

**Exam 1 – Principles of Normal Binocular Vision**

February 9, 2005

(Maximum points = 40)

1. In the case of a person with normal binocular vision, which of the following visual functions is/are only marginally better when viewing with two eyes rather than one? Circle all that apply. Do not include functions for which binocular vision contributes essentially nothing. (2)

- a. Visual acuity
- b. Contrast sensitivity
- c. Visual field
- d. Depth perception within arm's reach
- e. Depth perception beyond 500 meters
- f. Dark adaptation
- g. Color perception
- h. Motion perception for distant objects
- k. Perception of flicker

2. In the case of a person with normal binocular vision, which of the following visual functions is/are significantly better when viewing with two eyes rather than one? Circle all that apply. (2)

- a. Visual acuity
- b. Contrast sensitivity
- c. Visual field
- d. Depth perception within arm's reach
- e. Depth perception beyond 500 meters
- f. Dark adaptation
- g. Color perception
- h. Motion perception for distant objects
- k. Perception of flicker

3. What is another (not listed above) significant benefit of having two eyes rather than one? (1)

A spare eye in case one is lost to injury or disease.

4. Assume you are the student doctor in the optometry walk-in clinic at Hastings hospital. A patient was working under his car and got a small piece of iron in his cornea, which you successfully remove. You give him one drop of homatropine, patch the eye with antibiotic ointment and prepare to send him home. He is planning to drive himself home to his house in Tahlequah. After considering how the patient's vision, now monocular, will affect his driving, how should you advise him with regard to driving home? (3)

It should be fine for him to drive himself home with one eye. Except for a reduced visual field, his driving vision should be essentially the same with monocular or binocular vision. You should warn him to be careful, though, to scan the entire scene for possible hazards since his visual field will be reduced by about 30 degrees.

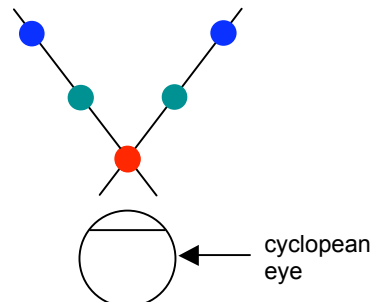
5. Assume both eyes are fixating a far object, while a near object is visible on the midline, straight ahead. Which of the following statements correctly describes this situation? (1)

- a. The OD and OS oculocentric visual directions both agree with the egocentric direction.
- b. The OD and OS oculocentric visual directions and the egocentric direction are all different.
- c. The OD and OS oculocentric visual directions agree, but differ from the egocentric direction.
- d. The egocentric direction will agree with one of the eyes, but not both.

6. When performing the cover test, the patient notices that the chart appears to jump vertically. As the paddle moves from OD to OS, the target appears to move up. When the cover moves from OS to OD, the target appears to move down. What kind of heterophoria is indicated? (1)

OD hypo, OS hyper

7. In VT clinic you are using a Brock string that has three beads spaced out across its length. The patient holds one end on the bridge of his nose and extends the string forward on the midline. He says that the string looks like a letter V that is opening away from him, as illustrated in the figure to the right. Which of the following best describes how he is viewing? (1)



- a. Both eyes are fixating on the near bead.
- b. Both eyes are fixating on the middle bead.
- c. Both eyes are fixating on the far bead.
- d. One eye is suppressing.

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

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

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

10. After the eyes have approximately converged on the near object, which of the following vergences completes the work by fine-tuning the alignment of the eyes? (1)

- a. proximal vergence
- b. accommodative vergence
- c. disparity vergence
- d. vergence adaptation

11. Briefly define the term, “horopter.” (1)

- The set of points in space, where a object must be placed to fall on corresponding points on the two retinas.
- Or, the set of points in space that lie at the intersection of corresponding visual lines from the two eyes, etc.

12. Briefly define, and describe the “Vieth-Müller circle.” (2)

- The theoretical horopter based on assumptions about the geometry of the eyes and visual directions in the two eyes.
- It is a circle that includes the fixation point and two nodal points of the eyes.

13. What is the most popular method used to measure the longitudinal horopter? (1)

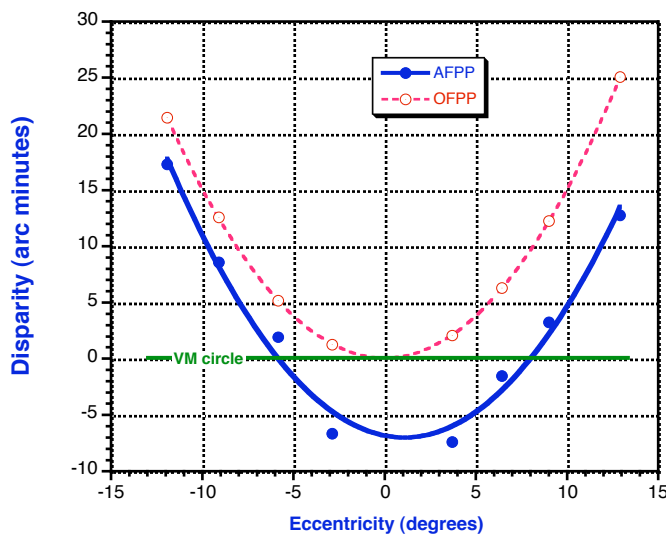
- a. Apparent fronto-parallel plane
- b. Nonius
- c. Diplopia threshold
- d. Stereo threshold

14. What is the most accurate way to measure the longitudinal horopter? (1)
- Apparent fronto-parallel plane
  - Nonius
  - Diplopia threshold
  - Stereo threshold

15. What is a point horopter? (1)
- A longitudinal horopter
  - The fixation point
  - A three-dimensional horopter
  - The Vieth-Müller Circle

16. The figure below shows a graph of horopter data (solid curve) collected for one subject during Lab 2. It plots disparity (relative to the Vieth-Müller circle) as a function of eccentricity (angle of gaze). Disparity is defined as the angle of convergence to fixation point ( $\theta$ ) minus the angle to the horopter rod ( $\alpha$ ). The dashed curve shows values for the OFPP. Which of the following best describes this subject's binocular vision? (1)

- The subject has no Hering-Hillebrand deviation.
- The subject has a Hering-Hillebrand deviation, but no fixation disparity.
- The subject has a Hering-Hillebrand deviation, a fixation disparity, and zero aniseikonia.
- The subject has a Hering-Hillebrand deviation, a fixation disparity, and a slight aniseikonia.

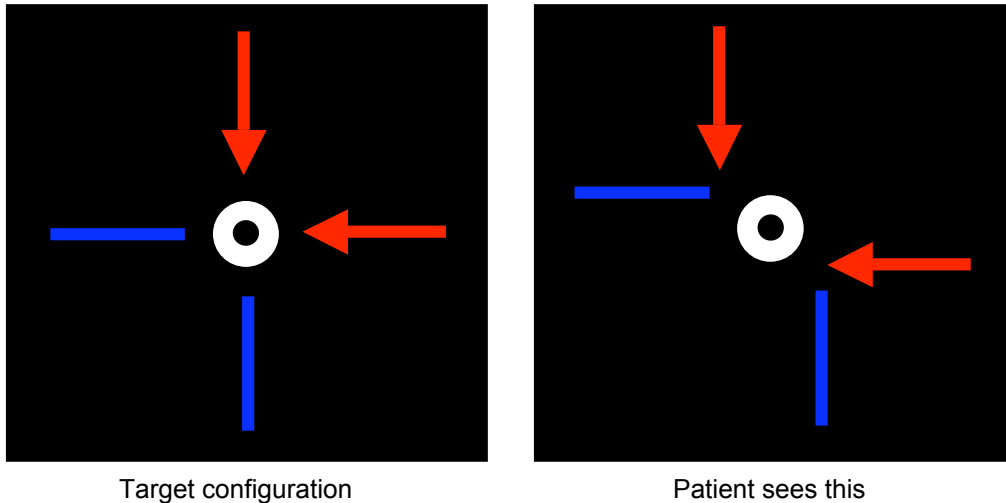


17. Which of the following best describes a fixation disparity? (1)
- The difference in visual directions that stimulates the sense of stereopsis.
  - The deviation of the eye that is being suppressed.
  - The deviation of the eyes that occurs when fusion is temporarily interrupted.
  - The deviation of the eyes that occurs during binocular fixation.
18. What is the difference between an associated and dissociated phoria? (1)

The associated phoria is the amount of prism needed to cause the fixation disparity to reduce to zero. The dissociated phoria is the heterophoria.

19. A computerized chart has a fixation disparity test that uses red arrows and blue lines on a black background, as shown in the figures below. Assume that the patient wears a red filter over OD and a blue filter over OS, and sees the lines deviated as shown in the right figure below. What kind of horizontal fixation disparity is indicated? (1)

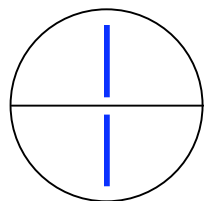
exo



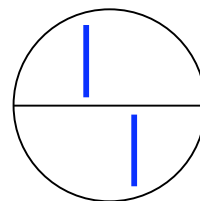
20. Referring to Question 19, and the figure above, what type of vertical fixation disparity is indicated? (1)

OD hyper

21. Assume that you are testing a patient who has an eso fixation disparity with a Sheedy Disparometer. The polarized spectacles allow OD to see the top line, while OS sees the bottom line. Complete the two pictures below to show (1) the appearance of the target, as seen by the patient after completing the measurement, and (2) the actual target configuration in the device. (2)



Patient sees this



Target configuration

22. Mention one clinical problem for which you would probably want to measure fixation disparity, and tell how you would use the data? (1)

- Horizontal phoria – verify it and prescribe prism equal to the associated phoria
- Vertical phoria – verify it and prescribe prism equal to or less than the vertical associated phoria
- Diagnose cases of eyestrain. Use the associated phoria to guide the prism Rx.

23. If there is a 50% probability of detecting a visual stimulus with one eye, what would the probability be of detecting the same stimulus with two eyes, assuming that any binocular summation is due to probability summation alone? Choose the closest answer.

- a. 50%
- b. 75%
- c. 85%
- d. 100%

24. Briefly describe how to demonstrate Fechner's paradox and mention what the person should see. (2)

Have a subject look at a light binocularly and notice its brightness. Put a neutral density filter over one eye, and the subject should notice that the light gets slightly dimmer. Cover the eye with the neutral density filter, and the light should get brighter.

25. When testing far sensory dominance for a monovision contact lens fit, you find that the patient sees slightly better binocularly when the plus lens is placed over OD. Based on this alone, which eye is dominant at far, and which should probably have the near correction? (1)

OS dominant, near correction on OD

26. You test the same monovision patient for sensory dominance at near. He sees better binocularly when the blurring minus lens is placed over OS. Which eye is dominant for near and which eye should have the near correction? (1)

OD dominant at near, near correction on OD

27. Describe or draw a figure to show what a pair of stereoscope slides should look like if they are designed to stimulate Worth Grade 1 fusion only. (1)

Two dissimilar images that cannot be fused.

28. Describe or draw a figure to show what a pair of stereoscope slides should look like if they are designed to stimulate Worth Grade 1 and 2 fusion only, and includes a check for suppression. (1)

Two identical images, plus a unique feature on the OD slide and a different unique feature on the OS slide.

29. Describe or draw a figure to show what a pair of stereoscope slides should look like if they are designed to stimulate Worth Grade 3 fusion. (1)

Two nearly identical images, except that there is some offset in certain parts of the image designed to create disparity.

30. If a person with optic neuritis in the right eye (which causes that eye's image to appear dimmer) views a pendulum swinging in the fronto-parallel plane, it will appear to ... (1)

- come nearer when swinging from left to right and farther on the return swing.
- come nearer when swinging from right to left and farther on the return swing.
- come nearer when swinging in both directions
- slow down when swinging from left to right, but speed up on the return swing.

31. What is the maximum distance that a person can use stereopsis to judge depth if he has a PD of 64 mm and a stereo acuity threshold equal to 30 arc seconds? (2)

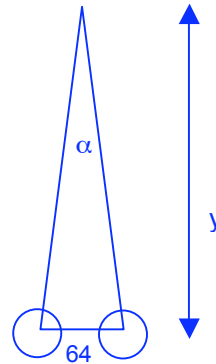
Calculate angle  $\alpha$ :

$$\text{Angle } \alpha = 0.0083^\circ = 0.000145 \text{ radians}$$

$$\text{Angle } \alpha \text{ in radians} = 64/y$$

Solve for y.

$$y = 64/(0.000145) = 440,031.6 \text{ mm} = 440 \text{ m}$$



32. Refer to your answer in Question 31. Assume that an object is located at the maximum distance of stereopsis, and the subject is fixating on that object. Where must a second object be located to stimulate 30 arc seconds of stereopsis, and thus be barely seen as nearer than the fixation point by stereopsis? (2)

Since the fixation object is located 30 arc seconds closer than the horizon, and the next, nearer object is another 30 arc seconds closer than that, the near object is located  $30+30=60$  arc seconds closer than the horizon. Use the same logic that was used to solve Question 31, except that Angle  $\alpha$  now equals 60 arc seconds.

Calculate angle  $\alpha$ :

$$\text{Angle } \alpha = 0.0167^\circ = 0.000290 \text{ radians}$$

$$\text{Angle } \alpha \text{ in radians} = 64/y$$

Solve for y.

$$y = 64/(0.000290) = 220,015.8 \text{ mm} = 220 \text{ m}$$

33. Write down one thing you learned from attending Dr. Perot's lecture last week. (2)