

STUDY GUIDE – ANSWERS

4: Sensation and Perception

Introduction

1. prosopagnosia
2. sensation; perception
3. bottom-up processing; top-down processing
4. selective attention
5. cocktail party effect; inattention blindness
6. inattention blindness; change blindness; choice blindness; change deafness
7. pop-out
8. psychophysics
9. absolute threshold; 50
10. signal detection
11. subliminal
12. conscious
13. prime; automatically
14. difference threshold; just noticeable difference (jnd)
15. Weber's law; stimulus
16. sensory adaptation
17. informative

Vision

1. transduced; neural
 2. electromagnetic
 3. wavelength; hue
 4. intensity; amplitude; brightness
 5. cornea; pupil; iris
 6. lens; retina
 7. accommodation
 8. rods; cones
 9. bipolar; ganglion; optic nerve; brain
 10. blind spot
 11. fovea; peripheral; bipolar
 12. cones; rods
 13. sensitive; 20
 14. abstract; thalamus; visual cortex; feature detectors
 15. gaze; head angle; posture; body movement; supercell clusters
 16. simultaneously; parallel processing
 17. Blind sight
 18. reflects (rejects); construction
 19. sex-linked
 20. Young-Helmholtz trichromatic; red; green; blue
 21. opponent; afterimage
 22. opponent-process; red; green; yellow; blue; black; white
- In the first stage of color processing, the retina's red, green, and blue cones respond in varying degrees to different color stimuli, as suggested by the three-color theory. The resulting signals are then processed in the thalamus by red-green, blue-yellow, and black-white opponent-process cells, which are turned "on" by one wavelength and turned "off" by its opponent.

Hearing

1. audition; air molecules

2. loudness
3. pitch
4. decibels; zero
5. outer; middle; inner
6. eardrum
7. hammer; anvil; stirrup
8. cochlea; oval window; basilar membrane; hair cells; thalamus; temporal
9. number
10. place; low
11. frequency; high; 1000
12. volley
13. speed (timing); intensity
14. harder
15. conduction hearing loss
16. sensorineural; aging
17. cochlear implant
18. Deaf culture; children; speak; disability
19. is; with; seem to
20. self-esteem; accepted

Other Senses

1. pressure; warmth; cold; pain; variations
 2. top-down; somatosensory cortex; rubber-hand
 3. kinesthesia; tendons; joints; bones; ears
 4. vestibular sense; semicircular canals; vestibular sacs
 5. injury; chronic
 6. physiology; experiences; attention; culture
 7. is not; nociceptors
 8. gate-control; gate; spinal cord; small; large; brain
 9. sensory input
 10. phantom limb; tinnitus
- Pain control techniques include drugs, surgery, acupuncture, thought distraction, exercise, hypnosis, relaxation training, electrical stimulation, and massage. Similarly, for burn victims, distraction during painful wound care can be created by immersion in a computer-generated 3-D world.
11. sweet; sour; salty; bitter; umami
 12. chemical; taste buds; pore
 13. week or two; decreases; decreases; smoking; alcohol
 14. sensory interaction; McGurk; see; hearing
 15. synaesthesia
 16. olfaction; chemical; is not
 17. limbic

Perceptual Organization

1. Gestalt; whole
2. figure; ground
3. grouping
4. continuity; closure; proximity; similarity; connectedness
5. depth perception; distance
6. visual cliff; mobile

Research on the visual cliff suggests that in many species the ability to perceive depth is present at, or very shortly after, birth.

7. binocular
8. retinal disparity
9. monocular
10. relative size
11. interposition
12. relative height
13. relative motion
14. linear perspective
15. light and shadow
16. retreating; approaching; more slowly
17. movement; stroboscopic movement
18. phi phenomenon
19. perceptual constancy
20. do not; retinal
21. Moon; Ponzo; size; distance; diminished
22. relative to
23. relative luminance
24. context; color constancy
25. reflected; surrounding objects

Perceptual Interpretation

1. Immanuel Kant
2. John Locke
3. cannot
4. infancy; critical period
5. will; perceptual adaptation
6. do not adapt
7. perceptual set
8. schemas; context
9. top-down; bottom-up
10. stereotypes; emotional
11. biopsychosocial

Is There Extrasensory Perception?

1. extrasensory perception
2. parapsychologists
3. telepathy; clairvoyance; precognition; psychokinesis
4. chance-level; interpreted (retrofitted); reconstruct
5. reproducible
6. beat; failed to replicate the results

Progress Test 1

Multiple-Choice Questions

1. b. is the answer. Psychological factors can affect the absolute threshold for a stimulus. (p. 120)
 - a. The absolute threshold for detecting a stimulus depends not only on the strength of the stimulus but also on psychological factors such as experience, expectations, motivation, and fatigue. Thus, the threshold cannot be a constant.
 - c. & d. The absolute threshold is defined as the minimum stimulus that is detected 50 percent of the time.
2. c. is the answer. According to Weber's law, the difference threshold is a constant proportion of the stimulus. There is a 10 percent difference between 10 and 11 pounds; since the difference threshold is a constant proportion, the weight closest to 100 pounds that can nonetheless be differentiated from it is 110 pounds (or 100 pounds plus 10 percent). (pp. 122-123)
3. c. is the answer. (p. 123)
 - a. "Sensory fatigue" is not a term in psychology.
 - b. Accommodation refers to an adaptive change in shape by the lens of the eye.
 - d. Sensory interaction is the principle that one sense may influence another.
4. d. is the answer. (p. 126)
 - a. The lens lies behind the pupil and focuses light on the retina.
 - b. The retina is the inner surface of the eyeball and contains the rods and cones.
 - c. The cornea lies in front of the pupil and is the first structure that light passes through as it enters the eye.
5. a. is the answer. (p. 126)
 - b. Sensory adaptation is our diminishing sensitivity to an unchanging stimulus.
 - c. Feature detection is the process by which neural cells in the brain respond to specific visual features.
 - d. Transduction refers to the conversion of an environmental stimulus, such as light, into a neural impulse by a receptor—a rod or a cone.
6. d. is the answer. (p. 128)
 - a. The fovea is not a receptor; it is a region of the retina that contains only cones.
 - b. Cones have a higher threshold for brightness than rods and therefore do not function as well in dim light.
 - c. Bipolar cells are not receptors; they are neurons in the retina that link rods and cones with ganglion cells, which make up the optic nerve.
7. a. is the answer. The Young-Helmholtz theory proposes that there are red-, green-, and blue-sensitive cones. (p. 132)
 - b. This answer describes Hering's opponent-process theory.
 - c. The Young-Helmholtz theory proposes that there are three types of cones, not four.
 - d. The Young-Helmholtz theory concerns only color vision, not the detection of visual detail.
8. b. is the answer. Just as wave frequency determines pitch, so wave amplitude determines loudness. (p. 134)
 - a. Amplitude is the physical basis of loudness; wavelength determines frequency and thereby pitch.
 - c. & d. Wavelength, amplitude, and intensity are physical aspects of light and sound. Because the question is based on a relationship between a physical property (frequency) of a stimulus and its psychological attribute (pitch), these answers are incorrect.
9. c. is the answer. The biopsychosocial approach tells us that our experience of pain depends on biological, psychological, and social-cultural factors. (pp. 143, 145)
10. d. is the answer. The small fibers conduct most pain signals; the large fibers conduct most other sensory signals from the skin. The gate either allows pain signals to pass on to the brain or blocks them from passing. When the large fibers are

- stimulated, the pain gate is closed and other sensations are felt in place of pain. (p. 144)
11. b. is the answer. (p. 126)
 - a. The iris controls the diameter of the pupil.
 - c. The lens accommodates its shape to focus images on the retina.
 - d. The optic nerve carries nerve impulses from the retina to the visual cortex.
 12. b. is the answer. (p. 130)
 - a. Feature detection is the process by which nerve cells in the brain respond to specific visual features of a stimulus, such as movement or shape.
 - c. Accommodation is the process by which the lens changes its curvature to focus images on the retina.
 - d. The opponent-process theory suggests that color vision depends on the response of brain cells to red-green, yellow-blue, and black-white opposing colors.
 13. b. is the answer. Kinesthesia, or the sense of the position and movement of body parts, is based on information from the tendons, joints, bones, and ears. (p. 142)
 - a. & c. The ear plays no role in kinesthesia.
 - d. Equilibrium, or the vestibular sense, is not involved in kinesthesia but is, rather, a companion sense.
 14. a. is the answer. Wavelength determines hue, or color. (p. 125)
 - b. & d. The amplitude of light determines its brightness.
 - c. Opponent processes are neural systems involved in color vision, not properties of light.
 15. d. is the answer. Color constancy is the perception that a familiar object has consistent color, even if changing illumination alters the wavelengths reflected by that object. (p. 158)
 - a. & b. These theories explain how the visual system detects color; they do not explain why colors do not seem to change when lighting does.
 - c. Feature detection explains how the brain recognizes visual images by analyzing their distinctive features of shape, movement, and angle.
 16. a. is the answer. Sensory adaptation means a diminishing sensitivity to an unchanging stimulus. Only the adjustment to cold water involves a decrease in sensitivity; the other examples involve an increase. (p. 123)
 17. a. is the answer. Thus, they have difficulty discriminating these two colors. (p. 132)
 - b. Those who are color deficient are usually not "color blind" in a literal sense. Instead, they are unable to distinguish certain hues, such as red from green.
 - c. Failure to distinguish red and green is separate from, and does not usually affect, general visual ability.
 - d. Color deficiency does not enhance vision. A deficit in one sense often is compensated for by overdevelopment of another sense—for example, hearing in blind people.
 18. d. is the answer. Gestalt psychology, which developed in Germany early in the twentieth century, was interested in how clusters of sensations are organized into "whole" perceptions. (p. 151)
 - a. Parapsychology is the study of ESP and other paranormal phenomena.
 - b. & c. Behavioral and functional psychology developed later in the United States.
 19. d. is the answer. (p. 152)
 - a. Connectedness refers to the tendency to see uniform and linked items as a unit.
 - b. Similarity refers to the tendency to group similar items.
 - c. Continuity refers to the tendency to group stimuli into smooth, continuous patterns.
 20. c. is the answer. Although we always differentiate a stimulus into figure and ground, those elements of the stimulus we perceive as figure and those as ground may change. In this way, the same stimulus can trigger more than one perception. (p. 151)
 - a. The idea of a figure-ground relationship has no bearing on the issue of whether perception is innate.
 - b. Perception cannot be simply a point-for-point representation of sensation, since in figure-ground relationships a single stimulus can trigger more than one perception.
 - d. Figure-ground relationships demonstrate the existence of general, rather than individual, principles of perceptual organization. Significantly, even the same person can see different figure-ground relationships when viewing a scene.
 21. d. is the answer. The greater the retinal disparity, or difference between the images, the less the distance. (p. 153)
 - a. Interposition is the monocular distance cue in which an object that partially blocks another object is seen as closer.
 - b. Linear perspective is the monocular distance cue in which parallel lines appear to converge in the distance.
 - c. Relative motion is the monocular distance cue in which objects at different distances change their relative positions in our visual image, with those closest moving most.
 23. d. is the answer. (p. 166)
 - a. Psychokinesis refers to the claimed ability to perform acts of "mind over matter."
 - b. Precognition refers to the claimed ability to perceive future events.
 - c. Clairvoyance refers to the claimed ability to perceive remote events.
 24. b. is the answer. (p. 159)
 - a. Locke argued that knowledge is not inborn but comes through learning.
 - c. & d. Gibson and Walk studied depth perception using the visual cliff; they made no claims about the source of knowledge.
 25. c. is the answer. (p. 160)
 - a. & b. The kittens had difficulty only with lines they had never experienced, and never regained normal sensitivity.
 - d. Both perceptual and feature-detector impairment resulted from visual restriction.
 26. b. is the answer. Because they have not had early visual experiences, these adults typically have difficulty learning to perceive objects. (pp. 159-160)
 - a. Such patients typically could not visually recognize objects with which they were familiar by touch, and in some cases this inability persisted.
 - c. Being able to perceive figure-ground relationships, patients are able to follow moving objects with their eyes.

- d. This answer is incorrect because eye-hand coordination is an acquired skill and requires much practice.
27. b. is the answer. (p. 116)
- a. Top-down processing refers to how our knowledge and expectations influence perception.
- c. Parapsychology is the study of perception outside normal sensory input.
- d. Psychophysics is the study of the relationship between the physical characteristics of objects and our psychological experience of them.
28. c. is the answer. Retinal disparity is a *binocular* cue; all the other cues mentioned are monocular. (p.153)
29. a. is the answer. The Moon appears larger at the horizon than overhead in the sky because objects at the horizon provide distance cues that make the Moon seem farther away and therefore larger. In the open sky, of course, there are no such cues. (p.157)
30. c. is the answer. We see a cloud as a figure against the background of sky. (p. 151)
- a, b., & d. The figure-ground relationship refers to the organization of the visual field into objects (figures) that stand out from their surroundings (ground).
31. d. is the answer. (p. 116)
- a. & b. The study of sensation is concerned with these processes.
- c. Although studying illusions has helped psychologists understand ordinary perceptual mechanisms, it is not the primary focus of the field of perception.
32. c. is the answer. (p. 166)
- a. This answer would be correct had Jack claimed to be able to read someone else's mind.
- b. This answer would be correct had Jack claimed to be able to sense remote events, such as a friend in distress.
- d. This answer would be correct had Jack claimed to be able to levitate objects or bend spoons without applying any physical force.
33. d. is the answer. (p. 168)
34. a. is the answer. Frequency theory best explains the lowest pitches. Place theory best explains the highest pitches, and some combination of the two theories probably accounts for our sensation of intermediate-range pitches. (p. 137)
35. b. is the answer. (p. 118)

Matching Items

- | | | |
|---------------|---------------|----------------|
| 1. e(p.126) | 5. k (p. 126) | 9. f (p. 144) |
| 2. d (p. 126) | 6. a(p.135) | 10. c (p. 142) |
| 3. g (p. 126) | 7. i (p. 135) | |
| 4. h (p. 126) | 8. b (p. 144) | |

Progress Test 2

Multiple-Choice Questions

- d. is the answer. (pp. 146-147)
- c. is the answer. Researchers have identified receptors for pressure but have been unable to do so for the other skin senses. (p. 141)
- d. is the answer. (p. 124)
- Sensory adaptation refers to the diminished sensitivity that occurs with unchanging stimulation.
- Feature detection refers to the process by which nerve cells in the brain respond to specific aspects of visual stimuli, such as movement or shape.
- Sensory interaction is the principle that one sense may influence another.
- a. is the answer. (p. 147)
- The cochlea contains receptors for hearing.
- The fovea contains receptors for vision (the cones).
- The cortex is the outer layer of the brain, where information detected by the receptors is processed.
- b. is the answer. (p. 118)
- b. is the answer. Kinesthesia, the sense of movement of body parts, would enable you to feel your toes wiggling. (p. 142)
- The vestibular sense is concerned with movement and position, or balance, of the whole body, not of its parts.
- The skin, or tactile, senses are pressure, pain, warmth, and cold; they have nothing to do with movement of body parts.
- Sensory interaction, the principle that the senses influence each other, does not play a role in this example, which involves only the sense of kinesthesia.
- d. is the answer. Feature detectors are cortical neurons and hence are located in the visual cortex. (p. 129)
- The fovea contains cones.

Matching Items

- | | | |
|---------------|---------------|----------------|
| 1. e(p.126) | 5. k (p. 126) | 9. f (p. 144) |
| 2. d (p. 126) | 6. a(p.135) | 10. c (p. 142) |
| 3. g (p. 126) | 7. i (p. 135) | 11. J (p.142) |
| 4. h (p. 126) | 8. b (p. 144) | |

Progress Test 2

Multiple-Choice Questions

- d. is the answer. (pp. 146-147)
- The optic nerve contains neurons that relay nerve impulses from the retina to higher centers in the visual system.
- The iris is simply a ring of muscle tissue, which controls the diameter of the pupil.
- d. is the answer. Weber's law concerns difference thresholds (jnd's), not absolute thresholds, and states that these are constant proportions of the stimuli, not that they remain constant. (p. 123)
- c. is the answer. Researchers have identified receptors for pressure but have been unable to do so for the other skin senses. (p. 141)
- d. is the answer. (p. 124)
- Sensory adaptation refers to the diminished sensitivity that occurs with unchanging stimulation.
- Feature detection refers to the process by which nerve cells in the brain respond to specific aspects of visual stimuli, such as movement or shape.
-
-
-
- c. is the answer. The inner ear contains the receptors for audition (hearing) and the vestibular sense; those for kinesthesia are

- located in the tendons, joints, bones, and ears. (pp. 135, 142)
- c. is the answer. After leaving the receptor cells, visual information is analyzed in terms of pairs of opponent colors; neurons stimulated by one member of a pair are inhibited by the other. (p.133)
- a. The idea that there are three types of color-sensitive cones is the basis of the Young-Helmholtz three-color theory.
- b. According to the opponent-process theory, and all other theories of color vision, the process of color vision begins in the retina.
7. b. is the answer. Kinesthesia, the sense of movement of body parts, would enable you to feel your toes wiggling. (p. 142)
- a. The vestibular sense is concerned with movement and position, or balance, of the whole body, not of its parts.
- c. The skin, or tactile, senses are pressure, pain, warmth, and cold; they have nothing to do with movement of body parts.
- d. Sensory interaction, the principle that the senses influence each other, does not play a role in this example, which involves only the sense of kinesthesia.
8. d. is the answer. Feature detectors are cortical neurons and hence are located in the visual cortex. (p. 129)
- a. The fovea contains cones.
- b. The optic nerve contains neurons that relay nerve impulses from the retina to higher centers in the visual system.
- c. The iris is simply a ring of muscle tissue, which controls the diameter of the pupil.
9. d. is the answer. Weber's law concerns difference thresholds (jnd's), not absolute thresholds, and states that these are constant proportions of the stimuli, not that they remain constant. (p. 123)
10. d. is the answer. (p. 147)
- a. Transduction is the process by which stimulus energy is converted into nerve impulses.
- b. . Sensory adaptation is diminished sensitivity to unchanging stimulation.
- c. Weber's law states that the jnd is a constant proportion of a stimulus.
- d. is the answer. (p. 126)
- a. is the answer. (p. 133)
- a. is the answer. Wavelength determines hue, and intensity determines brightness. (p. 125)
- d. is the answer. (pp. 121-122)
- c. is the answer. (p. 133)
- a. This answer is incorrect because separate red, green, and blue systems operate only in the retina.
- b. This answer is incorrect because opponent-process systems operate en route to the brain, after visual processing in the receptors is completed.
- d. This answer is incorrect because it reverses the correct order of the two stages of processing.
- d. is the answer. (p. 127)
- a. Feature detectors are nerve cells located in the visual cortex, not in the fovea of the retina.
- b. The proximity of rods and cones to the optic nerve does not influence their ability to resolve fine details. c. Rods are concentrated in the peripheral regions of the retina, not in the fovea; moreover, several rods share a single bipolar cell.
- c. is the answer. The absolute threshold is the minimum stimulation needed to detect a stimulus. (p. 120)
- a. & b. The difference threshold, which is also known as the jnd, is the minimum difference between two stimuli that a person can detect. In this example, there is only one stimulus-the sight of the flame.
- d. Feature detection refers to nerve cells in the brain responding to specific features of a stimulus.
18. b. is the answer. (p. 152)
- a. Closure refers to the tendency to perceptually fill in gaps in recognizable objects in the visual field.
- c. Similarity refers to the tendency to group items that are similar.
- d. Proximity refers to the tendency to group items that are near one another.
19. c. is the answer. (pp. 151)
- a. & b. The Gestalt psychologists did not deal with the origins of perception; they were more concerned with its form.
- d. In fact, they argued just the opposite: Perception is more than mere sensory experience.
20. c. is the answer. Humans are able to adjust to upside-down worlds and other visual distortions, figuring out the relationship between the perceived and the actual reality; lower animals, such as chicks, are typically unable to adapt. (p. 160)
- a. Humans are able to adapt quite well to distorted visual environments (and then to readapt).
- b. This answer is incorrect because humans are the most adaptable of creatures.
- d. Humans are able to adapt at any age to distorted visual environments.
21. a. is the answer. (p. 161)
- b. Retinal disparity is a binocular depth cue based on the fact that each eye receives a slightly different view of the world.
- c. Interposition is the monocular distance cue in which an object that partially blocks another object is seen as closer.
- d. Kinesthesia is the sense of the position and movement of the parts of the body.
22. a. is the answer. (p. 159)
- b. Kant claimed that knowledge is inborn.
- c. & d. Gibson and Walk make no claims about the origins of perception.
23. b. is the answer. (p. 156)
24. c. is the answer. There appears to be a critical period for perceptual development, in that sensory restriction has severe, even permanent, disruptive effects when it occurs in infancy but not when it occurs later in life. (p. 160)
- a. & d. Sensory restriction does not have the same effects at all ages, and it is more damaging to children than to adults. This is because there is a critical period for perceptual development; whether functional blindness will result depends in part on the nature of the sensory restriction.
- b. Research studies have not indicated that sensory restriction is more damaging to humans than to animals.
25. a. is the answer. (p. 117)
- b. This is the definition of consciousness.
- c. This defines inattentional blindness.
- d. In selective attention, awareness is focused on one stimulus.

26. c. is the answer. (p. 166)
 a., b., & d. These psychics claim to exhibit the phenomena studied by parapsychologists.
27. d. is the answer. When we move, stable objects we see also appear to move, and the distance and speed of the apparent motion cue us to the objects' relative distances. (p. 155)
 a., h" & c. These depth cues are unrelated to movement and thus work even when we are stationary.
 c. is the answer. (p. 155)
 a. Many ESP researchers are sincere, reputable researchers.
 b. & d. There have been no reliable demonstrations of ESP.
 c. is the answer. Because of perceptual constancy, we see the car's shape and size as always the same. (p. 156)
 a. Perceptual set is a mental predisposition to perceive one thing and not another.
 b. Retinal disparity means that our right and left eyes each receive slightly different images.
 d. Figure-ground refers to the organization of the visual field into two parts.
 d. is the answer. Gestalt means a "form" or "organized whole." (p. 151)
 a. is the answer. Most infants refused to crawl out over the "cliff" even when coaxed, suggesting that much of depth perception is innate. Studies with the young of "lower" animals show the same thing. (p. 153)
 d. is the answer. (pp. 153, 155)
 d. is the answer. (p. 152)
 a. Proximity is the tendency to group objects near to one another. The diagram is perceived as three distinct units, even though the points are evenly spaced.
 h. Continuity is the tendency to group stimuli into smooth, uninterrupted patterns. There is no such continuity in the diagram.
 c. Closure is the perceptual tendency to fill in gaps in a form. In the diagram, three disconnected units are perceived rather than a single whole.
34. a. is the answer. (p. 116)
 h. Bottom-up processing refers to the physical characteristics of stimuli rather than their perceptual interpretation.
 c. Parapsychology is the study of perception outside normal sensory input.
 d. Psychophysics is the study of the relationship between the physical characteristics of objects and our psychological experience of them.
35. a. is the answer. (p. 137)
 b. & c. Although the localization of low-pitched sounds along the basilar membrane is poor, that for sounds of middle and, especially, high pitch is good. Therefore, place theory accounts well for high-pitched sounds and, together with frequency theory, can account for middle-pitched sounds.
 d. As long as the notes of a chord are within the range of responsiveness of the basilar membrane, place theory can account for chord perception.
 d. is the answer. Sensorineural hearing loss is caused by destruction of neural tissue as a result of problems with the cochlea's receptors or the auditory nerve. (p. 138)
 a. & c. Wax buildup and blockage because of infection are temporary states; sensorineural hearing loss is permanent.

Moreover, sensorineural hearing loss involves the inner ear rather than the outer or middle ear.

- b. Damage to the eardrum impairs the mechanical system that conducts sound waves; it could therefore cause conduction hearing loss, not sensorineural hearing loss.

True-False Items

1. F (p. 151) 2. F(p.168) 3. F (p. 153) 4. F (p. 160)
 5. F (p. 159) 6. F(p.153) 7. T (p. 160) 8. F (p. 156)
 9. T (pp. 161-162) 10. F(p.159)

Psychology Applied

Multiple-Choice Questions

1. d. is the answer. (p. 122)
 a. The absolute threshold refers to whether a single stimulus can be detected, not to whether two stimuli can be differentiated.
 b. Subliminal refers to stimuli below the absolute threshold.
 c. A receptor threshold is a minimum amount of energy that will elicit a neural impulse in a receptor cell.
2. d. is the answer. Greater sensitivity to fine visual detail is associated with the cones, which have their own bipolar cells to relay information to the cortex. The cones are concentrated in the fovea, the retina's point of central focus. For this reason, staring directly at an object maximizes sensitivity to fine detail. (p. 127)
 a. If you stare off to one side, the image falls onto peripheral regions of the retina, where rods are concentrated and sensitivity to fine visual detail is poor.
 b. Sensitivity to detail is not directly influenced by whether one or both eyes are stimulated.
 c. Decreasing the intensity of light would only impair the functioning of the cones, which are sensitive to visual detail but have a high threshold for light intensity.
3. c. is the answer. Since pain is felt in the limb that does not exist, the pain is simply the brain's (mis)interpretation of neural activity. (p. 144)
 a. If pain were a purely sensory phenomenon, phantom limb pain would not occur, since the receptors are no longer present.
 b. That pain is experienced when a limb is missing indicates that the central nervous system, especially the brain, is where pain is sensed.
4. a. is the answer. (p. 144)
 b. Since endorphins relieve pain, a decrease in their production would have made Kirsten more likely to experience pain. Moreover, because endorphins are released in response to pain, their production probably would have increased.
 c. Neural activity in small fibers tends to open the pain gate.
 d. An increase in large-fiber activity would tend to close the pain gate.
5. d. is the answer. Each of these is an example of the interaction of two senses—vision and taste in the case of (a.),

- taste and smell in the case of (b.), and hearing and the vestibular sense in the case of (c.). (p. 147)
6. d. is the answer. Just as light strikes the film of a camera, visual images entering the eye are projected onto the retina. (p. 126)
 - a. The pupil would be analogous to the aperture of a camera, since both control the amount of light permitted to enter.
 - b. The lens of the eye performs a focusing function similar to the lens of the camera.
 - c. The cornea would be analogous to a camera's lens cap in that both protect delicate inner structures.
 7. b. is the answer. (p. 116)
 - a. Both recognition and interpretation are examples of perception.
 - c. This answer would have been correct if the question had read, "Perception is to sensation as ___ is to ____."
 - d. Sensation and perception are important processes in both hearing and seeing.
 8. d. is the answer. (p. 133)
 - a. Feature detectors are located in the visual cortex and respond to features such as movement, shape, and angle.
 - b. & c. Cones and bipolar cells are located in the retina. Moreover, neither are excited by some colors and inhibited by others.
 9. a. is the answer. (p. 135)
 10. d. is the answer. The hair cells, which transduce sound energy, are located on the basilar membrane. (p. 135)
 - a. & b. The eardrum and bones of the middle ear merely conduct sound waves to the inner ear, where they are transduced.
 - c. The semicircular canals are involved in the vestibular sense, not hearing.
 11. b. is the answer. Rods and cones enable vision in dim and bright light, respectively. If an animal is active only at night, it is likely to have more rods than cones in its retinas. (p. 128)
 - d. Bipolar cells link both cones and rods to ganglion cells. There is no reason to expect that a nocturnal mammal would have more bipolar cells than a mammal active both during the day and at night. If anything, because several rods share a single bipolar cell, whereas many cones have their own, a nocturnal animal (with a visual system consisting mostly of rods) might be expected to have fewer bipolar cells than an animal active during the day (with a visual system consisting mostly of cones).
 12. b. is the answer. (pp. 127-128)
 - a. & c. It is the cones, rather than the rods, that enable color vision.
 - d. If the cones' threshold were lower than the available light intensity, they would be able to function and therefore detect the colors of the players' uniforms.
 13. c. is the answer. (p. 133)
 - a. The trichromatic theory cannot account for the experience of afterimages.
 - b. & d. Afterimages are experienced as the complementary color of a stimulus. Green, not blue, is red's complement.
 14. c. is the answer. As people age they lose taste buds and their taste thresholds increase. For this reason, Mrs. Martinez needs more concentrated tastes than her son to find food palatable. (p. 147) a. & b. There is no evidence that women and men differ in their absolute thresholds for taste.
 15. a. is the answer. (p. 123)
 - b. The sense of touch (pressure) adapts very quickly.
 - c. On the contrary, the extreme sensitivity of the fingertips is due to the relatively large amount of cortical tissue that processes neural impulses from the fingertips.
 16. c. is the answer. (p. 116)
 17. c. is the answer. Because of the powerful sensory interaction between taste and smell, eliminating the odor of the cough syrup should make its taste more pleasant. (p. 147)
 - a. If anything, the contrasting tastes might make the bitter syrup even less palatable.
 - b. If Tamiko keeps the syrup in her mouth for several seconds, it will ensure that her taste pores fully "catch" the stimulus, thus intensifying the bitter taste.
 - d. It's probably impossible to miss the tongue completely.
 18. d. is the answer. The two people interpreted a briefly perceived object in terms of their perceptual sets, or mental predispositions, in this case conditioned by their work experiences. (p. 161)
 - a. Both Smith and Wesson had the same sensory experience of the object, so linear perspective cues would not cause their differing perceptions.
 - b. Shape constancy refers to the perception that objects remain constant in shape even when our retinal images of them change.
 - c. Retinal disparity is a binocular depth cue; it has nothing to do with individual differences in perception.
 19. d. is the answer. Although the amount of light reflected from a white object is less in dim light than in bright light-and may be less than the amount of light reflected from a brightly lit gray object-the brightness of the white object is perceived as remaining constant. Because a white object reflects a higher percentage of the light falling on it than does a gray object, and the brightness of objects is perceived as constant despite variations in illumination, white is perceived as brighter than gray even under dim illumination. (p. 158)
 - a. Relative luminance refers to the relative intensity of light falling on surfaces that are in proximity. Lightness constancy is perceived despite variations in illumination.
 - b. Perceptual adaptation refers to the ability to adjust to an artificially modified perceptual environment, such as an inverted visual field.
 - c. Color contrast is not discussed in this text.
 20. b. is the answer. The phenomenon described is the basis for the monocular cue of relative size. (p.155)
 - a. The object casting the *larger* retinal image would be perceived as closer.
 - c. & d. Because of size constancy, the perceived size of familiar objects remains constant, despite changes in their retinal image size.
 21. d. is the answer. (p. 116)
 22. d. is the answer. (p. 156)

23. a. is the answer. Because we perceive the size of a familiar object as constant even as its retinal image grows smaller, we perceive the object as being farther away. (p. 156)
 b. & c. Perceptual constancy is a cognitive, rather than sensory, phenomenon. Therefore, the absence of perceptual constancy would not alter sensitivity to monocular or binocular cues.
 d. Although the absence of perceptual constancy would impair depth perception based on the size-distance relationship, other cues to depth, such as texture gradient, could still be used.
24. b. is the answer. This is an example of the principle of interposition in depth perception. (p. 155)
 a. The partially obscured object is perceived as farther away.
 c. The perceived size of an object is not altered when that object overlaps another.
25. c. is the answer. (p. 155)
 a. Interposition is a monocular depth cue in which an object that partially covers another is perceived as closer.
 b. Retinal disparity refers to the difference between the two images received by our eyes that allows us to perceive depth. It has nothing to do with the way the artist placed the trees.
 d. Figure-ground refers to the organization of the field into objects that stand out from their surroundings.
26. c. is the answer. (p. 155)
 b. & d. Linear perspective is the apparent convergence of parallel lines as a cue to distance.
27. a. is the answer. (p. 156) 28. d. is the answer. (p. 166)
 a. Telepathy is the claimed ability to “read” minds.
 b. Clairvoyance refers to the claimed ability to perceive remote events.
 c. Precognition refers to the claimed ability to perceive future events.
29. c. is the answer. She perceives the line for the road as continuous, even though it is interrupted by lines indicating other roads. (p. 152)
 a. Closure refers to the perceptual filling in of gaps in a stimulus to create a complete, whole object.
 b. Similarity is the tendency to perceive similar objects as belonging together. On a road map, all the lines representing roads appear similar. Thus, this cue could not be the basis for Colleen’s ability to trace the route of a particular road.
 d. Proximity is the tendency to group objects near to one another as a single unit.

Essay Question 1

The senses that are most important to dancers are vision, hearing, kinesthesia, and the vestibular sense. Your answer should refer to any of these senses and include, at minimum, the following information.

Dancers rely on vision to gauge their body position relative to other dancers as they perform specific choreographed movements. Vision also helps dancers assess the audience’s reaction to their performance. Whenever dance is set to music, hearing is necessary so that the dancers can detect musical cues for certain parts of their routines. Hearing also helps the dancers keep their movements in time with the music. Kinesthetic receptors in dancers’ tendons, joints,

bones, and ears provide their brains with information about the position and movement of body parts to determine if their hands, arms, legs, and heads are in the proper positions. Receptors for the vestibular sense located in the dancers’ inner ears send messages to their brains that help them maintain their balance and determine the correctness of the position and movement of their bodies.

Essay Question 2

- Proximity.* We tend to perceive items that are near each other as belonging together. Thus, a small section of dancers or members of a marching band may separate themselves from the larger group in order to form part of a particular image.
- Similarity.* Because we perceive similar figures as belonging together, choreographers and band directors often create distinct visual groupings within the larger band or dance troupe by having the members of each group wear a distinctive costume or uniform.
- Continuity.* Because we perceive smooth, continuous patterns rather than discontinuous ones, dancers or marching musicians moving together (as in a column, for example) are perceived as a separate unit.
- Closure.* If a figure has gaps, we complete it, filling in the gaps to create a whole image. Thus, we perceptually fill in the relatively wide spacing between dancers or marching musicians in order to perceive the complete words or forms they are creating.

Summing Up

The Eye

- Cornea.** Light enters the eye through this transparent membrane, which protects the inner structures from the environment.
- Iris.** The colored part of the eye, the iris functions like the aperture of a camera, controlling the size of the pupil to optimize the amount of light that enters the eye.
- Pupil.** The adjustable opening in the iris, the pupil allows light to enter.
- Lens.** This transparent structure behind the pupil changes shape to focus images on the retina.
- Retina.** The light-sensitive inner surface of the eye, the retina contains the rods and cones, which transduce light energy into neural impulses.
- Blind spot.** The region of the retina where the optic nerve leaves the eye, the blind spot contains no rods or cones and so there is no vision here.
- Optic nerve.** This bundle of nerve fibers carries neural impulses from the retina to the brain.

The Ear

- Outer ear.** Hearing begins as sound waves enter the auditory canal of the outer ear.
- Auditory canal.** Sound waves passing through the auditory canal are brought to a point of focus at the eardrum.
- Eardrum.** Lying between the outer and middle ear, this membrane vibrates in response to sound waves.

4. Middle ear. Lying between the outer and inner ear, this air-filled chamber contains the hammer, anvil, and stirrup.
5. Hammer, anvil, and stirrup. These tiny bones of the middle ear concentrate the eardrum's vibrations on the cochlea's oval window.
6. Inner ear. This region of the ear contains the cochlea and the semicircular canals, which play an important role in balance.
7. Cochlea. This fluid-filled multi-chambered structure contains the hair cell receptors that transduce sound waves into neural impulses.
8. Auditory nerve. This bundle of fibers carries nerve impulses from the inner ear to the brain.

Key Terms

1. Sensation is the process by which our sensory receptors and nervous system receive and represent physical energy from the environment. (p. 116)
2. Perception is the process by which we organize and interpret sensory information. (p. 116)
3. Bottom-up processing is analysis that begins with the sensory receptors and works up to the brain's integration of sensory information. (p. 116)
4. Top-down processing is information processing guided by higher-level mental processes. (p. 116)
5. Selective attention is the focusing of conscious awareness on a particular stimulus. (p. 117)
6. Inattention blindness is a perceptual error in which we fail to see visible objects when our attention is directed elsewhere. (p. 118)
7. Change blindness occurs when we fail to notice changes in the environment. (p. 119)
8. Psychophysics is the study of relationships between the physical characteristics of stimuli and our psychological experience of them. (p. 120)
9. The absolute threshold is the minimum stimulation needed to detect a stimulus 50 percent of the time. (p. 120)
10. Signal detection theory explains precisely how and when we detect the presence of a faint stimulus ("signal") and background stimulation ("noise"). Detection depends partly on experience, expectations, motivation, and alertness. (p. 121)
11. A stimulus that is subliminal is one that is below one's absolute threshold for conscious awareness. (p. 121)

Memory aid: *Limen* is the Latin word for "threshold." A stimulus that is subliminal is one that is *sub* ("below") the *limen*, or threshold.

12. Priming is the activation, often unconsciously, of an association by an imperceptible stimulus, the effect of which is to predispose a perception, memory, or response. (p. 121)
13. The difference threshold (also called the *just noticeable difference*, or *jnd*), is the minimum difference between two stimuli required for detection 50 percent of the time. (p. 122)
14. Weber's law states that the just noticeable difference between two stimuli is a constant minimum proportion of the stimulus. (p. 123)

Example: If a difference of 10 percent in weight is noticeable, Weber's law predicts that a person could discriminate 10 and 11-pound weights or 50 and 55-pound weights.

15. Sensory adaptation refers to the decreased sensitivity that occurs with continued exposure to an unchanging stimulus. (p. 123)
16. In sensation, transduction refers to the process by which receptor cells in the eyes, ears, skin, and nose convert stimulus energies into neural impulses our brain can interpret. (p. 124)
17. Wavelength, which refers to the distance from the peak of one light wave to the next, gives rise to the perceptual experiences of hue, or color, in vision. (p. 125)
18. The intensity of light and sound is determined by the amplitude of the waves and is experienced as brightness and loudness, respectively. (p. 125)

Example: Sounds that exceed 85 decibels in amplitude, or intensity, will damage the auditory system.

19. The pupil is the adjustable opening in the eye through which light enters. (p. 126)
20. The iris is a ring of muscle tissue that forms the colored part of the eye that controls the diameter of the pupil. (p. 126)
21. The lens is the transparent structure of the eye behind the pupil that changes shape to focus images on the retina. (p. 126)
22. The retina is the light-sensitive, multilayered inner surface of the eye that contains the rods and cones as well as neurons that form the beginning of the optic nerve. (p. 126)
23. Accommodation is the process by which the lens of the eye changes shape to focus near objects on the retina. (p. 126)
24. The rods and cones are visual receptors that convert light energy into neural impulses. The rods are concentrated in the periphery of the retina, the cones in the fovea. The rods have poor sensitivity; detect black, white, and gray; function well in dim light; and are needed for peripheral vision. The cones have excellent sensitivity, enable color vision, and function best in daylight or bright light. (p. 126)
25. Comprised of the axons of retinal ganglion cells, the optic nerve carries neural impulses from the eye to the brain. (p. 126)
26. The blind spot is the region of the retina where the optic nerve leaves the eye. Because there are no rods or cones in this area, there is no vision here. (pp. 126-127)
27. The fovea is the retina's point of central focus. It contains only cones; therefore, images focused on the fovea are the clearest. (p. 127)
28. Feature detectors, located in the visual cortex of the brain, are nerve cells that selectively respond to specific visual features, such as movement, shape, or angle. Feature detectors are evidently the basis of visual information processing. (p. 129)
29. Parallel processing is information processing in which several aspects of a stimulus, such as light or sound, are processed simultaneously. (p. 130)
30. The Young-Helmholtz trichromatic (three-color) theory maintains that the retina contains red-, green-, and blue-sensitive color receptors that in combination can produce

the perception of any color. This theory explains the first stage of color processing. (p. 132)

31. The opponent-process theory maintains that color vision depends on pairs of opposing retinal processes (red-green, yellow-blue, and white-black). This theory explains the second stage of color processing. (p. 133)
32. Audition refers to the sense of hearing. (p. 134)
33. Frequency is directly related to wavelength: Longer waves produce lower pitch; shorter waves produce higher pitch. The pitch of a sound is determined by its frequency, that is, the number of complete wavelengths that can pass a point in a given time. (p. 134)
34. The middle ear is the chamber between the eardrum and cochlea containing the three bones (hammer, anvil, and stirrup) that concentrate the eardrum's vibrations on the cochlea's oval window. (p. 135)
35. The cochlea is the coiled, bony, fluid-filled tube of the inner ear through which sound waves trigger neural impulses. (p. 135)
36. The inner ear contains the semicircular canals and the cochlea, which includes the receptors that transform sound energy into neural impulses. Because it also contains the vestibular sac, the inner ear plays an important role in balance, as well as in audition. (p. 135)
37. The place theory of hearing states that we hear different pitches because sound waves of various frequencies trigger activity at different places on the cochlea's basilar membrane. (p. 137)

Memory aid: Place theory maintains that the *place* of maximum vibration along the cochlea's membrane is the basis of pitch discrimination.

38. The frequency theory of hearing presumes that the rate, or frequency, of nerve impulses in the auditory nerve matches the frequency of a tone, thus enabling us to sense its pitch. (p. 137)
39. Conduction hearing loss refers to the hearing loss that results from damage in the mechanics of the outer or middle ear, which impairs the conduction of sound waves to the cochlea. (p. 138)
40. Sensorineural hearing loss (nerve deafness) is hearing loss caused by damage to the auditory receptors of the cochlea or to the auditory nerve due to disease, aging, or prolonged exposure to ear-splitting noise. (p. 138)
41. A cochlear implant is an electronic device that converts sounds into electrical signals that stimulate the auditory nerve. (p. 138)
42. Kinesthesia is the sense of the position and movement of the individual parts of the body. (p. 142)
43. The sense of body movement and position, including the sense of balance, is called the vestibular sense. (p. 142)
44. Melzack and Wall's gate-control theory maintains that a "gate" in the spinal cord determines whether pain signals are permitted to reach the brain. Neural activity in small nerve fibers opens the gates; activity in large fibers or information from the brain closes the gate. (pp. 143-144)

Example: The gate-control theory gained support with the discovery of endorphins. Production of these opiate-like chemicals may be the brain's mechanism for closing the spinal gate.

45. Sensory interaction is the principle that one sense may influence another. (p. 147)
46. Gestalt means "organized whole." The Gestalt psychologists emphasized our tendency to integrate pieces of information into meaningful wholes. (p. 151)
47. Figure-ground refers to the organization of the visual field into two parts: the figure, which stands out from its surroundings, and the surroundings, or background. (p. 151)
48. Grouping is the perceptual tendency to organize stimuli into coherent groups. Gestalt psychologists identified various principles of grouping. (p. 152)
49. Depth perception is the ability to see objects in three dimensions although the images that strike the retina are two-dimensional; it allows us to judge distance. (p. 153)
50. The visual cliff is a laboratory device for testing depth perception, especially in infants and young animals. In their experiments with the visual cliff, Gibson and Walk found strong evidence that depth perception is at least in part innate. (p. 153)
51. Binocular cues are depth cues that depend on information from both eyes. (p. 153)

Memory aid: *Bi* indicates "two"; *ocular* means something pertaining to the eye. Binocular cues are cues for the "two eyes."

52. Retinal disparity refers to the differences between the images received by the left eye and the right eye as a result of viewing the world from slightly different angles. It is a binocular depth cue because the greater the difference between the two images, the nearer the object. (p. 153)
53. Monocular cues are depth cues that depend on information from either eye alone. (p. 154)

Memory aid: *Mono* means one; a monocle is an eyeglass for one eye. A monocular cue is one that is available to either the left or the right eye.

54. The phi phenomenon is an illusion of movement created when two or more adjacent lights blink on and off in succession. (p. 156)
55. Perceptual constancy is the perception that object-s have consistent lightness, color, shape, and size, even as illumination and retinal images change. (p. 156)
56. Color constancy is the perception that familiar objects have consistent color despite changes in illumination that shift the wavelengths they reflect. (p. 158)
57. Perceptual adaptation refers to our ability to adjust to an artificially displaced or even inverted visual field. Given distorting lenses, we perceive things accordingly but soon adjust by learning the relationship between our distorted perceptions and the reality. (p. 160)
58. Perceptual set is a mental predisposition to perceive one thing and not another. (p. 161)
59. Extrasensory perception (ESP) refers to the controversial claim that perception can occur without sensory input.

Supposed ESP powers include telepathy, clairvoyance, and precognition. (p. 166)

Memory aid: Extra means “beyond” or “in addition to”; extrasensory perception is perception outside or beyond the normal senses.

60. Parapsychology is the study of ESP, psychokinesis, and other paranormal forms of interaction between the individual and the environment. (p.166)

Memory aid: Para-, like *extra-*, indicates “beyond”; thus, paranormal is beyond the normal and parapsychology is the study of phenomena beyond the realm of psychology and known natural laws.