_____Name/PIN

Vision Science II – Monocular sensory aspects of vision

# Final Exam

12/16/08

Maxi points = 50

Choose the one best answer for each question.

1. The most common cause of poor vision is/are …
a. amblyiopia
b. aberrations
c. catarcts
d. glaucoma
e. injuries

2. Which of the following can we know about the visual system by analyzing the shape of a wavefront of light that has passed through the eye's optics?
a. visual acuity
b. corneal topography
c. contrast sensitivity
d. refractive errors
e. visually evoked response

3. Which of the following provides data that is most similar to basic data provided by an ocular wavefront sensor?
a. retinoscope
b. keratometer
c. tonometer
d. logMAR acuity chart
e. electroretinogram

4. Which of the following may be considered an ocular aberration?
a. myopia
b. astigmatism
c. coma
d. all of the above
e. none of the above

5. Given the higher-order Zernike coefficients, how do you compute the third-order RMS wavefront error?
a. Calculate the mean of the third-order coefficients.
b. Take the absolute value of the third-order coefficients, and compute the mean.
c. Square each of third-order coefficients and add them together
d. Square each of third-order coefficients, add them and compute the square root.
e. Square each of third-order coefficients, add them, compute the square root and divide by 4.

6. Which of the following designates spherical aberration in the Zernike system?
a. $Z_2^0$
b. $Z_3^{-3}$
c. $Z_3^1$
d. $Z_4^0$
e. $Z_4^2$

7. Which of the following is closest to the average higher-order RMS value expected for a normal eye?
a. 0.10 μm
b. 0.20 μm
c. 0.33 μm
d. 0.40 μm
e. Not enough information to answer the question.

8. Decreasing pupil size by one half causes a second-order Zernike coefficient to change by approximately what factor?
a. 0.50
b. 0.33
c. 0.25
d. square root of 2.0
e. square root of 1.0

9. What is the minimum quantity of light necessary to activate a rod photoreceptor?
a. one nit
b. one apostilb
c. one lux
d. one fool-lambert
e. one photon

10. The purpose of heterochromatic flicker photometry, as described in this course, is to find the
a. luminances at which two wavelengths have the same radiance.
b. radiances at which two wavelengths have the same luminance.
c. critical flicker fusion frequency for two wavelengths.
d. hue that results from the fusion of two wavelengths flickered above the CFF.
e. hue that results from the fusion of two wavelengths flickered below the CFF.

11. Which of the following is not a unit that quantifies light emitted from an extended surface?
a. nit
b. apostilb
c. lux
d. foot-lambert
e. candela/$m^2$

12. Decreasing pupil size by one half causes retinal illumination to change by what factor?
a. 0.50
b. 0.33
c. 0.25
d. square root of 2.0
e. square root of 1.0

13. Which of the following changes as a function of distance from an extended light source?
a. illumination
b. luminance
c. retinal illumination
d. perceived brightness
e. color temperature

14. Which of the following visual field directions has the shortest extent in a normal healthy eye?
a. superior
b. nasal
c. inferior
d. temporal
e. All have equal extent.

15. Why should you use a red light to read in the dark if you want to preserve dark adaptation?
a. Red light stimulates the rods, but not the cones.
b. Red light stimulates the cones, but not the rods.
c. Red light is not absorbed by either the rods or cones.
d. Red light stimulates both rods and cones, and rods absorb long wavelengths best.
e. Red light stimulates both rods and cones, and rods absorb long wavelengths relatively poorly.

16. An abnormally long recovery time in the photostress test usually indicates a problem with the …
a. optic nerve.
b. macula.
c. ciliary body.
d. higher-order aberrations.
e. light adaptation.

17. As vision adapts to a brighter background, what happens to sensitivity for detecting a fixed increment of light, which is added to the background? Sensitivity …
a. remains constant.
b. increases.
c. decreases.
d. fluctuates between increasing and decreasing sensitivity.
e. Not enough information to answer the question.

18. Cells and flare are a sign of iritis, but can be very difficult to see during a slit lamp exam. Which of the following does not explain how to improve visibility of the cells and flare?
a. Increase intensity of the slit lamp beam to increase the luminance increment of the cells relative to the background.
b. View the cells against a background with minimal luminance, such as the black pupil.
c. Allow your eyes to dark adapt to increase sensitivity.
d. Try to increase the luminance increment of the cells relative to the background so it exceeds Weber's fraction.
e. Try to increase Weber's fraction so it exceed the ratio of the luminance increment relative to the background.

19. According to Ricco's Law, for spot diameters smaller than the critical diameter, the intensity (quanta/area) of the spot necessary for detection
a. must increase for smaller spot diameters.
b. must decrease for smaller spot diameters.
c. must remain constant for all spot diameters (within the critical diameter).
d. is unrelated to spot diameter.

20. According to Bloch's Law, for durations within the critical duration, the product of intensity (quanta/time) and time
a. must increase with increasing duration.
b. must remain constant (within the critical duration).
c. must decrease with increasing duration.
d. is unrelated to duration.

21. What can you do to improve the apparent sharpness of a slightly blurry digital photo?
a. Magnify it slightly.
b. Decrease its size.
c. Decrease its contrast.
d. Decrease its saturation.
e. Process it with a low-pass filter.

22. Power vectors could be used to compute all of the following except one. Which one?
a. the contact lens power needed based on a toric trial len's power and the over-refraction.
b. how much a child's refraction has changed between last year's and this year's exam.
c. the internal (lenticular) astigmatism based on keratometry and subjective refraction.
d. the mean refraction between two different autorefractor measurements.
e. It could be used to compute all of the above.

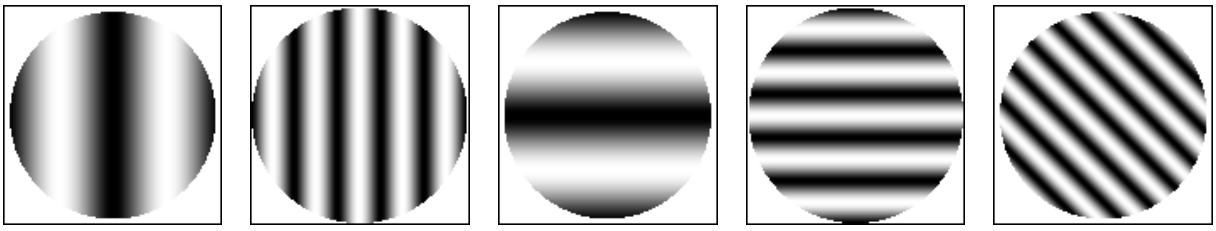
23. Which of the following Zernike coefficients should be used to compute the mean spherical equivalent refraction?
a. $C_2^{-2}$
b. $C_2^0$
c. $C_2^2$
d. $C_4^0$
e. $J_{45}$

24. Which Zernike mode is represented by the figure to the right?
a. $Z_{22}$
b. $Z_{33}$
c. $Z_{31}$
d. $Z_{30}$
e. $Z_{40}$

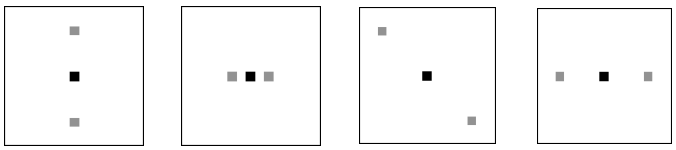
Interferometry is used to measure a patient's retinal visual acuity behind a cataract. In one clinical inteferometer, the doctor can know the orientation of the gratings seen by the patient by looking at the Fourier transform seen from his side. Match the following Fourier Transforms with the pattern that the patients will most likely see from his side of the instrument.

**Patient sees this from his side.**

**A** **B** **C** **D** **E**



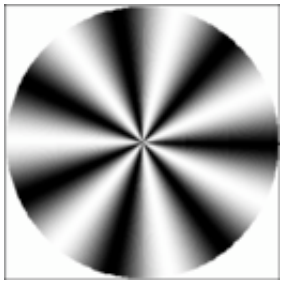
**Doctor sees this form his side.**

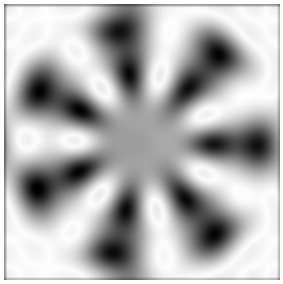


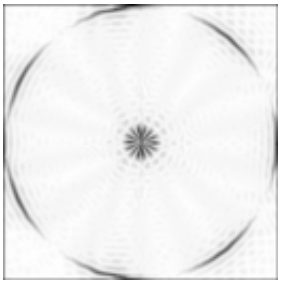
| Question # | 25. | 26. | 27. | 28. |
|---|---|---|---|---|
| Your answer | **D** | **A** | **E** | **B** |

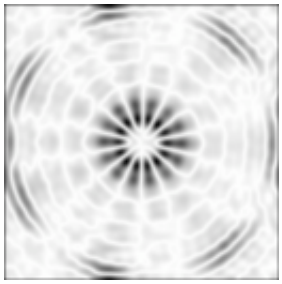
29. The effect of pupillary dilation upon perceived brightness is less than would be predicted based on the increase in incident flux on the retina that accompanies increases in pupil size. This phenomenon reflects the …
a. wave-guide properties of the cone photoreceptors.
b. nonlinearities in the pupil response.
c. Stile-Crawford effect for rods.
d. fact that the peripheral pupil transmits less light than the central pupil.
e. increased sensitivity to light entering from the corneal margins.

**Figure for Questions 30-32**


A


B


C


D

30. Figure A, above, is a spoke pattern whose circumferential luminance profile changes sinusoidally; that is, a polar sine wave grating. After processing, the image of A looks like B. In terms of what you learned about Fourier transformation and spatial filtering what happened to B? It has been …
a. high-pass filtered.
b. low-pass filtered.
c. band-pass filtered.
d. high- and low-pass filtered.
e. transformed into its spatial frequency spectrum.

31. What if, after processing, the image of A looks like C. What happened? It has been …
a. high-pass filtered.
b. low-pass filtered.
c. band-pass filtered.
d. high- and low-pass filtered.
e. transformed into its spatial frequency spectrum.

32. What if, after processing, the image of A looks like D. What happened? It has been …
a. high-pass filtered.
b. low-pass filtered.
c. band-pass filtered.
d. high- and low-pass filtered.
e. transformed into its spatial frequency spectrum.

33. The temporal modulation transfer function provides information about the visual system, including all of the following, except one. Which one?
a. The apparent brightness of a light that is flickering above the CFF.
b. The rate of flicker (in Hz) at which the eye can best see flicker.
c. For a low temporal contrast (percent depth modulation) the fastest flicker that a person can see.
d. For a low temporal contrast (percent depth modulation) the slowest flicker that a person can see.
e. None of the above.

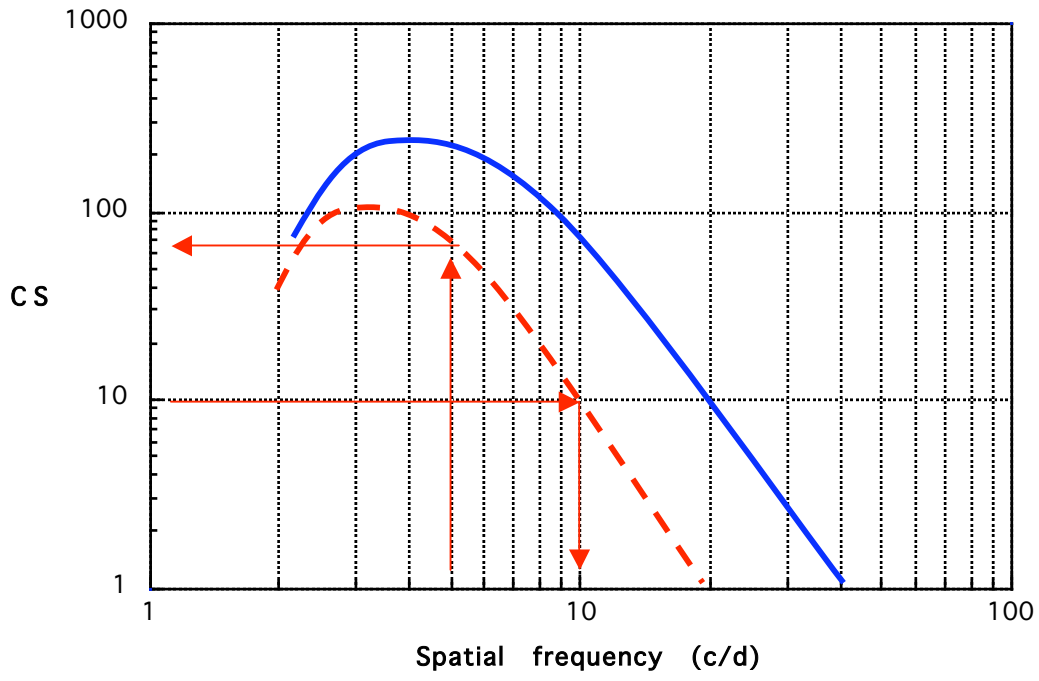
34. According to the Ferry-Porter law, the CFF …
a. is directly proportional to stimulus luminance.
b. is directly proportional to the log of the stimulus luminance.
c. is inversely proportional to the log of the stimulus luminance.
d. increases as the log of stimulus area.
e. None of the above.

35. Which of the following correctly describes the relationship between the size of a flashing light and the maximum rate of flicker than a person can normally see.
a. As a flashing light gets smaller, the flicker will be easier to see.
b. The fastest flicker that a person can see remains constant for flashing lights of any size.
c. As a flashing light gets larger, the flicker will be easier to see.
d. As a light becomes dimmer at the same time it becomes smaller, the flicker becomes easier to see.
e. None of the above.

36. According to the Broca-Sulzer effect, …
a. the longer a light (with fixed radiance) is left on, the brighter it appears to become.
b. a flickering light appears dimmest if it is flashed at a rate of about 10 Hz.
c. a light that is flashed on for about 75 msec will look slightly less bright than a steady light of the same radiance.
d. a light that is flashed on for about 75 msec will look slightly brighter than a steady light of the same radiance.
e. None of the above.

37. Hue shifts that accompany changes in luminosity are referred to as the …
a. Stiles-Crawford effect
b. Abney phenomenon
c. Wavelength discrimination function
d. Relative saturation function
e. Bezold-Brücke phenomenon

**Figure for Questions 38-42.**



38. Refer to the figure above. If the upper (solid) curve represents the CSF for a normal patient. Which of the following is most consistent with the lower (dashed) curve?
a. About 0.25 diopters of uncorrected refractive error
b. About 2.50 diopters of uncorrected refractive error
c. The phoropter lens is steamed up from water vapor.
d. A dense (20/200 VA) cataract

39. Assume that you are testing visual acuity with a 100% contrast acuity chart. What would the Snellen visual acuity be for the upper (solid) curve?
a. 20/15
b. 20/20
c. 20/30
d. 20/60
e. 20/150

40. Assume that you are testing visual acuity with a 100% contrast acuity chart. What would the Snellen visual acuity be for the lower (dashed) curve?
a. 20/15
b. 20/20
c. 20/30
d. 20/60
e. 20/150

41. Assume that you are testing visual acuity with a 10% contrast acuity chart. What would the Snellen visual acuity be for the lower (dashed) curve?
a. 20/15
b. 20/20
c. 20/30
d. 20/60
e. 20/150

42. Assume that you are testing contrast sensitivity with a letter chart that uses letters with an MAR of 6 arc minutes. For the lower (dashed) curve, what would the contrast threshold be? Choose the closest answer.
a. 0.2%
b. 1%
c. 1.5%
d. 4%
e. 14%

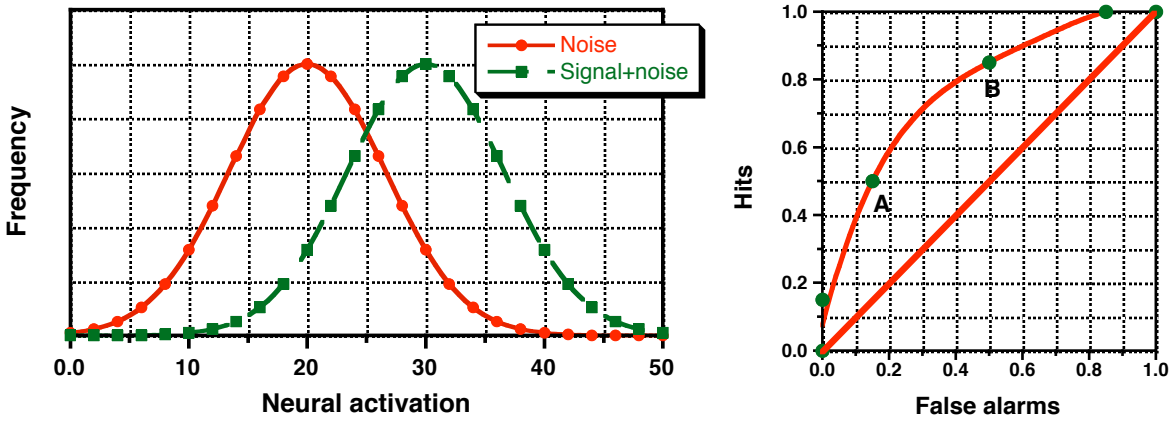
43. If a patient read as far as the 0.5 line on a standard ETDRS logMAR chart, but missed two letters on the 0.5 line, what is the equivalent Snellen visual acuity?
a. 20/40
b. 20/50
c. 20/60
d. 20/70
e. 20/80

44. Suppose a patient had supernormal vision due to a perfect optical correction. If he could read 20/8, what would the equivalent logMAR visual acuity be?
a. 2.5
b. 0.4
c. –0.2
d. –0.3
e. –0.4

45. A patient uses an anomaloscope to mix monochromatic green and red lights to obtain a metameric match with monochromatic yellow. No matter what the mixture setting is, the hues appear to match, but the brightness fluctuates depending on how he sets the mixture. He has …
a. protanomaly
b. protanopia
c. deuteranomaly
d. deuteranopia
e. tritanopia

46. Assume that another patient would only accept a certain mixture setting that had a slightly greater than normal amount of green, but had a normal luminance setting. He would have …
a. protanomaly
b. protanopia
c. deuteranomaly
d. deuteranopia
e. tritanopia

47. For which of the following anomalies would the patient not accept both a normal mixture and luminance settings (at the same time)?
a. tritanopia
b. tetartanomaly
c. monochromacy
d. deuteranopia
e. deuteranomaly




48. Refer to the figure above showing the noise (left curve) and signal plus noise (right curve) distributions. If the criteria for detection were set to 25, what would the false alarm and hit rates be?
a. 0.35 and 0.35
b. 0.65 and 0.65
c. 0.35 and 0.65
d. 0.65 and 0.35
e. 0.50 and 0.50

49. If the detection criterion were set to 25, what would the specificity be?
a. 0.35
b. 0.45
c. 0.50
d. 0.55
e. 0.65

50. Refer to the ROC curve above. What level of neural activation would be associated with Point A?
a. 10
b. 20
c. 30
d. 40
e. 50

Dear students,

Merry Christmas! I have enjoyed getting to know you, and it has been a privilege to have worked with you this semester. Hang on for a few more days, then enjoy a safe and relaxing Christmas break. I wish you well and look forward to seeing you in clinic next semester.

Sincerely,

Dr. Salmon