



International Examinations

INTERNATIONAL BASIC SCIENCE  
EXAMINATION FOR OPHTHALMOLOGISTS

Instructions for Candidates

Theoretical Optics  
and Refraction



## 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 promote the excellence of eye care worldwide by encouraging individuals to acquire and maintain the highest standard of knowledge for the practice of Ophthalmology. The International Basic Science Examination, Theoretical Optics & Refraction Examination and the Clinical Sciences Examinations are part of that initiative.

## Objectives of the International Theoretical Optics and Refraction 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 theoretical optics and refraction in order to understand the principles underlying their clinical practice.

### Effect on training programme

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

## Structure of the Examination

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

- a) The Examination will 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 Examination will consist of 30 multiple choice questions (MCQ) over a 1 hour period. Examples of the method used for these questions and the instructions can be found on pages 9-10
- 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) The questions will be in 2 sections  
**Optics**  
**Refraction**

## The MCQ papers are not available to candidates after the examination

- e) **Theoretical Optics and Refraction:** the candidates will be informed if they have failed or passed. 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 candidate in different years. The information is used to determine the pass mark, which ensures that the results of the Examination are comparable from year to year.
- The use of new MCQ questions each year results in slight variation in the standard of the papers. This may result in higher or lower marks being achieved because of the difficulty of the questions. Also it may be that the standard of the candidates will vary from year to year but the analysis of the results will identify this. This may also mean that a candidate may have scored higher than the average score of all the candidates, but may still not have passed the Examination.
- For all these reasons it is not appropriate to have a fixed pass mark for each Examination. This will be determined by the Examiners after full analysis of the results.
- g) Visual Acuities 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 Theoretical Optics & Refraction

Unless candidates have passed the 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, candidate may re-take the Basic Science and/or Theoretical Optics and Refraction at the same time as taking the Clinical Sciences Examination

## 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:  
Examinations Office  
International Council of Ophthalmology  
11-43 Bath Street, London EC1V 9EL  
E-mail: [assess@icoph.org](mailto:assess@icoph.org)  
Tel: +44 (0) 207 608 6949 or +44 (0) 207 608 6959
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 show 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 candidates 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 circumstances, 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 Examinations.

11. Candidates may be admitted to the International Theoretical Optics & Refraction 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 eraser. 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 Professor M.F.Goldberg, A.G.Lee and M.O.M.Tso.

## SYLLABUS

for the Theoretical Optics and Refraction 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 sections below.

### THEORETICAL OPTICS AND REFRACTION EXAMINATION

#### Optics

#### A Physical Optics

1. Properties of light
  - a. Electromagnetic spectrum
  - b. Wave theory
  - c. Particle theory
2. Diffraction
3. Interference
4. Resolution
5. Polarisation
6. Scattering
7. Transmission and absorption
8. Photometry
9. Lasers

#### B Geometric Optics

1. Reflection
  - a. Laws of reflection
  - b. Reflection at a plane surface
  - c. Reflection at curved surfaces
2. Refraction
  - a. Laws of refraction (Snell's law)
  - b. Refraction at a plane surface
  - c. Refraction at curved surfaces
  - d. Critical angle and total internal reflection
3. Prisms
  - a. Definition
  - b. Notation of prisms
  - c. Uses in ophthalmology (diagnostic and therapeutic)

### Types of prism

4. Spherical lenses
  - a. Cardinal points
  - b. Thin lens formula
  - c. thick lens formula
  - d. Formation of the image
  - e. Vergence power (dioptric power)
  - f. Magnification
  - g. Spherical decentration and prism power
  - h. Lens from
5. Astigmatic Lenses
  - a. Cylindrical lenses
  - b. Maddox rod
  - c. Toric lenses
  - d. Conoid of Sturm
  - e. Jackson's cross cylinder
6. Notation of lenses
  - a. Spectacle prescribing
  - b. Simple transposition
  - c. Toric transposition
7. Identification of unknown lenses
  - a. Neutralisation
  - b. Focimeter
  - c. Geneva lens measure
8. Aberrations of lenses
  - a. Correction of aberrations relevant to the eye
  - b. Duochrome test

## C Clinical Optics

1. Optics of the eye
2. Transmittance of light by the optic media
3. Schematic and reduced eye
4. Pupillary response and its effect on the resolution of the optical system (Stiles Crawford Effect)
5. Visual acuity
6. Contrast sensitivity
7. Catoptric images
8. Emmetropia
9. Accommodation
10. Purkinje shift
11. Pinhole
12. Ametropia
  - a. Myopia
  - b. Hypermetropia
  - c. Astigmatism
  - d. Anisometropia
  - e. Aniseikonia
  - f. Aphakia

13. Accommodative problems
  - a. Insufficiency
  - b. Excess
  - c. AC/A ratio
14. Refractive errors
  - a. Prevalence
  - b. Inheritance
  - c. Changes with age
  - d. Surgically induced
15. Correction of ametropia
  - a. Spectacle lenses
  - b. Contact lenses
  - c. Intraocular lenses
  - d. Principles of refractive surgery
16. Problems of spectacles in aphakia
17. Effect of spectacles and contact lens correction on accommodation and convergence
18. Effective power lenses
19. Back vertex distance
20. Spectacle magnification
21. Calculation of intraocular lens power
22. Presbyopia
23. Low visual aids
  - a. High reading addition
  - b. Magnifying lenses
  - c. Telescopic aids – Galilean telescope

### **Refraction**

- A
- Clinical Refraction
1. Retinoscopy
  2. Subjective refraction
  3. Measurement of BVD
  4. Muscles balance tests
  5. Accommodative power
  6. Measurement of IPD
  7. Decentration of lenses and prismatic effect
  8. Best form lens
  9. Prescribing multifocal lenses
  10. Prescribing for children
  11. Cycloplegic refraction
- B
- Instruments
1. Direct ophthalmoscope
  2. Indirect ophthalmoscope
  3. Retinoscope
  4. Focimeter

5. Simple magnifying glass (loupe)
6. Lensmeter
7. Glare and contrast testing
8. Potential acuity meter
9. Automated refractor
10. Slitlamp microscope – including methods of examination
11. Stereo tests
12. Keratometer and other instruments for measuring correct covertures
13. Applanation tonometer
14. Specular microscope
15. Operating microscope
16. Zoom lens principle
17. Corneal pachymeter
18. Lens screen/Hess chart
19. Synoptophore
20. Lenses used for fundus biomicroscopy (panfunduscope, Goldmann lens, Hruby lens, 90 D lens, etc.)
21. Fundus Camera
22. Gonioscope
23. Tonometers
24. Retinal Optical Tomography
25. Corneal Topography
26. Compound Microscope
27. Refractive error

## Guide 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 30 Multiple Choice Questions. The answer paper is numbered 1-30  
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

Regarding vision and refraction in children:

- |   |  |
|---|--|
| (a) Acuity normally reaches adult levels by 5 years age.  | <input type="checkbox"/> (F)                                     |
| (b) Accommodation is accurate by 12 months of age.  | <input type="checkbox"/> (F)                                     |
| (c) In an infant under one year of age, hypermetropia of 2-3 Dioptres is common.                | <input type="checkbox"/> (T) (F)                                 |
| (d) Binocular vision and stereopsis are present at birth.                                       | <input type="checkbox"/> (T) <input checked="" type="checkbox"/> |
| (e) Most children over the age of one year have a small degree of against the rule astigmatism. | <input type="checkbox"/> (F)                                     |

### IMPORTANT

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.



# Theoretical Optics and Refraction

*Design and production* James Butler, Saffron Walden, Essex 01799 523438 (September 2011)