

1 Optical Engineering Exam

2 Preface

My Optical Engineering exam was scheduled for the 24th Feb 2016 at 3 PM. It started only at around 4. The reason was another examinee before me and a short meeting (scheduled for 3.30). I agreed for the meeting to take place before my exam.

The exam took place in German, my mother tongue, since 'It would be weird if three Germans sit together to take an exam in English' (Quote from Prof. Stork, translated)

3 Questions

3.1 Introduction

First question: Definition of Optical Engineering → lecture slide.

Second question: What optical system would I like to present in the exam?

3.2 The Eye

Third question: What is the eye?

→ Optical system with two lenses (Cornea and natural lens), an aperture (Iris/Pupil) and screen (Retina)

Fourth question: What is the dioptic power of cornea? → I struggled a bit with that one. He gave me the radius of curvature of the cornea as a hint (8mm) as well as the dependence not on n but on the difference between inner and outer n .

I managed to derive the proportionalities, with $D = \frac{\Delta n}{r_{curv}} \approx 40 \text{ Dpt}$. → The first calculation of many. They were all 'petty', but $\frac{1}{3.8 \text{ mm}}$ was good enough to make me a bit nervous.

Fifth question: What is then the total dioptic power of the eye? → using imaging equation with object at infinity and image at 24 mm, I got a power of 40 Dpt.

He emphasized the importance of refractive index → optical pathlength in the eye is only $24/1.37 = 17 \text{ mm}$. → Total dioptic power 60 Dpt.

Sixth question: What is then the Dioptic power of the lens?

→ Gullstrand: $D \approx D_1 + D_2$ D of lens is 20 Dpt.

Seventh question: So what happens then, when the eye is accomodated?

→ object distance is now no more infinity, he gave me 10 cm to calculate with. Still imaging equation.

Eighth question: What is then the difference in Dioptic Power ΔD ?

Ninth question: How does it change with age?

→ important to know, stressed it a lot in the lecture. ΔD at age of 50 is 2 Dpt.

Tenth question: What is the importance of these 2 Dpt?

→ near point is moved to 0.5 m (→ Reading glasses necessary.)

Eleventh question: What is the resolution of the eye?

→ Rayleigh criterion (subquestion: Where does the 1.22 come from → diameter of Airy disc
→ Bessel function) → about 1 arcminute (subquestion: how do I calculate from radians to arcminutes)

Twelfth question: What is then the size of a 'pixel' on the retina?

→ draw triangle, calculate.

Last question: If I were to construct a camera similar to the eye, how big should a chip (detector) be?

→ Needn't be smaller than the pixelsize, since information would be made redundant.

4 Summary

All in all a fair exam with Prof. Stork helping when I got lost in my thoughts.

As apparent, the questions kept to the eye, my chosen optical system. Nonetheless it might be useful to prepare a second system in case Prof. Stork has already heard the same topic five times on that day...

The exam took about 20 to 30 minutes, I did not check my watch so I cannot give it accurately. With drawing and thinking and answering the time went by quickly and the end came somewhat as a surprise.