



International Examinations

# Optics, Refraction and Instruments

**Instructions for Candidates**

The International Council of Ophthalmology  
**Examinations for Ophthalmologists**





## 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 Visual Sciences Examination, Optics, Refraction and Instruments Examination and the Clinical Ophthalmology Examinations are part of that initiative.

## Objectives of the International Optics, Refraction and Instruments 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 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 Optics, Refraction and Instruments 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 60 multiple choice questions (MCQ) over a 1 hour 30mins 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 3 sections
  - Optics**
  - Refraction**
  - Instruments**

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

- e) **Optics, Refraction and Instruments:** 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 LogMAR 0.5 (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 only a small percentage of questions are 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 Optics, Refraction and Instruments

Unless candidates have passed the Visual Sciences Examination (or been granted exemption from it) they cannot normally proceed to the Clinical Ophthalmology Examination. In order not to delay their training, candidate may re-take the Visual Sciences and/or Optics, Refraction and Instruments at the same time as taking the Clinical Ophthalmology 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:  
Examination Office,  
International Council of Ophthalmology,  
Unit 2, Forest Industrial Park, Redbridge, London IG6 3HL  
E-mail: assess@icoph.org  
to whom all enquiries should be addressed.
4. Application forms must reach the Examination Office before the closing date 24th January.  
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 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 Optics, Refraction and Instruments 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 Optics, Refraction and Instruments 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.

## OPTICS, REFRACTION AND INSTRUMENTS EXAMINATION

### A Physical Optics

1. The wave and particle nature of light  
The electromagnetic spectrum
2. Diffraction
3. Interference and coherence
4. Optical resolution
5. Polarization
6. Light scattering
7. Transmission and absorption
8. Photometry
9. Illumination
10. Image quality
11. Brightness and radiance
12. Refractive index
13. Fluorescence
14. Lasers  
Properties of LASER light  
Principles of laser technology related to lasers used in ophthalmology

### B Geometric Optics

#### *a Reflection (Mirrors)*

1. Laws of reflection, Plane and curved surfaces
2. Images and objects as light sources

#### *b Refraction*

1. Laws of refraction (Snell law), including:
  - a. Passage of light from one medium to another
  - b. Refractive index
  - c. Refraction at plane and curved surfaces

2. Critical angle and total internal reflection

*c Prisms*

1. Prism definition
2. Notation of prisms (eg, prism diopters)
3. Use of prisms in ophthalmology (ie, diagnostic and therapeutic)
4. Prentice rule
5. Fresnel and similar prisms
6. Concept of thin prisms
7. Prismatic effect of lenses
8. Spherical decentration and prism power

*d Spherical Lenses*

1. Spherical lenses concave and convex
2. Cardinal points
3. Thin lens and thick lens formulas
4. Vergence of light, including diopter, convergence, divergence, and vergence formula
5. Magnification, including linear, angular, relative size
6. Ray diagrams of common lenses, prisms and magnifying devices

*e Astigmatic Lenses*

1. Cylindrical lenses, including
  - a. Spherocylinder lenses and surfaces
  - b. Cross cylinders (eg, Jackson cross cylinder)
2. Toric lenses

**C Clinical Optics**

1. Optics of the eye, including the dioptric power of different structures
2. Schematic eye and reduced eye, including cardinal points
3. Aberrations of the eye including higher-order aberrations
4. Catoptric / Purkinje – Sanson images
5. Entoptic phenomena
6. Hazards of blue light sources
7. Accommodation

*a Refractive errors*

1. Emmetropia
2. Ametropia
3. Myopia
4. Hypermetropia (hyperopia)
5. Astigmatism, including conoid of Sturm
6. Anisometropia
7. Aniseikonia (including Knapp rule)
8. Aphakia
9. Optical parameters affecting retinal image size
10. Pupillary response and its effect on the resolution of the optical system (Stiles-Crawford effect)

11. Epidemiology of refractive errors, including:
  - a. Prevalence
  - b. Inheritance
  - c. Changes with age
  - d. Surgical considerations

**b Visual Acuity**

1. Distance and near acuity measurement
2. Minimal acuity (ie, visible, perceptible, separable, legible)
3. Visual acuity charts
4. Effect of crowding
5. How pin-hole effect impacts visual acuity
6. Colour vision

**c Accommodation**

1. How accommodation is affected by age
2. Accommodative problems
3. Convergence or accommodative insufficiency or excess
4. Accommodative-convergence over accommodation (AC/A) ratio

**d Correction of refractive errors**

1. Correction of ametropia, including:
  - a. General principles
  - b. Spectacle lenses
    1. Spherical equivalent
    2. Prismatic effect of de-centering lenses
    3. Prescribing for presbyopia
    4. Bifocal and progressive lenses
    5. Aberrations of lenses and their minimisation
  - c. Contact lenses materials, design principles and clinical uses
  - d. Intraocular lenses materials, design, biometry and choice of formulae and choice of IOL power
  - e. Principles of refractive surgery
    1. Incisional corneal refractive surgery
    2. Surface EXCIMER ablation
    3. Intracorneal rings
    4. Phakic intraocular lenses
    5. Clear lens extraction
  - f. Correction of high ametropia
 

Optical advantages of different methods
2. Problems with aphakic spectacles
3. Effect of spectacles and contact lens correction on accommodation and convergence (ie, amplitude, near point, far point)

**D Clinical Refraction**

**a Objective Refraction: Retinoscopy**

1. Principles, indications and difficulties of retinoscopy
2. Refraction based upon retinoscopic results

**b Subjective Refraction Techniques**

1. Major types of refractive errors
2. Indications for and use of trial lenses for simple refractive error
3. Refraction techniques for myopia, hyperopia, and astigmatism, including Jackson cross cylinder, Maddox rod and Duo-chrome tests
4. Techniques for the correction for presbyopia (ie, measuring for near adds)
5. Measurement of interpupillary distance (IPD) and back vertex distance
6. Prisms for diplopia

**c Cycloplegic Refraction**

1. Medication concentrations according to age (eg, cycloptolate, atropine)

**d Notation of Lenses**

1. Myopic, hyperopic, and astigmatic lenses
2. Simple and toric transposition
3. Lens prescription

**e Aberration of Lenses**

1. Correct aberrations relevant to the eye, including spherical, colour, coma, astigmatism (including surgical), and distortion

**E Instruments and Tests used in ophthalmology, including the optics**

1. Direct ophthalmoscope
2. Indirect ophthalmoscope
3. Retinoscope
4. Glare and contrast sensitivity testing
5. Automated refractor
6. Measurement of higher-order aberrations
7. Stereoacuity testing
8. Corneal topography (eg, placido disc, keratometer, automated corneal topography)
9. Use of the Hess Chart/Lees Screen
10. Corneal Pachymetry
11. Colour vision tests (eg, Ishihara color plates; Hardy-Rand-Rittler test)
12. Slit lamp microscope
13. Keratometer and other instruments for measuring corneal thickness
14. Applanation tomometry
  - Goldman tonometer
  - Rebound tonometer
  - Pressure gauge
15. Optical coherence tomography
16. Contrast sensitivity assessment
17. Gonioscopy
18. Lenses used for fundus biomicroscopy (indirect e.g. 90D 78D etc, Goldmann, panfunduscope)
19. Principles of visual field assessment including automated

20. Focimeters
21. Operating microscope
22. Intraocular lens calculation (biometry)
23. Interpretation of tests
  - Plain Xray
  - CT scan
  - MRI scan
  - Ophthalmic ultrasound
  - Optical coherence tomography
24. Wave Front analysis
25. Endothelial specular microscopy
26. Fundus photography
  - Wide field
  - Fluorescein Angiography and indocyanine Green
  - Confocal optics
  - Scanning laser ophthalmoscope

**F Low Vision Aids**

1. Principles of prescribing low visual aids
2. Simple magnifying glass
3. High reading addition
4. Galilean telescope
5. Compound microscope

## 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 60 Multiple Choice Questions. The answer paper is numbered 1-60

All 60 questions are of the four options multiple-choice type with only one correct answer. Each question has four statements. Stems a, b, c, and d.

On the ANSWER PAPER there are corresponding boxes for each statement.

IT IS ESSENTIAL THAT YOU MARK EACH ANSWER CLEARLY.

### Specimen Question

Regarding transposition of prescriptions from positive cylinder notation to negative cylinder notation or vice versa, which ONE of the following statements is TRUE?

- a)  $+1.00 / -3.00 \times 165 = -3.00 / +3.00 \times 75.$  ( )
- b)  $-1.25 / -14.25 \times 63 = -14.25 / +1.25 \times 153.$  ( )
- c)  $-2.25 / +4.75 \times 45 = -2.50 / -4.75 \times 135.$  ( )
- d)  $+4.00 / +1.25 \times 70 = +5.25 / -1.25 \times 160.$  (—)

### IMPORTANT

It is vital to use only a horizontal, clear line. If any line is other than horizontal, the whole question will not be marked and will not score.

You are advised *initially* to mark your answers in the QUESTION BOOK. When you are satisfied with your answers, 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.





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*Design and production* James Butler, Saffron Walden, Essex 01799 523438 (September 2018)