PIN or Name _____

Vision Science II – Monocular sensory aspects of vision

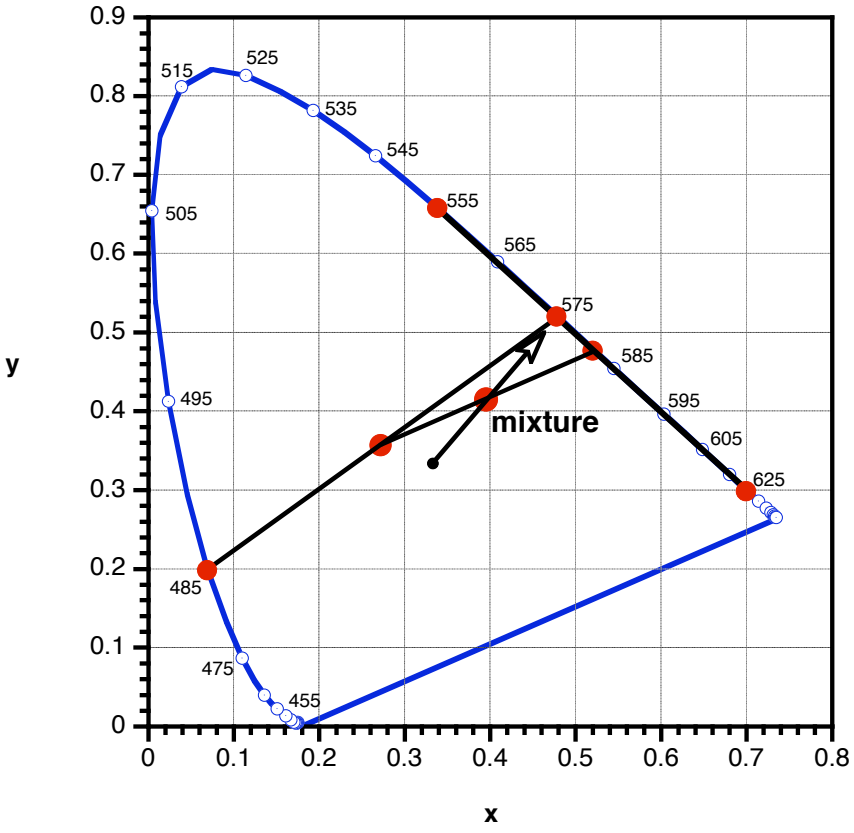
Exam 3 – Color vision, electrodiagnostics, retinal electrophysiology

Maximum points = 50

11/15/06

1. Computer monitors can display millions of different colors using microscopic lights with three primary hues. Specify by wavelength, the three primary hues that should be used to create the greatest range of colors. Explain the logic for your choice of primary hues. (2)

Based on color mixing and the CIE chromaticity diagram, you should select hues (represented by 3 points on the CIE diagram) that, when connected by lines, enclose the largest possible area. For example, 460, 520 and 650 nm.



2. Using the CIE chromaticity diagram above, calculate the color that results from an equal mix of the following four wavelengths: 625 nm red, 555 nm green, 485 nm blue and 575 nm yellow. Indicate your answer on the diagram above. (1)

3. What is the dominant wavelength for this mixture? (1) **~575 mm**

4. What is its excitation purity? (1) **About 0.4 or 0.5**

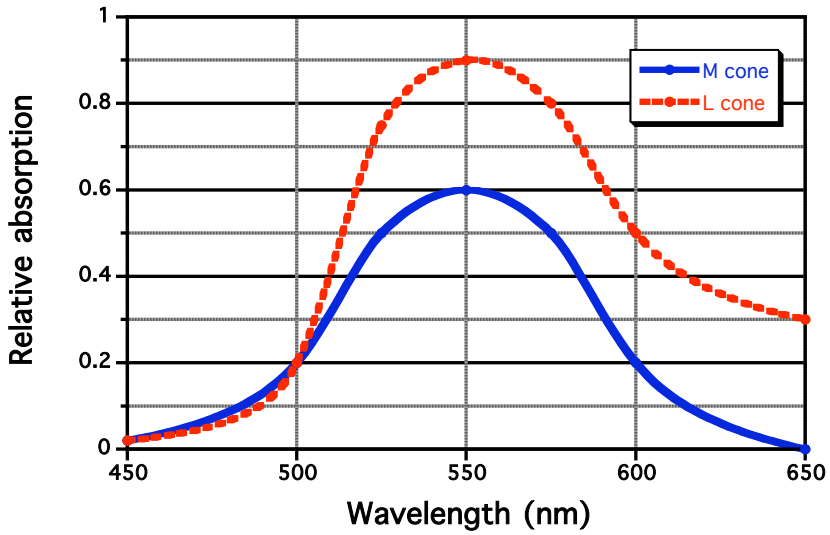
5. What color should result from an equal mix of a pure spectral hue and its complement? (1)

White or very close to white

6. What is the difference between tristimulus values and chromaticity coordinates in the CIE system? (2)

Tristimulus values tell the amount of primary X, Y, and Z that must be mixed together to match each wavelength hue. Chromaticity coordinates give the proportion of each primary in the total mix.

7. A subject views two patches of light. One patch consists of an additive mixture of 475 and 510 nm, and the other patch consists of an additive mixture of 490 and 420 nm. By adjusting the intensities of the four wavelengths the subject is able to perfectly match the two patches. The subject … (1)
a. must be a monchromat.
b. must be a dichromat.
c. must be a trichromat.
d. could be any of the above.



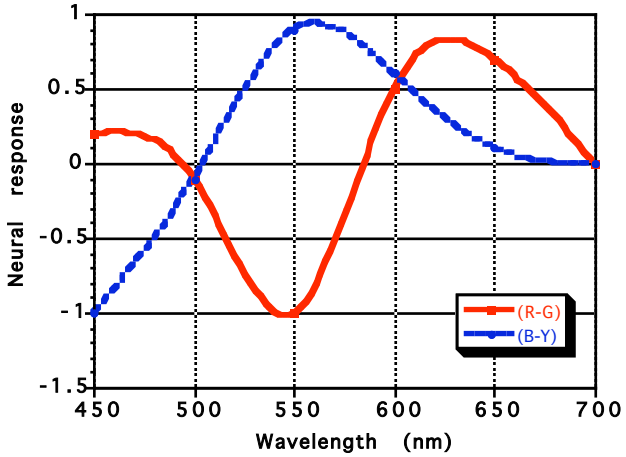
8. Refer to the figure above, which shows the relative absorption of two hypothetical cone photopigments. In a color-matching experiment, the subject adjusts the intensities of 500- and 600-nm monochromatic lights, which are mixed, to match 550 nm light. Which of the following statements best describes this mix? (1)
a. 10 watts of 500 nm + 10 watts of 600 nm will look identical to 10 watts of 550 nm light.
b. 20 watts of 500 nm + 10 watts of 600 nm will look identical to 10 watts of 550 nm light.
c. 10 watts of 500 nm + 20 watts of 600 nm will look identical to 10 watts of 550 nm light.
d. 30 watts of 500 nm + zero watts of 600 nm will look identical to 10 watts of 550 nm light.

9. The Munsell color appearance system describes any color in terms of three basic parameters, each of which can be though of as one dimension in a three-dimensional cylindrical coordinate system. List and briefly define the three terms. (3)

hue = hue or the feature of color most closely assocatiated with a particular wavelength
chroma = saturation or purity of the color
value = brightness

10. How will the perceived hue of a monochromatic green light (525 nm) change as its luminance is increased? It will … (1)
a. gradually shift toward yellow.
b. gradually shift away from yellow.
c. gradually desaturate into white.
d. remain invariant.

11. How will the perceived hue of a monochromatic blue-green light (490 nm) change as its luminance in increased? It will … (1)
a. gradually shift toward blue.
b. gradually shift away from blue.
c. gradually desaturate into white.
d. remain invariant.



12. 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 450 nm?
a. Strong inhibition of the R-G system and slight excitation of the B-Y system.
b. Slight excitation of the R-G system and strong inhibition of the B-Y system.
c. Slight inhibition of both the R-G and B-Y systems.
d. Strong inhibition of the R-G system with strong excitation of the B-Y system.
e. None of the above.

13. List five characteristics that can be used to differentially diagnose an acquired from a hereditary color anomaly. (5)

An acquired anomaly would have the following characteristics:
- Could be blue/yellow as well as red/green
- Monocular or asymmetric
- Recent onset and progressive
- Color naming errors more common
- Other ocular symptoms or indications of disease
- The patient could be a woman
- Diagnosis as a protan/deutans/tritan might not be clear-cut

14. How would the green and red lights of a traffic signal differ for a protanope, compared to a normal trichromat? (3)

- The green would be brighter than normal.
- The red would be dimmer than normal.
- Both colors would be less saturated.

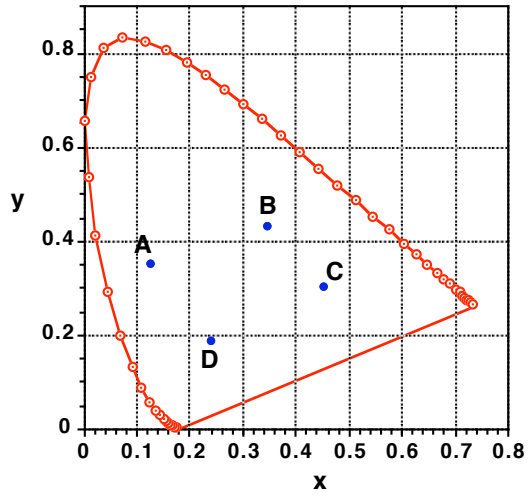
15. What is the prevalence, in percent, of males with a hereditary red-green color vision anomaly? (1)

8%

16. Which of the following color vision anomalies is most common? (1)
a. Tritanopia
b. Tritanomaly
c. Deuteranopia
d. Deuteranomaly
e. Protanopia
f. Protanomaly

17. How does wavelength discrimination for a deuteranope differ from that of a normal trichromat? (2)

Worse-than-normal wavelength discrimination for violets and blues, and no discrimination for wavelengths longer than 540 nm.



18. Refer to the CIE chromaticity diagram above. The copunctal point for a protanope has (x, y) coordinates equal to about (0.73, 0.26). Based on this, which of the colors, indicated by the labeled points on the diagram above, would most likely look the same to a protanope? (1)
a. A and B
b. B and C
c. A and C
d. B and D

19. The neutral point for a protanope is … (1)
a. the wavelength that appears to have no color.
b. near 600 nm.
c. 570 nm yellow.
d. an imaginary color.

20. If the father has hereditary protanomaly, and the mother is not a carrier, what is the probability that a son will inherit the protanomaly? (1)
a. 0%
b. 25%
c. 50%
d. 100%

21. If the father has hereditary deuteranomaly and the mother carries the gene for deuteranomly (but is not a deuteranope herself), what is the probability that a son will inherit the color anomaly? (1)
a. 0%
b. 25%
c. 50%
d. 100%

22. In the same case as described in Question 20, what is the probability that a daughter will have deuteranomaly (and not just be a carrier)? (1)
a. 0%
b. 25%
c. 50%
d. 100%

If you referred to Question 21, the correct answer would be c., 50%.

23. Briefly explain why patients often experience cyanopia following cataract surgery. (2)

- Cataract absorbs short wavelengths, so they become accustomed to blue-deficient vision.
- The IOL passes a more complete spectrum, including more blue light, so they see more blue.

24. According to Köllner's rule, a patient with an acquired R-G anomaly probably has a disease of which of the following tissues? (1)
a. crystalline lens (cataract)
b. retinal nerve fiber layer
c. photoreceptor layer
d. RPE

25. Assume that you evaluate a patient's color vision using your HRR book. List the important steps, from beginning to end, of the testing procedure. Mention the results you expect to see for a mild deuteranomalous trichromat. (3)

- Illuminate the book with Standard Illuminant C and test monocularly
- Test using the screening series (6 plates) first
- He would miss at least one in the R-G section
- Continue test with the R-G diagnostic series
- Record the number seen correctly in the protan or deutan column. The deutan column should have more checks.
- He should have errors only in the top section for a mild defect.

26. Which of the following is the minimum criterion for a definitive (not borderline) failure on the D-15 test? (1)
a. A one-place error
b. A two-place error
c. A cross over
d. Two or more cross overs

27. How can you diagnose whether the person is a protan, deutan or tritan with the D-15 test? (1)

See which reference line that parallels the cross over. It indicates the diagnosis.

28. 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 hereditary color anomaly. No treatment or follow up is necessary.
c. Refer him to someone else who knows more about color vision. (Perhaps Dr. Penisten.)
d. Retest him on another day to validate results and check for progression.

29. 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.

30. 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.

31. 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.

32. 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

33. 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

34. 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

35. Name one other use for the VER test. (1)

Objective estimate visual acuity
Malingering
Evaluate progess in VT for an amblyope
Evaluate processing speed of the visual system

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. parvocellular ganglion cell
b. magnocellular ganglion cell
c. L- or M-cone
d. rod