

Vision Science III – Binocular Vision

Name or PIN _____

Exam 1

4/10/07

Total Points = 66

1. Name three significant benefits of binocular vision. (3)

- Stereopsis
- Larger visual field
- Spare eye

2. How is it possible for a person to have depth perception if he loses one eye? (1)

monocular depth cues.

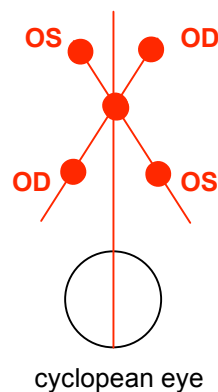
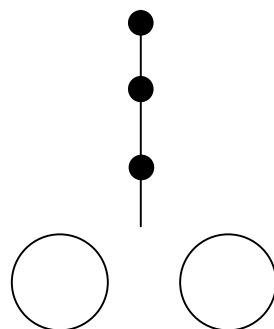
3. During direct ophthalmoscopy you observe the pupil filled with light and a small opacity in the ocular media that appears to move in the same direction as your head. Which of the following is the most likely diagnosis? (1)

- Mittendorf dot
- Corneal opacity
- Cell and flare
- Persistent papillary membrane

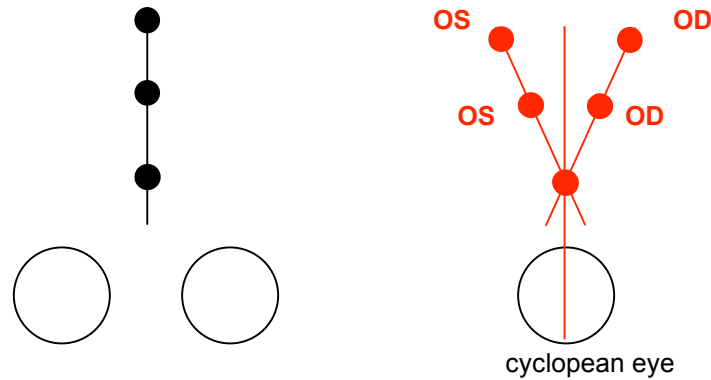
4. The NTSB report on the Delta Flight 554 accident concluded that “... *the probable cause of this accident was the inability of the captain, because of his use of monovision contact lenses, to overcome his misperception of the airplane’s position relative to the runway during the visual portion of the approach.*” Contrary to what they concluded, what facts about binocular vision would indicate that monovision was probably not the primary cause? (3)

- Stereopsis contributes little to depth perception at longer distance
- Monocular depth cues would have been more significant than stereopsis
- Monocular illusions were present that may have conflicted with and superceded stereopsis
- Adverse viewing conditions would have degraded stereopsis
- Stereopsis is degraded only slightly with monocular blur

5. A Brock string consists of a string threaded through several beads, and is a simple tool used to evaluate and train binocular vision. The figure below shows the string in front of the patient viewed from above. Assume a patient with normal binocular vision fixates the middle bead. On the figure to the right, draw what his binocular perception should be relative to the cyclopean eye. Identify which parts of the image would be contributed by OD and OS. (3)



6. Assuming bifoveal fixation on the near bead, draw a figure to illustrate the perception for a person with normal binocular vision. Indicate which portions are seen by the right and left eyes. (3)



7. When adding BI prism OU in the blur/break/recovery test, the target will appear to be straight ahead, as long as both eye are fusing. If the patient begins to suppress OS during the test what should he see? (2)

target begins to move to his right

8. When performing the cover test, the patient notices that the chart appears to jump downward as the paddle moves from OD to OS, and upward when the paddle moves OS to OD. What kind of heterophoria is indicated? (1)

OD hyper or OS hypo

9. When performing the cover test in the case of an exophoria, the chart will appear to the patient to move (1)

- a. in the same direction as the occluder and the eye.
- b. in the same direction as the occluder, but in the opposite direction as the eye.
- c. in the opposite direction to the occluder, but in the same direction as the eye.
- d. in the opposite direction to both the occluder and the eye.

10. When performing the cover test In the case of an esophoria, the chart will appear to the patient to move (1)

- a. in the same direction as the occluder and the eye.
- b. in the same direction as the occluder, but in the opposite direction as the eye.
- c. in the opposite direction to the occluder, but in the same direction as the eye.
- d. in the opposite direction to both the occluder and the eye.

11. At the abathic distance the AFPP horopter coincides with the (1)

- a. point horopter
- b. Vieth-Müller Circle
- c. a line parallel to the facial plane
- d. Circle of least confusion

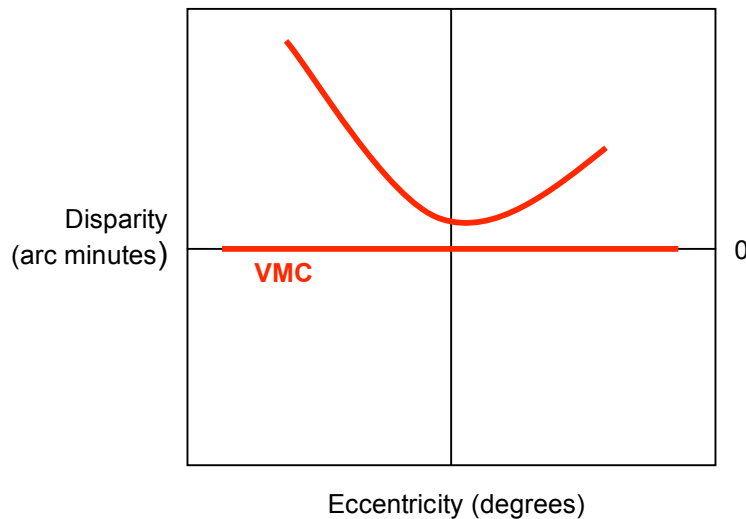
12. All of the following except one can contribute to the Hering-Hillebrand deviation? Which would be least likely to contribute? (1)

- a. binocular summation
- b. unequal image sizes on the two retinas
- c. fixation disparity
- d. asymmetric distribution of local sign across the nasal and temporal retinas

13. Why does the Nonius technique provide the truest estimate of the horopter? (1)

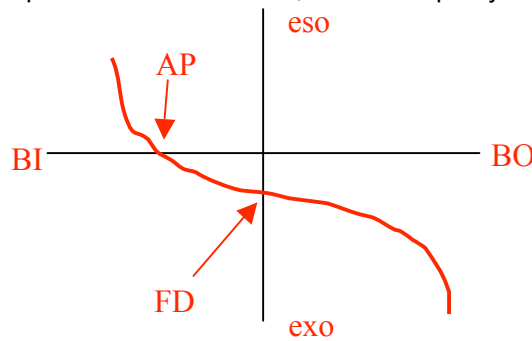
- a. It is not affected by the Hering-Hillebrand deviation.
- b. It uses a vernier alignment technique, which is very accurate.
- c. It is designed to locate the true apparent fronto-parallel plane.
- d. When a rod appears aligned, it will be in a location that stimulates corresponding points.

14. On the axes below, plot a curve (similar to the one in Lab 2) showing the disparities measured by the AFPP techniques, as a function of visual direction (eccentricity). Draw the appropriate curve that indicates an exo fixation disparity and greater magnification in OD. Disparity is defined as the convergence angle to the fixation point, minus the angle to the AFPP rod. (2)



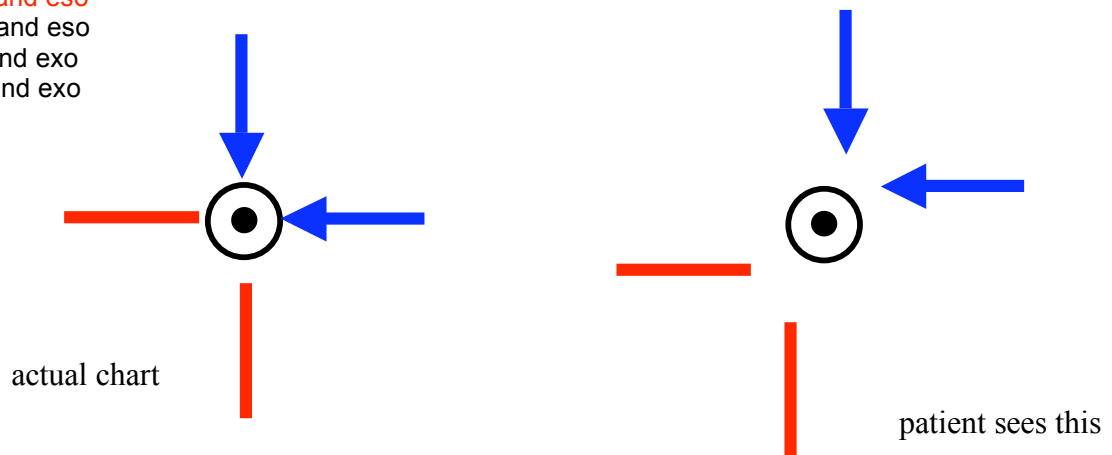
15. On the graph above, show how the Vieth-Müller Circle would be plotted and label it. (1)

16. Draw an example of a disparity/forced-vergence graph for an Ogle Type I pattern, with an exo fixation disparity and BI associated phoria. Label the axes, fixation disparity and associated phoria. (5)



17. A fixation disparity tests that uses blue arrows and red lines on a white background is shown below. Assume that the patient wears a red filter over OD and a blue filter over OS, and see the lines deviated as shown in the right figure below. What kind of fixation disparity does he have? (1)

- a. OS hyper and eso
- b. OD hyper and eso
- c. OS hypo and exo
- d. OD hypo and exo

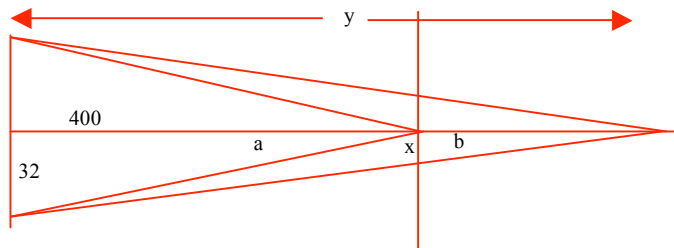


18. Using a standard Wesson card with standard polarized spectacles (top line seen by OD), you can measure a vertical fixation disparity by rotating the card 90 degrees. Assume that the patient continues to wear the same polarized glasses, but you rotate the card 90 degrees counter-clockwise. If the patient now reports that the right line is above center, and the left line is below center, what kind of fixation disparity does he have? (1)

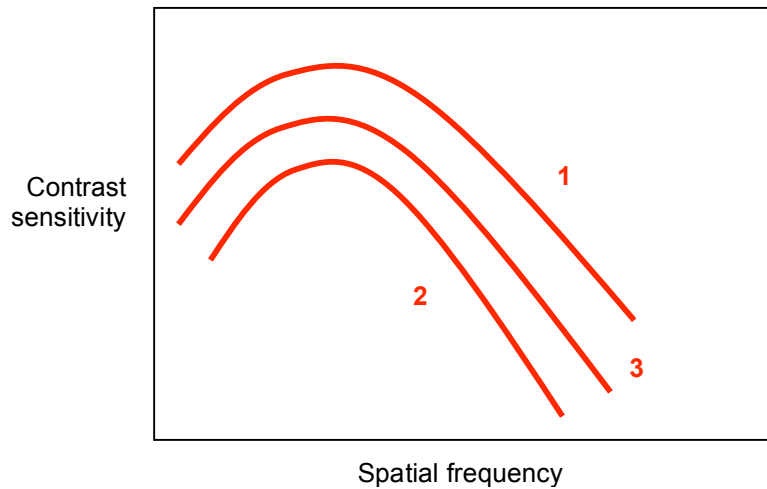
- a. OD hyper
- b. OS hyper

19. If you were going to design a Sheedy Disparometer to measure an 8-arc minute exo fixation disparity, how far apart should the bars be separated (to the nearest 0.1 mm)? Assume a PD of 64 mm and a viewing distance of 40 cm. Show your work. (4)

- Calc convergence angle a to center of faceplate. Angle $a = \text{atan}(32/400) = 4.5739^\circ$
- Convert to arc minutes and subtract 4 for angle b. Angle $b = 270.43' = 4.5073^\circ$
- Compute distance y to intersection of visual axes: $y = 32/(\tan(b)) = 405.94 \text{ mm}$
- By similar triangles solve for half-separation, x: $x/5.94 = 32/405.94 = 0.468$
- Double this for the answer: 0.94 mm.



20. On the graph below, draw three contrast sensitivity functions that represent 1) normal binocular contrast sensitivity 2) monocular contrast sensitivity and 3) binocular contrast sensitivity with +1.00 D of monovision. (3)



21. Imagine that you are looking into the Synoptophore with identical slides of a circle on a white background on each side. The light for OS is turned off, but the white background seen by OD has a luminance of 30 apostilbs. You then turn on the light for OS, with a setting of 15 apostilbs. Assuming normal binocular vision, what should happen to the binocular perception of brightness? (1)

- a. The brightness should increase slightly.
- b. The brightness should appear the same as that seen by OD alone.
- c. The brightness should appear the same as that seen by OS alone.
- d. The light should appear to get slightly dimmer (less bright).

22. The scenario described in Question 21 is a demonstration of (1)

- a. the Pulfrich phenomenon.
- b. Fechner's paradox.
- c. the Hering-Hillebrand deviation.
- d. facilitation.

23. Which degree of fusion would be stimulated by the Synoptophore slide pair shown below? (1)



Worth 2°

24. Which degree of fusion would be stimulated by the Synoptophore slide pair shown below? (1)



Worth 3°

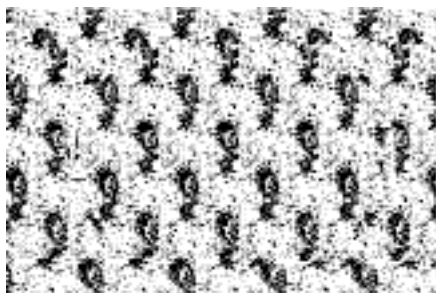
25. Sometimes, when viewing a color slide with red and blue letters against a black background, the red and blue letters appear to be at different distances in space. What basic principle explains this phenomenon? (1)

- a. Neurons from the retina conduct data at a slightly slower rate for dim than for bright images.
- b. Binocular sensory integration is based on brightness averaging.
- c. Probability summation
- d. Different wavelengths are refracted differently for light entering the eye off the optic axis.

26. What important principle was demonstrated by the random dot stereograms of Julesz? (1)

- a. Monocular form perception and stereopsis are processed by different centers in the brain.
- b. Monocular form perception must precede stereopsis in visual processing.
- c. Two identical random dot patterns can stimulate stereopsis.
- d. Objects located on the horopter stimulate disparate retinal points.

27. Below is an example of a famous autostereogram created by Dr. Christopher Tyler (1979). State the basic principles of how an autostereogram works. (2)



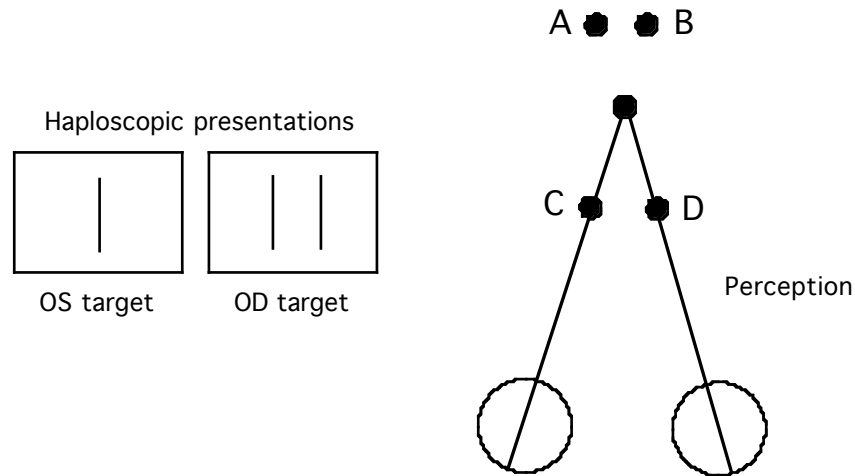
repetitive pattern, eyes converge/diverge one repetitive width, disparity on the retina stimulates stereopsis

28. Why are stereoacuity threshold tests so useful in pediatric eye examinations? (2)

These tests are easy to perform, and if the child can successfully identify the object stereoscopically, you know that they have achieved all the lower levels of fusion.

29. The figure below shows an example of the minimum stimulus needed to create a sense of stereopsis in a haploscope. Referring to the right figure, where in space would the non-fixated object appear to be? (1)

- a. Either position A or D depending on fixation.
- b. Either position B or C depending on fixation.
- c. Position B only.
- d. Position C only.



30. Which of the following is least likely to be associated with a large fixation disparity? (1)

- a. Asthenopia
- b. Headaches
- c. Poor reading skills
- d. Heterophoria
- e. Diplopia

31. A stereogram of a pyramid is made up of a red pyramid on a black background slightly to the left and a green pyramid slightly to the right. If you view it with red-green anaglyph glasses (OD red/OS green), the binocularly view image will be seen with (1)

- a. crossed disparity and the pyramid will appear to come out toward you.
- b. uncrossed disparity and the pyramid will appear to come out toward you.
- c. crossed disparity and the pyramid will appear to recede away from you.
- d. uncrossed disparity and the pyramid will appear to recede away from you.

32. If a person with glaucomatous damage to OD experiences the Pulfrich effect, how would a pendulum swinging from left to right in his fronto-parallel plane appear to move? (1)
- Away from the person, or in a clockwise elliptical path if seen from above.
 - Toward the person, or in a counter-clockwise elliptical path if seen from above.
 - In a circle that contains the fixation point and nodal points of both eyes.
 - In the opposite direction, that is, right to left in the fronto-parallel plane.

33. Explain how you could create a pair of free-fusion crossed disparity stereograms on a computer. Assume parallel viewing. (4)

- Draw an object with a background or outline.
- Put another object inside the frame
- Create an exact duplicate of this image
- Shift the inner detail slightly to one side; to the left for the OD image and/or to the right for the OS image.

34. Explain how to create a random dot stereogram that stimulates uncrossed disparity. (4)

- Generate a pattern of random dots.
- Duplicate the pattern so you will have one for each eye.
- On one pattern, cut out a center section and shift it slightly to the right if it's the OD slide or the left if it's the OS slide.
- Fill in the remaining uncovered region with random dots.

35. In the Stereo fly test, the wings of the fly appear to be raised 43.0 mm off the page. What is the disparity in arc seconds? Assume PD = 60 mm, viewing distance = 16 inches. (Calculate by angle, not the linear disparity equation). (5)

