MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Cerebrospinal fluid is produced by the
   a) choroid plexus.
   b) pia mater.
   c) ventricles.
   d) arachnoid villi.
   e) frontal sinuses.

2) The brain consumes about half of the ________ circulating in the body.
   a) glucose b) fatty acids c) potassium d) sodium e) oxygen

3) Cell bodies of sensory neurons are located in
   a) dorsal horns.
   b) propriospinal tracts.
   c) dorsal root ganglia.
   d) ventral root ganglia.
   e) ventral horns.

4) The mixed cranial nerve that projects to and from many internal organs and glands is the ________ nerve.
   a) spinal accessory
   b) vagus
   c) trochlear
   d) glossopharyngeal
   e) trigeminal

5) The brainstem consists of these structures.
   a) medulla oblongata, pons, and midbrain
   b) medulla oblongata, pons, and thalamus
   c) pons, midbrain, and cerebellum
   d) pons, midbrain, and thalamus
   e) medulla oblongata, cerebellum, and pons

6) The hormone that is released to enhance the fight-or-flight response is
   a) prolactin.
   b) oxytocin.
   c) epinephrine.
   d) thyroid hormone.
   e) antidiuretic hormone.

7) This sensation involves a simple system with receptors that are neuron dendrites.
   a) pain b) balance c) taste d) hearing e) smell

8) With the exception of olfaction, all sensory pathways first travel to the ________, which acts as a relay and processing station.
   a) thalamus
   b) cerebrum
   c) cerebellum
   d) medulla oblongata
   e) hypothalamus
9) A receptor potential is
a) an action potential.
b) a graded potential.
c) the resting membrane potential of a receptor cell.
d) A or B
e) none of the above

10) The larger the receptive field,
a) the more sensory receptors it includes.
b) the larger the stimulus needed to stimulate a sensory receptor.
c) the larger the area of the somatosensory cortex in the brain that deals with the area.
d) the harder it is to discriminate the exact point of stimulation.
e) all of the above

11) There are ________ primary taste sensations.
a) 5 b) 12 c) 20 d) 2 e) more than 50

12) Tonic receptors
a) are activated by parameters that must be continuously monitored by the body.
b) fire rapidly when first activated, then slow and stop firing even with a continuing stimulus.
c) are proprioceptors, for example.
d) are slowly adapting receptors.
e) A, C, and D

13) The external auditory canal ends at the
a) tympanic membrane.
b) vestibule.
c) pinna.
d) cochlea.
e) ossicles.

14) The ossicles connect the
a) oval window to the round window.
b) tympanic membrane to the oval window.
c) cochlea to the oval window.
d) tympanic membrane to the round window.
e) cochlea to the tympanic membrane.

15) Sound waves are converted into mechanical movements by the
a) round window.
b) auditory ossicles.
c) tympanic membrane.
d) cochlea.
e) oval window.

16) A structure that allows the middle ear to communicate with the nasopharynx is the
a) eustachian tube.
b) membranous labyrinth.
c) auditory meatus.
d) pinna.
e) bony labyrinth.

17) The senses of equilibrium and hearing are provided by receptors of the
a) inner ear.
b) perilymph.
c) middle ear.
d) outer ear.
e) bony labyrinth.
18) Movement of the cupula in the ampullae of the semicircular canals
a) allows us to perceive linear acceleration.
b) allows us to hear sounds.
c) stimulates hair cells alerting us to rotational movements.
d) stimulates hair cells alerting us to a change in body position with respect to gravity.
e) produces sound.

19) After an injury, Paul finds that he has a difficult time recognizing and interpreting certain sounds. He is still able to hear and his acoustic reflexes are normal. These symptoms imply damage to the
a) cochlear nerve.
b) inferior colliculus.
c) auditory cortex.
d) cochlear nucleus.
e) all of the above

20) Put these structures in the correct order in which sound waves are transmitted for hearing.
1. malleus  
2. oval window  
3. tympanic membrane  
4. stapes  
5. endolymph  
6. perilymph  
7. incus
a) 3, 1, 7, 4, 2, 6, 5  
b) 1, 7, 4, 3, 2, 5, 6  
c) 2, 1, 7, 4, 3, 6, 5  
d) 3, 2, 1, 7, 4, 6, 5  
e) 3, 1, 4, 7, 2, 5, 6

21) Damage to the fovea of the eye would interfere with the ability to
a) bleach visual pigments.  
b) regulate the amount of light striking the retina.  
c) focus an image.  
d) see color.  
e) see black and white.

22) A sudden flash of bright light would
a) increase the size of the iris.  
b) cause contraction of the pupillary constrictor muscles.  
c) cause relaxation of the ciliary ligaments.  
d) cause relaxation of the ciliary body.  
e) cause contraction of the pupillary dilator muscles.

23) The amount of light reaching the retina is controlled by the
a) lens.  
b) ciliary muscle.  
c) iris.  
d) optic disk.  
e) more than one of the above

24) If your vision is 20/20, this means that you can clearly
a) see objects at 20 feet that individuals with eye problems see at 20 feet.  
b) see 20 letters on an eye chart from 20 feet.  
c) only see objects that are not more distant than 20 feet.  
d) see 20 point type at 20 feet.  
e) see objects at 20 feet that individuals with normal eyesight can see at 20 feet.

25) The central opening in the eye through which light passes is the
a) cornea.  b) conjunctiva.  c) pupil.  d) lens.  e) fovea.
26) The ciliary muscle helps to
a) control the shape of the lens.
b) control the amount of light reaching the retina.
c) move the eyeball.
d) control the production of aqueous humor.
e) none of the above

27) An area of the retina that contains only cones and is the site of sharpest vision is the
a) outer segment.
b) fovea.
c) inner segment.
d) tapetum lucidum.
e) optic disc.

28) The hair cells of utricle and saccule are clustered in
a) cupulae. b) otoliths. c) cristae. d) maculae. e) ampullae.

29) What we perceive as the pitch of a sound is our sensory response to its
a) amplitude. b) wavelength. c) intensity. d) duration. e) frequency.

30) The receptors of equilibrium and hearing are the
a) saccules.
b) supporting cells.
c) ampullae.
d) utricles.
e) hair cells.

31) The loudness or intensity of a sound wave is related to its
a) amplitude. b) decibels. c) duration. d) frequency.

32) The primary purpose of the auditory ossicles is
a) to amplify vibration.
b) to transmit otitis media.
c) to equalize pressure in the middle ear.
d) to dampen vibration.
e) none of the above

33) Umami
a) is another name for salty taste.
b) describes the way glutamate and some nucleotides taste.
c) signals nutritious, desirable foods.
d) A and C
e) B and C

34) Chemicals such as histamine, prostaglandins, serotonin, and substance P
a) increase the inflammatory response.
b) activate nociceptors by lowering their activation threshold.
c) can cause tissue damage.
d) A and B
e) all of the above

35) Pain from one area of the body, such as in cardiac ischemia, can be felt in another area, such as
the neck and left shoulder; this is called
a) analgesia.
b) adaptation.
c) tonic reception.
d) latency.
e) referred pain.
36) Phasic receptors
a) are rapidly adaptive receptors.
b) include pressure sensitive baroreceptors.
c) cease firing unless the strength of the stimulus remains constant.
d) are not attuned to changes in a parameter.
e) A, B, and D

37) The adrenal medulla is important to the sympathetic branch of the autonomic nervous system because
a) it releases epinephrine and norepinephrine directly into the blood.
b) it is a source of catecholamines.
c) it is considered a modified sympathetic ganglion.
d) A and B
e) A, B, and C

38) The two divisions of the efferent side of the peripheral nervous system are
a) voluntary nervous system and somatic motor neurons.
b) the sympathetic and parasympathetic divisions.
c) somatic motor neurons and voluntary neurons.
d) somatic motor neurons and autonomic neurons.

39) Which of the following has its cell body in the ganglion?
a) preganglionic neuron
b) somatic motor neuron
c) postganglionic neuron
d) A and B
e) all of the above

40) Which area(s) of the brain exert(s) control over the autonomic nervous system?
   1. cerebrum
   2. cerebellum
   3. hypothalamus
   4. pons
   5. medulla
   6. thalamus
   a) 1, 2, 3, 5  b) 1, 3, 4, 5  c) 1, 2, 3, 4, 5, 6  d) 2, 3, 4, 5  e) 1, 3, 5

41) Which functions are controlled through the autonomic nervous system?
   1. blood pressure
   2. heart rate
   3. water balance
   4. temperature regulation
   a) 1, 2, 3, 4  b) 2, 3, 4  c) 1 and 3  d) 1, 2, 3  e) 1 and 2

42) Sweat glands contain
a) beta receptors.
b) alpha receptors.
c) cholinergic receptors.
d) all of the above
e) none of the above

43) Increased parasympathetic stimulation
a) causes blood vessels in the skin to dilate.
b) increases heart rate.
c) causes the pupils to dilate.
d) increases gastric motility.
e) causes sweat glands to release sweat.
44) "Dual innervation" refers to an organ receiving
a) both autonomic and somatomotor nerves.
b) both sympathetic and parasympathetic nerves.
c) nerves from both the brain and the spinal cord.
d) two nerves from the spinal cord.
e) none of the above

45) The motor end plate is
a) a folded area of muscle cell membrane with ACh receptors clustered at the top of each fold.
b) the same as the neuromuscular junction.
c) a special fibrous matrix whose collagen fibers hold the axon terminal in proper position.
d) the same as the synaptic cleft.
e) formed by the membrane of enlarged axon terminals, or boutons, that lie on the surface of skeletal muscle cells.

46) The division of the autonomic nervous system that prepares the body for intense levels of activity and stress is the
a) parasympathetic division.
b) sympathetic division.
c) intramural division.
d) craniosacral division.
e) somatomotor division.

47) Which statements apply to the parasympathetic division of the nervous system?
a) Its ganglia are nearby, on or within their target organs.
b) It is dominant during "resting and digesting."
c) Epinephrine is the primary neurotransmitter of the parasympathetic division.
d) A and B
e) A, B, and C

48) In muscles used for fine actions, such as controlling eye movement or use of the hand, a motor unit will have _________ muscle fibers when compared to a motor unit in muscles used for power and strength.
a) very few
b) approximately the same numbers of
c) hundreds more
d) Any of these answers could be correct, as this is impossible to predict.

49) Which fibers fatigue faster?
a) slow-twitch fibers b) fast-twitch fibers

50) In the body, the bones act as _______ whereas the joints form the ________, so that the muscles attached to the bones can create force when they contract.
a) levers, pulleys b) levers, fulcrums c) fulcrums, levers d) fulcrums, pulleys

51) Compared to skeletal muscle, smooth muscle
a) sustains contractions longer without fatigue.
b) is slower to contract in response to a stimulus.
c) develops tension more rapidly and relaxes more rapidly.
d) A and B
e) A, B, and C

52) A contraction that generates force and moves a load is known as ________, whereas one that generates force without movement is known as ________.
a) isotonic, eccentric
b) isotonic, isometric
c) isotropic, isometric
d) isometric, eccentric
e) isometric, isotonic
53) When a muscle cell contracts,
a) some myosin heads form crossbridges as others release them.
b) the position of each myosin head is identical at any given moment.
c) the myosin heads produce a single power stroke.
d) the intracellular calcium concentration decreases.

54) A motor unit consists of
a) one nerve and the body region it controls.
b) one muscle fiber and all the neurons that control it.
c) one nerve and the skeletal muscles it controls.
d) one neuron and the muscle fibers it controls.
e) one axon terminal branch and the myofibrils it controls.

55) The brief period of time between the end of the action potential in the muscle and the beginning of contraction is referred to as
a) the refractory period.
b) the relaxation phase.
c) the latent period.
d) the repolarization period.
e) the depolarization period.

56) The period of time during which the sarcomeres return to their resting length is referred to as
a) the relaxation phase.
b) the latent period.
c) the repolarization period.
d) the depolarization period.
e) the refractory period.

57) Metabolism of ________ is the fastest way for cells to increase their supply of ATP in order to meet the ATP demands of heavy exercise.
a) proteins b) fatty acids c) glucose d) A and B e) A, B, and C

58) The contraction cycle is triggered by the rise in ________ released from the SR.
a) K+ b) Ca2+ c) Na+ d) A and B e) A, B, and C

59) The purpose of transverse tubules is to
a) ensure a supply of glycogen throughout the muscle sarcoplasm.
b) ensure a supply of Ca2+ ions through the muscle fiber.
c) conduct ATP molecules out of the mitochondria throughout the sarcoplasm.
d) rapidly conduct action potentials to the interior of the muscle fiber.
e) All of the above are true.

60) The I band contains
a) thick filaments.
b) an area of overlapping filaments.
c) thin filaments.
d) all of the above.
e) none of the above.

61) The H zone contains
a) an area of overlapping filaments.
b) thin filaments.
c) thick filaments.
d) all of the above.
e) none of the above.

62) The origin of a particular skeletal muscle is defined as
a) the attachment site to the more movable bone.
b) the attachment site to the less movable bone.
c) the embryonic structure from which it initially developed.

63) Put these events in the correct chronological sequence:
   1. End-plate potentials trigger action potentials.
   2. Transverse tubules convey potentials into the interior of the cell.
   3. Acetylcholine binds to receptors on the motor end plate.
   4. Binding sites on actin are uncovered, allowing myosin to bind and carry out power strokes.
   5. Ca2+ is released from the sarcoplasmic reticulum.
   6. Chemically regulated ion channels open, causing depolarization.
   7. Ca2+ ions bind to troponin-C, pulling on tropomyosin.

a) 2, 4, 7, 6, 3, 1, 5
b) 3, 6, 1, 5, 7, 2, 4
c) 3, 6, 1, 2, 5, 7, 4
d) 4, 1, 3, 7, 2, 6, 5
e) 5, 3, 2, 1, 4, 7, 6

64) After death, when metabolism stops, in which step of the contractile cycle will skeletal muscles remain stuck, for most of the first day or so?
a) It depends on what part of the contractile cycle they were in at the time of death.
b) the power stoke phase
c) a weak binding state
d) the rigor state
e) none of the above

65) One of the major differences among skeletal muscle fiber types is in their resistance to fatigue. The fibers with the most endurance rely on ________ for energy.
a) oxidative phosphorylation  b) lactic acid accumulation
c) ketone body degradation  d) anaerobic glycolysis

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.
Match these terms with their descriptions.

A. gray matter
B. white matter
C. ascending tracts
D. descending tracts
E. propriospinal tracts

66) myelinated axons with very few cell bodies
67) projections that carry sensory information to the brain
68) unmyelinated, consists of cell bodies, dendrites, and axon terminals
69) projections of white matter that remain in the spinal cord
70) carry primarily efferent signals from the brain

Match these brain areas with their descriptions.

A. cerebellum
B. hypothalamus
C. thalamus
D. cerebrum
71) playing key roles in homeostasis, an area that contains centers for hunger and thirst, as well as controlling the autonomic nervous systems
72) composed of distinct regions of gray and white matter, a section of the brain that develops with sulci and gyri
73) receives sensory input from the inner ear's receptors for equilibrium and balance
74) composed of many small nuclei, an area that integrates as well as relays sensory information that passes through it

Match these brain areas with their locations.

A. primary somatic sensory cortex
B. visual cortex
C. auditory cortex
D. association areas

75) occipital lobe
76) temporal lobe
77) parietal lobe
78) all lobes

For the structures listed below, choose one of the following:

A. structure is composed of gray matter
B. structure is composed of white matter

79) cerebral cortex

80) Your best friend, Fred, was injured when he fell several meters from a cliff, but his vital signs are stable and all lacerations have been repaired. His physician is in the process of determining what neural damage he has sustained. What may be damaged if Fred is unable to walk normally? (Hint: Consider various types of factors that influence motor output, as well as the structures immediately responsible for movement.)

81) Ginger was a happy, healthy 17-year-old girl. One day while sitting at the kitchen table with her family, she looked up with an odd expression, complained that her head hurt, dropped her fork, and fell off her chair as she lost consciousness. Her father caught her before her head hit the floor. Ginger regained consciousness at the hospital, where it was determined that she had suffered from a ruptured brain aneurysm. An aneurysm results when a blood vessel wall becomes progressively thinner and weaker, and can ultimately rupture, depriving of blood the areas it normally supplies. Sometimes permanent brain damage results. Ginger seems to have all of her normal functions and cognitive abilities, except she cannot see. What areas did the ruptured blood vessel possibly supply with blood? If instead of blindness she could see normally but control of eye movement was abnormal, what areas may have been damaged by loss of blood?

82) Parkinson's disease affects the cerebral basal ganglia, resulting in tremors in limbs, slowness in beginning and completing movements, and other abnormalities of muscle control. The specific population of neurons involved degenerates and thus fails to produce the neurotransmitter dopamine. An obvious treatment option to try is to administer dopamine, yet this is completely ineffective at alleviating the symptoms. Propose a reason why this treatment fails, and a related alternative to address the dopamine deficit. (Hint: Think about how the brain protects itself from chemicals in the blood.)

Match the type of receptor with the appropriate description.
A. chemoreceptors
B. touch receptors
C. temperature receptors
D. nociceptors

83) These receptors respond to stimuli that are harmful or potentially harmful to body tissues.

84) "No brain, no pain" is a cute phrase, but is it true that a brain is required to feel pain? Explain. Brain surgery can be performed on awake patients with anesthesia only to the overlying tissues (i.e. brain, no pain). Does this fact indicate that "no brain, no pain" is just a rhyme with no scientific basis? Explain.

Match the symptoms to the problem.

A. damage to the cerebral cortex
B. degeneration of hair cells
C. ringing in the ears
D. dizziness and nausea
E. problems with structures of the middle ear

85) conductive hearing loss
86) sensorineural hearing loss
87) central hearing loss
88) tinnitus
89) Ménière's disease

90) ________ is the loss of accommodation that occurs with age and is associated with a loss of lens elasticity.

91) ________ is a condition that causes blurred vision due to the cornea and/or lens not being smoothly curved and symmetrical.

92) The process by which the eye adjusts the shape of the lens to keep objects in focus is known as ________.

93) A person suffering from ________ can see objects that are close, but distant objects appear blurred.

Match the response with the type of chemical.

A. sympathetic agonist
B. parasympathetic agonist

94) fat breakdown
95) decreased activity in digestive tract
96) salivation
97) pupil dilation
98) The two varieties of adrenergic receptors are ________ and ________.

99) ________ are swellings that contain vesicles filled with neurotransmitter.
Match the answers to the questions.

A. true only for the sympathetic division  
B. true only for the parasympathetic division  
C. true for both divisions  

100) Dominates during resting-and-digesting activities.  
101) Important during stress or emergencies (fight-or-flight) .  
102) The two types of cholinergic receptors are ________ and ________.  
103) Cholinergic receptors respond to the neurotransmitter ________.  
104) Cholinergic nicotinic receptors are found in the ________ of the ANS.  
105) Cholinergic muscarinic receptors are found at the ________ in the ANS.  

Match the following with its description.

A. acetylcholine  
B. norepinephrine  
C. cholinergic nicotinic receptor  
D. adrenergic receptor  
E. cholinergic muscarinic receptor  

106) sympathetic tissue receptor  
107) primary sympathetic neurotransmitter  
108) released by all autonomic preganglionic neurons  
109) target receptor for preganglionic neurons  
110) parasympathetic tissue receptor  

Match the structures with the accurate description.

A. muscle fiber  
B. fascicle  
C. sarcolemma  
D. myofibril  
E. t-tubules  

111) a bundle of adjacent muscle cells  
112) the muscle cell membrane  
113) a single muscle cell  
114) an intracellular structure that generates the force of muscle contraction  
115) inward extensions of the muscle cell membrane  

Match from the following list.

A. A band  
B. I band
116) The darkest band, with the most overlapping filaments; its abbreviation derives from its property of scattering light unevenly.

117) The lightest color bands of the sarcomere, occupied only by thin filaments

118) The letter assigned to this structure stands for the German word for middle; it is the attachment site for the thick filaments.

119) The structures that serve as the attachment site for the thin filaments and mark the boundaries for one sarcomere

120) _______ and _______ are striated muscles. Why are these muscles classified as striated muscles?

121) CSF is formed at the _______ and circulates around the CNS. It exits at _______ and returns to the blood.
   a) dural sinuses / choroid plexus       b) choroid plexus / dural sinuses
   c) synapse / vestibular apparatus     d) varicosities / ventricles
   e) none of the above are correct

122) Damage to Wernicke’s area would have which effect:
   a) receptive aphasia             b) expressive aphasia
   c) successive aphasia           d) deceptive aphasia
   e) total amnesia

123) REM is a phase of:
   a) real effective mode          b) rapid Ipecac movement
   c) rapid eye movement           d) real emotional mood

124) Suprachiasmatic nuclei is a center for:
   a) breathing                     b) heart rate
   c) sex drive                     d) equilibrium
   e) non of the above
   (see http://www.hhmi.org/biointeractive/media/SCN-sm.mov)

125) If a lost arm still hurt even if not attached any more this would be:
   a) perceptive pain              b) phantom pain
   c) ghostly pain                 d) skeletal pain
   e) referred pain

126) Meniere’s disease is a problem with:
   a) suprachiasmatic nuclei       b) medulla
   c) cochlea                      d) vestibular apparatus
   e) juxtaglomerular apparatus

127) What is MAO, and if it was inhibited what would happen.
   a) a famous Chinese leader / no communism   b) monoamine oxidase / over sympathetic
   c) enzyme for Ach / over parasympathetic   d) sympathetic agonist / cessation of smoking
ESSAY. Write your answer in the space provided or on a separate sheet of paper.

1. In 1848, a railroad foreman named Phineas Gage was injured in an explosion, when a tamping iron penetrated his skull and caused brain damage; surprisingly, he survived. The rod was 1.25" in diameter and 3.5' long. After the accident he was able to speak, get himself up and down from a cart, and climb a flight of stairs to see the local physicians. Years later, the doctors reported that he physically recovered, but the balance between his intellectual facilities and animal propensities was destroyed. He was no longer mild-mannered, kind, and respectful; he grew obstinate, ill-tempered, and showed little self-restraint. Based on this story, what area(s) of the brain (and/or systems) do you think he injured and why?

2. You work in a paper mill. The smell is horrible every day when you get to work, but by the end of the day, you hardly notice it. Why?

3. Describe the major anatomical differences between the sympathetic and parasympathetic branches.

4. What steps are necessary to terminate neurotransmitter action? What would happen if these steps failed?

5. List the late developmental regions of the brain and the structures they develop into.

6. Discuss smoking addiction, using nicotinic receptors, up and down regulation, agonist and antagonist, and drug mechanisms used to help.

7. List the meninges from closest to the brain out.

8. Draw and label a spinal reflex arc. Include all 5 components.

9. Compare sympathetic and parasympathetic. Note function, location, neurotransmitters, ganglia, and effects on several organs.

10. List the sources for ATP production from first used to last.

11. Compare fast twitch white and slow twitch red fibers for function and makeup of each. Note which type of activities are suited for each.

12. Where in your ear is sound sensed? Be very specific.

13. Label a brain with the following functional areas of the cerebrum:

Frontal association
Premotor
Primary Motor
Primary Sensory
Visual cortex
Visual association
Auditory cortex
Auditory association
Gustatory
Olfactory
Wernicke’s area
Broca’s area

Bonus: What is a frontal lobotomy? What was the intended purpose?