

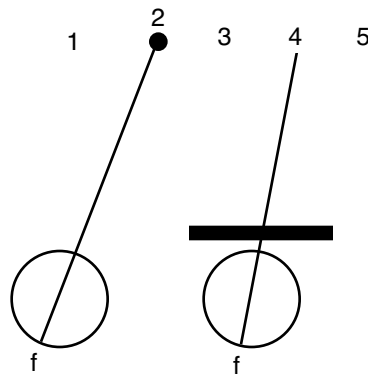
*Vision Science IV: Principles of Binocular Vision***Final Examination**

5/7/99

This test consists of 48 multiple-choice questions. Select the one best answer and record it on the separate answer sheet. The maximum score is 100, but for simplicity 2 points will be subtracted for each incorrect answer. When finished you may keep the test, but please turn in your answer sheet. If you would like me to contact you with your grades, please include your telephone number or e-mail address on the answer sheet.

1. Binocular vision is usually preferable to monocular vision, but in which of the following situations would monocular vision actually be preferable?

- | | |
|----|---|
| A. | Dealing with diplopia following an acute fourth nerve palsy |
| B. | A driver who needs the largest possible field of view |
| C. | A pilot who needs to distinguish between a dot in the sky and a bug on the windshield |
| D. | When trying to achieve the best possible visual acuity |



2. A person with a near exophoria is fixating a near point with the left eye while the right eye is covered (refer to figure). According to the principles of visual direction discussed early in this course, where should the fixated object (black dot) appear to be located?

- | | |
|----|---|
| A. | Left of the true object (position 1). |
| B. | In its true location (position 2). |
| C. | Between the two visual axes (position 3). |
| D. | On the right eye visual axis (position 4). |
| E. | To the right of the right eye's visual axis (position 5). |

3. Which of the following is most closely associated with egocentric localization?

- | | |
|----|---|
| A. | Local sign |
| B. | Direction relative to a point midway between the eyes |
| C. | The retinal direction of an image relative to the fovea |
| D. | The unique direction associated with each eye's visual line |
| E. | Eccentric fixation |

4. Which of the following is part of Hering's law of oculo-centric visual direction?

- | | |
|----|---|
| A. | All objects on the visual axis of each eye, appear to be on the egocentric visual axis. |
| B. | Each point on the retina has a unique visual direction, relative to its own fovea. |
| C. | Each visual line in one eye has a corresponding visual line in the other eye which has the same visual direction in egocentric space. |
| D. | Objects situated in the common axis, do not appear to be in that line, but in the axis of the eye by which they are not seen. |
| E. | Horizontal magnification before one eye causes a fronto-parallel plane to appear to be rotated away from that side. |

5. Which of the following is NOT one of the eye movements which works together with disparity vergence when shifting fixation on the midline from far to near?

- | | |
|----|---------------------------|
| A. | Tonic vergence |
| B. | Proximal vergence |
| C. | Accommodative convergence |
| D. | Vergence adaptation |
| E. | Conjunctive versions |

6. Which of the following is NOT a correct description of disparity vergence?

- | | |
|----|---|
| A. | Regulated by a negative feedback loop |
| B. | The mechanism which is used to fine tune motor fusion |
| C. | Appears to be supported by fine and coarse disparity vergence mechanisms in the brain |
| D. | The only type of vergence stimulated by retinal disparity |
| E. | Initiates the large vergence movement when shifting fixation from far (6 m) to near (40 cm) |

7. Which of the following contains the two nodal points and the fixation point?

- | | |
|----|-----------------------------|
| A. | Abathic distance |
| B. | Hering-Hillebrand deviation |
| C. | Vieth-Müller circle |
| D. | Nonius horopter |
| E. | Longitudinal horopter |

8. At the abathic distance, the AFPP horopter is ...

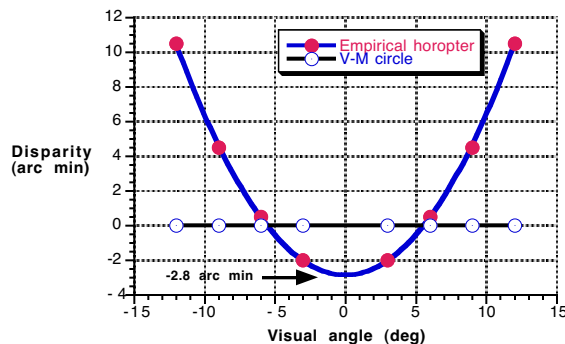
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|----|--|
| A. | a vertical line passing through the fixation point. |
| B. | concave toward the observer, but inside the Veith-Müller circle. |
| C. | convex away from the observer. |
| D. | coincident with the objective fronto-parallel plane. |

9. Which of the following does NOT correctly describe a property of the theoretical horopter?

- | | |
|----|---|
| A. | An object located anywhere on the horopter will have a constant retinal image size. |
| B. | It is the locus of points in space which stimulate corresponding points. |
| C. | Objects located on the horopter give rise to zero retinal disparity. |
| D. | The convergence angle between the two nodal points and any point on the horopter is constant. |
| E. | The distance from the egocenter to any point on the horopter is constant. |

10. Which of the following may account for the Hering-Hillebrand deviation?

- | | |
|----|---|
| A. | Corresponding points in the two retinas are probably not symmetrically distributed. |
| B. | Each retina is a portion of a perfect sphere. |
| C. | Image magnification is probably equal in the two eyes. |
| D. | The nodal points and centers of rotation do not coincide. |
| E. | There is a disagreement between directional and sensory dominance tests. |



11. The empirical horopter was measured, and in this case, the two inner-most rods were located nearer to the subject than the fixation point, while the other rods were beyond the fixation point. The disparity to each rod was computed, and disparity was plotted as a function of eccentricity (visual angle) in the graph above. Which of the following best explains why the parabola crosses the midline below the zero disparity level?

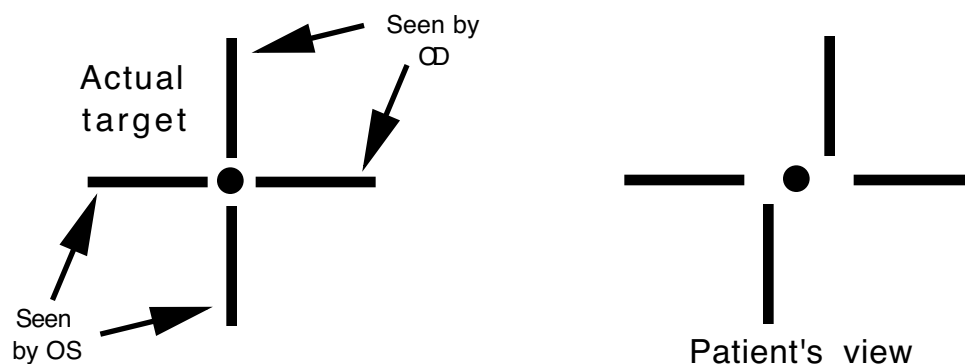
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|----|---|
| A. | An eso fixation disparity |
| B. | An exo fixation disparity |
| C. | Greater magnification of the right eye retinal image. |
| D. | Eccentric fixation |
| E. | Panum's area |

12. Referring to the graph in question 11, compute the point in space where the visual axes cross relative to the fixation point. Assume that the PD is 65 mm, and the fixation point was located at 40 cm.

- A. ~ 0.005 mm proximal to fixation
- B. ~ 2.0 mm distal to the fixation point
- C. ~ 0.3 mm proximal to fixation
- D. ~ 2.0 mm proximal to the fixation point
- E. ~ 6.9 mm proximal to fixation

13. Fixation disparity is ...

- A. a small non-correspondence in visual directions for the foveas of the two eyes.
- B. a minor under- or over-convergence of the visual axes, which is small enough that the fixation object is still fused.
- C. the small area on either side of the horopter within which it is possible to see objects as single, in spite of the fact that the images falls on non-corresponding retinal points.
- D. a unique binocular perception of relative distance between objects based on retinal disparity.
- E. a binocular anomaly in which one eye uses a non-foveal point to fixate.



14. A vectographic target, shown by the left figure above, was used to test a patient for fixation disparity. The right figure shows what the patient saw. What condition can you diagnose from this information?

- A. Eso fixation disparity
- B. Exo fixation disparity
- C. Eso associated phoria
- D. Exo associated phoria
- E. Right hyper fixation disparity

15. The Sheedy Disparometer uses a different principle to diagnose fixation disparity. The upper line is seen by the right eye, the lower by the left eye, and the lines are displaced until they appear aligned. In an exo fixation disparity, how would the patient adjust the lines?

- | | |
|----|--|
| A. | Upper and lower lines centered |
| B. | Upper line to the left; lower line to the right |
| C. | Upper line to the right; lower line to the left |
| D. | Upper and lower lines aligned to the right of fixation |
| E. | Upper and lower lines aligned to the left of fixation |

16. Which of the following is LEAST likely to be associated with a fixation disparity?

- | | |
|----|---------------------|
| A. | Asthenopia |
| B. | Headaches |
| C. | Poor reading skills |
| D. | Heterophoria |
| E. | Diplopia |

17. What is the range of normal horizontal fixation disparity values at near? (Units are arc minutes.)

- | | |
|----|------------------------------------|
| A. | 1 exo to 1 eso |
| B. | 4 exo to 6 eso |
| C. | 6 exo to 4 eso |
| D. | 10 exo to 10 eso |
| E. | Any fixation disparity is abnormal |

18. Which of the following does NOT correctly describe Ogle's fixation disparity curves

- | | |
|----|---|
| A. | A Type I response is considered anomalous because it shows a rapid change in fixation disparity with small amounts of forced vergence (BI and BO prism). |
| B. | A Type II plot is usually associated with esophoria and indicates a system which can converge easily, but has difficulty keeping up with forced divergence (BI prism). |
| C. | A Type III plot is usually associated with exophoria and indicates a system which can diverge easily, but has difficulty keeping up with forced convergence (BO prism). |
| D. | A Type IV plot is is not well understood but is associated with binocular dysfunction. |

19. Which of the following pairs of factors are both used to determine the relationship between horizontal angular disparity (η) and linear depth difference (ΔD)?

- | | |
|----|---|
| A. | Stereoacuity threshold and PD |
| B. | Viewing distance and PD |
| C. | Visual angle (eccentricity) and minimum angle of resolution (MAR) |
| D. | Visual angle (eccentricity) and viewing distance |

20. Using stereopsis, if a person can first tell that an object is closer than infinity when it is 1,000 meters away, what is their stereoacuity threshold? Assume a PD of 65.

- | | |
|----|-----------------|
| A. | 2.3 arc sec |
| B. | 4.1 arc sec |
| C. | 6.5 arc sec |
| D. | 13.4 arc sec |
| E. | 13407.2 arc sec |

21. Which of the following depth cues is probably least useful for person trying to judge the distance to an aircraft approaching from over the horizon?

- | | |
|----|--------------------|
| A. | Superposition |
| B. | Stereopsis |
| C. | Linear perspective |
| D. | Aerial perspective |

22. When viewing equidistant red and blue objects binocularly, the red ones usually (but not always) appear nearer than the blue. This phenomenon is known as:

- | | |
|----|--------------------|
| A. | The Purkinje shift |
| B. | Fechner's paradox |
| C. | Patent stereopsis |
| D. | Autostereopsis |
| E. | Chromostereopsis |

23. With respect to perceived brightness, Fechner's paradox suggests that binocular sensory integration is based on ...

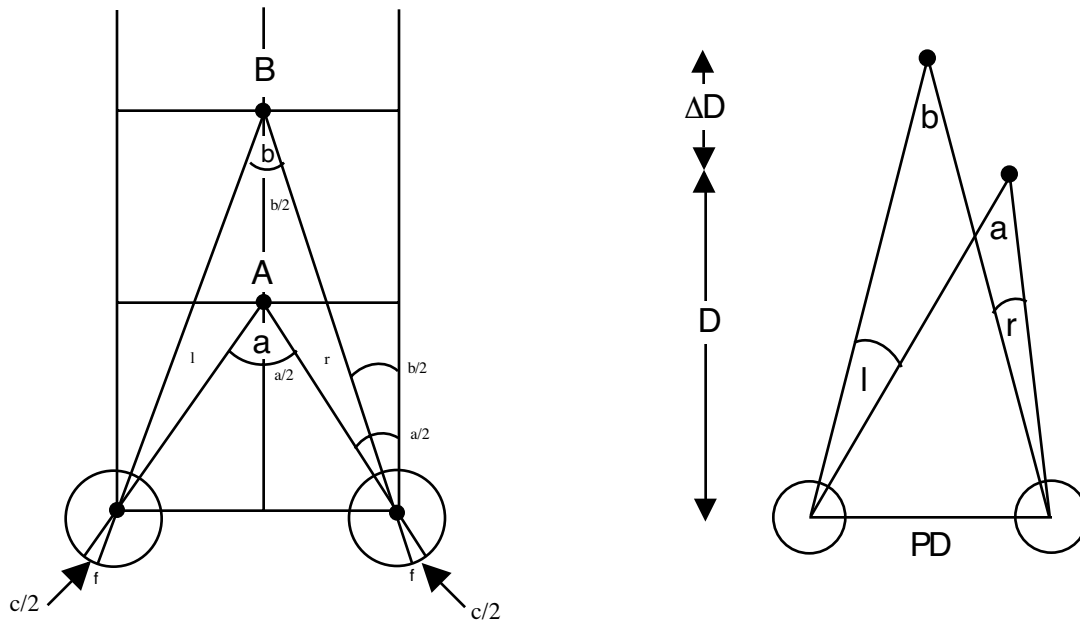
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|----|-------------------------|
| A. | Binocular luster |
| B. | Probability summation |
| C. | Physiological summation |
| D. | Brightness averaging |
| E. | Weber's law |

24. If an ND filter is placed before the right eye, a swinging pendulum confined to the subject's fronto-parallel plane will appear to swing ...

- A. more slowly than its physical motion.
- B. in a clockwise elliptical pattern (closer to the subject when swinging right to left).
- C. in a counterclockwise elliptical pattern (closer when swinging left to right).
- D. in the apparent fronto-parallel plane (AFPP).
- E. in a figure eight pattern centered on the fixation point.

25. Which of the following is NOT true about stereopsis?

- A. Stereopsis is only possible within Panum's area — it is impossible with diplopia.
- B. Binocular parallax makes stereopsis possible.
- C. It is a useful way to test the overall function of the binocular system.
- D. It is stimulated by horizontal retinal disparity.
- E. Stereoacuity thresholds may be as small as 2-10 arc seconds.

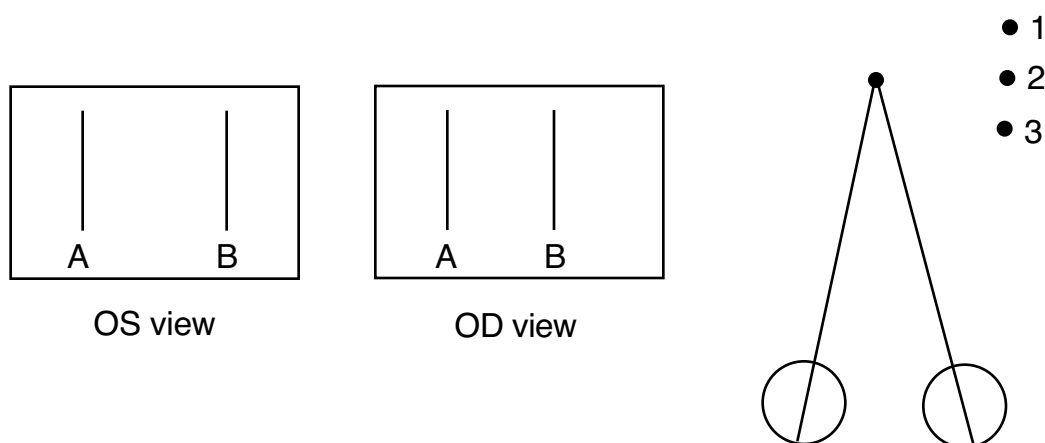


26. Which of the following statements does NOT correctly describe how to compute the binocular disparity which gives rise to stereopsis? (See figures above. Assume all angles are positive.)

- A. In the left figure, disparity is the sum of angles l and r , but in the right figure, it is the difference between angles l and r .
- B. In the left figure, binocular disparity is the sum of both retinal disparities ($c/2 + c/2$).
- C. In the right figure, the difference between angles a and b is not equal to the difference between angles l and r .
- D. The disparity can be computed from the PD, D and ΔD .
- E. In both figures, disparity is the difference between angles a and b .

27. Random dot stereograms ...

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|----|--|
| A. | are useful for laboratory research, but have no clinical application. |
| B. | demonstrate that monocular form perception is not required for stereopsis. |
| C. | require the subject to make use of both local and global stereopsis. |
| D. | are like autostereograms without the use of polaroids. |
| E. | are made by selecting the central portion of two identical dot patterns and shifting both in the same direction and the same distance. |



28. In the stereogram shown above, line B will most likely ...

- | | |
|----|---|
| A. | appear to be located at position 1. |
| B. | appear to be located at position 2. |
| C. | appear to be located at position 3. |
| D. | be suppressed. |
| E. | will alternate between positions 1 and 3. |

29. Which of the following statements about suppression is NOT correct?

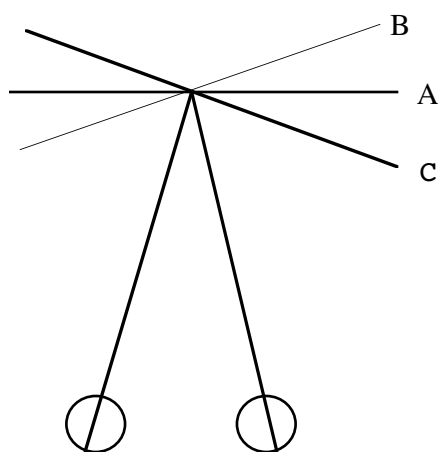
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|----|---|
| A. | Nothing is seen by the suppressed eye and all visual input comes from the other eye. |
| B. | Relative suppression proneness may be measured using Bagolini lenses and neutral density filters. |
| C. | High contrast features tend to suppress low contrast features. |
| D. | Foveal suppression eliminates confusion while peripheral suppression eliminates diplopia. |
| E. | Suppression zones may be plotted using stereocampimetry. |

30. How does binocular contrast sensitivity compare with monocular contrast sensitivity in a subject with normal binocular vision?

- | | |
|----|---|
| A. | Binocular contrast sensitivity should be about 1.4 times greater at all spatial frequencies. |
| B. | Binocular contrast sensitivity should be about 2 times greater at all spatial frequencies. |
| C. | They should be essentially identical. |
| D. | Binocular contrast sensitivity should be 1.4 times greater for high spatial frequencies only. |
| E. | Binocular contrast sensitivity should be 2 times greater for low spatial frequencies only. |

31. After testing a monovision patient's sensory dominance at far and near, you decide to put the near correction on the left eye. Which of the following results is consistent with this plan?

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|----|--|
| A. | With the distance Rx in place, the distance binocular visual acuity is better when a +1.50 lens is placed over the left eye. |
| B. | With the near Rx in place, the near binocular visual acuity is better when a -1.50 lens is placed over the left eye. |
| C. | With the distance Rx in place, a directional dominance indicates that the left eye is dominant at far. |
| D. | With the distance Rx in place, the left eye's distance visual acuity gets worse when a +1.50 add is placed over that eye. |



32. If A represents the true fronto-parallel plane, which of the following is correct? (On meridional size lenses the axis is perpendicular to the meridian of magnification.)

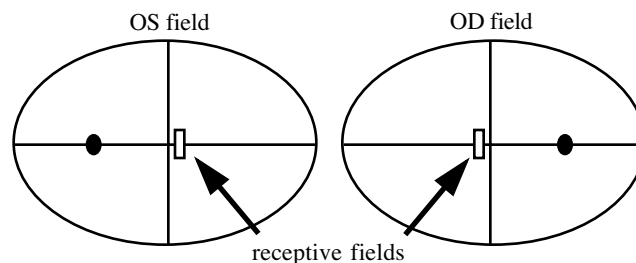
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|----|---|
| A. | Plane B would appear to be fronto-parallel when an axis 90 magnifier is placed in front of the right eye. |
| B. | Plane C would appear to be fronto-parallel when an axis 180 magnifier is placed in front of the right eye. |
| C. | Plane A would appear to tilt in the direction of plane B when an axis 90 meridional magnifier is placed in front of the left eye. |
| D. | Plane A would appear to tilt in the direction of plane B when an axis 90 meridional minifier is placed in front of the left eye. |

33. According to Knapp's law, aniseikonia should be ...

- | | |
|----|---|
| A. | less if the refractive anisometropia is corrected with spectacles rather than contact lenses. |
| B. | less if the refractive anisometropia is corrected with contact lenses rather than spectacles. |
| C. | less if the axial anisometropia is corrected with contact lenses rather than spectacles. |
| D. | the same with either spectacles or contact lenses in the case of refractive anisometropia. |
| E. | the same with either spectacles or contact lenses in the case of axial anisometropia |

34. Which of the following is NOT associated with the human parvocellular pathway?

- | | |
|----|--|
| A. | Color perception |
| B. | Fine stereopsis |
| C. | Synapses in layers II and III of area V1 |
| D. | Layer IV β in area V1. |
| E. | Layer IVA |

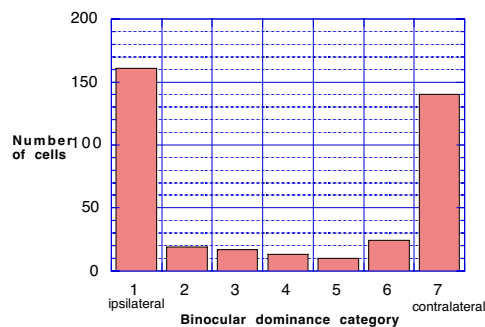


35. A trained monkey maintains straight ahead fixation on a point 60 cm away, while you record from a neuron in the visual cortex. The location of the receptive fields for the right and left eye are shown above (both tested at 60 cm). Which answer best describes the neuron?

- | | |
|----|---|
| A. | The neuron is a monocular neuron since it is sensitive to a stimulus in either the right or left eye, but they are in non-corresponding locations. |
| B. | The neuron is binocular, but when stimulated by identical objects in each receptive field, the animal should perceive diplopia since the receptive fields are located in non-corresponding retinal locations. |
| C. | The neuron is binocular and specifically tuned to detect an object in space with a certain amount of crossed disparity (located nearer than the fixation point). |
| D. | The neuron is binocular and specifically tuned to detect an object in space with a certain amount of uncrossed disparity (located beyond the fixation point). |
| E. | The response shown in the figure cannot be correct since it is impossible for a single neuron to have receptive fields in non-corresponding locations. |

36. According to Held's two stage model for the development of binocular vision, which of the following statements does NOT correctly describe normal binocular development in the visual cortex?

- A. Monocular deprivation can cause abnormal development of the ocular dominance columns such that those for one eye atrophy while those for the other eye expand.
- B. At birth there is considerable overlap of afferent from the LGN in the primary visual cortex, but over the next several months, neurons receiving input from the right and left eyes begin to segregate into distinct binocular dominance columns.
- C. At birth there may be a primitive sort of binocularity among first order neurons in layer IVC of the primary visual cortex, but with maturity neurons at this level become monocular.
- D. Nearly equal and good quality input from both eyes is required to stimulate the development of normal ocular dominance columns in layer IVC. These monocular neurons then compete for synaptic sites on binocular neurons at higher levels in the primary visual cortex.
- E. At birth layer IVC of the primary visual cortex is clearly delineated into right and left ocular dominance columns, but as the system matures, afferents from the LGN increasingly overlap, thereby allowing development of binocular neurons at this level.



37. Which of the following conditions, if present during much of the critical period, would most likely result in the ocular dominance histogram shown above?

- A. Normal binocular vision
- B. Ipsilateral esotropia
- C. Contralateral esotropia
- D. Alternating esotropia
- E. Eccentric fixation in the ipsilateral eye

38. Which of the would NOT be normal for a one year old infant?

- A. A constant face turn
- B. Preference for a random dot stereogram with 60 arc seconds of disparity versus a flat pattern of random dots
- C. Symmetric smooth pursuits in all directions
- D. Normal ocular alignment all the time — that is, no strabismus.

39. Which of the following would be most unusual for a 3 month old infant?

- | | |
|----|--|
| A. | Equal preference for a random dot stereogram with 300 arc seconds of disparity and a flat pattern of random dots |
| B. | Constant unilateral esotropia |
| C. | Preference for smooth pursuits in the nasal direction |
| D. | Unstable ocular alignment with an intermittent exotropia |

40. Which of the following is true about amblyopia in humans?

- | | |
|----|---|
| A. | Any treatment after 3 years of age is past the critical period, therefore futile. |
| B. | The first priority is to surgically correct any strabismus, then check for a refractive error. |
| C. | If not removed, a congenital cataract will cause pattern deprivation and severe irreversible amblyopia. |
| D. | Treatment should include direct occlusion of the amblyopic eye to maintain superior vision in the dominant eye. |
| E. | Development of the magnocellular system is more severely retarded by optical defocus than the parvocellular system. |

41. Eccentric fixation is an abnormal condition in which ...

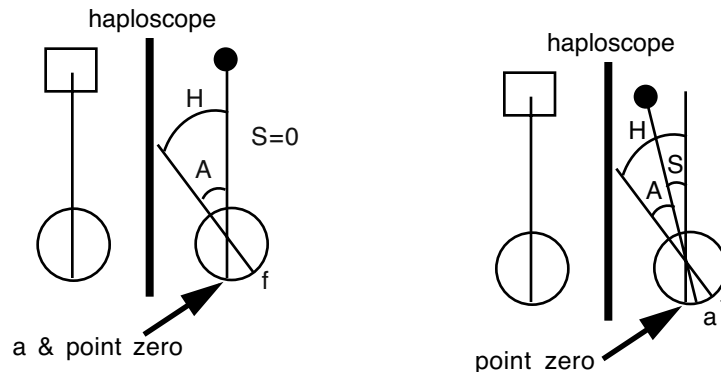
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| A. | the subjective and objective angles of strabismus are different. |
| B. | a non-foveal point in one eye corresponds with the fovea of the other eye. |
| C. | the visual axes cross slightly in front or behind the fixation point. |
| D. | fixation is abnormal but visual acuity is normal. |
| E. | an eye monocularly fixates with some retinal point other than the fovea. |

42. The principle of after-image transfer may be used to diagnose eccentric fixation in object space. Assuming normal correspondence, an after-image on the right fovea is transferred perceptually to the left fovea when the right eye is occluded. Assuming a 2 degree nasal eccentric fixation in the left eye, and with the right eye still covered, the patient should see the after-image ...

- | | |
|----|---|
| A. | located to the right of the fixation target. |
| B. | located to the left of the fixation target. |
| C. | centered on the fixation target. |
| D. | only and be unable to fixate on the fixation target |

43. In anomalous correspondence ...

- A. the subjective and objective angles of strabismus are different.
- B. the foveas in the two eyes have the same visual directions.
- C. the patient learns to suppress the strabismic eye.
- D. the visual system is left with peripheral diplopia and foveal confusion.
- E. one eye always monocularly fixates using some retinal point other than the fovea.



44. Which of the following correctly describes both of the above figures?

- A. Both show examples of normal correspondence.
- B. The left figure illustrates normal and the right anomalous correspondence..
- C. The left figure illustrates unharmonious and the right harmonious correspondence.
- D. The left figure illustrates harmonious and the right unharmonious correspondence.
- E. Both show examples of paradoxical anomalous correspondence.

45. For an easily visible target fixated foveally, the minimum speed for perception of motion is ...

- A. 1-3 arc sec / sec
- B. 1-3 arc min / sec
- C. 1-3 deg / sec
- D. 10 - 30 arc min / sec
- E. 10 - 30 deg / sec

46. When a stationary dot is located within a frame which is slowly moving to the left, the ...

- A. dot will appear to be stationary.
- B. dot will appear to move slowly to the right.
- C. dot will appear to move slowly to the left.
- D. frame will appear to move to the right.
- E. frame will induce a more rapid apparent motion in the dot.

47. Self motion orvection (subject stationary but feels that he is moving) is most noticeable when the ...

- | | |
|----|--|
| A. | objects in the central and peripheral visual field are stationary. |
| B. | moving objects are small. |
| C. | moving objects fill most of the visual field. |
| D. | object is foveally fixated. |

48. A powerful sense of object shape and depth can be elicited when a pattern of dots moves in a coordinated fashion, even though the same pattern contains no visible structures when stationary. This is known as the ...

- | | |
|----|----------------------|
| A. | geometric effect |
| B. | induced effect |
| C. | Fechner's paradox |
| D. | kinetic depth effect |
| E. | binocular parallax |

Name _____

ANSWER KEY

| <i>Question #</i> | <i>Answer</i> | <i>Question #</i> | <i>Answer</i> |
|-------------------|---------------|-------------------|---------------|
| 1 | A | 25 | A |
| 2 | C | 26 | C |
| 3 | B | 27 | B |
| 4 | B | 28 | C |
| 5 | E | 29 | A |
| 6 | E | 30 | A |
| 7 | C | 31 | A |
| 8 | D | 32 | D |
| 9 | E | 33 | B |
| 10 | A | 34 | E |
| 11 | A | 35 | C |
| 12 | D | 36 | E |
| 13 | B | 37 | D |
| 14 | A | 38 | A |
| 15 | C | 39 | B |
| 16 | E | 40 | C |
| 17 | C | 41 | E |
| 18 | A | 42 | A |
| 19 | B | 43 | A |
| 20 | D | 44 | D |
| 21 | B | 45 | B |
| 22 | E | 46 | B |
| 23 | D | 47 | C |
| 24 | C | 48 | D |