

## Vision Science II - Monocular sensory aspects of vision

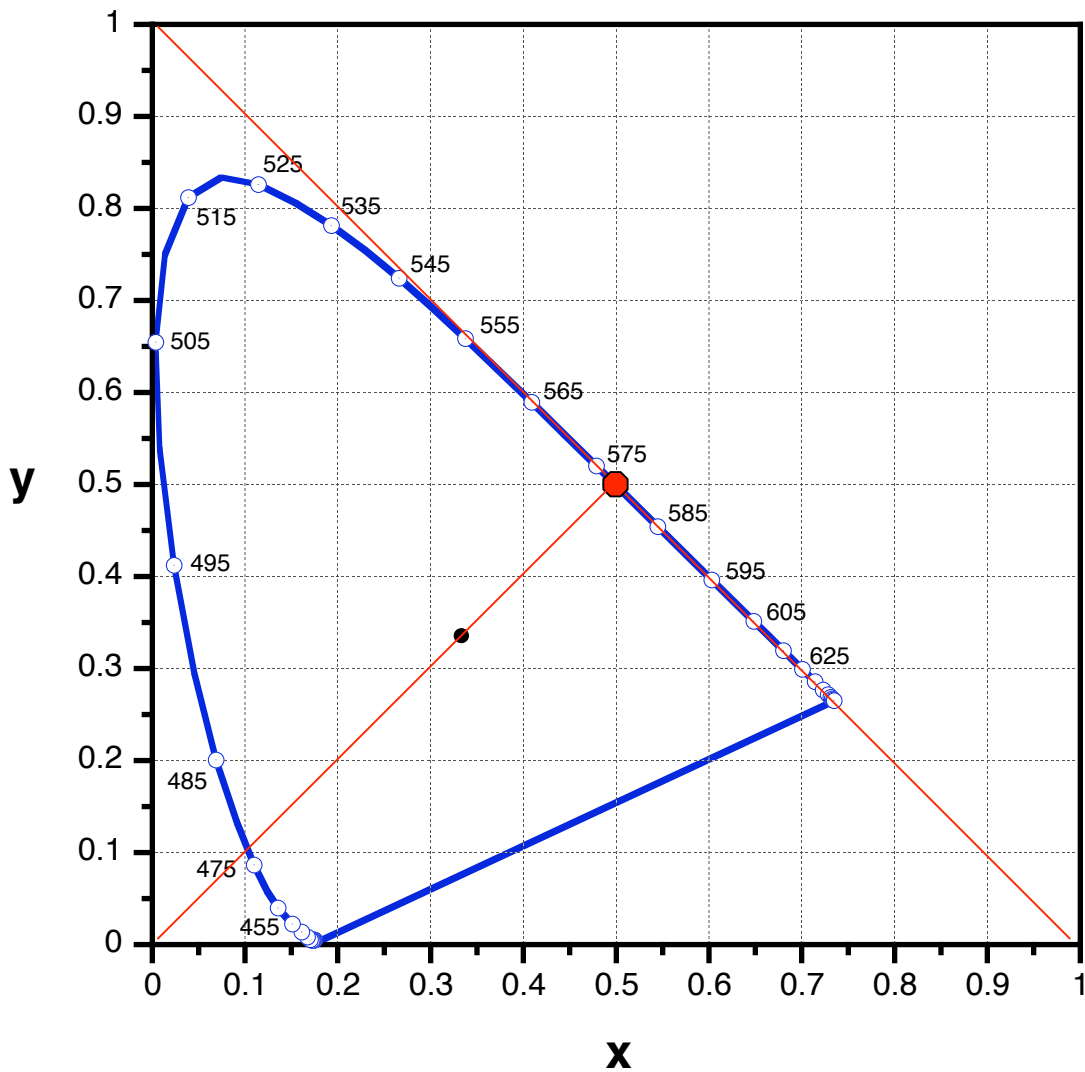
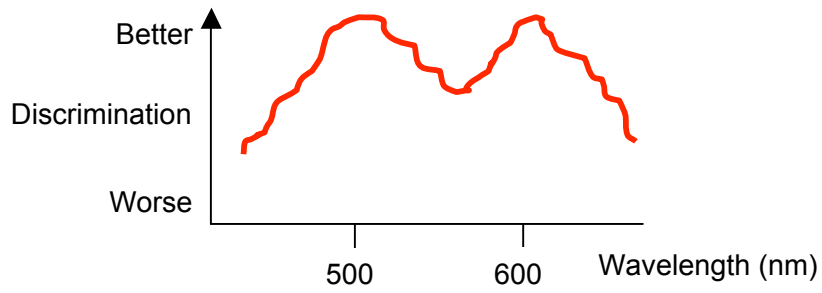
**Exam 3**

11/30/07

Total points = 52

1. Which of the following is most consistent with the trichromatic theory of color vision?
  - a. **The 3 cones types have different, broad and overlapping absorption spectra.**
  - b. There are 3 cones types, one each for monochromatic red, green or blue light.
  - c. There are 3 cones types, one each for hue, saturation, and brightness.
  - d. The visual system 3 pathways, two are color opponent and one is non-opponent.
  
2. A metamer is best described as a pair of stimuli with ...
  - a. identical wavelength content but different color appearances.
  - b. **different wavelength content but identical color appearances.**
  - c. identical wavelength content and identical color appearances.
  - d. different wavelength content and different color appearances.
  
3. 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 ...
  - a. darker and bluer.
  - b. brighter and bluer.
  - c. darker and yellower.
  - d. **brighter and yellower.**
  
4. Which of the following phenomena best explains the difference in the appearances mentioned in Question 3?
  - a. color constancy
  - b. simultaneous color contrast
  - c. **Bezold-Brücke phenomenon**
  - d. CIE chromaticity
  
5. Even if all of the following colors have a colorimetric purity (or excitation purity) equal to 1.0, which would appear to have the least relative saturation?
  - a. 450 nm violet
  - b. 500 nm blue
  - c. **570 nm yellow**
  - d. 620 nm red
  - e. They would all appear to be equally saturated.
  
6. If all of the following have the same radiance, which wavelength would appear darkest to a protanope?
  - a. 450 nm violet
  - b. 500 nm blue
  - c. 570 nm yellow
  - d. **620 nm red**
  - e. They would all appear to have equal brightness.

7. Complete the following graph to show the general shape of the wavelength discrimination function for a normal eye. (2)



If necessary, use this chromaticity diagram for Questions 8-12.

8. Calculate the color that would result from an equal mix of pure primary X and pure primary Y. What are its chromaticity coordinates? (2)

(0.5, 0.5)

9. What is the dominant wavelength of this color? (1)

About 577 nm

10. What is its excitation purity? (1)

1.0

11. Next, add to this, another color that has chromaticity coordinates (0, 0), so that the final mix contains equal amounts of the three colors. What are the chromaticity coordinates of the final mix? (2)

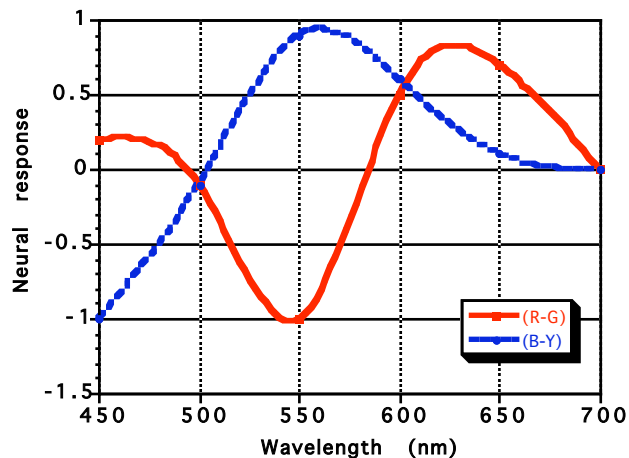
(0.33, 0.33)

12. What is its excitation purity? (1)

0

13. What color would this appear to be? (1)

white



14. The figure above plots the neural response of two color opponent channels. Which of the following best describes the signal the brain would receive when the subject looks at a monochromatic light with a wavelength of 550 nm?

- a. Excitation of both channels.
- b. Inhibition of both channels.
- c. Excitation of the R-G channel and inhibition the B-Y channel.
- d. Inhibition of the R-G channel and excitation the B-Y channel.

15. List five characteristics that may be found in an acquired color anomaly that are not usually seen in a hereditary color anomaly. (5)

- Could be blue/yellow
- Monocular or asymmetric
- Recent onset and progressive
- Color naming errors more common
- Other ocular symptoms or indications of disease
- Female
- Defective color but hard to diagnose as protan, deutan or tritan

16. Assume that you see an average of 20 patients a day, half of them male. Based on the incidence of hereditary color anomalies, how many men with some sort of protan or deutan defect should you expect to see in a typical 5-day work week?

- a. 2
- b. 4
- c. 6
- d. 8

17. Which of the following statements about Köllner's Rule is not correct?

- a. Glaucoma follows Köllner's Rule and produces red-green anomalies.
- b. Köllner's Rule is hard to apply clinically because it has exceptions.
- c. Diseases of the choroid, outer retina and ocular media cause blue-yellow defects.
- d. Diseases of the inner retina or optic nerve cause red-green defects.

18. Briefly explain why some elderly patients experience cyanopsia after cataract surgery. (2)

- Cataracts absorbs short wavelengths more.
- Patient adapts to blue-deficient vision.
- After cataract surgery, the retinas receive more short wavelength light.
- The patient suddenly receive much more blue light than he is used to.

19. If a male congenital protanope marries a woman who does not carry a gene for protanopia, what is the probability that, if she has a son, he will be a protanope?

- a. 0%
- b. 12.5%
- c. 25%
- d. 50%
- e. 100%

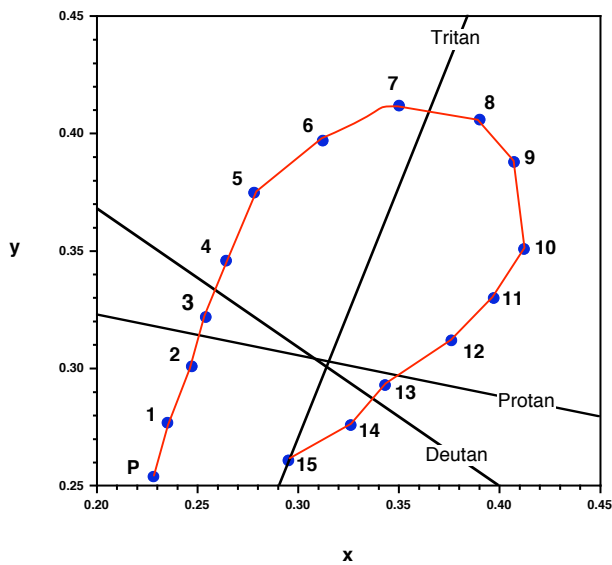
20. If the male and female children of the couple described above marry mates who do not carry a gene for protanopia, what is the probability that one of the grandchildren will be a protanope?

- a. 0%
- b. 12.5%
- c. 25%
- d. 50%
- e. 100%

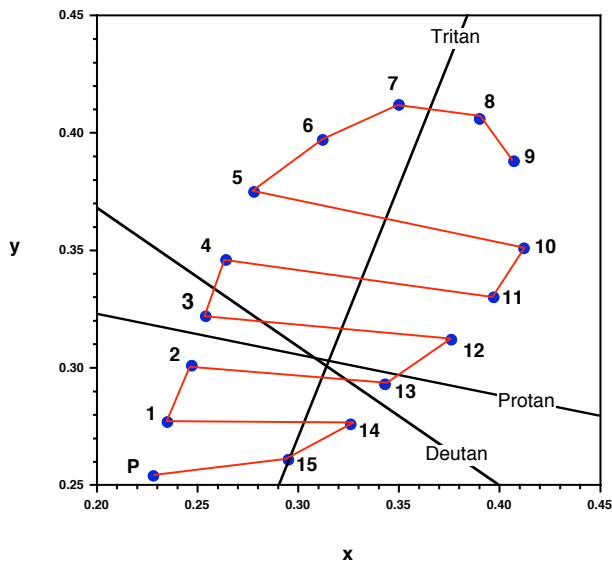
21. Describe the testing conditions, procedure and expected response for the HRR color vision test. Assume that the patient has medium deuteranomaly. (6)

- Use Standard illuminant C
- Test eye separately (monocularly)
- Start with the 6 screening plates. He should get error in the R-G section.
- Test with the R-G diagnostic series. Record correct responses in the protan or deutan column.
- The column labeled, "deutan" will have more checks.
- The last errors will be in the middle section.

22. The figure below shows the central area of a CIE chromaticity diagram and plots the colors used in the D-15 test. Draw in the test results you would expect for a patient who passes the D-15 test with no errors. (1)



23. Using the figure below, plot an example showing test results for a protanope. (2)



24. What are the diagonal reference lines shown on the D-15 plots called?

- a. Hue contour lines
- b. Color confusion lines
- c. Excitation purity lines
- d. Complementary lines

25. What should you do if a patient has a borderline or equivocal result with the D-15 test?

- a. Diagnose him as having normal color vision. No follow up is necessary.
- b. Diagnose him as having a color anomaly. No treatment or follow up is necessary.
- c. Refer him to an ophthalmologist, preferably Dr. Castillo.
- d. Retest him on another day to validate results and check for progression.

26. How can the Nagel anomaloscope differentiate between a normal trichromat and a red-green dichromat (either protanope or deuteranope)? (1)

The trichromat will select only one specific color mix. The dichromat can accept any color mix.

27. How would the Nagel anomaloscope settings for a protan and deutan differ? (1)

When the mixture is shifted toward a red-strong mix, the protan will set the brightness to a lower-than-normal setting. If the mixture is green strong, he will set the brightness higher than usual. The deutan has normal brightness settings.

28. How can the Nagel anomaloscope differentiate between a deuteranope and a deuteranomalous trichromat? (1)

The deuteranope can accept any mixture setting. The deuteranomalous trichromat will prefer a mixture that is slightly stronger in the green direction.

29. How can the Nagel anomaloscope differentiate between a protanope and a protanomalous trichromat? (1)

The deuteranope can accept any mixture setting. The deuteranomalous trichromat will prefer a mixture that is slightly stronger in the red direction.

30. The EOG test would be most useful in diagnosing which of the following? (1)

- a. optic neuritis
- b. retinitis pigmentosa
- c. Stargardt's disease
- d. pinguecula

31. The standard ERG test would be most useful in diagnosing which of the following? (1)

- a. optic neuritis
- b. retinitis pigmentosa
- c. Stargardt's disease
- d. pinguecula

32. The VER test would be most useful in diagnosing which of the following? (1)

- a. optic neuritis
- b. retinitis pigmentosa
- c. peripheral retinal hole
- d. pinguecula

33. Name another use for the VER test. (1)

- Estimate visual acuity in a baby or patient who can't communicate
- Malingering
- Evaluate progress in VT for an amblyope
- Evaluate processing speed of the visual system

34. In the ERG test, three electrodes are attached to the patient, including one on the forehead and one on the earlobe. Where is the third electrode placed? (1)

Corneal contact lens

35. In the VER test three electrodes are attached to the patient, including one on the forehead and one on the earlobe. Where is the third electrode placed? (1)

Scalp, occipital region

36. When recording from a single cell in a cat retina, we observe a continuous burst of action potentials when the center is illuminated and silence when the surrounding region is illuminated. In addition, the receptive field is relatively small. The electrode was probably recording from what kind of neuron? (1)

- a. cone
- b. horizontal cell
- c. magnocellular ganglion cell
- d. parvocellular ganglion cell

37. Which of the following best summarizes a key biochemical event in the process of phototransduction?

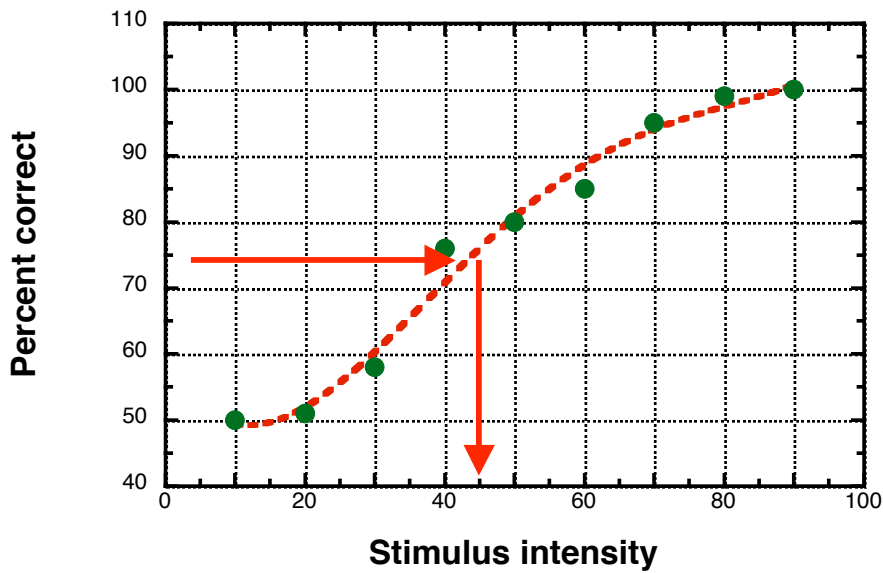
- a. Cyclic GMP clusters break up, sodium pores open, sodium influx, depolarization
- b. Cyclic GMP clusters break up, sodium pores open, sodium influx, depolarization
- c. Cyclic GMP clusters reconstitute, sodium pores open, sodium diffuses out, hyperpolarization
- d. Cyclic GMP clusters break up, sodium pores close, sodium influx stops, hyperpolarization

38. Which of the following best describes the two main retino-cortical parallel pathways?

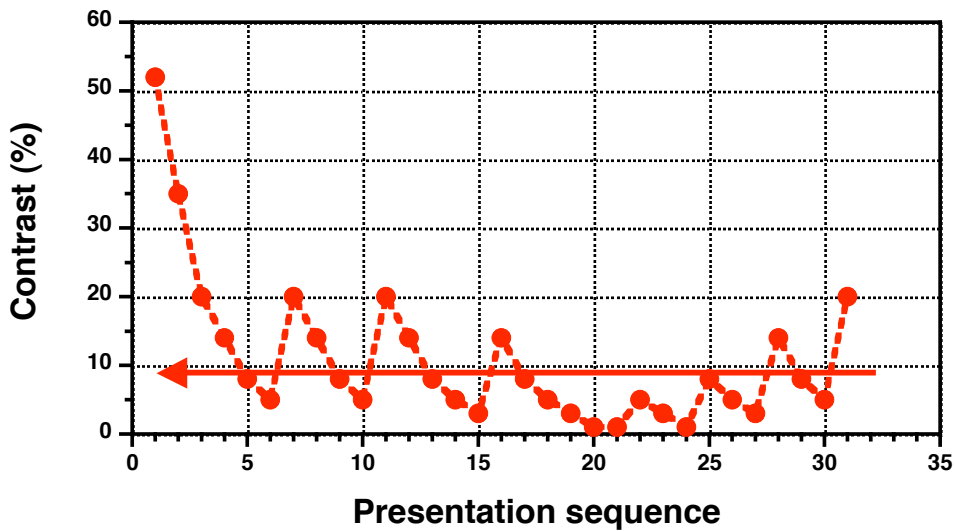
- a. Cones send input to the parvo pathway; rods send input to the magno pathway.
- b. Rods send input to the parvo pathway; cones send input to the magno pathway.
- c. Central retinal cones send input to the parvo pathway; peripheral cones send input to the magno pathway.
- d. Central cones send input to the magno pathway; peripheral cones send input to the parvo pathway.

39. Which of the following statements does *not* explain part of the theoretical basis for frequency doubling perimetry?

- a. The target's flicker frequency exceeds the parvocellular CFF, and is not temporally resolvable by that neural pathway.
- b. The counter-phase flickering grating is linearly summed over time by the parvocellular system, and it perceives a uniform gray field (no gratings).
- c. The flicker frequency is sub-CFF for the magnocellular system and is therefore resolvable by that neural pathway.
- d. The magnocellular's non-linear response causes an apparent doubling of the sine-wave grating's temporal frequency, so it appears to flicker twice as fast.
- e. This is essentially a contrast sensitivity task, and glaucoma will cause a decrease in contrast sensitivity.



40. The results of a vision experiment are graphed above. What is the best estimate of the threshold?
- a. 45
  - b. 50
  - c. 62.5
  - d. 75



41. The graph above plots the results of a contrast threshold experiment. What psychophysical technique was used and what is the threshold?
- a. Constant stimuli; 50%
  - b. Adjustment; 20%
  - c. Descending limits; 10%
  - d. Staircase; 10%