

Vision Science II - Monocular sensory aspects of vision

Final exam

(12/12/07)

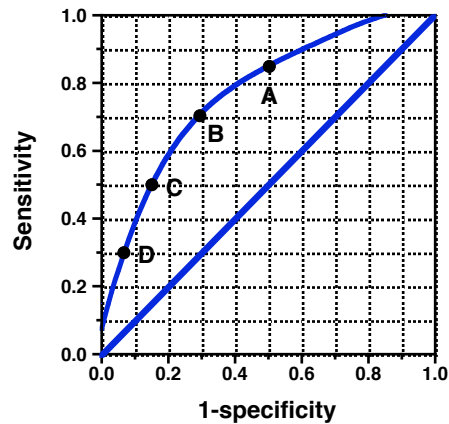
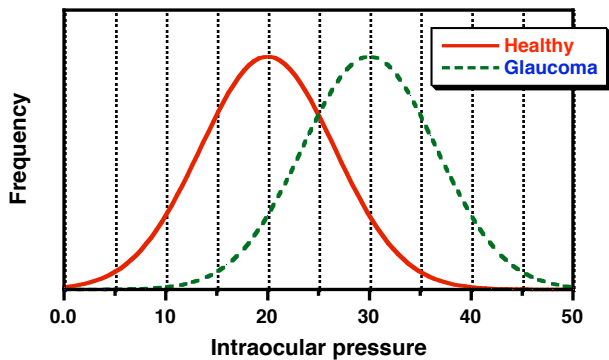
Maximum points = 57

1. When using IOP to screen for glaucoma you must set a diagnostic criterion to decide whether the patient is normal or a glaucoma suspect. If you want to detect as many true glaucoma patients as possible your criterion should be
 - a. lax, that is a low IOP.
 - b. moderate; that is a mid-range IOP.
 - c. strict; that is a high IOP.
 - d. lax for normals but strict for glaucoma suspects.

2. What is a disadvantage of having too strict of a criterion?
 - a. Too many false alarms
 - b. Too many hits
 - c. Too many misses
 - d. Too few correct rejections

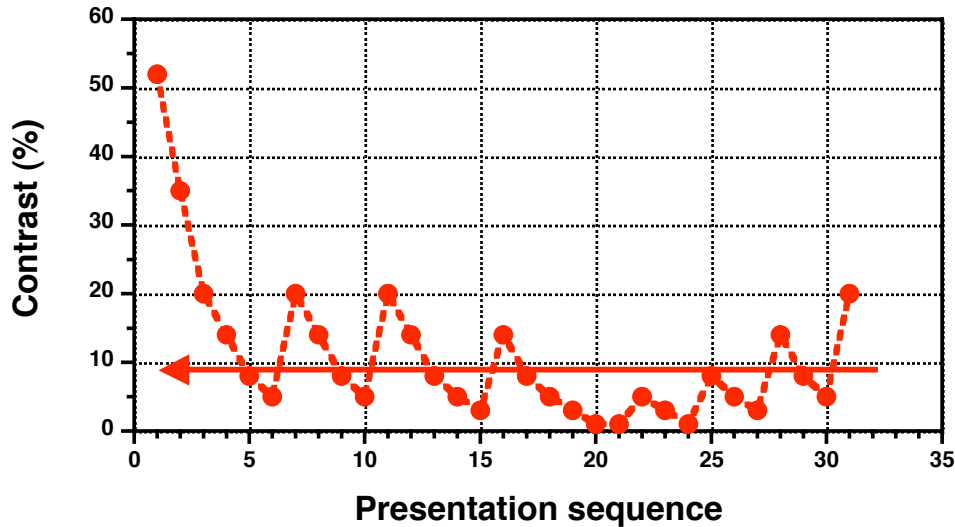
3. Refer the figures below. If you want to screen for glaucoma with a sensitivity of 85% and specificity of 50%, which IOP value should you use as your diagnostic criterion?
 - a. 15
 - b. 20
 - c. 25
 - d. 30

4. Which point on the ROC curve most closely corresponds to an IOP criterion of 35?
 - A
 - B
 - C
 - D



5. Assume that a scientist is comparing four different screening tests (A-D) for glaucoma by computing the area under the ROC curve for each. Which value indicates the best test?
 - a. 1.5
 - b. 0.9
 - c. 0.5
 - d. 0.0

6. How does the Humphrey Matrix frequency doubling technology perimeter work to isolate the magnocellular ganglion cells from the parvocellular neurons?
- The parvo non-linear response doubles the frequency seen by the magnocellular system.
 - The grating flickers so rapidly that it cannot be temporally resolved the parvo system.
 - The counter-phase flickering grating is fused into a uniform gray field by the parvo system.
 - Both b and c work together.



7. The graph above plots the results of a contrast threshold experiment. Which of the following is the best estimate of the threshold?
- < 1%
 - 3%
 - 10%
 - 20%
8. If a patient experiences simultaneous contrast, what color should a gray field appear to be if a highly saturated yellow field surrounds it?
- Reddish gray
 - Yellowish gray
 - Greenish gray
 - Bluish gray
9. Which of the following best supports the principle that letter size from line to line in visual acuity charts should change in proportion to the log of the visual angle?
- Size constancy
 - Shape constancy
 - Direct scaling
 - Fechner's law

Reference formulas

$$J_{45} = -\frac{C}{2} \sin(2A)$$

$$M = S + \frac{C}{2}$$

$$J_{180} = -\frac{C}{2} \cos(2A)$$

$$C = -2\sqrt{J_{45}^2 + J_{180}^2}$$

$$S = M - C/2$$

$$A = \frac{1}{2} \tan^{-1} \left(\frac{J_{45}}{J_{180}} \right)$$

$$J_{45} = (-2\sqrt{6}/y^2) C_2^{-2}$$

$$M = (-4\sqrt{3}/y^2) C_2^0$$

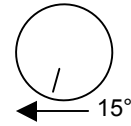
$$J_{180} = (-2\sqrt{6}/y^2) C_2^2$$

10. Use the following data to estimate the true corneal plane refraction needed by this eye, then answer the question below.

Biomedics Toric CL on the eye, power = $-3.00 -0.75 \times 180$

Rotation: 15° clockwise

COAS over refraction: $+0.21 -0.88 \times 022$



What contact lens power should you order for this eye? (3)
(sphere, cyl, closest 0.25 diopters; axis closest 10°)

$-3.00 - 1.25 \times 020$ (with 15° clockwise rotation)

11. An aberrometer reports the following values (in μm) for an eye's second-order aberrations: $C_2^{-2} = -0.33$, $C_2^0 = 2.25$, $C_2^2 = -0.43$ (5.0-mm diameter pupil). Convert this to the equivalent sphere, cylinder and axis. (sphere, cyl, within 0.25 diopters; axis within 10°) (3)

$-2.07 -0.85 \times 019$

12. What was the mean total higher-order RMS expected 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.**

13. 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

14. Assume that an eye's higher-order aberrations consist of $0.12 \mu\text{m}$ in each third-order mode, plus $0.18 \mu\text{m}$ of Z_4^0 only. Calculate the total higher-order RMS for this eye to the nearest $0.1 \mu\text{m}$.

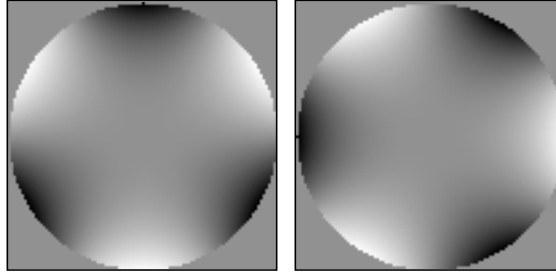
- a. < 0.05
- b. 0.1
- c. 0.2
- d. 0.3**

15. 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

16. The Humphrey Visual Field Analyzer projects a white spot with a maximum luminance of 10,000 apostils onto the background. It uses neutral density filters to adjust brightness of the spot below 10,000 apostils. What luminance value, in nits, corresponds with a setting of 23 decibels?

- a. 15**
- b. 50
- c. 150
- d. 200



Figures for Question 17

17. The figures above show wavefront maps of two Zernike modes. They have the same shape, but are rotated with respect to each other. Name the aberration and which Zernike order it comes from.

- a. Coma; third order
- b. Trefoil; third order
- c. Spherical aberration; fourth order
- d. Astigmatism; third order

18. Which of the following gives about the correct extent of the normal visual field in the superior (S), nasal (N), inferior (I) and temporal (T) directions?

	S	N	I	T
a.	70	60	50	90
b.	50	60	70	90
c.	90	60	90	90
d.	90	80	70	60

19. 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. If a value of 0.0 decibels corresponds to a perfect score (100%), what percentage value would correspond to a -1.0 decibel score?

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

20. 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.

21. 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, only if the spot size is less than 10 arc minutes in size.
- b. Yes, only if both lights are presented within the critical duration.
- c. Yes for all wavelengths since radiance and luminance are synonymous.
- d. No

22. A Lambertian surface is illuminated by 1,000 lux, and it produces a luminance of 160 nits. What is the reflectance of the surface?
- 5%
 - 15%
 - 50%
 - 85%
23. Which of the following decreases as you move away from a luminous object (light source)?
- Radiant power of the source
 - Luminance measured by a "nit-picker"
 - Retinal illumination
 - Illumination
24. On a logMAR visual acuity chart letter, size doubles every _____ line(s). (How many lines?)
- one
 - two
 - three
 - four
25. After 15 minutes of dark adaptation what percentage of rod photopigment will have regenerated?
- 50%
 - 75%
 - 88%
 - 94%
26. According to Ricco's Law, for spot diameters smaller than the critical diameter, the intensity (quanta/area) of the spot necessary for detection
- must increase for smaller spot diameters.
 - must decrease for smaller spot diameters.
 - must remain constant for all spot diameters (within the critical diameter).
 - is unrelated to spot diameter.
27. According to Bloch's Law, for durations within the critical duration, the product of intensity (quanta/time) and time
- must increase with increasing duration.
 - must remain constant (within the critical duration).
 - must decrease with increasing duration.
 - is unrelated to duration.
28. What is an advantage of using sine-wave rather than square-wave gratings to measure the MTF of an optical system?
- Sine wave gratings are the clinical standard for visual acuity testing.
 - Square wave gratings can only have a contrast of 1.0.
 - Square wave gratings contain only a single spatial frequency.
 - Sine wave gratings allow test a single spatial frequency at a time.
29. Suppose you want to include a photograph on your web page, but it is slightly blurry. Which of the following techniques would give the photograph a sharper appearance?
- Decrease the contrast
 - Increase the size
 - Decrease the size
 - Low-pass filter it

30. Under ideal conditions, Vernier acuity thresholds are about

- a. 2-10 arc seconds.
- b. 2-10 arc minutes.
- c. 2-10 prism diopters.
- d. 2-10 degrees.

31. If the center-to-center distance between two adjacent cones is $2.6 \mu\text{m}$, and one degree on the retina spans $312 \mu\text{m}$, what is the Nyquist limit, in terms of Snellen acuity, for this retina?

- a. 20/40
- b. 20/20
- c. 20/10
- d. 20/5

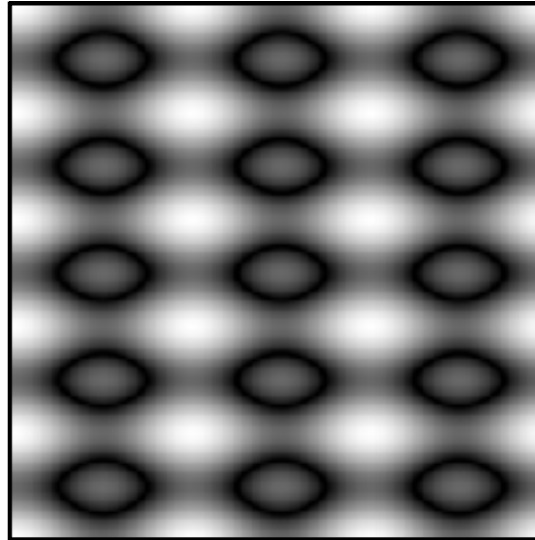
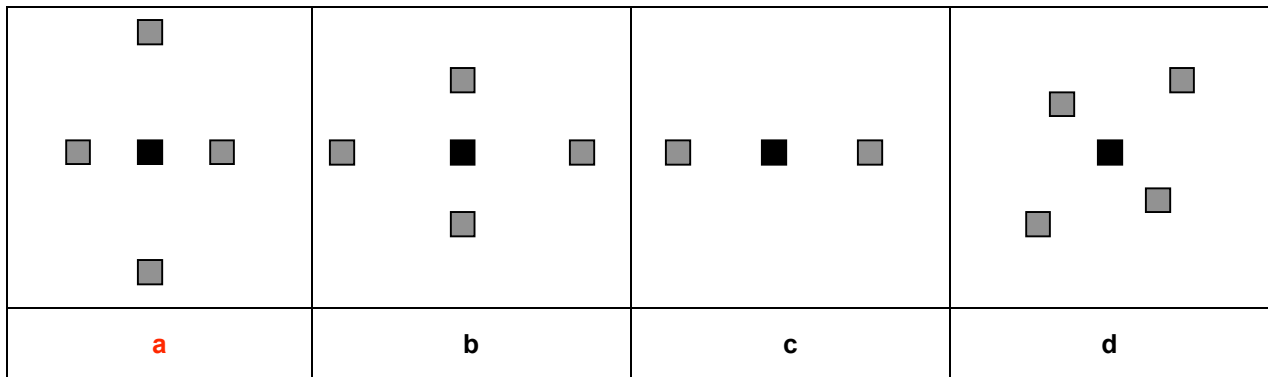


Figure for Question 32.

32. Which of the choices below best represents the spatial frequency spectrum (center portion) corresponding to the figure above? Circle the letter indicating the best choice.



33. A vision test consists of several rows of low contrast Sloan letters that gradually decrease in size as you go down. This chart is most likely designed to test

- a. high contrast visual acuity.
- b. low contrast visual acuity.
- c. contrast sensitivity.
- d. modulation transfer function.

34. The temporal modulation transfer function provides information about the visual system, including all of the following, except one. Which one?
- The frequency (in Hz) at which the eye can best see flicker.
 - The duration (in seconds) for which a single flash of fixed radiant power appears brightest.**
 - For a low temporal contrast the fastest flicker that a person can see.
 - For a low temporal contrast the slowest flicker that a person can see.
35. According to the Ferry-Porter law, the CFF
- is directly proportional to stimulus luminance.
 - is directly proportional to the log of the stimulus luminance.**
 - is inversely proportional to the log of the stimulus luminance.
 - increases as the log of stimulus area.
36. Which of the following correctly describes the relationship between the size of a flashing light (of fixed radiant power) and how well a person can see high frequency flicker?
- As a flashing light gets smaller, the flicker will be easier to see.
 - The fastest flicker that a person can see remains constant for flashing lights of any size.
 - As a flashing light gets larger, the flicker will be easier to see.**
 - As a light becomes dimmer at the same time it becomes smaller, the flicker becomes easier to see.
37. According to the Broca-Sulzer effect
- the longer a light (with fixed radiant power) is left on, the brighter it appears to become.
 - lights that enters the peripheral pupil appears dimmer than light entering the center.
 - a light that is flashed on for about 75 msec will look slightly less bright than a steady light of the same radiant power.
 - a light that is flashed on for about 75 msec will look slightly brighter than a steady light of the same radiant power.**
38. How does the frequency affect the perceived brightness of a flickering light with fixed radiant power?
- It will be constant for all rates of flicker below the CFF only.
 - It will be constant for all rates of flicker above and below the CFF
 - It appears brightest if flickered at a frequency of about 10 Hz.**
 - It appears to get brighter the faster it is flickered.
39. According to the Talbot-Plateau law, how will the brightness of a light that is flickering above the CFF compare to a steady non-flickering light, which has the same radiance?
- The flickering light will appear dimmer.**
 - The flickering light will have the same brightness.
 - The flickering light will appear brighter.
 - None of the above.
40. Assume that a patient has pupil diameters of 4.0 mm for OD and 6.0 mm for OS and normal color perception. What he should notice when looking at a green light? Compared to the appearance seen by OD, the light seen by OS should appear ...
- brighter and yellower.**
 - brighter and bluer.
 - darker and yellower.
 - darker and bluer.

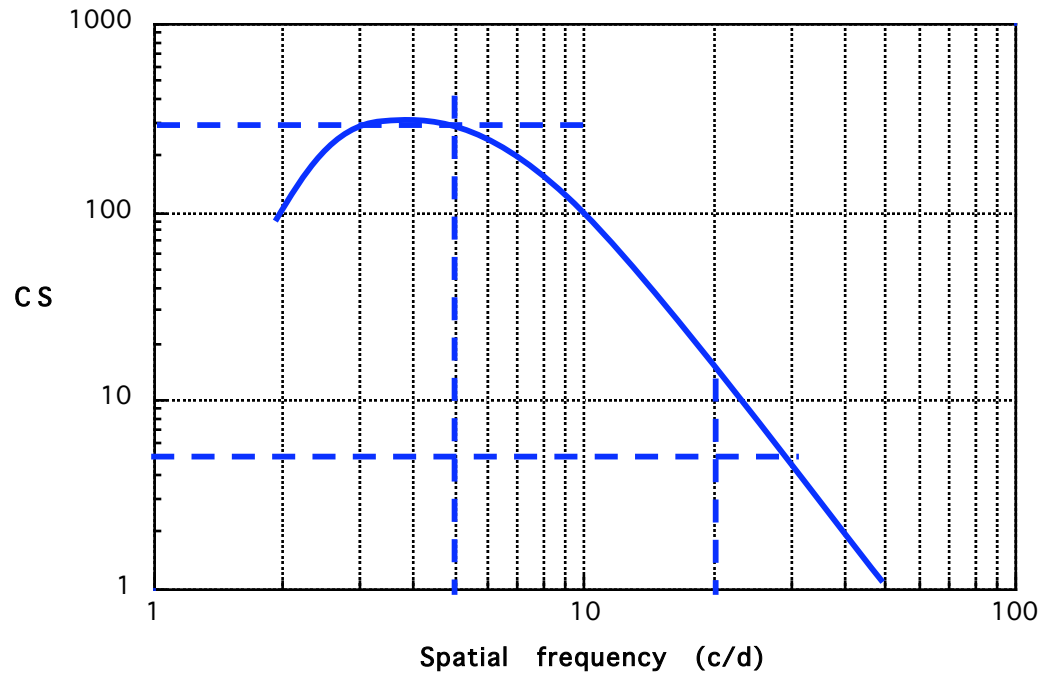
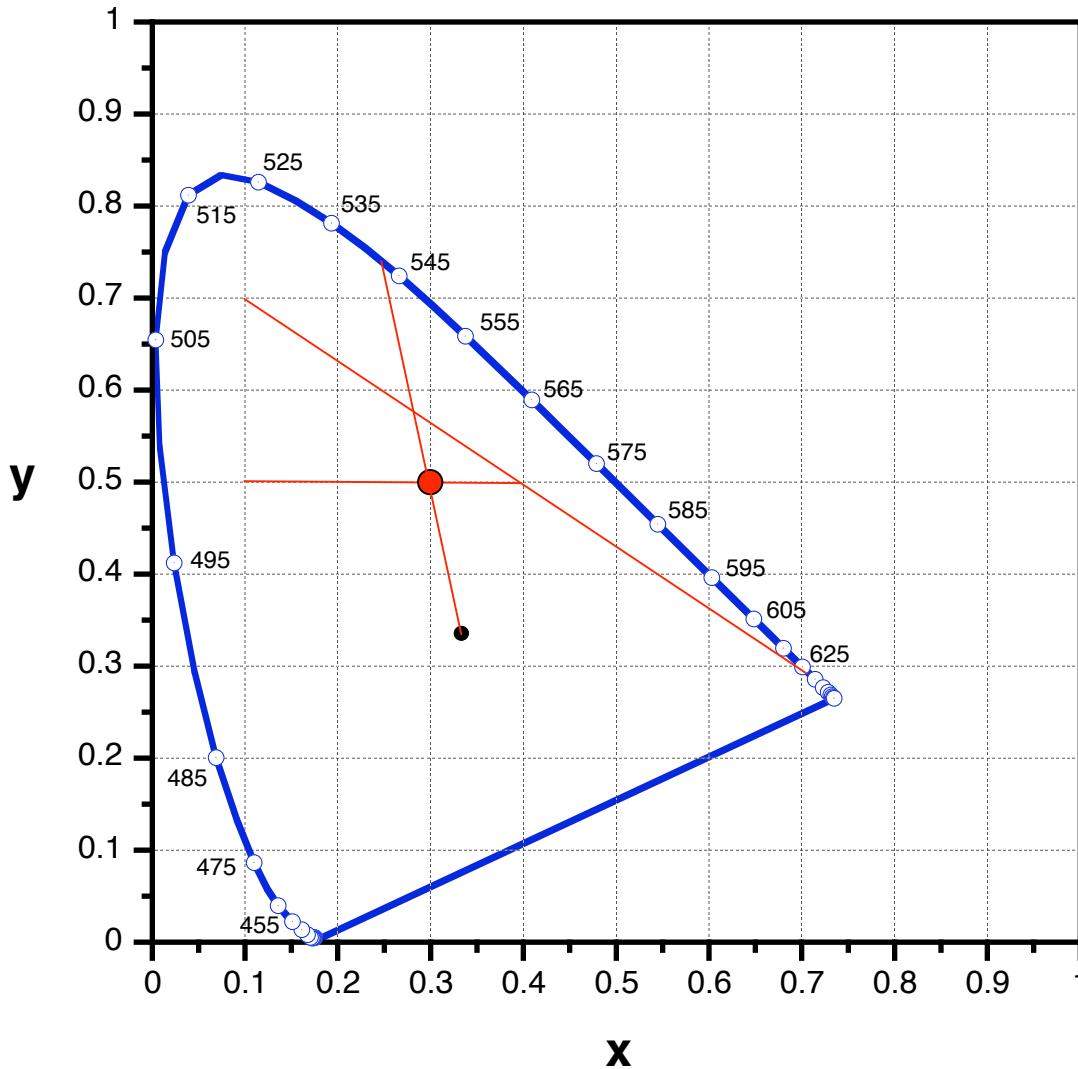


Figure for Questions 41-44.

41. Based on the information in the figure above, what is the Snellen-equivalent high-contrast visual acuity?
- 20/50
 - 20/30
 - 20/20
 - 20/12
42. What would the visual acuity be if a 7%-contrast chart were used?
- 20/50
 - 20/30 **Originally marked answer was wrong. Sorry, b is correct. Everyone gets 1 more point back.**
 - 20/20
 - 20/12
43. What is the contrast threshold for a target that has a size equivalent to 20/120?
- 0.25% **Oops! I got it wrong—sorry. The answer is 0.33%. Everyone gets 1 point back.**
 - 0.5%
 - 1.0%
 - 2.0%
44. What is the largest target, in terms of Snellen equivalent, that could be seen with a contrast of 1%?
- 20/60
 - 20/120
 - 20/200
 - 20/300



45. Calculate the color that would result from an equal mix of the following three colors:

- Hue = 625 nm, excitation purity = 1.0
- Color with (x, y) coordinates = (0.1, 0.7)
- Color with (x, y) coordinates = (0.1, 0.5)

What are the chromaticity coordinates of the resultant color?

- a. (0.2, 0.5)
- b. (0.3, 0.5)
- c. (0.4, 0.5)
- d. (0.5, 0.4)

46. What is the dominant wavelength for the resultant of the mix in Question 45? (You must get the correct answer in Question 45—no partial credit this time.)

- a. 510 nm
- b. 543 nm
- c. 566 nm
- d. 589 nm

47. What is the excitation purity of the resultant for the mix in Question 45? (You must get the correct answer in Question 45—no partial credit this time.)
- 0.2
 - 0.3
 - 0.4
 - 0.5
48. How can the Nagel anomaloscope diagnose a red-green dichromat from a patient with normal color vision?
- The dichromat will prefer a red-strong mixture, with the correct luminance.
 - The dichromat will prefer a green-strong mixture, with the incorrect luminance.
 - The dichromat can accept any mixture, and the luminance may vary.
 - The anomaloscope cannot diagnose red-green dichromats, but only deuterans and protans.
49. How will the anomaloscope setting for a protan differ from a deutan?
- The protan will accept an abnormal luminance setting, but the deutan will not.
 - The deutan will accept an abnormal luminance setting, but the protan will not.
 - The protan will accept an abnormal mixture setting, but the deutan will not.
 - The deutan will accept an abnormal mixture setting, but the protan will not.
50. How will the anomaloscope setting for a red-green anomalous trichromat differ from a red-green dichromat?
- All red-green trichromats prefer a red-strong mix.
 - All red-green trichromats prefer a green-strong mix.
 - All red-green trichromats prefer a blue-strong mix.
 - All red-green trichromats will prefer either a red-strong or green-strong mix.
51. The standard ERG test would be most useful in diagnosing which of the following?
- Optic neuritis
 - Retinitis pigmentosa
 - Stargardt's disease
 - Pinguecula
52. The VER test would be most useful in diagnosing which of the following?
- Optic neuritis
 - Retinitis pigmentosa
 - Peripheral retinal hole
 - Pinguecula
53. In the VER test, where are the three electrodes placed?
- Forehead, earlobe, cornea
 - Forehead, earlobe, occipital scalp
 - Forehead, cornea, occipital scalp
 - Forehead, earlobe, top of head

Dear Class of 2010,

I have enjoyed getting to know you and working with you this semester. Thank you for your hard work and interest in Vision Science II. I hope you persevere through the remainder of finals week, then enjoy a well deserved rest over Christmas break. Merry Christmas!

-- Dr. Salmon

