to assess their performance in relation to a universal standard.

### *Effect on Promotion:*

Heads of eye departments throughout the world have great difficulty in deciding on the level of competence and knowledge of a particular candidate applying for training in ophthalmology, or in promotion from one post to another. The acquisition of this qualification will indicate the level of theoretical knowledge of the candidate in relationship to an international standard. This can be of particular importance if a candidate is moving from one country to another to undertake further training.

### *Relationships to other Diplomas:*

The International Basic Science Examination is intended to complement but not to replace existing examinations in basic science. However, certain countries and examining bodies have accepted this Examination as equivalent to the basic science part of their examinations. Candidates should check with their own ophthalmological society or examining body to ascertain the status of the Examination in their own country.

## **Structure of the Examination**

The Basic Science Examination is aimed at doctors in training who wish to become ophthalmologists. The Examination will be directed by the Examiners appointed by the Examination Committee of the International Council of Ophthalmology. At present the offices of this Committee are in London, England.

- a) The Examination shall be held annually in April. At present it is conducted in Chinese, English, French, Portuguese and Spanish. Other languages will be considered if there are sufficient numbers of candidates to justify the additional translation of the questions. The Examination will normally be held in the candidate's own country.
- b) The Basic Science Examination will consist of 80 multiple-choice questions (MCQ) over a 2 hour period. Examples of the method used for these questions and the instructions can be found on pages 15–16.
- c) The candidates will enter their answers on the "Answer Paper" which will be computer marked. A positive mark will be awarded for each correct answer. No mark is given to those questions marked incorrectly or left blank. The computerised results are then analysed by the Examiners.
- d) Questions will be asked from all or some of the following:

**Basic Science subjects related to Ophthalmology**

Part 1

- i) Anatomy of the Eye, the Orbit and related structures
- ii) Embryology
- iii) Neuro-Anatomy
- iv) Principles of General Physiology
- v) Vision, Ocular Physiology and Biochemistry
- vi) Pharmacology
- vii) Epidemiology and Statistics
- viii) Genetics
- ix) Pathology including Micro-biology

A syllabus will be found on pages 5–14 of this booklet.

**The MCQ papers are not available to candidates after the examination.**

- e) **Basic Science:** the candidates will be informed if they have failed, passed, passed with merit or, exceptionally, passed with distinction. The marks for each section will be given to each candidate to enable them to assess their strengths and weaknesses.
- f) To aid the Examiners and to ensure the quality of the questions, the answers to each part of each question are also analysed. This information is used to identify the core knowledge questions and those which can compare different groups of candidates in different years. This information is used to determine the pass mark, which ensures that the results of the Examination are comparable from year to year.
- g) Visual Acutities will be given in LogMAR with, in brackets, the metric Snellen, the imperial Snellen and the decimal notations. For example, "Visual acuity was LogMAR 0.48 (6/6, 20/60, 0.33)".
- h) Answering all the questions accurately is the best way of obtaining a pass grade but because accuracy of answers is very important and takes time **it is still possible to pass the examination without completing all the questions.**
- i) The question bank is large and questions are not repeated from year to year. Candidates are warned that, although good for practice, using books of questions and answers may be misleading.

## Certificates

A candidate will be given a signed certificate indicating whether she/he has

- a) passed the Basic Science
  - passed with distinction
  - passed with merit

Unless candidates have passed the complete Basic Science Examination (or been granted exemption from it) they cannot normally proceed to the Clinical Sciences Examination. In order not to delay their training, candidates may re-take the Basic Science and/or Theoretical Optics and Refraction at the same time as taking the Clinical Sciences Examination. However under these circumstances certificates will only be issued if all sections are passed.

## Examination regulations

1. The structure of the examination is described on pages 1 and 2.
2. The certificate will be presented to those who have achieved the appropriate level in the Examination and who have complied with the regulations.
3. The fees and dates of the Examination are obtainable from the:  
Examination Office,  
International Council of Ophthalmology,  
11–43 Bath Street, London EC1V 9EL  
E-mail: [assess@icoph.org](mailto:assess@icoph.org)  
Tel: +44 (0)20 7608 6949 or +44 (0)20 7608 6959  
Fax: +44 (0)20 7608 6947  
to whom all enquiries should be addressed.
4. Application forms must reach the Examination Office before the closing date – 24.01.2012.  
Applications received after the closing date will not be processed.
5. The appropriate fee must be paid and cleared before the closing date.
6. Applications for admission to the Examination must be accompanied by a photocopy of the candidate's medical qualification and certificate of registration, together with a small passport-size photograph. (No certificates are required for 2nd and subsequent entries.)
7. Candidates wishing to withdraw their applications must do so *in writing*. For withdrawals received before 24th January a refund will be given, but there will be a 30% deduction to cover administrative charges. No fee refund will be given to candidates wishing to withdraw after the closing date for applications 24th January.
8. A candidate withdrawing an application on or after the closing date for applications - as shown in the Examination Calendar - or who fails to appear for the Examination for which his entry fee has been accepted, *will not be entitled to any refund or transfer of the fee.*

9. A candidate who may desire to make representations with regard to the conduct of their Examination must address them to the Examination Executive and not, in any circumstance, to an Examiner.
10. The Examination Committee may refuse to admit to an Examination, or to proceed with the Examination of any candidate who infringes any of the regulations, or who is considered by the Examiners to be guilty of behaviour prejudicial to the proper management and conduct of the Examination.
11. Candidates may be admitted to the International Basic Science Examination for Ophthalmologists provided they possess a medical qualification acceptable in the country in which the Examination is taken.
12. The above conditions may be modified at the discretion of the Examination Committee.
13. If a candidate is determined by the Examinations Committee to have cheated in the examination, he or she will not have their answer sheet marked and they will be determined as having failed the examination. She/he will not be allowed to re-sit the examination for a period of 1 to 5 years and they may be reported to their local Ophthalmological Society and/or Ministry of Health.

*On the day of the Examinations candidates must provide their own HB pencils, a sharpener and erasers. The answer papers cannot be marked with a pen or biro. **Only HB pencils may be used.***

# Guide to Candidates

## CURRICULUM

The ICO Curriculum is published in *Klinische Monatsblätter für Augenheilkunde* November 2006, pages S1–S48. It was drawn up by a task force under the leadership of Professors M.F.Goldberg, A.G.Lee and M.O.M.Tso

## SYLLABUS

for the Basic Science Examination

A syllabus is indicative of the areas of knowledge expected of candidates. The syllabus is, however, not intended to be exhaustive or to exclude other items of knowledge which are of similar relevance. Questions will be based on the main sections below.

### BASIC SCIENCE EXAMINATION

#### Anatomy of the eye, orbit and related structures

- A Orbit
  - 1. Sinuses
  - 2. Bones comprising the orbital walls
  - 3. Orbital foramina, ducts, canals, and fissures
- B Eyelids
  - 1. Anatomy, histology and innervation
    - a. Skin
    - b. Orbicularis muscle
    - c. Orbital septum
    - d. Levator muscle, Müller's muscle
    - e. Tarsus
    - f. Conjunctiva
    - g. Plica semilunaris and caruncle
  - 2. Vascular supply
- C Lacrimal Gland
  - 1. Anatomy and histology
  - 2. Function
  - 3. Innervation
  - 4. Vascular supply
  - 5. Accessory glands
  - 6. Lacrimal excretory system – anatomy and histology
- D Globe
  - 1. Changes with age
  - 2. Blood supply
  - 3. Vortex veins
- E Conjunctiva and Tenon's Capsule
  - 1. Histology
  - 2. Zones
  - 3. Vascular supply

- F Tear Film
  1. Structure
  2. Function
- G Cornea
  1. Topography
  2. Histology
  3. Composition
- H Sclera
- I Anterior Chamber
  1. Angle structures
  2. Aqueous pathway
  3. Relation to the limbus
  4. Outflow structures
  5. Clinical anatomy - gonioscopy
- J Lens and Zonules
  1. Size and change with age
  2. Histology
- K Extraocular Muscles
  1. Origin
  2. Insertion
  3. Blood supply
  4. Two types of muscle fibres
- L Uvea
  1. Attachments to the sclera
  2. Iris
    - a. Vascular supply
    - b. Innervation
  3. Ciliary body
    - a. Function
    - b. Blood supply
  4. Choroid
    - a. Ultrastructure of the vascular system
    - b. Ultrastructure of the Bruch's membrane
    - c. Function
- M Retina
  1. Retinal pigment epithelium
    - a. Ultrastructure
    - b. Function
  2. Neurosensory retina
    - a. Ultrastructure
    - b. Regional differences
    - c. Vascular supply
    - d. Macula
    - e. Ora serrata

## N Vitreous

1. Composition
2. Attachments

## Embryology

### A Ocular Development

1. Chronological sequence of events in the formation of the eye
2. Neuroectoderm - differentiation
3. Surface ectoderm - differentiation
  - a. Lids
  - b. Lens
4. Neural crest cells - differentiation
  - a. Uvea
  - b. Cornea
  - c. Chamber angle
5. Vascular system

## Neuro Anatomy

### A Optic Nerve including the Nerve Head or Papilla

1. Anatomy
2. Blood Supply
3. Arrangement of Neuro fibres and their connections
4. Pia, Dura and Arachnoid sheaths

### B Optic chiasm

1. Anatomy and relationships
2. Arrangement of fibers
3. Blood supply

### C Optic Tracts

1. Anatomy

### D Lateral Geniculate Body

1. Anatomy and connections

### E Optic Radiations

1. Anatomy and connections

### F Optic Cerebral Cortex

1. Anatomy and connections

### G Cranial Nerves

1. Olfactory nerve
  - a. Central and peripheral course
  - b. Function
2. Optic Nerve
  - a. Central and peripheral course
  - b. Blood supply of different topographical areas
  - c. Meningeal sheaths

3. Oculomotor nerve
  - a. Nuclear anatomy
  - b. Anatomical central and peripheral anatomical course
  - c. Function
4. Trochlear nerve
  - a. Anatomical central and peripheral course
  - b. Function
5. Trigeminal nerve
  - a. Nuclear complex
  - b. Anatomical central and peripheral course
  - c. Function
6. Abducens nerve
  - a. Anatomical central and peripheral course
  - b. Function
7. Facial nerve
  - a. Anatomical and peripheral course
  - b. Function

#### H Parasympathetic Ganglia

1. Composition
2. Synapses
3. Function

#### I Other visual pathways

1. Mid brain
2. Cerebellum
3. Frontal cortex

## Principles of General Physiology

- #### A Cell Structure and Function
1. Homeostasis and characteristics of control systems
    - a. Nervous
    - b. Hormonal
  2. Body fluids
    - a. Volume
    - b. Osmolarity
    - c. Electrolyte (including H<sup>+</sup>) concentrations
  3. Cells, cell membranes and intracellular structure
  4. Extracellular matrix
  5. Excitable tissues
    - a. Membrane potential
    - b. Generator potential
    - c. Action potential
    - d. Nerve conduction
    - e. Synapse
    - f. Motor end-plate
    - g. Muscle
  6. Blood
    - a. Plasma composition and functions
    - b. Immune mechanisms

- c. Blood groups
- d. Haemoglobin and red and white cell formation and destruction
- e. Anaemias
- 7. Cardiovascular system
  - a. Pressure resistance and flow in blood vessels
  - b. The activity of the heart and its control
  - c. Cardiac output
  - d. Control mechanisms within the CVS
  - e. Tissue fluid formation
- 8. Respiratory system
  - a. Structure
  - b. Lung volumes
  - c. Composition of respiratory gases
  - d. Lung mechanics
  - e. Carriage of O<sub>2</sub> and CO<sub>2</sub> in blood
  - f. Ventilation-perfusion relationships
  - g. Chemical and neural control of ventilation
- 9. Nervous System and Special Senses
  - a. Receptors
  - b. Synapses
  - c. Afferent pathways
  - d. Efferent pathways
  - e. Cerebral cortex
  - f. Control of movement
  - g. Autonomic function
- 10. Endocrinology
  - a. Hormonal control
  - b. Hypothalamus
  - c. Pituitary / thyroid
  - d. Adrenals
  - e. Pancreas
  - f. Calcium homeostasis
- 11. Nutrition
  - a. Dietary requirements
  - b. Absorption
  - c. Vitamins
- 12. Kidney and Adrenal Cortex
  - a. Glomerular and tubular function
  - b. Osmolarity and pH of body fluids

## Vision

- 1. Visual Acuity and Contrast sensitivity
- 2. Summation
- 3. Light and Dark adaptation
- 4. Form and Depth perception
- 5. Motion detection
- 6. Flicker detection

- A Colour vision
  - 1. Colour discrimination
  - 2. Luminosity
  - 3. Spectral sensitivity
  - 4. Colour detection
  - 5. Colour blindness
- B Electrophysiology
  - 1. Photoinduction
  - 2. Single cell potential
  - 3. Retinal connections
  - 4. Neurotransmitters
  - 5. Electroretinogram
  - 6. Electroculogram
  - 7. Visually evoked potential
  - 8. Receptive fields
  - 9. Receptor/neural cell responses
  - 10. Ganglion cell responses
- C Binocular vision
  - 1. Stereopsis and Depth perception
  - 2. The horopter
  - 3. Image disparity
  - 4. Retinal rivalry
- D Visual System
  - 1. Magnocellular pathways
  - 2. Parvocellular pathways
  - 3. Pre Striate and Striate cortical pathways and processing
  - 4. Control of Ocular Movements
  - 5. Mid brain control
  - 6. Cerebellar function

## **Ocular Physiology, Biochemistry and Cell Biology**

- A General
  - 1. Oxidative metabolism and ATP production
  - 2. Glucose metabolism and tissue Glycation
  - 3. Oxidation and reduction
  - 4. Free radical production
  - 5. Lipid metabolism
- B Tear film
  - 1. Constitution
  - 2. Production
  - 3. Control
- C Conjunctiva
  - 1. Physiological characteristics

#### D Cornea and sclera

1. Corneal transparency
2. Metabolism
3. Wound healing
4. Fluid transport

#### E Uveal Tract

1. Blood supply
2. Function of the iris, ciliary body, choroid and its components
3. Blood aqueous barrier
4. Metabolism including eicosanoids, detoxification and antioxidation
5. The outflow system
6. Control of aqueous secretion

#### F Lens

1. Lens transparency
2. Transmission and structural properties
3. Transport of nutrients
4. Lens metabolism
5. Age changes and free radical damage

#### G Vitreous

1. Architectural properties
2. Physico chemical properties
3. Diffusion

#### H Retina

1. Glucose metabolism
2. Protein metabolism
3. Lipid metabolism
4. Photochemical reactions
5. Synaptic connections
6. Dopamine reactions
7. Blood flow
8. Blood–retinal barrier
9. Metabolism, restoration and renewal
10. Rhodopsin
11. Photoreceptor proteins
12. Mechanisms of damage

#### I Retinal Pigment Epithelium

1. Functions of the RPE
2. Transport in the RPE

## **Pharmacology**

#### A Basic Principles

1. Pharmacokinetics
2. Pharmacodynamics

- B Pharmacotherapeutics
1. Cholinergic agents
    - a. Muscarinic agents
    - b. Nicotinic agents
  2. Adrenergic agents
    - a. Alpha-adrenergic
    - b. Beta-adrenergic
      - (1) Agonists
      - (2) Antagonists
  3. Carbonic anhydrase inhibitors
  4. Osmotic agents
  5. Prostaglandins
  6. Anti-inflammatory agents
    - a. Glucocorticoids
    - b. Non-steroidal agents
    - c. Antihistamines
    - d. Antimetabolites
  7. Antibiotics
    - a. Antibacterials
    - b. Antifungals
    - c. Antivirals
    - d. Therapy for endophthalmitis
  8. Anaesthetics
    - a. Local
    - b. General

## Principles of Ophthalmic Epidemiology

1. Prevalence, Incidence and Distribution of Visual Impairment and Blindness
2. Patterns of sight-threatening eye disease
3. Epidemiological methodology
4. Cross-sectional, case control and cohort studies
5. Visual impairment and blindness in children
6. Prevention strategies

## Statistics

A basic understanding is required of:

Arithmetic mean

Median

Mode

Bimodal distribution

Standard deviation

Confidence intervals

p values

Analysis of variance, Student's t test

Chi-squared ( $\chi^2$  test)

Mann-Whitney test

Relative risk  
Risk reduction  
Odds ratio  
Correlation coefficient  
Regression  
Survival analysis  
Hazard ratio  
Sensitivity, specificity, predictive value  
Incidence  
Prevalence

## **Genetics**

### **A Terminology**

1. Familial
2. Hereditary
3. Congenital
4. Genotype
5. Phenotype
6. Phenocopy

### **B Genes and Chromosomes**

1. DNA, RNA
2. Codon
3. Exon
4. Intron
5. Base Pairs
  - a. Adenine - thymine
  - b. Guanine - cytosine
6. Transcription
7. Translation
8. Lyon hypothesis
  - a. Barr bodies
  - b. Random inactivation
9. Allele
  - a. Homozygote
  - b. Heterozygote

### **C Patterns of Genetic Transmission**

1. Autosomal dominant
  - a. Penetrance
  - b. Expressivity
  - c. Pleiotropism
  - d. Recurrence risk
2. Autosomal Recessive
  - a. Heterozygotes
  - b. Recurrence risk
    - (1) Gene frequency
    - (2) Heterozygote frequency
    - (3) Consanguinity

3. X-Linked Inheritance
  - a. Hemizygous
  - b. Heterozygous
  - c. Lyon hypothesis
4. Polygenic and Multifactorial Inheritance

## General Principles of Pathology and Microbiology

### A Inflammation/Immunology

- a. Humoral immunity
- b. Cell mediated immunity
- c. Hypersensitivity
1. Types of inflammatory cells
  - a. Cytologic features
  - b. Function
2. Patterns of inflammation
  - a. Acute
  - b. Chronic
    - (1) Granulomatous
    - (2) Nongranulomatous
    - (3) Vasculitis
3. Causes of inflammation
  - a. Infectious agents
    - (1) Staining properties, morphology
    - (2) Reaction pattern - (acute, chronic, etc.)
  - b. Noninfectious
    - (1) Trauma
    - (2) Systemic conditions
    - (3) Immune mediated
4. Sequelae of inflammation - repair

### B Cell Growth

1. Hyperplasia
2. Metaplasia
3. Dysplasia
4. Neoplasia
5. Apoptosis

### C Microbiology

1. General microbiology
2. Cocci
3. Bacilli
4. Chlamydia
5. General virology
6. Herpes viruses
7. Airborne and enteric viruses
8. Hepatitis B, Hepatitis C and HIV
9. Fungi
10. Protozoa
11. Antimicrobial agents

## Guidance on Multiple Choice Questions

### 1 Documents

On your desk you will find the following:

- (a) An ANSWER PAPER (response sheet)
- (b) A QUESTION BOOK

### 2 DO NOT USE PEN OR BIRO - USE ONLY AN HB PENCIL

Use a *high quality* eraser which *does not smudge* and bring 2 HB pencils, and a pencil sharpener to the examination.

Do not fold or crease the Answer Paper.

### 3 Identification

Please check that the *Name* and *Centre* on your Answer Paper are correct before answering the questions.

Please fill in the stage of training on the Answer Paper.

*Please check your name and number on the front cover of the question book.*

### 4 Method of answering

There are 80 Multiple Choice Questions. The answer paper is numbered 1–80. Each question has five statements: stems a, b, c, d and e. On the ANSWER PAPER there are corresponding numbers and five pairs of boxes containing the letters T (true) and F (false). Place a horizontal line in the box which, in your opinion, contains the *correct* answer. Only one line must be placed opposite each answer otherwise the answer will be marked wrong. IT IS ESSENTIAL THAT YOU MARK EACH ANSWER CLEARLY.

### Specimen Question

In the corneal endothelium:

- (a) Tight junctions between the endothelial cells enable the endothelium to act as a barrier to the passage of water ~~(T)~~ (F)
- (b) The endothelial cells pump  $\text{Na}^+$  into the stroma (T) ~~(F)~~
- (c) The  $\text{Na}^+$ - $\text{K}^+$  ATPase helps regulate the intraocular pressure (T) (F)
- (d) The regular hexagonal arrangement of the cells is important for the maintenance of corneal transparency (T) ~~(F)~~
- (e) Efficient function is dependent upon the intraocular pressure being within the physiological range ~~(T)~~ (F)

It is vital to use only a horizontal, clear line. If any line is other than horizontal, that part of the question will not be marked.

One stem (e) was incorrect (no mark) one (c) was left blank (no mark). The total score is therefore three marks. You are advised *initially* to mark your answers in the QUESTION BOOKLET. When you are satisfied with your answer, you **MUST** transfer them to the Answer Paper. The transfer of the answers **MUST** be made within the period allotted for the examination. Disqualification will occur if the candidate does not stop writing when instructed by the invigilator.

If you decide to change a response, careful rubbing out is essential before entering the new mark as smudge marks may be misread as a response. Should your ANSWER PAPER be spoilt a spare paper can be obtained from the invigilator.

- 5      **Marking** *each item* is as follows:
- |                              |         |
|------------------------------|---------|
| CORRECT:                     | +1 Mark |
| NO ANSWER / INCORRECT ANSWER | 0 Mark  |

- 6      **Confidentiality**  
THE QUESTION BOOK MUST NOT BE REMOVED NOR MAY ANY PARTS OF IT COPIED. IT WILL BE COLLECTED FROM YOU BY THE INVIGILATORS, TOGETHER WITH THE ANSWER PAPER.





# Basic Science