

Vision Science II – Monocular sensory aspects of vision

Exam 1

9/12/07

Max points = 43

1. Assume that a patient achieves only 20/30 with the best spherocylindrical correction. The eye has no diseases but may have excessive higher-order aberrations. If you don't have an aberrometer, which of the following tools (used alone) would best help you diagnose the presence of higher-order aberrations?

- a. **pinhole**
- b. slit lamp
- c. ophthalmoscope
- d. logMAR chart

2. Which of the following best describes the total monochromatic aberrations of an eye?

- a. spherical defocus and astigmatism only
- b. third- and fourth-order refractive errors only
- c. third-, fourth- and higher-order refractive errors
- d. **spherical defocus, astigmatism and higher-order refractive errors**

3. Which of the following correctly identifies a third-order Zernike mode?

- a. Z_2^{-2} defocus
- b. Z_3^0 astigmatism
- c. **Z_3^{-1} coma**
- d. Z_4^0 spherical aberration

4. Assume that an eye's higher-order aberrations consist of 0.12 μm in each third-order mode, plus 0.18 μm of Z_4^0 only. Calculate the total higher-order RMS for this eye to the nearest 0.1 μm .

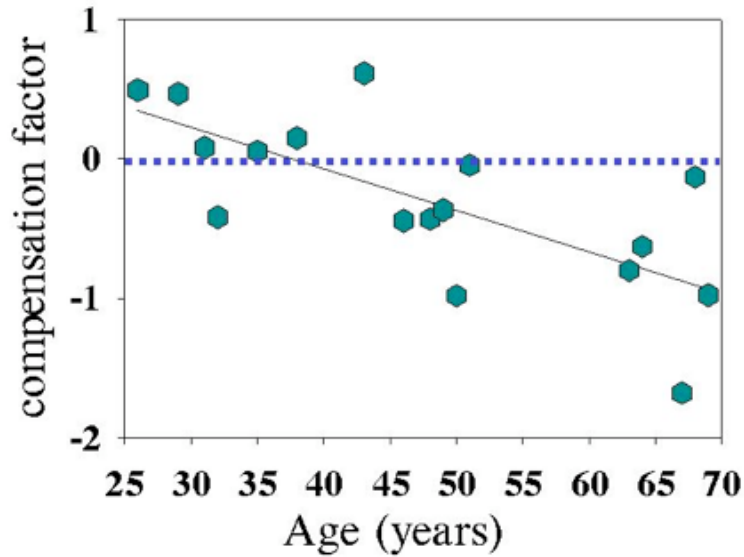
- a. < 0.05
- b. 0.1
- c. 0.2
- d. **0.3**
- e. >0.35

5. If the values above are for a 6.0-mm pupil, re-compute the spherical aberration for a 3-mm pupil.

- a. **< 0.05**
- b. 0.1
- c. 0.2
- d. 0.3
- e. >0.35

6. Based on recent work by Dr. Salmon, what was the mean total higher-order RMS for a normal, healthy adult eye?

- a. 0.33
- b. 0.19
- c. 0.10
- d. **Any of the above could be correct depending on pupil size.**



compensation factor = 1 - [RMS(eye)/RMS(cornea)]

7. The book chapter by Salmon and West included the figure and formula above, which came from a study by Dr. Pablo Artal (University of Murcia, Spain). Which of the following statements is most consistent with this graph?

- a. Ocular aberrations decrease but corneal aberrations increase from age 25 to 70.
- b. The best optical quality for the eye as a whole occurs at about age 35 to 40.
- c. Internal aberrations neutralize most corneal aberrations in young eyes but the balance degrades with age.**
- d. Optical quality for a normal eye is best when it is focused at an intermediate distance.

8. List the maximum extent of the visual field you should expect in most normal eyes in the four cardinal directions. (4)

Direction	Superior	Nasal	Inferior	Temporal
Extent (degrees)	50	60	70	90

9. Which of the following words, associated with visual fields testing, describe concepts that are most consistent with each other?

- a. High decibel value, bright stimulus, low sensitivity
- b. High decibel value, dim stimulus, good vision**
- c. Low decibel value, bright stimulus, low threshold
- d. Low decibel value, low threshold, poor vision

10. The Humphrey Visual Field Analyzer projects a white spot with a maximum luminance of 10,000 apostilbs onto the background. It uses neutral density filters to adjust brightness of the spot below 10,000 apostilbs. What luminance value, in nits, corresponds with a setting of 30 decibels?

- a. **3**
- b. 10
- c. 30
- d. 1000

11. If academic performance, like visual performance, increases on a logarithmic rather than linear scale, it might be more appropriate to score your test in decibels rather than percentage points. A value of 0.0 decibels would correspond to a perfect score (100%). What percentage value would correspond to a -1 decibel score?

- a. 90
- b. **80**
- c. 70
- d. 60

12. Anatomic tests such as ophthalmoscopy are important for clinical diagnosis in optometry. For example during ophthalmoscopy we grade the cup to disc ratio to screen patients for glaucoma. Psychophysical tests, such as Humphrey Visual Fields analysis, are also used to manage glaucoma. Which of the following best describes a benefit of using a psychophysical method?

- a. Psychophysical tests are objective but anatomic procedures are subjective.
- b. Psychophysical tests can be done without patient cooperation.
- c. **Psychophysical tests may detect functional vision loss before anatomic damage is visible.**
- d. Psychophysical tests allow the doctor to visualize structural changes in ocular tissues.

13. Name one disadvantages of using a psychophysical testing method.

Subjective, relies on good patient understanding or cooperation, sometimes less sensitive or less reliable than anatomic tests.

14. Which of the following statements about the famous experiment by Hecht, Schlaer and Pirenne is correct?

- a. Ten photons must be absorbed by a rod before it can respond to light.
- b. **Ten photons received by 10 rods near each other, and at about the same time, are required for detection.**
- c. Across most of the spectrum, foveal cones capture light more efficiently than rods.
- d. Approximately 90% of the retinal cones are located in the fovea.

15. In a heterochromic flicker photometry experiment, the reference light is set to 555 nm and testing is done under photopic conditions. Is it possible to neutralize the flicker with another wavelength of light that has both the same radiance and luminance as the reference light?

- a. Yes, if the spot size is less than 10 arc minutes in size.
- b. Yes, if both lights are presented within the critical duration.
- c. Yes for all wavelengths since radiance and luminance are synonymous.
- d. **None of the above**

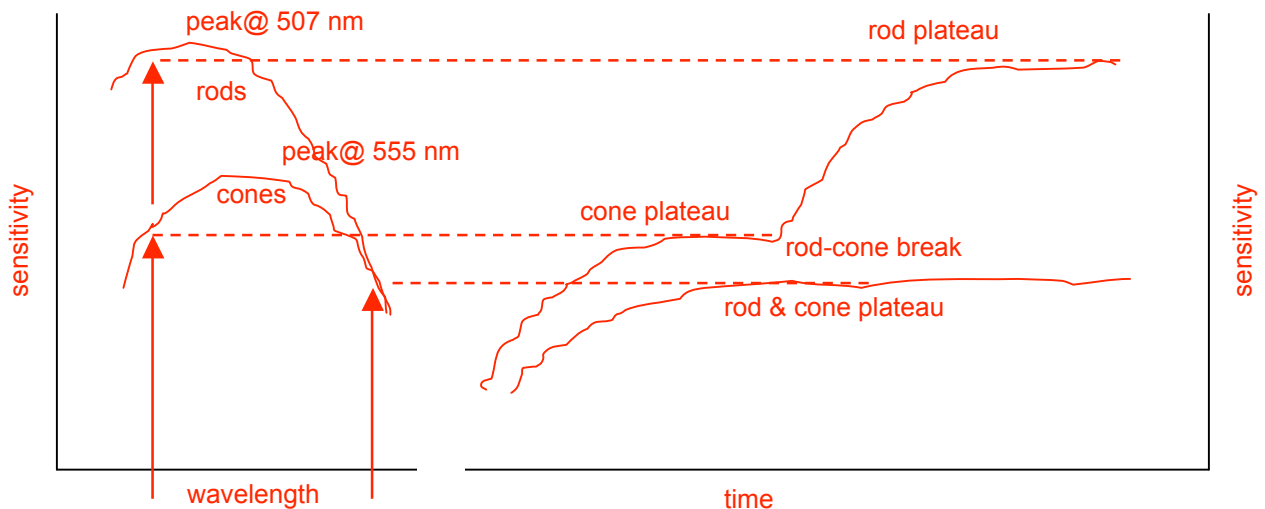
16. A Lambertian surface is illuminated by 1,000 lux, and it produces a luminance of 100 nits. What is the reflectance of the surface?

About 30%

17. Which of the following changes with distance from the luminous object?

- a. **Illumination from the object**
- b. Luminance of the object
- c. Retinal illumination of the image of the object
- d. None of the above

18. Using the empty plots and axes below, draw the following functions. On the left plot, draw curves showing the spectral sensitivity of the photopic and scotopic systems. On the right plot, draw two dark adaptation functions—in terms of sensitivity as a function of time—for a short wavelength that has a large photochromic interval, and a long wavelength that has no photochromic interval. Indicate approximately which wavelength you are plotting in the left plot. The major features of the right plot should correspond with the sensitivity levels in the left, similar to the double-graph shown in Schwartz Fig. 3-11. Label all axes, curves and major features of the curves. (10)



Left plot: Label rod, cone curves correctly, correct peaks, photochromic intervals, axis labels
 Right plot: Correct rod, cone, both plateaus, with/ without r-c break, axis labels

19. On a logMAR visual acuity chart letter, size doubles every _____ line(s). (How many lines?)

- a. one
- b. two
- c. **three**
- d. four
- e. None of the above

- c. must decrease with increasing duration.
- d. is unrelated to duration.

27. Assuming a critical duration of 10 milliseconds (photopic system), which of the following is not correct?

- a. If a light (with 75% of threshold luminance) is flashed, then 90 milliseconds later re-flashed, the person will see no flash.
- b. If a light (with 75% of threshold luminance) is flashed, then 2 milliseconds later re-flashed, the person will see two flashes.**
- c. If a light (with 75% of threshold luminance) is flashed, then 5 milliseconds later re-flashed, the person will see one flash.
- d. If a light (with 125% of threshold luminance) is flashed, then 25 milliseconds later re-flashed, the person will see two flashes.

28. How would the Stiles-Crawford effect benefit a refractive surgery patient who has relatively large pupils in normal lighting conditions?

Large pupils allow more aberrations, which can adversely affect vision. One way to reduce aberrations is to decrease pupil size. The Stiles-Crawford Effect reduces the effect of light in the peripheral pupil, as if the pupil were slightly smaller than its true size. That helps reduce the adverse effect of aberrations and improves image quality.

29. Which of the following scientists was the first person to measure the wavefront aberration function of the human eye using a Shack-Hartmann wavefront sensor?

- a. Dr. Larry Thibos at Indiana University
- b. Dr. David Williams at the University of Rochester
- c. Dr. Ray Applegate at the University of Houston
- d. Dr. Jeff Miller at the University of Arkansas
- e. Dr. Junzhong Liang at the University of Heidelberg**

Where did this guy come from?

Thank you for your hard work and study. The answer key will be posted on the web site shortly after the last person departs.

-- Dr. Salmon