

UNIVERSITY OF TEXAS AT ARLINGTON

DEPARTMENT OF BIOLOGY

HUMAN PHYSIOLOGY  
(Biol 3345)

Dr. David G. Bernard

SECOND INTRASESSIONAL EXAMINATION

March 22, 2007

3

First Name SMITA Last Name: SHARMA UTA ID # 1000389323

There are 55 items in this booklet; 50 are multiple choice questions and the remainder are either short essay questions or diagrams to be labeled. Be careful not to overlook any pages in the examination booklet. You have 80 minutes to complete these questions.

During the course of the examination students will remain in their assigned seats. If assistance is needed, the student should raise his/her hand and a proctor will attend the individual needs of that student.

Upon completion of the exam, each student is to remain seated, raise her/his hand, and the exam materials will be collected by a proctor. At no time is the student to leave his/her seat and carry the exam materials to the proctors or other areas of the room.

After collection of exam materials, the student is to immediately, quietly, and promptly leave the Examination Room.

**NO EXTRA TIME WILL BE ALLOWED AT THE END OF THE EXAMINING PERIOD  
FOR ANSWERS TO BE TRANSFERRED.**

 **GOOD LUCK!** 

**DIRECTIONS:** Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points. **YOU DO NOT HAVE TO ATTEMPT ALL THE QUESTIONS TO EARN 100 POINTS.**

1. The subdural space
  - A. separates the arachnoid mater from the pia mater
  - B. separates the pia mater from the dura mater
  - C. separates the dura mater from the brain
  - ☒ D. contains cerebrospinal fluid
  - E. is between the vertebrae and the dura mater
2. 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. the same as the synaptic cleft
  - D. formed by the membrane of enlarged axon terminals, or boutons, that lie on the surface of skeletal muscle cells
  - E. a special fibrous matrix whose collagen fibers hold the axon terminal in proper position
3. The role of acetylcholinesterase is to:
  - A. act as a transmitting agent
  - B. amplify or enhance the effect of ACh
  - ☒ C. destroy ACh a brief period after its release by the axonal endings
  - D. stimulate the production of acetylcholine
  - E. inhibit the release of acetylcholine
4. How does blocking the ability for retrograde flow in an axon affect the activity of a neuron?
  - A. The neuron is unable to produce neurotransmitters.
  - B. The neuron is unable to produce action potentials.
  - C. The soma is unable to export products to the synaptic knobs.
  - ☒ D. The soma is unable to respond to changes in the distal end of the neuron.
  - E. The neuron is unable to depolarize when stimulated.
5. Each of the following is a function of the nervous system, EXCEPT:
  - A. providing sensation of the internal and external environments
  - B. integrating sensory information
  - C. coordinating voluntary and involuntary activities
  - ☒ D. directing activities that continue for extended periods such as growth and pregnancy
  - E. regulating or controlling peripheral structures and systems
6. Which statement is TRUE about sleep?
  - A. It is an easily reversible state of inactivity.
  - B. It is characterized by lack of interaction with the external environment.
  - C. Sleep is now considered an active state, requiring neuronal activity.
  - D. During a sleep cycle a person alternates between REM sleep and deep wave sleep.
  - ☒ E. All of these statements are true.
7. On which lobe would one expect to find the primary sensory cortex?
  - A. Frontal
  - ☒ B. Parietal
  - C. Occipital
  - D. Temporal.
8. Select the statement that is most correct.
  - A. Ganglia are collections of neuron cell bodies in the CNS that are associated with efferent fibers.
  - B. Efferent ganglia are not associated with the autonomic system.
  - C. The dorsal root ganglion is a motor only structure.
  - D. The cell bodies of afferent ganglia are located in the spinal cord.
  - ☒ E. Ganglia exist outside the spinal cord.
9. The spinal cord has grey matter on the:
  - A. outside, white matter on the inside, and a dorsal motor root
  - ☒ B. inside, white matter on the outside, and a ventral motor root
  - C. inside, white matter on the outside, and a dorsal motor root
  - D. outside, white matter on the inside, and a ventral motor root

10. At resting membrane potential:
- A. the membrane is more permeable to  $K^+$  than to  $Na^+$
  - B. the membrane is more permeable to  $Na^+$  than to  $K^+$
  - C.  $Cl^-$  is at its equilibrium potential
  - ☒ D. both A and C above
  - E. Both B and C above
11. An alien retrieved alive from a crashed UFO has had a thorough medical examination. A hormone with a distinct but similar structure to epinephrine has been isolated, and named ufo-epi. Which of the following responses in humans administered a physiological dose of ufo-epi would indicate it is indeed an epinephrine agonist?
- A. constriction of respiratory tubes
  - ☒ B. increase in fatty acids in the blood
  - C. hyperglycemia (high blood glucose)
  - D. localized sweating
  - E. decreased heart rate
12. Nicotinic receptors
- A. bind ACh and open monovalent cation channels.
  - B. are found on skeletal muscles at the neuromuscular junction.
  - C. are identical throughout the nervous system.
  - ☒ D. A and B
  - E. A, B, and C
13. The interior of the cell becomes less negative due to an influx of sodium ions.
- A. Action potential
  - B. Repolarization
  - C. Absolute refractory period
  - ☒ D. Depolarization
  - E. Relative refractory period
14. Because of the presence of both activation and inactivation gates, voltage-gated  $Na^+$  channels can:
- A. be closed but capable of opening
  - B. Be activated
  - C. be closed and not capable of opening
  - ☒ D. All of the above answers are correct.
  - E. None of these answers.
15. Which term below best describes an excitable tissue when a resting membrane potential is present?
- ☒ A. polarized
  - B. depolarized
  - C. hyperpolarized
  - D. repolarized
  - E. nonpolarized
16. The outermost connective tissue covering of spinal nerves is the:
- A. endoneurium
  - B. endomysium
  - C. perineurium
  - ☒ D. epineurium
  - E. epimysium
17. Branches that sometimes occur along the length of an axon are called:
- A. telodendria
  - B. synaptic knobs
  - ☒ C. collaterals
  - D. hillock
  - E. synapse
18. An IPSP is associated with:
- A. a change in sodium ion permeability
  - ☒ B. hyperpolarization
  - C. opening of voltage-gated channels
  - D. lowering the threshold for an action potential to occur
  - E. All of these are correct answers.
19. The all-or-none principle states that:
- A. all stimuli will produce identical action potentials
  - ☒ B. all stimuli great enough to bring the membrane to threshold will produce identical action potentials
  - C. the greater the magnitude of the stimuli, the greater the intensity of the action potential
  - D. only sensory stimuli can activate action potentials
  - E. only motor stimuli can activate action potentials
20. Major centers concerned with autonomic control of breathing, blood pressure, heart rate, and digestive activities are located in the
- ☒ A. medulla oblongata
  - B. pons
  - C. mesencephalon
  - D. diencephalon
  - E. cerebellum

21. Which statement regarding CSF production and flow is correct?  
 A. CSF is produced along the spinal cord ✓  
 B. CSF is produced by meningeal cells. ✓  
 C. CSF enters the meningeal layer through the cerebral aqueduct  
 (D) CSF flows inferiorly along the dorsal subarachnoid space of the spinal cord X  
 E. CSF does not flow through the meningeal layers X
22. In which of the following would the rate of impulse conduction be the greatest?  
 (A) a myelinated fiber 20 microns in diameter  
 B. a nonmyelinated fiber 20 microns in diameter  
 C. a myelinated fiber 2 microns in diameter  
 D. a nonmyelinated fiber 2 microns in diameter  
 E. a nonmyelinated fiber 25 cm long
23. In a condition known as hypocalcemia, the level of calcium ions in the blood and interstitial fluid is lower than normal. How would this condition affect the function of the nervous system?  
 A. Cholinergic synapses would be more active.  
 B. Neurons would generate action potentials spontaneously.  
 (C) Less neurotransmitter would be released in response to an action potential.  
 D. Depolarizing events would occur more frequently at the postsynaptic membrane.  
 E. Potassium channels would fail to open.
24. The dorsal root ganglia contain:  
 A. axons of motor neurons  
 C. cell bodies of motor neurons  
 E. C and D  
 B. axons of sensory neurons  
 (D) cell bodies of sensory neurons
25. Astrocytes:  
 A. induce formation of the blood-brain barrier  
 B. are important in the repair of brain injuries and in neural scar formation  
 C. take up excess  $K^+$  from the brain ECF  
 D. physically support neurons  
 (E) All of these answers are correct.
- 
- Match each with its function (Questions 26 to 27):
- |               |                       |
|---------------|-----------------------|
| A. Dura mater | B. Pia mater          |
| C. Arachnoid  | D. Subarachnoid space |
| E. Ventricles |                       |
26. The innermost layer of the meninges, delicate, contains many blood vessels. B
27. The weblike, spidery middle meningeal layer. C
- 
28. The difference between electronic and saltatory conduction is that:  
 (A) saltatory conduction requires the presence of myelin ✓  
 B. during electronic conduction only subthreshold depolarizations are conducted —  
 C. saltatory conduction is a graded event —  
 D. in electronic conduction the amplitude of the signal gets smaller  
 E. saltatory conduction only occurs near the cell body
29. The cranial nerves that are involved in controlling eye movements are:  
 A. I, II, and III ✓  
 D. II and VI ✓  
 (B) III, IV, and VI  
 E. III and V  
 C. II, III, and IV
30. Which of these has a higher concentration in cerebrospinal fluid than in the blood?  
 A.  $K^+$   
 D.  $HCO_3^-$   
 (B)  $H^+$   
 E.  $Na^+$   
 C.  $Ca^{2+}$
31. During the rising phase of the action potential:  
 A.  $K^+$  permeability is much greater than  $Na^+$  permeability  
 (B)  $Na^+$  permeability is much greater than  $K^+$  permeability  
 C.  $K^+$  permeability is the same as  $Na^+$  permeability  
 D.  $Na^+$  efflux occurs  
 E. Two of these answers are correct.

32. The third and fourth ventricles are linked by the:  
 A. central canal B. lateral ventricles (C) mesencephalic aqueduct  
 D. interventricular foramina E. medulla oblongata
33. Excess cerebrospinal fluid is drained into the:  
 A. jugular veins B. dural sinus (C) superior sagittal sinus  
 D. falx cerebri E. cranial vein
34. Which of the following nerve fibers will have the highest conduction velocity?  
 A. an unmyelinated nerve fiber with conduction velocity = 0.35 m/sec  
 B. an unmyelinated nerve fiber smaller than the nerve fiber in A  
 (C) a myelinated nerve fiber the same size as the nerve fiber in A  
 (D) a myelinated fiber larger than the nerve fiber in A  
 E. it is impossible to determine with the information provided
35. Motor innervation of the voluntary swallowing muscles and intrinsic laryngeal muscles is by way of the D nerve.  
 A. abducens B. vestibulocochlea C. spinal accessory  
 (D) hypoglossal E. vagus
36. A second nerve impulse cannot be generated until:  
 (A) the membrane potential has been reestablished  
 B. the Na ions have been pumped back into the cell  
 C. the K ions have been pumped back out of the cell  
 D. All of the above are correct..
37. Graded potentials:  
 A. are local changes in membrane potential that occur in varying degrees of magnitude  
 B. serve as short-distance signals  
 C. serve as long-distance signals  
 (D) both A and B  
 E. both A and C
38. The ion needed to initiate the release of acetylcholine into the synaptic cleft is:  
 A. sodium B. potassium (C) calcium  
 D. chloride E.  $\text{HCO}_3^-$
39. Interneurons:  
 (A) are found only in the central nervous system  
 B. carry only sensory impulses  
 C. carry only motor impulses  
 D. only connect motor neurons to other motor neurons  
 E. are found between neurons and their effectors
40. The brainstem consists of the:  
 A. cerebrum, pons, midbrain, and medulla  
 (B) midbrain, medulla, and pons  
 C. pons, medulla, cerebellum, and midbrain  
 D. midbrain only  
 E. diencephalon, midbrain and medulla
41. Target receptor for preganglionic neurons:  
 A. acetylcholine  
 B. norepinephrine  
 (C) cholinergic nicotinic receptor  
 D. adrenergic receptor  
 E. cholinergic muscarinic receptor
- X 42. Motor innervation of the voluntary swallowing muscles and intrinsic laryngeal muscles is by way of the \_\_\_\_\_ nerve.  
 A. abducens B. vestibulocochlea C. spinal accessory  
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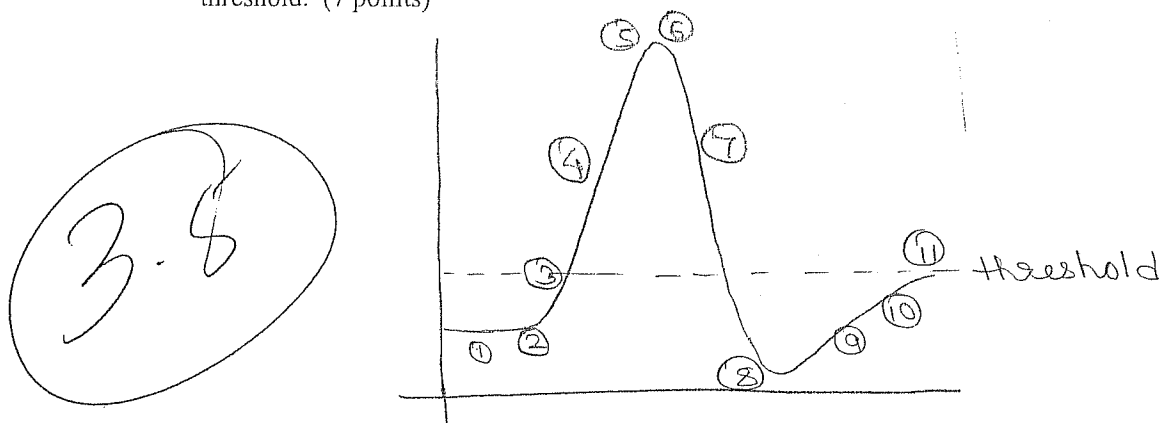
43. If the ventral root of a spinal nerve were cut, what would be the result in the tissue or region that nerve supplies?
- A. complete loss of sensation
  - ☒ B. a complete loss of voluntary movement
  - C. loss of neither sensation nor movement but only autonomic control
  - D. a complete loss of sensation and movement
  - E. only loss of sympathetic information
44. The two divisions of the efferent side of the peripheral nervous system are:
- A. somatic motor neurons and voluntary neurons ✗
  - ☒ B. somatic motor neurons and autonomic neurons ✓
  - C. the sympathetic and parasympathetic divisions ✗
  - D. voluntary nervous system and somatic motor neurons ✗
  - E. visceral nervous system and the involuntary nervous system ✗
45. Myelinated axons conduct impulses much faster because:
- A. the myelin insulates the axon
  - B. channels only have to open at the nodes
  - C. voltage is not lost through and along myelinated areas
  - D. of saltatory conduction
  - ☒ E. All of these answers are correct
46. Postganglionic fibers of autonomic neurons are usually:
- A. myelinated
  - B. larger than preganglionic fibers
  - C. located in the brain
  - D. located in the spinal cord
  - ☒ E. unmyelinated
47. Preganglionic fibers of parasympathetic neurons can be found in all of the following cranial nerves, EXCEPT C.N.:
- A. III
  - B. VII
  - C. IX
  - D. X
  - ☒ E. XII
48. Membrane potential:
- ☒ A. refers to a separation of charges across the membrane or to a difference in the relative number of + and - charges in the ECF and ICF.
  - B. is measured in units of millivolts with the sign always designating the charge on the outside
  - C. is less at the equilibrium potential for  $K^+$  than at resting membrane potential
  - D. cannot be measured easily
  - E. All of these answers
49. If a somatic motor neuron fires an action potential, then \_\_\_\_.
- A. acetylcholine is released from the axon terminal
  - ☒ B. a skeletal muscle is triggered to contract
  - C. the response is always excitatory
  - D. A and B
  - ☒ E. A, B and C
50. Each peripheral nerve provides \_\_\_\_ innervation to specific structures
- A. motor
  - B. sensory
  - C. tactile
  - ☒ D. A and/or B
  - E. B and/or C

## Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!

You can use the back of the last page to continue any question. Number them, please!!

51. Draw and completely label a graph showing what would happen to the resting membrane potential if the sodium/potassium pumps were made non-functional and immediately after the nerve was stimulated to threshold. (7 points)



- ① Resting Membrane potential
- ② depolarising stimulus
- ③ threshold
- ④  $\text{Na}^+$  entry (depolarising)
- ⑤ Isopotential
- ⑥ Overshoot
- ⑦  $\text{K}^+$  out (repolarising)
- ⑧ after hyperpolarisation (undershoot)
- ⑨ absolute refractory period
- ⑩ relative refractory period
- ⑪ threshold stimulus

52. You are walking to class, pondering the intricacies of physiology, when you trip over an uneven place in the sidewalk, and fall. Unhurt but embarrassed and angry, you jump up and glance around to see if anyone is watching. From your knowledge of neuroanatomy and function, explain how the following areas of the brain might be involved in this scenario: (3 points)

- a. cerebrum —
- b. cerebellum —
- c. limbic system —

a) Cerebrum — didn't see the uneven place in sidewalk  
brain cannot communicate about that place and fall.

b) Cerebellum — jump up

c) limbic system — embarrassed and angry (emotions)


53. Please answer only ONE of the following (A OR B). Circle the one you are answering. (3 points each)

A.

Write out the Nernst equation and explain its significance. What is the equilibrium potential for an ion?

B.

In multiple sclerosis, there is progressive and intermittent damage to the myelin sheath of axons of the central nervous system. One symptom is poor motor control of the affected area. Why does destruction of the myelin sheath affect motor control?


$$E_{ion} = \frac{61}{z} \log \frac{[ion]_{out}}{[ion]_{in}}$$

$z$  is the electrical charge of an ion.

Nernst equation gives the equilibrium potential at which an ion is not permeable to enter the cell.

Equilibrium potential is the potential in which the potential of ions inside and outside will be equal. No flow of ions outside and inside.



54. List the anatomic and functional categories of neurons. (3 points)

Anatomic

Functional

Pseudounipolar  
bipolar  
anoxonic  
Multipolar

Sensory  
Interneurons  
Efferent neurons

3

55. Using ions, describe two ways a cell can become hyperpolarized. (2 points)

① Graded potential ( $K^+$  influx)

Potential of  
② cell going below threshold and coming back to threshold limit again.

# SUBJECTIVE SCORE INSTRUCTOR USE ONLY

## PART 1

100	90	80	70	60
50	40	30	20	10
9	8	7	6	5
4	3	2	1	0

(T) (F) KEY  
 % 2 3 5

- 1 A B C D E
- 2 A B C D E
- 3 A B C D E
- 4 A B C D E
- 5 A B C D E
- 6 A B C D E
- 7 A B C D E
- 8 A B C D E
- 9 A B C D E
- 10 A B C D E
- 11 A B C D E
- 12 A B C D E
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- 14 A B C D E
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- 47 A B C D E
- 48 A B C D E
- 49 A B C D E
- 50 A B C D E

**IMPORTANT**

USE NO. 2 PENCIL ONLY

• MAKE DARK MARKS  
 • ERASE COMPLETELY  
 • TO CHANGE

EXAMPLE: A B C D E

TO USE SUBJECTIVE SCORE FEATURE:

• Mark total possible subjective points  
 • Only one mark per line on key  
 • 163 points maximum

EXAMPLE OF STUDENT SCORE:

100	90	80	70	60
50	40	30	20	10
9	8	7	6	5
4	3	2	1	0

EXAS AT ARLINGTON

NT OF BIOLOGY

PHYSIOLOGY  
 (3345)

d G. Bernard

SIONAL EXAMINATION

h 22, 2007

**SCANTRON**

FORM NO. 882-E

FOR USE ON TEST SCORING MACHINE ONLY

NAME	Michael Lam
SUBJECT	Human Phy.
DATE	
TEST NO.	2
PERIOD	

**TEST RECORD**

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PART 1	37.2
PART 2	10.5
TOTAL	24.5

Lam UTA ID # 1000050627

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- B. synaptic knobs
- E. synapse



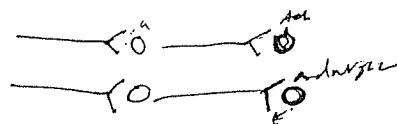
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11. The dorsal root ganglia contain:

- ☒ A. axons of motor neurons
- ☒ B. axons of sensory neurons - on nerves (spinal)
- C. cell bodies of motor neurons
- ☒ D. cell bodies of sensory neurons
- E. C and D

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- B. separates the pia mater from the dura mater
- ☒ C. separates the dura mater from the brain
- ☒ D. contains cerebrospinal fluid
- E. is between the vertebrae and the dura mater

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- C.  $Ca^{2+}$
- D.  $HCO_3^-$
- E.  $Na^+$

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Match each with its function (Questions 22 to 23):

- |               |                       |
|---------------|-----------------------|
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| C. Arachnoid  | D. Subarachnoid space |
| E. Ventricles |                       |

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23. The weblike, spidery middle meningeal layer. **C**

24. Motor innervation of the voluntary swallowing muscles and intrinsic laryngeal muscles is by way of the \_\_\_\_\_ nerve.

- |  |                            |  |
|--|----------------------------|--|
| A. abducens - eye movement                               | B. vestibulocochlea - hear | <input checked="" type="radio"/> C. spinal accessory |
| <input checked="" type="radio"/> D. hypoglossal - tongue | E. vagus - internal organs |  |

25. Which statement is TRUE about sleep?

- A. It is an easily reversible state of inactivity.
- ☒ B. It is characterized by lack of interaction with the external environment.
- C. Sleep is now considered an active state, requiring neuronal activity.
- D. During a sleep cycle a person alternates between REM sleep and deep wave sleep.
- ☒ E. All of these statements are true.

26. Which of the following nerve fibers will have the highest conduction velocity?

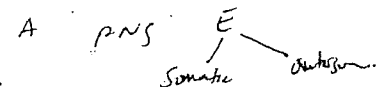
- A. an unmyelinated nerve fiber with conduction velocity = 0.35 m/sec
- B. an unmyelinated nerve fiber smaller than the nerve fiber in A
- C. a myelinated nerve fiber the same size as the nerve fiber in A
- ☒ D. a myelinated fiber larger than the nerve fiber in A
- E. it is impossible to determine with the information provided

27. Postganglionic fibers of autonomic neurons are usually:

- |  |  |
|--|--|
| <input checked="" type="radio"/> A. myelinated   | B. larger than preganglionic fibers                            |
| C. located in the brain                          | <input checked="" type="radio"/> D. located in the spinal cord |
| <input checked="" type="radio"/> E. unmyelinated |  |

28. The two divisions of the efferent side of the peripheral nervous system are:

- A. somatic motor neurons and voluntary neurons
- ☒ B. somatic motor neurons and autonomic neurons
- C. the sympathetic and parasympathetic divisions
- D. voluntary nervous system and somatic motor neurons
- E. visceral nervous system and the involuntary nervous system



29. The ion needed to initiate the release of acetylcholine into the synaptic cleft is:

- |             |                     |   |
|-------------|---------------------|---|
| A. sodium   | B. potassium        | <input checked="" type="radio"/> C. calcium |
| D. chloride | E. $\text{HCO}_3^-$ |   |

30. The spinal cord has grey matter on the:

- A. outside, white matter on the inside, and a dorsal motor root
- ☒ B. inside, white matter on the outside, and a ventral motor root
- C. inside, white matter on the outside, and a dorsal motor root
- D. outside, white matter on the inside, and a ventral motor root

31. How does blocking the ability for retrograde flow in an axon affect the activity of a neuron?

- A. The neuron is unable to produce neurotransmitters.
- B. The neuron is unable to produce action potentials.
- ☒ C. The soma is unable to export products to the synaptic knobs.
- D. The soma is unable to respond to changes in the distal end of the neuron.
- E. The neuron is unable to depolarize when stimulated.

And PSP is associated with:

- A. a change in sodium ion permeability
- ☒ B. hyperpolarization
- C. opening of voltage-gated channels
- D. lowering the threshold for an action potential to occur
- E. All of these are correct answers.

33. Each of the following is a function of the nervous system, EXCEPT:

- A. providing sensation of the internal and external environments
- B. integrating sensory information
- ☒ C. coordinating voluntary and involuntary activities
- D. directing activities that continue for extended periods such as growth and pregnancy
- E. regulating or controlling peripheral structures and systems

34. 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. the same as the synaptic cleft
- D. formed by the membrane of enlarged axon terminals, or boutons, that lie on the surface of skeletal muscle cells
- E. a special fibrous matrix whose collagen fibers hold the axon terminal in proper position

35. Preganglionic fibers of parasympathetic neurons can be found in all of the following cranial nerves, EXCEPT

- A. III
- B. VII
- C. IX
- ☒ D. X
- ☒ E. XII

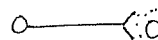
36. If a somatic motor neuron fires an action potential, then \_\_\_\_\_.

- A. acetylcholine is released from the axon terminal
- B. a skeletal muscle is triggered to contract
- C. the response is always excitatory
- D. A and B
- ☒ E. A, B and C

37. At resting membrane potential:

- ☒ A. the membrane is more permeable to  $K^+$  than to  $Na^+$
- B. the membrane is more permeable to  $Na^+$  than to  $K^+$
- C.  $Cl^-$  is at its equilibrium potential
- ☒ D. both A and C above
- ☒ E. Both B and C above

*ACh = cholinergic*



38. Target receptor for preganglionic neurons:

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

39. The cranial nerves that are involved in controlling eye movements are:

- A. I, II, and III
- ☒ B. III, IV, and VI
- C. II, III, and IV
- D. II and VI
- E. III and V

40. Major centers concerned with autonomic control of breathing, blood pressure, heart rate, and digestive activities are located in the

- ☒ A. medulla oblongata
- B. pons
- C. mesencephalon
- D. diencephalon
- E. cerebellum

*omit*

41. Major centers concerned with autonomic control of breathing, blood pressure, heart rate, and digestive activities are located in the

- A. medulla oblongata
- B. pons
- C. mesencephalon
- D. diencephalon
- E. cerebellum

42. During the rising phase of the action potential:

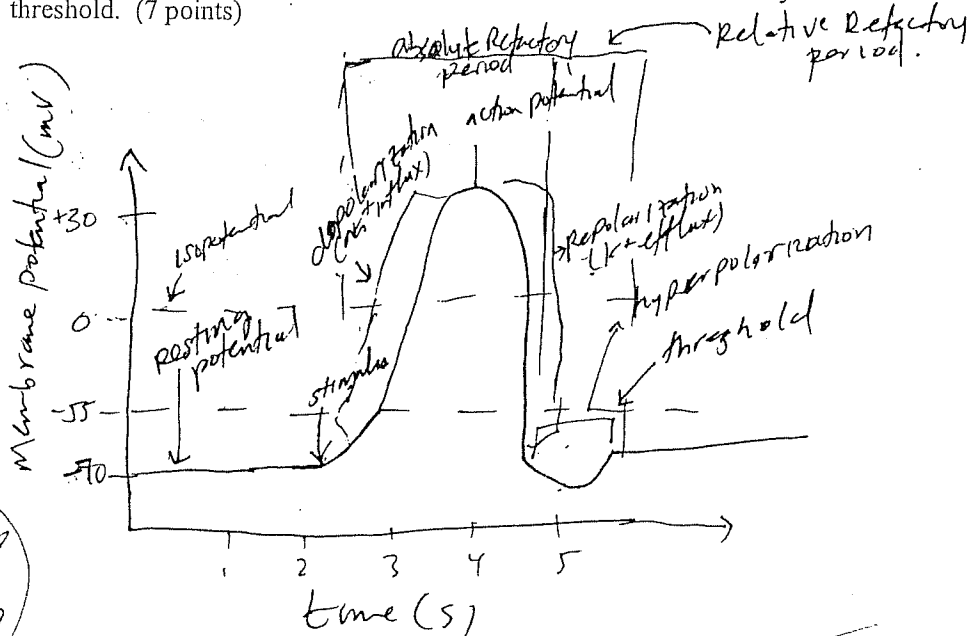
- ☒ A.  $K^+$  permeability is much greater than  $Na^+$  permeability
- B.  $Na^+$  permeability is much greater than  $K^+$  permeability
- C.  $K^+$  permeability is the same as  $Na^+$  permeability
- D.  $Na^+$  efflux occurs
- E. Two of these answers are correct.

43. <sup>symp + rest</sup> ~~Parasympathetic~~ blocking agents would be useful in treating:  
A. heart failure  
B. high blood pressure  
C. A and C  
D. All of the above
44. In which of the following would the rate of impulse conduction be the greatest?  
A. ~~a myelinated fiber 20 microns in diameter~~  
B. a nonmyelinated fiber 20 microns in diameter  
C. a myelinated fiber 2 microns in diameter  
D. a nonmyelinated fiber 2 microns in diameter  
E. a nonmyelinated fiber 25 cm long
45. ~~Myelinated~~ axons conduct impulses much faster because:  
A. the myelin insulates the axon  
B. channels only have to open at the nodes  
C. voltage is not lost through and along myelinated areas  
D. of saltatory conduction  
E. All of these answers are correct
46. Because of the presence of both activation and inactivation gates, voltage-gated  $\text{Na}^+$  channels can:  
A. be closed but capable of opening  
B. Be activated  
C. be closed and not capable of opening  
D. All of the above answers are correct.  
E. None of these answers.
47. ~~Select~~ the statement that is most correct.  
A. Ganglia are collections of neuron cell bodies in the CNS that are associated with efferent fibers.  
B. Efferent ganglia are not associated with the autonomic system.  
C. The dorsal root ganglion is a motor only structure.  
D. The cell bodies of afferent ganglia are located in the spinal cord.  
E. Ganglia exist outside the spinal cord.
48. The role of acetylcholinesterase is to:  
A. act as a transmitting agent  
B. amplify or enhance the effect of ACh  
C. destroy ACh a brief period after its release by the axonal endings  
D. stimulate the production of acetylcholine  
E. inhibit the release of acetylcholine
49. Interneurons:  
A. are found only in the central nervous system  
B. carry only sensory impulses  
C. carry only motor impulses  
D. only connect motor neurons to other motor neurons  
E. are found between neurons and their effectors
50. Each peripheral nerve provides \_\_\_\_\_ innervation to specific structures  
A. motor  
B. sensory  
C. tactile  
D. A and/or B  
E. B and/or C

## Short Answer Questions

Answer these questions briefly. Label diagrams correctly, with lines pointing to proper structures. Partial credit will be given where appropriate. Write legibly!! You can use the back of the last page to continue any question. Number them, please!!

51. Draw and completely label a graph showing what would happen to the resting membrane potential if the sodium/potassium pumps were made non-functional and immediately after the nerve was stimulated to threshold. (7 points)



52. You are walking to class, pondering the intricacies of physiology, when you trip over an uneven place in the sidewalk, and fall. Unhurt but embarrassed and angry, you jump up and glance around to see if anyone is watching. From your knowledge of neuroanatomy and function, explain how the following areas of the brain might be involved in this scenario: (3 points)

- cerebrum -
- cerebellum -
- limbic system -

- Cerebrum - involve in pondering about physiology  
- involve of being embarrassed because Part of Cerebral cortex received information about the fall.  
- involve in getting up because the somatomotor of the frontal lobe is being activated.
- Cerebellum : involve in movement as you walk + maintaining position
- limbic system : also involve of obtaining information of physiology from memory (Cental gyrus)



53. Please answer only ONE of the following (A OR B). Circle the one you are answering. (3 points each)

A. Write out the Nernst equation and explain its significance. What is the equilibrium potential for  $\text{Na}^+$ ?

B. ~~In multiple sclerosis, there is progressive and intermittent damage to the myelin sheath of axons in the central nervous system. One symptom is poor motor control of the affected area. Why does destruction of the myelin sheath affect motor control?~~

①

$$E_p = \frac{61}{z} \log \frac{[\text{ion}]_{\text{out}}}{[\text{ion}]_{\text{in}}}$$

equilibrium potential for  $\text{Na}^+$  is -90 mV

the significance of Nernst equation determines the charge inside the cell + allows an idea of when a stimulus depolarizes the cell + when repolarization occurs.

54. List the anatomic and functional categories of neurons. (3 points)

Anatomic

- ① dendrites
- ② cell bodies
- ③ Axon

④ Axon terminals

Functional

- ① receive incoming messages
- ② integrate information + makes protein which sends it to axon
- ③ convert signal ~~etc~~  
Chemical  $\rightarrow$  Electrical,  
where action potential  
occur throughout.
- ④ release neurotransmitters  
to synaptic cleft.

55. Using ions, describe two ways a cell can become hyperpolarized. (2 points)

① efflux of  $K^+$ : when  $K^+$  become permeable, efflux of  $K^+$  make cell more negative

② or influx of  $Cl^-$  making inside of cell more negative, thus hyperpolarization

②

UNIVERSITY OF TEXAS AT ARLINGTON

DEPARTMENT OF BIOLOGY

HUMAN PHYSIOLOGY  
(Biol 3345)

Dr. David G. Bernard

SECOND INTRASESSIONAL EXAMINATION

March 22, 2007

3

First Name Nasser Last Name: Aslari UTA ID # 1000185292

There are 55 items in this booklet; 50 are multiple choice questions and the remainder are either short essay questions or diagrams to be labeled. Be careful not to overlook any pages in the examination booklet. You have 80 minutes to complete these questions.

During the course of the examination students will remain in their assigned seats. If assistance is needed, the student should raise his/her hand and a proctor will attend the individual needs of that student.

Upon completion of the exam, each student is to remain seated, raise her/his hand, and the exam materials will be collected by a proctor. At no time is the student to leave his/her seat and carry the exam materials to the proctors or other areas of the room.

After collection of exam materials, the student is to immediately, quietly, and promptly leave the Examination Room.

**NO EXTRA TIME WILL BE ALLOWED AT THE END OF THE EXAMINING PERIOD  
FOR ANSWERS TO BE TRANSFERRED.**

✱ GOOD LUCK! ✱

**DIRECTIONS:** Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points. **YOU DO NOT HAVE TO ATTEMPT ALL THE QUESTIONS TO EARN 100 POINTS.**

1. The subdural space
  - ~~A.~~ separates the arachnoid mater from the pia mater
  - ~~B.~~ separates the pia mater from the dura mater
  - ~~C.~~ separates the dura mater from the brain
  - D. contains cerebrospinal fluid
  - E. is between the vertebrae and the dura mater

Dura  
Arach  
pia
2. 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.~~ the same as the synaptic cleft
  - D. formed by the membrane of enlarged axon terminals, or boutons, that lie on the surface of skeletal muscle cells
  - E. a special fibrous matrix whose collagen fibers hold the axon terminal in proper position
3. The role of acetylcholinesterase is to:
  - A. act as a transmitting agent
  - ~~B.~~ amplify or enhance the effect of ACh
  - C. destroy ACh a brief period after its release by the axonal endings
  - D. stimulate the production of acetylcholine
  - E. inhibit the release of acetylcholine
4. How does blocking the ability for retrograde flow in an axon affect the activity of a neuron?
  - ~~A.~~ The neuron is unable to produce neurotransmitters.
  - ~~B.~~ The neuron is unable to produce action potentials.
  - ~~C.~~ The soma is unable to export products to the synaptic knobs.
  - D. The soma is unable to respond to changes in the distal end of the neuron.
  - E. The neuron is unable to depolarize when stimulated.
5. Each of the following is a function of the nervous system, EXCEPT:
  - A. providing sensation of the internal and external environments
  - B. integrating sensory information
  - ~~C.~~ coordinating voluntary and involuntary activities
  - D. directing activities that continue for extended periods such as growth and pregnancy
  - E. regulating or controlling peripheral structures and systems
6. Which statement is TRUE about sleep?
  - ~~A.~~ It is an easily reversible state of inactivity.
  - ~~B.~~ It is characterized by lack of interaction with the external environment.
  - ~~C.~~ Sleep is now considered an active state, requiring neuronal activity.
  - D. During a sleep cycle a person alternates between REM sleep and deep wave sleep.
  - E. All of these statements are true.
7. On which lobe would one expect to find the primary sensory cortex?
  - A. Frontal
  - B. Parietal
  - C. Occipital
  - D. Temporal.
8. Select the statement that is most correct.
  - ~~A.~~ Ganglia are collections of neuron cell bodies in the CNS that are associated with efferent fibers.
  - ~~B.~~ Efferent ganglia are not associated with the autonomic system.
  - ~~C.~~ The dorsal root ganglion is a motor only structure.
  - ~~D.~~ The cell bodies of afferent ganglia are located in the spinal cord.
  - E. Ganglia exist outside the spinal cord.
9. The spinal cord has grey matter on the:
  - ~~A.~~ outside, white matter on the inside, and a dorsal motor root
  - B. inside, white matter on the outside, and a ventral motor root
  - ~~C.~~ inside, white matter on the outside, and a dorsal motor root
  - ~~D.~~ outside, white matter on the inside, and a ventral motor root

10. At resting membrane potential:
- ☐ A. the membrane is more permeable to  $K^+$  than to  $Na^+$
  - ☒ B. the membrane is more permeable to  $Na^+$  than to  $K^+$
  - ☐ C.  $Cl^-$  is at its equilibrium potential
  - ☐ D. both A and C above
  - ☐ E. Both B and C above
11. An alien retrieved alive from a crashed UFO has had a thorough medical examination. A hormone with a distinct but similar structure to epinephrine has been isolated, and named ufo-epi. Which of the following responses in humans administered a physiological dose of ufo-epi would indicate it is indeed an epinephrine agonist?
- ☒ A. constriction of respiratory tubes
  - ☒ B. increase in fatty acids in the blood
  - ☒ C. decreased heart rate
  - ☒ D. hyperglycemia (high blood glucose)
  - ☐ E. localized sweating
12. Nicotinic receptors
- ☒ A. bind ACh and open monovalent cation channels.
  - ☒ B. are found on skeletal muscles at the neuromuscular junction.
  - ☒ C. are identical throughout the nervous system.
  - ☒ D. A and B
  - ☐ E. A, B, and C
13. The interior of the cell becomes less negative due to an influx of sodium ions.
- ☐ A. Action potential
  - ☐ B. Repolarization
  - ☐ C. Absolute refractory period
  - ☒ D. Depolarization
  - ☐ E. Relative refractory period
14. Because of the presence of both activation and inactivation gates, voltage-gated  $Na^+$  channels can:
- ☒ A. be closed but capable of opening
  - ☒ B. Be activated
  - ☒ C. be closed and not capable of opening
  - ☒ D. All of the above answers are correct.
  - ☐ E. None of these answers.
15. Which term below best describes an excitable tissue when a resting membrane potential is present?
- ☒ A. polarized
  - ☐ B. depolarized
  - ☐ C. hyperpolarized
  - ☐ D. repolarized
  - ☐ E. nonpolarized
16. The outermost connective tissue covering of spinal nerves is the:
- ☒ A. endoneurium
  - ☐ B. endomysium
  - ☐ C. perineurium
  - ☒ D. epineurium
  - ☐ E. epimysium
17. Branches that sometimes occur along the length of an axon are called:
- ☐ A. teleodendria
  - ☐ B. synaptic knobs
  - ☒ C. collaterals
  - ☐ D. hillock
  - ☐ E. synapse
18. An IPSP is associated with:
- ☒ A. a change in sodium ion permeability
  - ☒ B. hyperpolarization
  - ☒ C. opening of voltage-gated channels
  - ☒ D. lowering the threshold for an action potential to occur
  - ☐ E. All of these are correct answers.
19. The all-or-none principle states that:
- ☐ A. all stimuli will produce identical action potentials
  - ☒ B. all stimuli great enough to bring the membrane to threshold will produce identical action potentials
  - ☐ C. the greater the magnitude of the stimuli, the greater the intensity of the action potential
  - ☐ D. only sensory stimuli can activate action potentials
  - ☐ E. only motor stimuli can activate action potentials
20. Major centers concerned with autonomic control of breathing, blood pressure, heart rate, and digestive activities are located in the
- ☒ A. medulla oblongata
  - ☐ B. pons
  - ☐ C. mesencephalon
  - ☐ D. diencephalon
  - ☐ E. cerebellum

21. Which statement regarding CSF production and flow is correct?  
 A. CSF is produced along the spinal cord  
 B. CSF is produced by meningeal cells *ependymal*  
 C. CSF enters the meningeal layer through the cerebral aqueduct  
 D. CSF flows inferiorly along the dorsal subarachnoid space of the spinal cord  
 E. CSF does not flow through the meningeal layers
22. In which of the following would the rate of impulse conduction be the greatest?  
 A. a myelinated fiber 20 microns in diameter  
 B. a nonmyelinated fiber 20 microns in diameter  
 C. a myelinated fiber 2 microns in diameter  
 D. a nonmyelinated fiber 2 microns in diameter  
 E. a nonmyelinated fiber 25 cm long
23. In a condition known as hypocalcemia, the level of calcium ions in the blood and interstitial fluid is lower than normal. How would this condition affect the function of the nervous system?  
 A. Cholinergic synapses would be more active.  
 B. Neurons would generate action potentials spontaneously.  
 C. Less neurotransmitter would be released in response to an action potential.  
 D. Depolarizing events would occur more frequently at the postsynaptic membrane.  
 E. Potassium channels would fail to open.  
*Ca<sup>2+</sup> ↓*
24. The dorsal root ganglia contain:  
 A. axons of motor neurons  
 B. axons of sensory neurons  
 C. cell bodies of motor neurons  
 D. cell bodies of sensory neurons  
 E. C and D  
*D - affer*  
*- sensory*
25. Astrocytes:  
 A. induce formation of the blood-brain barrier  
 B. are important in the repair of brain injuries and in neural scar formation  
 C. take up excess K<sup>+</sup> from the brain ECF  
 D. physically support neurons  
 E. All of these answers are correct.
- 
- Match each with its function (Questions 26 to 27):
- |               |                       |
|---------------|-----------------------|
| A. Dura mater | B. Pia mater          |
| C. Arachnoid  | D. Subarachnoid space |
| E. Ventricles |                       |
26. The innermost layer of the meninges, delicate, contains many blood vessels. *Pia* *B*
27. The weblike, spidery middle meningeal layer. *C*
- 
28. The difference between electronic and saltatory conduction is that:  
 A. saltatory conduction requires the presence of myelin  
 B. during electronic conduction only subthreshold depolarizations are conducted  
 C. saltatory conduction is a graded event  
 D. in electronic conduction the amplitude of the signal gets smaller  
 E. saltatory conduction only occurs near the cell body
29. The cranial nerves that are involved in controlling eye movements are:  
 A. I, II, and III  
 B. III, IV, and VI  
 C. II, III, and IV  
 D. II and VI  
 E. III and V
30. Which of these has a higher concentration in cerebrospinal fluid than in the blood?  
 A. K<sup>+</sup>  
 B. H<sup>+</sup>  
 C. Ca<sup>2+</sup>  
 D. HCO<sub>3</sub><sup>-</sup>  
 E. Na<sup>+</sup>
31. During the rising phase of the action potential:  
 A. K<sup>+</sup> permeability is much greater than Na<sup>+</sup> permeability  
 B. Na<sup>+</sup> permeability is much greater than K<sup>+</sup> permeability  
 C. K<sup>+</sup> permeability is the same as Na<sup>+</sup> permeability  
 D. Na<sup>+</sup> efflux occurs  
 E. Two of these answers are correct.

32. The third and fourth ventricles are linked by the:  
 A. central canal B. lateral ventricles C. mesencephalic aqueduct  
 D. interventricular foramina E. medulla oblongata
33. Excess cerebrospinal fluid is drained into the:  
 A. jugular veins B. dural sinus C. superior sagittal sinus  
 D. falx cerebri E. cranial vein
34. Which of the following nerve fibers will have the highest conduction velocity?  
 A. an unmyelinated nerve fiber with conduction velocity = 0.35 m/sec  
 B. an unmyelinated nerve fiber smaller than the nerve fiber in A  
 C. a myelinated nerve fiber the same size as the nerve fiber in A  
 D. a myelinated fiber larger than the nerve fiber in A  
 E. it is impossible to determine with the information provided
35. Motor innervation of the voluntary swallowing muscles and intrinsic laryngeal muscles is by way of the \_\_\_\_ nerve.  
 A. abducens B. vestibulocochlea C. spinal accessory  
 D. hypoglossal E. vagus
36. A second nerve impulse cannot be generated until:  
 A. the membrane potential has been reestablished  
 B. the Na ions have been pumped back into the cell  
 C. the K ions have been pumped back out of the cell  
 D. All of the above are correct.
37. Graded potentials:  
 A. are local changes in membrane potential that occur in varying degrees of magnitude  
 B. serve as short-distance signals  
 C. serve as long-distance signals  
 D. both A and B  
 E. both A and C
38. The ion needed to initiate the release of acetylcholine into the synaptic cleft is:  
 A. sodium B. potassium C. calcium  
 D. chloride E.  $\text{HCO}_3^-$
39. Interneurons:  
 A. are found only in the central nervous system  
 B. carry only sensory impulses  
 C. carry only motor impulses  
 D. only connect motor neurons to other motor neurons  
 E. are found between neurons and their effectors
40. The brainstem consists of the:  
 A. cerebrum, pons, midbrain, and medulla  
 B. midbrain, medulla, and pons  
 C. pons, medulla, cerebellum, and midbrain  
 D. midbrain only  
 E. diencephalon, midbrain and medulla
41. Target receptor for preganglionic neurons:  
 A. acetylcholine  
 B. norepinephrine  
 C. cholinergic nicotinic receptor  
 D. adrenergic receptor  
 E. cholinergic muscarinic receptor
42. Motor innervation of the voluntary swallowing muscles and intrinsic laryngeal muscles is by way of the \_\_\_\_ nerve.  
 A. abducens B. vestibulocochlea C. spinal accessory  
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tounge

SC

ACH nic

mit

43. If the ventral root of a spinal nerve were cut, what would be the result in the tissue or region that nerve supplies?
- A. complete loss of sensation
  - ☒ B. a complete loss of voluntary movement
  - C. loss of neither sensation nor movement but only autonomic control
  - D. a complete loss of sensation and movement
  - E. only loss of sympathetic information
44. The two divisions of the efferent side of the peripheral nervous system are:
- A. somatic motor neurons and voluntary neurons
  - ☒ B. somatic motor neurons and autonomic neurons
  - C. the sympathetic and parasympathetic divisions
  - D. voluntary nervous system and somatic motor neurons
  - E. visceral nervous system and the involuntary nervous system
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  - ☒ D. of saltatory conduction
  - ☒ E. All of these answers are correct
46. Postganglionic fibers of autonomic neurons are usually:
- A. myelinated
  - ☒ B. larger than preganglionic fibers
  - C. located in the brain
  - ☒ D. located in the spinal cord
  - ☒ E. unmyelinated
47. Preganglionic fibers of parasympathetic neurons can be found in all of the following cranial nerves, EXCEPT C.N.:
- A. III motor
  - ☒ B. X motor
  - ☒ C. VII motor
  - ☒ D. XII motor
  - ☒ E. IX motor
48. Membrane potential:
- ☒ A. refers to a separation of charges across the membrane or to a difference in the relative number of + and - charges in the ECF and ICF.
  - ☒ B. is measured in units of millivolts with the sign always designating the charge on the outside
  - C. is less at the equilibrium potential for  $K^+$  than at resting membrane potential
  - D. cannot be measured easily
  - E. All of these answers
49. If a somatic motor neuron fires an action potential, then \_\_\_\_\_.
- ☒ A. acetylcholine is released from the axon terminal
  - ☒ B. a skeletal muscle is triggered to contract
  - ☒ C. the response is always excitatory
  - D. A and B
  - ☒ E. A, B and C
50. Each peripheral nerve provides \_\_\_\_\_ innervation to specific structures
- A. motor
  - ☒ B. sensory
  - C. tactile
  - D. A and/or B
  - E. B and/or C

PNS → somatic  
→ Autonomic

ANS  
Somatic

SMN → Ach A/C

O	S	
O	S	
O	M III	Oculomotor Eye App'l
T	M	
T	X	
A	M	
F	X VII	Salivary
V	S	
G	X IX	chemo/bare solivd
V	X X	
S	M	
Fl	M XII	Tongue

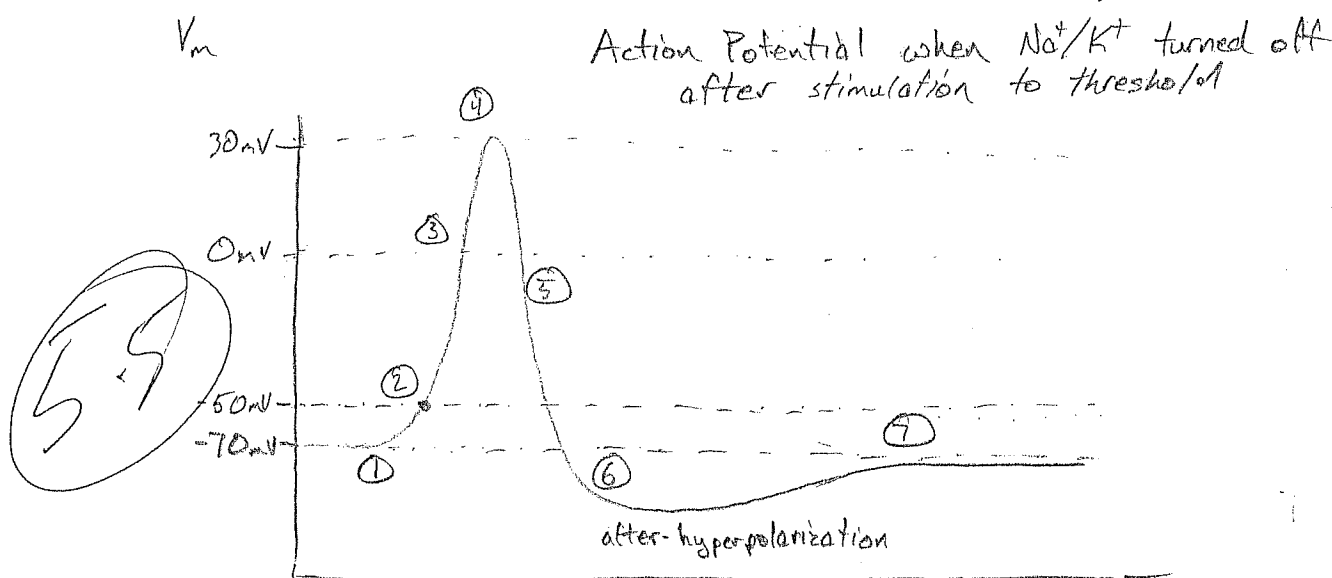


## Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!

You can use the back of the last page to continue any question. Number them, please!!

51. Draw and completely label a graph showing what would happen to the resting membrane potential if the sodium/potassium pumps were made non-functional and immediately after the nerve was stimulated to threshold. (7 points)



- ① membrane is stimulated to threshold  $\text{Na}^+/\text{K}^+$  pumps turned off
- ② at threshold potential, there is a depolarization of triggering,  $\text{Na}^+$  channels activate and action potential starts
- ③ Overshoot  $\text{Na}^+$  channels start closing inactivation starts  $\text{K}^+$  channels start opening
- ④ At peak of A.P.  $\text{Na}^+$  channels are inactivated  $\text{K}^+$  channels are all open
- ⑤ Repolarization  $\text{K}^+$  channels start closing
- ⑥ After hyperpolarization -  $\text{K}^+$  channels closed  $\text{Na}^+$  channels reset to their resting position
- ⑦ Membrane returns to resting potential (Continued on last pg.)

52. You are walking to class, pondering the intricacies of physiology, when you trip over an uneven place in the sidewalk, and fall. Unhurt but embarrassed and angry, you jump up and glance around to see if anyone is watching. From your knowledge of neuroanatomy and function, explain how the following areas of the brain might be involved in this scenario: (3 points)

- a. cerebrum
- b. cerebellum
- c. limbic system

Walking movement utilizes cerebellum for balance and amygdala in limbic system for "muscle memory". Falling sends information from proprioceptors to cerebrum and cerebellum to track your position in space. Your feelings of embarrassment and anger are centered in limbic system (anger specifically in amygdala).

(primary motor cortex)

jumping up involves cerebrum for planned action then transfers info to cerebellum. Glancing around also requires cerebrum to process visual information.

53. Please answer only ONE of the following (A OR B). Circle the one you are answering. (3 points each)

- A. Write out the Nernst equation and explain its significance. What is the equilibrium potential for an ion?
- B. In multiple sclerosis, there is progressive and intermittent damage to the myelin sheath of axons of the central nervous system. One symptom is poor motor control of the affected area. Why does destruction of the myelin sheath affect motor control?

3

$$E_{ion} = \left( \frac{61}{z} \right) \log \frac{[ion]_{out}}{[ion]_{in}}$$

- The Nernst equation is used to find the equilibrium potential of an ion ( $E_{ion}$ )
- $E_{ion}$  is the membrane potential at which the force due to the concentration gradient acting on an ion is equal <sup>and opposite</sup> to the force due to the electrical gradient.

54. List the anatomic and functional categories of neurons. (3 points)

Anatomic

Bipolar

Unipolar

Pseudounipolar

Anaxonic

Multipolar

Functional

Sensory Afferent neuron

Interneurons

Motor Efferent neuron

55. Using ions, describe two ways a cell can become hyperpolarized. (2 points)

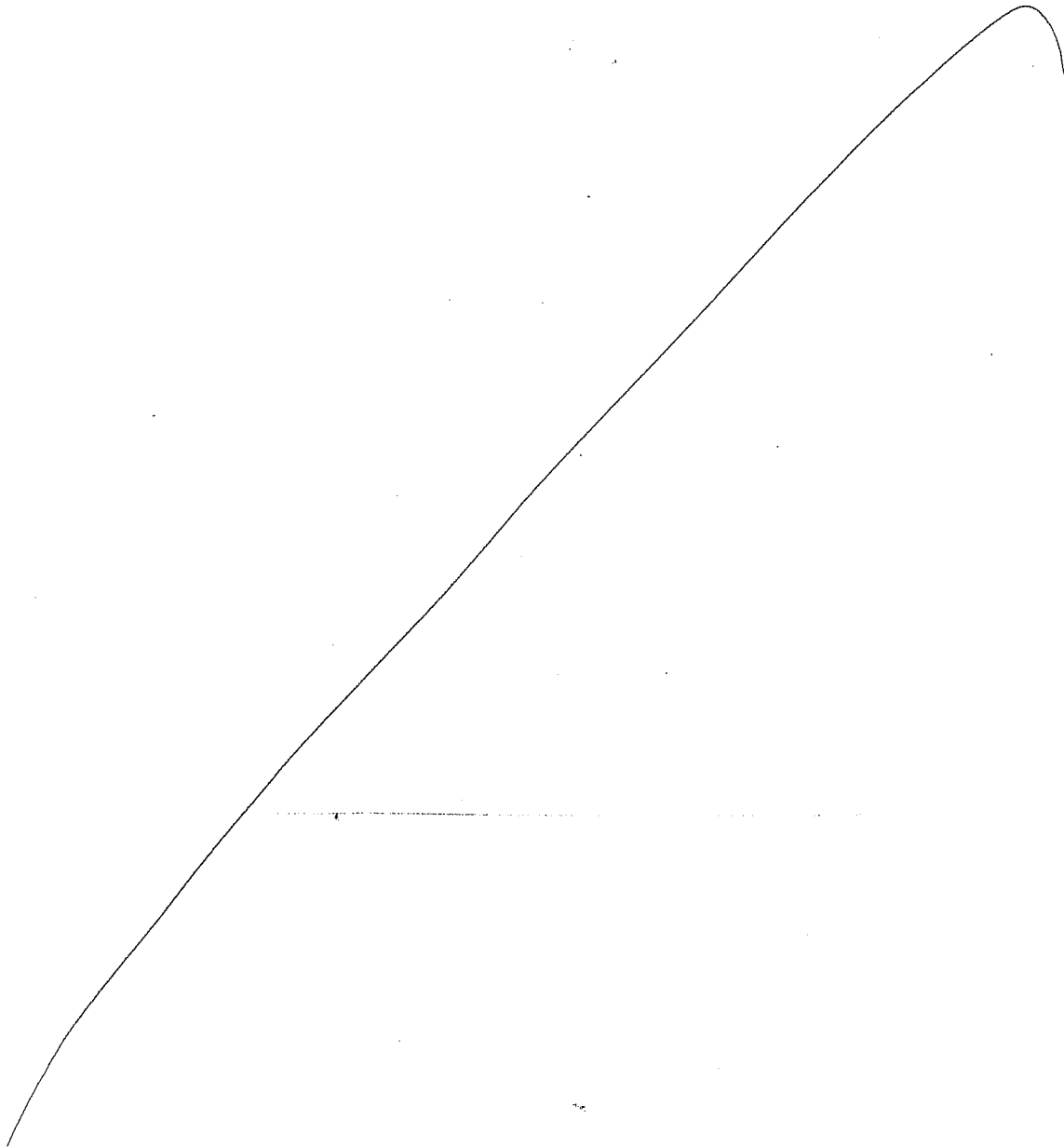
A cell can become hyperpolarized if there is

• a net efflux of  $K^+$  ions

• a net influx of  $Cl^-$  ions (like in an IPSP)

# 51 continued

- Inactivating  $\text{Na}^+/\text{K}^+$  pumps has no immediate effect on neurons ability to conduct an action potential.



SUBJECTIVE SCORE INSTRUCTOR USE ONLY					
100	90	80	70	60	
50	40	30	20	10	
9	8	7	6	5	
4	3	2	1	0	

PART 1

**IMPORTANT**

USE NO. 2 PENCIL ONLY

TO USE SUBJECTIVE SCORE FEATURE:

- MAKE DARK MARKS
- ERASE COMPLETELY TO CHANGE
- Mark total possible subjective points
- Only one mark per line on key
- 163 points maximum

EXAMPLE OF STUDENT SCORE:

1	2	5
100	90	80
50	40	30
9	8	7
4	3	2
1	2	5

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	50	40	30
	9	8	7
	4	3	2
	1	2	5
1	A	B	C
2	A	B	C
3	A	B	C
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5	A	B	C
6	A	B	C
7	A	B	C
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32	A	B	C
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34	A	B	C
35	A	B	C
36	A	B	C
37	A	B	C
38	A	B	C
39	A	B	C
40	A	B	C
41	A	B	C
42	A	B	C
43	A	B	C
44	A	B	C
45	A	B	C
46	A	B	C
47	A	B	C
48	A	B	C
49	A	B	C
50	A	B	C

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UNIVERSITY OF TEXAS AT ARLINGTON

DEPARTMENT OF BIOLOGY

HUMAN PHYSIOLOGY  
(Biol 3345)

Dr. David G. Bernard

SECOND INTRASESSIONAL EXAMINATION-2

March 13, 2008

First Name Nicole Last Name: Khatibi UTA ID # 1000546162

There are 64 items in this booklet; 58 are multiple choice questions and the remainder are either short essay questions or diagrams to be labeled. Be careful not to overlook any pages in the examination booklet. You have 80 minutes to complete these questions.

During the course of the examination students will remain in their assigned seats. If assistance is needed, the student should raise his/her hand and a proctor will attend the individual needs of that student.

Upon completion of the exam, each student is to remain seated, raise her/his hand, and the exam materials will be collected by a proctor. At no time is the student to leave his/her seat and carry the exam materials to the proctors or other areas of the room.

After collection of exam materials, the student is to immediately, quietly, and promptly leave the Examination Room.

**NO EXTRA TIME WILL BE ALLOWED AT THE END OF THE EXAMINING PERIOD  
FOR ANSWERS TO BE TRANSFERRED.**

 **GOOD LUCK!** 

**DIRECTIONS:** Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 1.5 points. **YOU DO NOT HAVE TO ATTEMPT ALL THE QUESTIONS TO EARN 100 POINTS.**

1. The term that describes a neural pathway where a single neuron is stimulated and synapses with many neurons, resulting in multiple responses, is:  
 A. convergence ☒ B. divergence C. feedforward  
 D. polysynaptic E. reflex
2. The fourth ventricle is associated with the:  
 A. interventricular tube B. medulla oblongata C. pons  
☒ D. both B and C E. None of these.
3. The region of the brain that is involved in conscious thought and intellectual function as well as processing somatic sensory and motor information is the:  
 A. medulla oblongata B. pons C. mesencephalon  
 D. diencephalon ☒ E. cerebrum
4. Which term below best describes an excitable tissue when a resting membrane potential is present?  
☒ A. polarized B. depolarized C. hyperpolarized  
 D. repolarized E. nonpolarized
5. These carry primarily efferent signals from the brain:  
 A. gray matter B. white matter C. ascending tracts  
☒ D. descending tracts E. propriospinal tracts
6. The structure that separates the cochlear duct (scala media) from the tympanic duct (scala tympani) is the:  
 A. tectorial membrane ☒ B. basilar membrane C. bony labyrinth  
 D. membranous labyrinth E. stapedius
7. Receptors on postganglionic neurons of the sympathetic nervous systems are?  
 A. muscarinic ☒ B. nicotinic C. Both A and B  
 D. adrenergic E. acetylcholine
8. The third and fourth ventricles are linked by the:  
 A. central canal B. lateral ventricles ☒ C. mesencephalic aqueduct  
 D. interventricular foramina E. medulla oblongata
9. Branches that sometimes occur along the length of an axon are called:  
☒ A. collaterals B. axon terminals C. dendrites  
 D. axon hillocks E. synapses
10. The central nervous system interprets signal frequency as:  
☒ A. stimulus intensity B. stimulus importance C. convergence  
 D. divergence E. a reflex
11. The auditory cortex is located in the  
 A. frontal lobe B. parietal lobe ☒ C. temporal lobe  
 D. occipital lobe E. limbic lobe
12. Which of the following is **NOT** a target of autonomic neurons?  
 A. smooth muscle B. cardiac muscle  
 C. adipose tissue D. exocrine glands  
☒ E. All of the above are autonomic targets.
13. The interior of the cell becomes less negative due to an influx of sodium ions.  
 A. Action potential B. Repolarization  
 C. Absolute refractory period ☒ D. Depolarization  
 E. Relative refractory period

14. The primary motor cortex is located in the region of the  
 A. temporal lobe  
 D. cingulate gyrus  
 (B) precentral gyrus  
 E. corpus callosum  
 C. postcentral gyrus
15. After suffering a stroke, Mary find that she cannot move her right arm. This would suggest that the stroke damage is in the area of the \_\_\_\_\_ lobe.  
 A. right frontal  
 D. left temporal  
 (B) left frontal  
 E. occipital  
 C. right temporal
16. Transduction involves:  
 A. a stimulus altering the permeability of a receptor membrane  
 B. changes in the transmembrane potential of the sensory receptor  
 C. production of a receptor potential  
 D. generation of an action potential that can be processed and interpreted by the CNS  
 (E) All of the above are correct.
17. Some of the fibers that form the spinothalamic tracts are damaged before they decussate (cross) the midline. This type of injury would affect:  
 A. motor function on the same side as the damage  
 B. motor function on the opposite side from the damage  
 C. sensory function on the same side as the damage.  
 D. Sensory function of the opposite side from the damage  
 (E) Both A and C
- 
- Match each with its function (Questions 18 to 19):
- A. Action potential  
 B. Depolarization  
 C. Absolute refractory period  
 D. Repolarization  
 E. Relative refractory period
18. The interior of the cell becomes less negative due to an influx of sodium ions. B
19. The specific period during which potassium ions diffuse out of the neuron due to a change in membrane permeability. D
- 
20. Which statements apply to the parasympathetic division of the nervous system?  
 A. It is dominant during "resting and digesting." ✓  
 B. Its ganglia are nearby, within or on their target organs. ✓  
 C. Epinephrine is the primary neurotransmitter of the parasympathetic division. ✗  
 (D) A and B  
 E. A, B and C
21. Cerebrospinal fluid:  
 A. is secreted by the arachnoid villi.  
 B. enters the four ventricles after filling and circulating through the subarachnoid space  
 (C) is secreted mostly by the ependymal cells lining the brain. ✓  
 D. is formed mostly by the choroid plexuses  
 E. is found beneath the pia mater ✗
22. The sympathetic nervous system is characterized by peripheral ganglia near the:  
 A. organs and by short postganglionic fibers  
 B. organs and by long postganglionic fibers  
 C. spinal cord and by short postganglionic fibers  
 (D) spinal cord and by long postganglionic fibers  
 E. only involves one neuron
23. If the ventral root of a spinal nerve were cut, what would be the result in the tissue or region that nerve supplies?  
 A. Complete loss of sensation.  
 (B) A complete loss of voluntary movement. ✓  
 C. Loss of neither sensation nor movement but only of autonomic control.  
 D. A complete loss of sensation and movement.



24. Sympathetic fibers leave the spinal cord in the:
- craniosacral regions, and the postganglionic fibers secrete norepinephrine
  - thoracolumbar region and the postganglionic fibers secrete acetylcholine
  - craniosacral region and the postganglionic fibers secrete acetylcholine
  - ☒ thoracolumbar region and the postganglionic fibers secrete norepinephrine
25. An alien retrieved alive from a crashed UFO has had a thorough medical examination. A hormone with a distinct but similar structure to epinephrine has been isolated, and named ufo-epi. Which of the following responses in humans administered a physiological dose of ufo-epi would indicate it is indeed an epinephrine agonist?
- constriction of respiratory tubes
  - hyperglycemia (high blood glucose)
  - ☒ increase in fatty acids in the blood
  - localized sweating
  - ☒ decreased heart rate
26. The site of origin of the preganglionic fibers of the parasympathetic nervous system is:
- The thoracolumbar region of the spinal cord.
  - The higher brain centers.
  - The sympathetic chain.
  - ☒ The brain stem and the sacral region of the spinal cord.
27. If a neuron were experimentally placed in conditions where intracellular potassium were depleted, which of the following is a logical consequence?
- The neuron would hyperpolarize.
  - There would be a reduction in the membrane potential.
  - The neuron would spontaneously "fire."
- ☒ 1 only  
☐ 2 only  
☐ 3 only  
☐ 1 and 3
28. Membrane potential:
- ☒ refers to a separation of charges across the membrane or to a difference in the relative number of + and - charges in the ECF and ICF. ✓
  - is measured in units of millivolts with the sign always designating the charge on the outside
  - is less at the equilibrium potential for  $K^+$  than at resting membrane potential
  - cannot be measured easily
  - All of these answers
29. The motor end plate is:
- ☒ a folded area of muscle cell membrane with ACh receptors clustered at the top of each fold
  - the same as the neuromuscular junction
  - the same as the synaptic cleft
  - formed by the membrane of enlarged axon terminals, or boutons, that lie on the surface of skeletal muscle cells
  - a special fibrous matrix whose collagen fibers hold the axon terminal in proper position
30. A shallow groove on the surface of the cortex is called a:
- |   |            |
|---|------------|
| <input checked="" type="radio"/> sulcus | B. fissure |
| C. gyrus                                | D. furrow  |
31. At resting membrane potential:
- the membrane is more permeable to  $K^+$  than to  $Na^+$
  - the membrane is more permeable to  $Na^+$  than to  $K^+$
  - $Cl^-$  is at its equilibrium potential
  - ☒ both A and C above
  - Both B and C above
32. The brainstem consists of the:
- cerebrum, pons, midbrain, and medulla
  - ☒ midbrain, medulla, and pons
  - pons, medulla, cerebellum, and midbrain
  - midbrain only
  - diencephalon, midbrain and medulla

33. When graded potentials reach the trigger zone:  
 A. an action potential may be initiated  
 B. they may depolarize the membrane to the threshold voltage  
 C. they may hyperpolarize the membrane  
 D. they may be called EPSPs or IPSPs  
☒ E. All of these are true.
34. The larger the receptive field, the:  
 A. larger the stimulus needed to stimulate a sensory receptor X  
 B. fewer sensory receptors there are ✓  
☒ C. harder it is to discriminate the exact point of stimulation  
 D. larger the area of the somatosensory cortex in the brain that deals with the area X  
 E. closer together the receptor cells X
35. Lystra is in an automobile accident and injures her spinal cord. She has lost feeling in her right hand and her doctor tells her that it is the result of swelling in spinal cord. Which part of her cord is likely to be compressed?  
 A. the anterior gray horns X  
 B. the gray commissure X  
☒ C. an ascending tract  
 D. a descending tract  
 E. the anterior white commissure X
36. Which of the following is an important similarity between the endocrine system and the nervous system?  
 A. The transmitters from both cause a change in target cells throughout the body. ✓  
 B. Both involve both electrical and chemical aspects. X  
 C. The speed of response is about the same. X  
 D. Both transmit their compounds into the bloodstream. X  
☒ E. Both synthesize messenger compounds which are released outside the cell. X
37. Which is **NOT** true of a synapse?  
 A. Neurotransmitters affect postsynaptic neurons. ✓  
☒ B. Neurotransmitters are released from dendrites.  
 C. Many neurons may be involved. ✓  
 D. A synaptic cleft separates the neurons of the synapse. ✓  
 E. Receptors for neurotransmitters are located in the postsynaptic membrane. ✓
38. The cell bodies of motor neurons are located:  
☒ A. in the gray matter of the spinal cord  
☒ B. in the brain  
 C. outside the spinal cord  
 D. in the muscles  
 E. next to the sensory terminals *Frequency*
39. We are able to perceive the pitch of a sound because:  
 A. the hammer, anvil, and stirrup vibrate at different speeds  
☒ B. different parts of the basilar membrane vibrate at different frequencies of sound  
 C. different parts of the tectorial membrane vibrate at different frequencies of sound ✓  
 D. the basilar membrane is stiff and narrow at the away from the oval window X  
 E. the tympanic membrane vibrates more strongly at high pitches
40. Target receptor for preganglionic neurons contain:  
 A. acetylcholine  
 B. norepinephrine  
☒ C. cholinergic nicotinic receptor  
 D. adrenergic receptor  
 E. cholinergic muscarinic receptor
41. The ventral root ganglia:  
 A. contain axons of motor neurons  
 B. contain axons of sensory neurons  
 C. contain cell bodies of motor neurons  
 D. contain cell bodies of sensory neurons  
☒ E. do not exist

42. Nicotinic receptors
- A. are found at the neuromuscular junction of skeletal muscles
  - B. may be located on the postganglionic fibers of the sympathetic nervous system X
  - C. are found in the parasympathetic nervous system ✓
  - D. bind ACh and open monovalent cation channels ✓
  - ☒ E. A, B, and C
43. When compared to the spinal cord, the arrangement of white and gray matter in the medulla is similar, yet there are also significant differences. These differences include all of the following, EXCEPT:
- A. the arrangement of tracts and nuclei ✓
  - B. tracts passing through nuclei ✓
  - C. a lack of clear functional organization of the nuclei ✓
  - ☒ D. the absence of distinct regions of gray matter
  - E. tracts crossing, merging, and branching
44. The primary purpose of the auditory ossicles is:
- A. to equalize pressure in the middle ear
  - B. to dampen vibration
  - ☒ C. to amplify vibration
  - D. to transmit otitis media
  - E. None of the above are correct.
45. What structures monitor rotational movements of the head?
- ☒ A. cristae and the semicircular canals
  - B. maculae of the saccule →
  - C. maculae of the utricle
  - D. B and C
  - E. All of the above are correct.
46. Our perception of the pull of gravity and linear acceleration is the result of:
- A. changes in the pressure exerted by the cupula on hair cells X
  - B. vibrations of the tectorial membrane striking hair cells:
  - ☒ C. the pressure exerted by the otolithic organ on hair cells of the maculae X
  - D. the movement of the otolithic organ within the ampullae of the semicircular canals
  - E. None of the above are correct X
47. The afferent and efferent axons together form the:
- A. central nervous system
  - B. autonomic division system
  - C. somatic motor division of the nervous system
  - ☒ D. peripheral nervous system
  - E. visceral nervous system
48. Varicosities:
- A. are found the autonomic division
  - B. are enlarged regions found along the axon ✓
  - C. store and release neurotransmitters ✓
  - D. A and B
  - ☒ E. All of these answers are correct.
49. The term axonal transport refers to:
- A. the release of neurotransmitter molecules from the axon ✓
  - B. the transport of microtubules to the axon for structural support X
  - ☒ C. vesicle transport of proteins and organelles down the axon X
  - D. the movement of the axon terminal to synapse with a new postsynaptic cell ✓
  - E. None of these are correct answers.
50. In a condition known as hypocalcemia, the level of calcium ions in the blood and interstitial fluid is lower than normal. How would this condition affect the function of the nervous system?
- A. Cholinergic synapses would be more active.
  - B. Neurons would generate action potentials spontaneously.
  - ☒ C. Less neurotransmitter would be released in response to an action potential. ✓
  - D. Depolarizing events would occur more frequently at the postsynaptic membrane.
  - E. Potassium channels would fail to open.

51. Each of the following is a function of the nervous system, **EXCEPT**:
- A. providing sensation of the internal and external environments
  - B. integrating sensory information
  - C. coordinating voluntary and involuntary activities
  - ☒ D. directing activities that continue for extended periods such as growth and pregnancy
  - E. regulating or controlling peripheral structures and systems
52. The difference between electronic and saltatory conduction is that:
- ☒ A. saltatory conduction requires the presence of myelin
  - B. during electronic conduction only subthreshold depolarizations are conducted
  - C. saltatory conduction is a graded event
  - D. in electronic conduction the amplitude of the signal gets smaller
  - E. saltatory conduction only occurs near the cell body
53. Which statement regarding CSF production and flow is correct?
- A. CSF is produced along the spinal cord X
  - B. CSF is produced by meningeal cells ✓
  - C. CSF enters the meningeal layer through the cerebral aqueduct X
  - ☒ D. CSF flows inferiorly along the dorsal subarachnoid space of the spinal cord
  - E. CSF does not flow through the meningeal layers

---

Match each with its function (Questions 54 to 57):

- A. This is a true statement only for the sympathetic division of the nervous system
  - B. This is a true statement only for the parasympathetic division of the nervous system
  - C. This is a true statement only for both of these divisions of the nervous system
  - D. This is not true for either of these divisions of the nervous system
54. The targets include smooth muscle, cardiac muscle, many exocrine glands, a few endocrine glands and some adipose tissue. C
55. Contains cholinergic neurons. C
56. Pathways have a single neuron originating in the CNS and projecting its axon to the target tissue. D
57. All axons are myelinated. D
- 
58. If the dorsal root of a spinal nerve were cut, what would be the result in the tissue or region that nerve supplies?
- A. complete loss of sensation
  - B. a complete loss of voluntary movement
  - C. loss of neither sensation nor movement but only autonomic control
  - D. a complete loss of sensation
  - E. only loss of sympathetic information
-

## Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!! You can use the back of the last page to continue any question. Number them, please!!

59. Imagine a neuron which has several hundred axonal knobs impinging on it. The majority of these axonal knobs are shown to be "firing." However, the neuron in question does not transmit an impulse. Give a valid explanation of why this could occur. (5 points)

1<sup>st</sup> it might be not to reach the threshold of the action potential doesn't take place. 2<sup>nd</sup>, there are inhibitory interneuron inside the spinal cord that decrease the transmission of impulse to go up to the cerebral cortex to identify.

60. Neurons are treated with a drug that instantly and permanently stops the Na,K-ATPase pumps. What happens to the resting membrane potential immediately and over time? (4 points)

if the Na,K-ATPase pump stops working, as we know the concentration of  $K^+$  inside the cell is much more than outside and conc. of  $Na^+$  is much more outside the cell and less inside. Na-K ATPase use ATP to move this ions opposite to their conc. gradient  $\Rightarrow$  immediately the  $K^+$  diffuse outside the cell and  $Na^+$  diffuse inside the cell  $\Rightarrow$  inside the cell become much more positive

61. Describe the paths a preganglionic sympathetic fiber may take to reach its synapse point with the post ganglionic neuron. (3 points)

the cell body of preganglionic sympathetic fiber is located in spinal cord the ganglion is placed outside the spinal cord the preganglion is short and the post ganglionic sympathetic is long and unmyelinated and released ACh and release norepinephrine or epinephrine at the target.

62. List the anatomic and functional categories of neurons. (3 points)

Anatomic

Functional

multipolar

Afferent (Sensory)

Bipolar

efferent (motor)

Anaxonic

intermedian neuron  
(interneuron)

Pseudounipolar

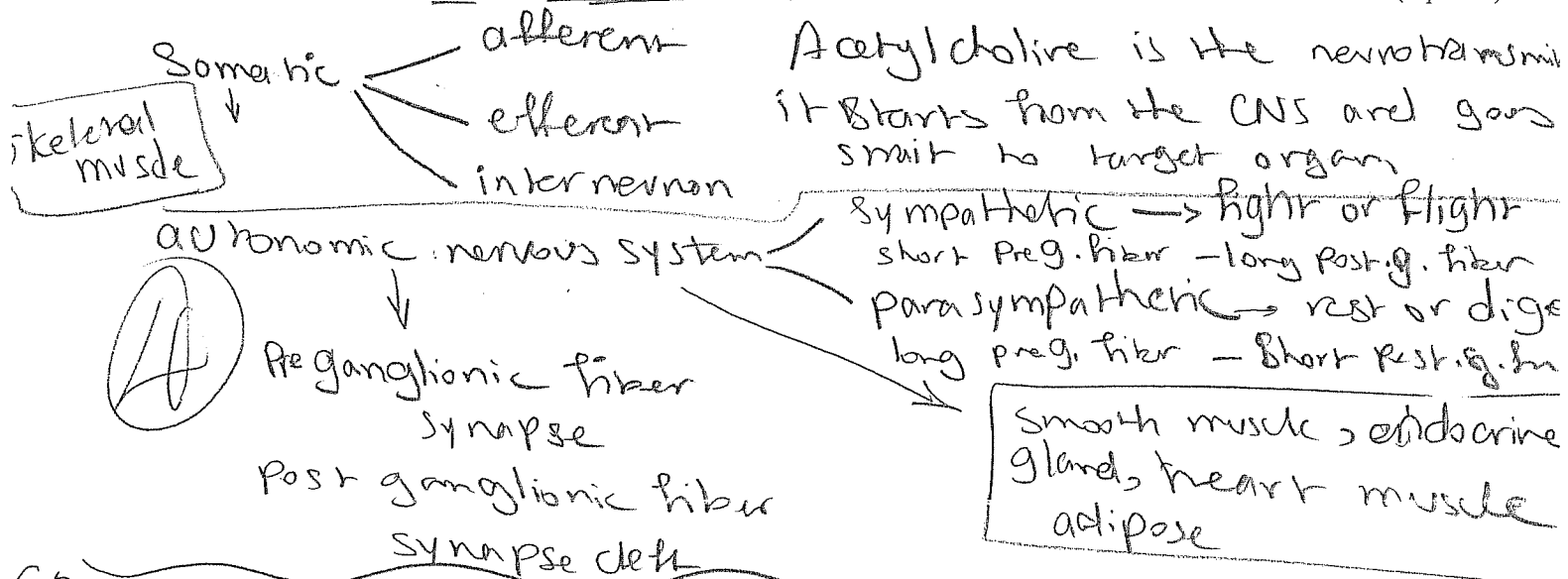
63. NAME the cranial nerves that are purely sensory and NAME those that are involved with eye movement. (5 points)

Sensory  
 Olfactory I  
 Optic II  
 Vestibulocochlear VIII

Eye Movement  
 III oculomotor  
 IV Trochlear  
 VI Abducen

5

64. Contrast the somatic and autonomic nervous systems; mention at least three characteristics of each. (6 points)



60. much more positive than resting membrane potential.  
 and the cell going to Action potential.  
 after a while by phasic receptors the number of AP decrease but still the group doesn't proceed.

2N

**DIRECTIONS:**

Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 1.5 points. **YOU DO NOT HAVE TO ATTEMPT ALL THE QUESTIONS TO EARN 100 POINTS.**

1. ✓ The brainstem consists of the:
- ☒ A. cerebrum, pons, midbrain, and medulla
  - ☐ B. midbrain, medulla, and pons
  - ☐ C. pons, medulla, cerebellum, and midbrain
  - ☐ D. midbrain only
  - ☐ E. diencephalon, midbrain and medulla

2. ✓ Each of the following is a function of the nervous system, EXCEPT
- ☐ A. providing sensation of the internal and external environments
  - ☐ B. integrating sensory information
  - ☒ C. coordinating voluntary and involuntary activities
  - ☐ D. directing activities that continue for extended periods such as growth and pregnancy (hormonal)
  - ☐ E. regulating or controlling peripheral structures and systems

3. ✓ The part of the peripheral nervous system which brings information to the central nervous system is:
- ☐ A. motor
  - ☐ B. afferent
  - ☐ C. efferent
  - ☐ D. autonomic
  - ☐ E. somatic

4. A shallow groove on the surface of the cortex is called a:
- ☒ A. sulcus shallow groove
  - ☐ B. fissure deep groove
  - ☐ C. gyrus flattened groove
  - ☐ D. furrow - deep groove

Match each with its function (Questions 5 to 6):

- A. Action potential
- B. Depolarization
- C. Absolute refractory period
- D. Repolarization
- E. Relative refractory period

5. ✓ The interior of the cell becomes less negative due to an influx of sodium ions. **B Depolarization**
6. ✓ The specific period during which potassium ions diffuse out of the neuron due to a change in membrane permeability. **D Repolarization**

7. ✓ The all-or-none principle states that
- ☐ A. all stimuli will produce identical action potentials
  - ☒ B. all stimuli great enough to bring the membrane to threshold will produce identical action potentials
  - ☐ C. the greater the magnitude of the stimuli, the greater the intensity of the action potential
  - ☐ D. only sensory stimuli can activate action potentials
  - ☐ E. only motor stimuli can activate action potentials

8. ✓ Major centers concerned with autonomic control of breathing, blood pressure, heart rate, digestive activities are located in the
- ☒ A. medulla oblongata
  - ☐ B. pons
  - ☐ C. cerebellum
  - ☐ D. diencephalon
  - ☐ E. on

The primary motor cortex is located in the region of the

- A. temporal lobe
- D. cingulate gyrus
- ☒ B. precentral gyrus
- E. corpus callosum
- C. postcentral gyrus

10. Which statements apply to the parasympathetic division of the nervous system?

- ☒ A. It is dominant during "resting and digesting."
- ☒ B. Its ganglia are nearby, within or on their target organs.
- C. Epinephrine is the primary neurotransmitter of the parasympathetic division.
- D. A and B
- E. A, B and C

40.5 + 41.5

11. The subdural space

- A. separates the arachnoid mater from the pia mater
- B. separates the pia mater from the dura mater
- ☒ C. separates the dura mater from the arachnoid mater
- D. contains cerebrospinal fluid
- E. is between the vertebrae and the dura mater

12. The spinal cord has grey matter on the:

- ☒ A. outside, white matter on the inside, and a dorsal motor root.
- ☒ B. inside, white matter on the outside, and a ventral motor root.
- ☒ C. inside, white matter on the outside, and a dorsal motor root.
- D. outside, white matter on the inside, and a ventral motor root.

13. The cerebrospinal fluid:

- ☒ A. is secreted by the arachnoid villi.
- ☒ B. enters the four ventricles after filling and circulating through the subarachnoid space
- C. is secreted mostly by the ependymal cells lining the brain
- D. is formed mostly by the choroid plexuses

14. If the ventral root of a spinal nerve were cut, what would be the result in the tissue or region that nerve supplies?

- A. Complete loss of sensation.
- ☒ B. A complete loss of voluntary movement.
- C. Loss of neither sensation nor movement but only of autonomic control.
- D. A complete loss of sensation and movement.

15. Select the statement that is most correct:

- ☒ A. Ganglia are collections of neuron cell bodies in the CNS that are associated with efferent fibers.
- ☒ B. Efferent ganglia can be associated with the autonomic system.
- C. The dorsal root ganglion is a motor only structure.
- D. The cell bodies of afferent ganglia are located in the spinal cord.

16. Sympathetic nervous system is characterized by peripheral ganglia near the:

- A. organs and by short postganglionic fibers
- B. organs and by long postganglionic fibers
- C. spinal cord and by short postganglionic fibers
- ☒ D. spinal cord and by long postganglionic fibers

17. Receptors on postganglionic neurons of the sympathetic nervous systems are?

- ☒ A. muscarinic
- ☒ B. Both A and B
- ☒ C. acetylcholine
- ☒ D. nicotinic
- ☒ E. adrenergic

PA  
SN

40.5 + 41.5

P  
A  
D

dorsal sensory root

Vagus

PAS

SAME

Parasymp is closer to target cells.

ACN  
NRE  
ACN

Acch

parasymp = muscarinic

nicotinic

adren

symp

p

preganglionic = cholinergic  
postganglionic = adrenergic



18. ✓ Sympathetic fibers leave the spinal cord in the:

- A. craniosacral regions, and the postganglionic fibers secrete norepinephrine
- B. thoracolumbar region and the postganglionic fibers secrete acetylcholine
- C. craniosacral region and the postganglionic fibers secrete acetylcholine
- D. thoracolumbar region and the postganglionic fibers secrete norepinephrine

19. ✓ In a condition known as hypocalcemia, the level of calcium ions in the blood and interstitial fluid is lower than normal. How would this condition affect the function of the nervous system?

- A. cholinergic synapses would be more active
- B. neurons would generate action potentials spontaneously
- C. less neurotransmitter would be released in response to an action potential
- D. depolarizing events would occur more frequently at the postsynaptic membrane
- E. potassium channels would fail to open

20. ✓ The outermost connective tissue covering of spinal nerves is the:

- A. endoneurium
- B. endomysium
- C. perineurium
- D. epineurium

21. ✓ Which of these effectors is NOT directly controlled by the autonomic nervous system?

- A. smooth muscle
- B. cardiac muscle
- C. skeletal muscle
- D. most glands

22. ✓ A second nerve impulse cannot be generated until:

- A. The membrane potential has been reestablished.
- B. The Na ions have been pumped back into the cell.
- C. The K ions have been pumped back out of the cell.
- D. All of the above are correct.

23. ✓ The role of acetylcholinesterase is to:

- A. act as a transmitting agent
- B. amplify or enhance the effect of ACh
- C. destroy ACh a brief period after its release by the axonal endings
- D. Stimulate the production of acetylcholine

24. ✓ Which statement is true?

- A. Stimulus strength is encoded by action potential amplitude.
- B. Stimulus strength is encoded by action potential frequency.
- C. Receptor potentials are essentially the same as IPSPs.
- D. Subthreshold receptor potentials become generator potentials

25. ✓ The site of origin of the preganglionic fibers of the parasympathetic nervous system is:

- A. The thoracolumbar region of the spinal cord.
- B. The higher brain centers.
- C. The sympathetic chain.
- D. The brain stem and the sacral region of the spinal cord.

26. ✓ Peptide hormones are

- A. composed of amino acids
- B. produced by cells in the adrenal glands
- C. derived from the amino acid tyrosine
- D. lipids
- E. chemically related to cholesterol

SAME  
DAVE  
PASW  
Endo - inside  
Peri -  
Epi - outside

Para = sacral & brain  
Sym = thoracic & lumbar

selected - then it's correct  
Action potential

Each of the following statement concerning peptide hormones is true EXCEPT one. Identify the exception.

- B
- A. peptide hormones are first synthesized as prohormones ✓
  - (B) prohormones can be activated before or after their release
  - C. peptide hormones remain in circulation for relatively short periods of time ✓
  - D. peptide hormones are always found in the bloodstream bound to carrier proteins ✓
  - E. peptide hormones interact with receptors on the surface of their target cells ✓

Match each with its function (Questions 28 to 31):

- A. This is a true statement only for the sympathetic division of the nervous system
- B. This is a true statement only for the parasympathetic division of the nervous system
- C. This is a true statement only for both of these divisions of the nervous system
- D. This is not true for either of these divisions of the nervous system

28. ✓ The targets include smooth muscle, cardiac muscle, many exocrine glands, a few endocrine glands and some adipose tissue. *acetylcholine* *Sym & Para*

29. ✓ Contains cholinergic neurons. *C*

30. ✓ Pathways have a single neuron originating in the CNS and projecting its axon to the target tissue. *D*

31. ✓ All axons are myelinated. *preganglion* *D*

32. ✓ If a somatic motor neuron fires an action potential, then \_\_\_\_\_

- E
- A. acetylcholine is released from the axon terminal
  - B. a skeletal muscle is triggered to contract
  - C. the response is always excitatory
  - D. A and B
  - (E) A, B and C

33. ✓ Hormones can alter cellular operations by changing all of the following, EXCEPT:

- C
- A. hormones from other endocrine glands ✓
  - B. changes in the genetic makeup of certain hypothalamic cells ✓
  - C. direct neural stimulation
  - D. changes in the composition of extracellular fluid ✓
  - E. releasing hormones from the hypothalamus ✓

34. All of the following are true of the endocrine system, EXCEPT:

- D
- A. releases chemicals into the bloodstream for distribution throughout the body ✓
  - B. releases hormones that alter the metabolic activities of many different tissues and organs simultaneously ✓
  - C. produces effects that can last for hours, days and even longer ✓
  - D. produces specific responses to internal stimuli
  - E. functions to control ongoing metabolic processes ✓

35. ✓ Which of the following is a change that may be caused by a hormonal stimulus?

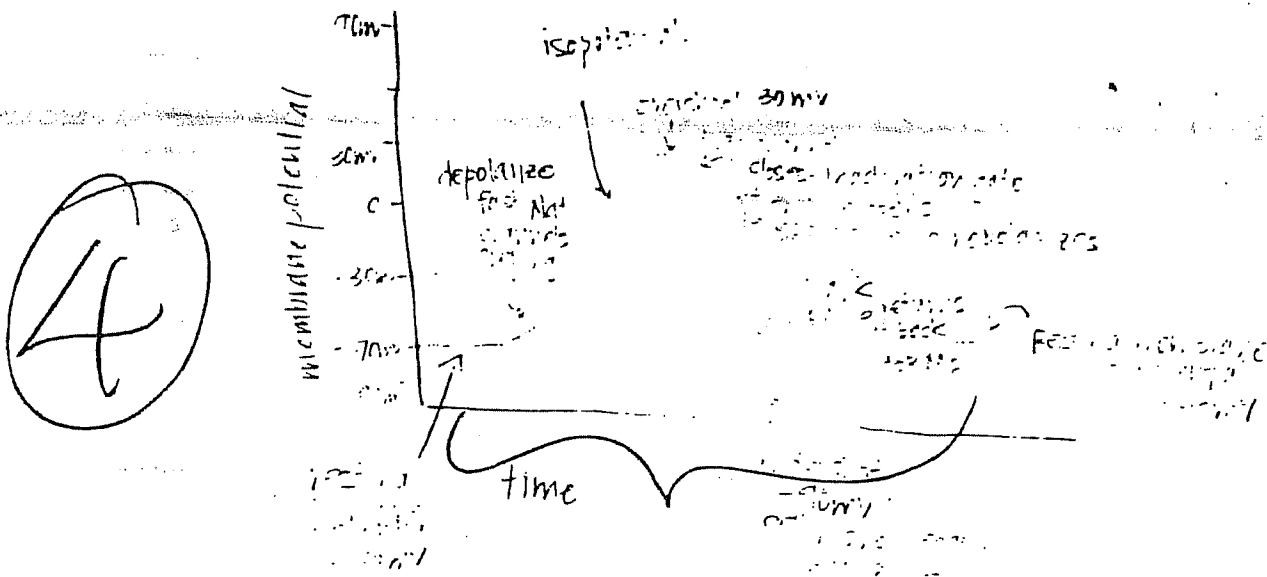
- D
- A. a change in the membrane potential
  - B. the stimulation of genetic even resulting in protein synthesis
  - C. an increase in enzymatic activity
  - D. All of the above

36. ✓ Cerebrospinal fluid circulates within the ventricles of the brain and in the subarachnoid space outside the brain.

### Short Answer Questions

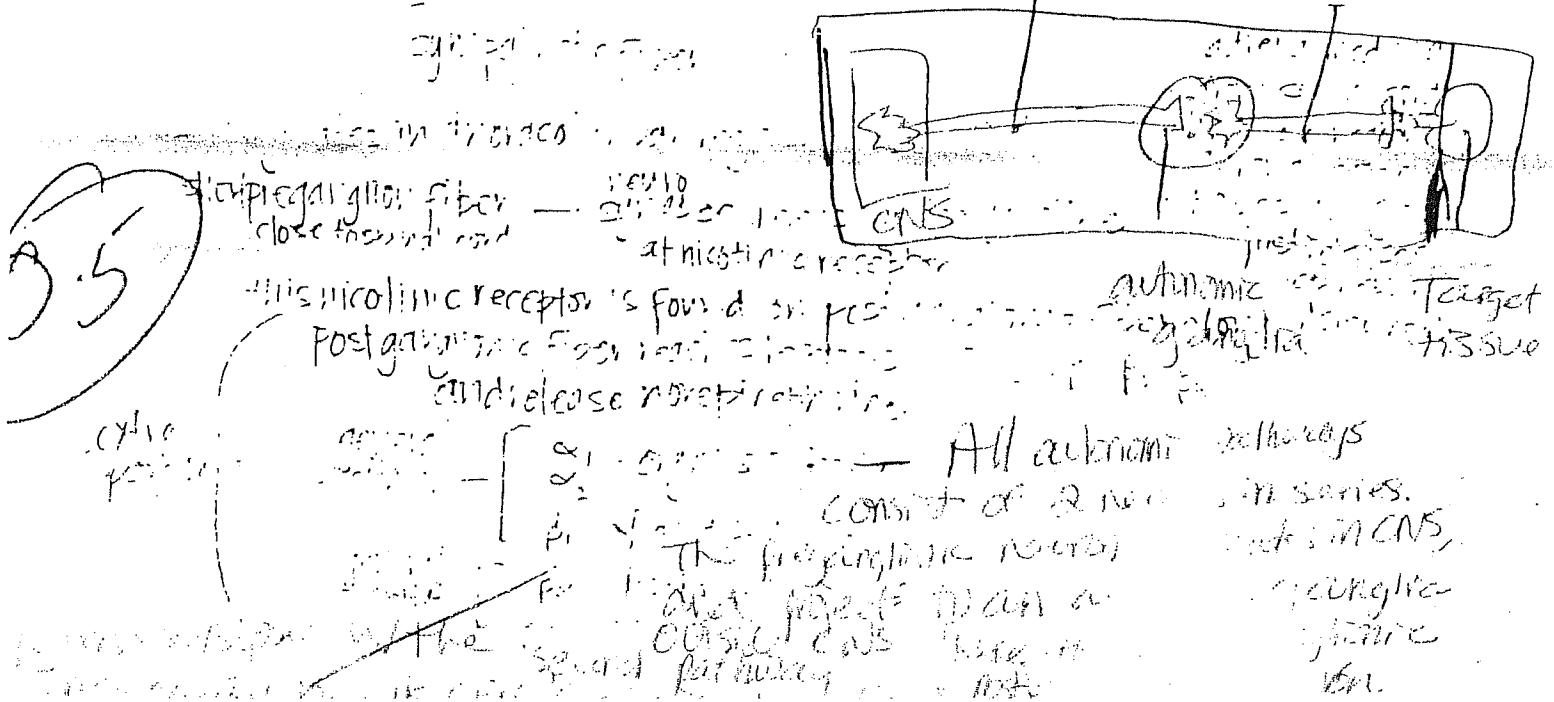
Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!! You can use the back of the last page to continue any question. Number them, please!!

37. Draw and completely label a graded potential and an action potential on a graph of membrane potential versus time. (10 points)



- 30mV is threshold.  
for depolarization + release of neurotransmitter

38. Describe the paths a preganglionic sympathetic fiber may take to reach its synapse point with the postganglionic neuron. (5 points)



3. Neurons are treated with a drug that instantly and permanently stops the Na,K-ATPase pumps. What happens to the resting membrane potential immediately and over time? (5 points)
- resting membrane potential would not remain at -70mV since Na/K pump does not work against the natural gradient (K high outside cell, Na high inside cell). Therefore the K<sup>+</sup> will eventually go to C, the isopotential to maintain equilibrium of charges at inside & outside the cell.

0.5 When an graded potential or action potential occurs, there will be little or no effect since the neuron is at only to begin with. Even if the Na<sup>+</sup> channels open & Na<sup>+</sup> moves in, there is no concentration gradient for depolarization to occur, therefore the other steps will not follow as well.

- A neuron w/o a functional Na<sup>+</sup>-K<sup>+</sup> pump must fire a 1000 or more action potentials before there will be a significant change in ion gradients.

40. Imagine a neuron which has several hundred axonal knobs impinging on it. The majority of these axonal knobs are shown to be "firing." However, the neuron in question does not transmit an impulse. Give a valid explanation of why this could occur. (5 points)

5 Even though the axonal knobs are "firing" it does not mean that it is all excitatory stimuli (EPSPs). They could also be inhibitory (IPSPs) and prevent the cell from firing an impulse by blocking Na<sup>+</sup> channels from opening or Ca<sup>2+</sup> from closing. neurotransmitter.

41. NAME the cranial nerves that are purely sensory and NAME those that are involved with eye movement. (10 points)

Sensory  
I olfactory  
II optic  
VIII vestibulocochlear

Eye Movement  
III optic  
IV oculomotor  
VI trochlear  
VI abducens

9-5

**DIRECTIONS:**

Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points. **YOU DO NOT HAVE TO ATTEMPT ALL THE QUESTIONS TO EARN 100 POINTS.**

1. In what way does the interior surface of the cell membrane of a resting (non-conducting) neuron differ from the external environment? The interior is:

☒ A. positively charged and contains less sodium  
☐ B. negatively charged and contains less sodium *Na<sup>+</sup>*  
☐ C. negatively charged and contains more sodium  
☒ D. positively charged and contains more sodium

*RMP + + + + +*  
*- - - - -*

2. If a neuron were experimentally placed in conditions where intracellular potassium were depleted, which of the following is a logical consequence?

1. The neuron would hyperpolarize.  
 2. There would be a reduction in the membrane potential.  
 3. The neuron would spontaneously "fire."

☐ A. 1 only  
☐ B. 2 only  
☐ C. 3 only  
☒ D. 1 and 3

*K<sup>+</sup>*  
*V<sup>+</sup> low hyperpolarize*  
*not fire*

3. The spinal cord has grey matter on the:

☐ A. outside, white matter on the inside, and a dorsal motor root  
☒ B. inside, white matter on the outside, and a ventral motor root  
☐ C. inside, white matter on the outside, and a dorsal motor root  
☐ D. outside, white matter on the inside, and a ventral motor root

*HAVE*  
*AVE*

4. On which lobe would one expect to find the primary sensory cortex?

☐ A. Frontal ☒ B. Parietal ☐ C. Occipital ☐ D. Temporal.

5. The brainstem consists of the:

☒ A. cerebrum, pons, midbrain, and medulla  
☐ B. midbrain, medulla, and pons  
☐ C. pons, medulla, cerebellum, and midbrain  
☐ D. midbrain only  
☐ E. diencephalon, midbrain and medulla

*MS*  
*circled*

6. An IPSP is associated with:

☐ A. A change in sodium ion permeability.  
☒ B. Hyperpolarization  
☐ C. Opening of voltage-gated channels  
☒ D. Lowering the threshold for an action potential to occur

*cytoskeleton resistance*  
*current*  
*potential*

7. In the autonomic nervous system:

☒ A. The sympathetic division is composed of short preganglionic and long postganglionic fibers.  
☐ B. The parasympathetic division is composed of short preganglionic and long postganglionic fibers.  
☐ C. The pre and postganglionic fibers are of equal length in the sympathetic and parasympathetic divisions.  
☐ D. The pre and postganglionic fibers are of equal length in the sympathetic division only.

*short preganglionic - long post*  
*long preganglionic - short post*

8. Branches that sometimes occur along the length of an axon are called:

☐ A. telodendria ☐ B. synaptic knobs ☒ C. collaterals  
☐ D. hillock ☐ E. synapse

If the cell membrane were suddenly to become permeable to sodium ions for a brief moment:

- ~~A.~~ The cell would be hyperpolarized.  
~~B.~~ The cell would lose positive charges.  
~~C.~~ The internal concentration of  $\text{Na}^+$  would decrease appreciably.  
 D. The membrane potential would become less negative.

Lots of APs

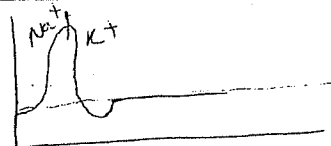
$A2 + 38.5$

10. The difference between electronic and saltatory conduction is that:

- A. Saltatory conduction requires the presence of myelin.  
~~B.~~ During electronic conduction only subthreshold depolarizations are conducted.  
~~C.~~ Saltatory conduction is a graded event.  
~~D.~~ In electronic conduction the amplitude of the signal gets smaller.  
 E. Saltatory conduction only occurs near the cell body.

Match each with its function (Questions 11 to 12):

- A. Action potential 11  
 B. Depolarization 11  
 C. Absolute refractory period 11  
 D. Repolarization 12  
 E. Relative refractory period 12



11. B The interior of the cell becomes less negative due to an influx of sodium ions. → B, C, A  
 12. D The specific period during which potassium ions diffuse out of the neuron due to a change in membrane permeability. D, E

13. In which of the following would the rate of impulse conduction be the greatest?

- A. a myelinated fiber 20 microns in diameter  
~~B.~~ a nonmyelinated fiber 20 microns in diameter  
~~C.~~ a myelinated fiber 2 microns in diameter  
~~D.~~ a nonmyelinated fiber 2 microns in diameter  
 E. a nonmyelinated fiber 25 cm long

10 m/s  
 = 500 of regular  
 nano - 9  $10^9$  nano  
 micro - 6  $10^6$  micro  
 milli - 3  $1000$  mm  
 cm - 2  $100$  cm  
 $\frac{10^2}{10^6} = \frac{1}{10^4}$

14. The ion needed to initiate the release of acetylcholine into the synaptic cleft is:

- A. sodium  
 B. potassium  
 C. calcium  
 D. chloride  
 E.  $\text{HCO}_3^-$

15. Major centers concerned with autonomic control of breathing, blood pressure, heart rate, and digestive activities are located in the

- A. medulla oblongata  
~~B.~~ pons  
 C. mesencephalon  
~~D.~~ diencephalon  
~~E.~~ cerebellum

16. Graded potentials

- ~~A.~~ produce an effect that increases with distance from the point of stimulation  
~~B.~~ produce an effect that spreads actively across the membrane surface  
 C. may involve either depolarization or hyperpolarization  
~~D.~~ are all-or-none  
 E. involve repolarization

17. The subdural space

- A. separates the arachnoid mater from the pia mater  
~~B.~~ separates the pia mater from the dura mater  
~~C.~~ separates the dura mater from the brain - ?  
 D. contains cerebrospinal fluid  
~~E.~~ is between the vertebrae and the dura mater



done  
 Dura  
 Arach.  
 Pia

18. If the ventral root of a spinal nerve were cut, what would be the result in the tissue or region that nerve supplies?
- same*  
*not efferent motor*
- B* ☒ A. complete loss of sensation  
☐ B. a complete loss of voluntary movement  
☐ C. loss of neither sensation nor movement but only autonomic control  
☐ D. a complete loss of sensation and movement
19. In a condition known as hypocalcemia, the level of calcium ions in the blood and interstitial fluid is lower than normal. How would this condition affect the function of the nervous system?
- release of NT*
- C* ☐ A. cholinergic synapses would be more active  
☐ B. neurons would generate action potentials spontaneously  
☒ C. less neurotransmitter would be released in response to an action potential  
☐ D. depolarizing events would occur more frequently at the postsynaptic membrane  
☐ E. potassium channels would fail to open
20. The auditory cortex is located in the
- C* ☒ A. frontal lobe  
☐ B. occipital lobe  
☐ C. parietal lobe  
☐ D. limbic lobe  
☒ E. temporal lobe
21. Damage to the pyramidal cells of the cortex that lead to the corticospinal tract would directly affect
- B* ☒ A. understand written words  
☐ B. perceive pain  
☒ C. performance of voluntary motor activity  
☐ D. hearing  
☐ E. both A and C
22. The all-or-none principle states that
- B* ☒ A. all stimuli will produce identical action potentials  
☐ B. all stimuli great enough to bring the membrane to threshold will produce identical action potentials  
☐ C. the greater the magnitude of the stimuli, the greater the intensity of the action potential  
☐ D. only sensory stimuli can activate action potentials  
☐ E. only motor stimuli can activate action potentials
23. Select the statement that is most correct:
- B* ☐ A. Ganglia are collections of neuron cell bodies in the CNS that are associated with efferent fibers.  
☒ B. Efferent ganglia can be associated with the autonomic system.  
☐ C. The dorsal root ganglion is a motor only structure.  
☐ D. The cell bodies of afferent ganglia are located in the spinal cord.
24. Sympathetic fibers leave the spinal cord in the:
- D* ☐ A. Craniosacral regions, and the postganglionic fibers secrete norepinephrine.  
☐ B. Thoracolumbar region and the postganglionic fibers secrete acetylcholine.  
☐ C. Craniosacral region and the postganglionic fibers secrete acetylcholine.  
☒ D. Thoracolumbar region and the postganglionic fibers secrete norepinephrine.
25. Rapid anterograde transport of a neurotropic substance in a sensory nerve from the hand to the cell body (a distance of 40 cm) will take how long?
- A* ☒ A. 1 hour  
☐ B. 2 days  
☐ C. 3 weeks  
☐ D. 4 months  
☐ E. 6 months
26. When two or more graded potentials arrive at the trigger zone of a neuron's axon, their effects are additive and spatial occurs.
- summation.*

## Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!! You can use the back of the last page to continue any question. Number them, please!!

27. Define neurotransmitter. What are the different classes of neurotransmitter. Name two (2) from each class. (10 points)

\* A neurotransmitter is a substance that can elicit the same physiological event everytime it is released. It should be released by the pre-synaptic neuron & affect the post synaptic neuro. The neurotransmitter should be able to be blocked by the same natural processes it elicits.

The 5 classes are

(11)

- ① Acetylcholine → It has its own class
- ② Amino acids → GABA, glycine, glutamate
- ③ Amino acid derived catecholamines (NE, E & Dopamine)  
Amines → serotonin & histamine
- ④ Polypeptides → CCK, Endorphins, Bradykinin
- ⑤ Purines → Adenosine & ATP

28. What forces maintain a steady state "resting" membrane potential? (5 points) RMP

- ① A concentration gradient for ions (like Na<sup>+</sup>, K<sup>+</sup>, etc)
- &
- ② The membrane permeability to those ions.

29. If the intracellular concentration for sodium is doubled, what would the Nernst potential for sodium be? (5 points)
- 60 +  $\frac{RT}{zF} \ln \frac{[Na^+]_{out}}{[Na^+]_{in}}$   $\ln 15M$  out  $145Mm$   $30Mm$

$$E_{ion} = \frac{60}{z} \log \frac{[out]}{[in]}$$

$$= \frac{60}{1} \log \frac{145Mm}{30Mm} = 41.05$$



30. A drug that blocks ATPase is introduced into an experimental neuron preparation. The neuron is then repeatedly stimulated, and recordings are made of the response. What effects would you expect to observe and why? (5 points)

① The cell (neuron) would not be able to completely come to the Resting membrane Potential after hyperpolarization ~~be~~ it is that  $\text{Na}^+/\text{K}^+$  ATPase pump that restores the RMP potential, so eventually it will be hard to fire it at a

31. NAME the cranial nerves that are purely sensory and NAME those that are involved with eye movement. (10 points)

3 S

2 S

2 M

1 M

1 Mix

1 Motor

= Mix

1 Sen

1 Mix

1 mix

1 Auto

1 Motor

#### Sensory

① Olfactory (CN I)

② Optic (CN II)

③ Vestibulo (CN VIII)

choclear

↑ Vestibulochochlear

~~Vestibulochochlear~~

⑧ 5

#### Eye Movement

① Oculomotor (CN III)

② Abducens (CN VI)

Trochlear

32. How is the action of neurotransmitters terminated? (3 points)

② Neurotransmitters can either be broken down for example NE is broken down by MAO or they can be recycled for use again

33. List four (4) different types of glial cells, and briefly explain the role of each. (10 points)

- ① Microglial cells → are in CNS they are special immune cells to fight foreign invaders.
- ② Schwann cells → are in the PNS they myelinate the neurons in the PNS.
- ③ Oligodendrocytes cells → are in the CNS they myelinate the neurons in the CNS.
- ④ Astrocytes → They supply nutrients between the blood & neuron & help in repair.
- ⑤ Ependymal cells → Cause the Blood Brain Barrier.

4. Describe the path sound must take to reach the inner ear. (7 points)

The external pinna directs the sound waves into the ear canal which passes the tympanic membrane & then causes vibrations through the malleus <sup>(1)</sup> → incus <sup>(2)</sup> and then reaches the <sup>(3)</sup> staples <sup>(3)</sup> inner ear with the help of the oval & round windows

35. Trace the path of cerebrospinal fluid from its point of production until it is reabsorbed into the blood. (5 points)

The production of the CSF is in the choroid plexes of the 4 ventricles, they come into contact with the blood through the ependymal cells that recycle them. They <sup>are</sup> circulated through the subdural space until they reach the venous sinuses where they are reabsorbed.

36. How is grey matter different from white matter? (5 points)

- grey matter contains dendrites & axon terminals  
- white matter has only the myelinated part of the axons.

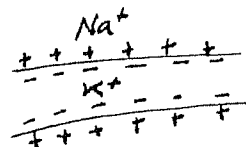
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1. ✓

In what way does the interior surface of the cell membrane of a resting (non-conducting) neuron differ from the external environment? The interior is:

- A. positively charged and contains less sodium
- B. negatively charged and contains less sodium
- C. negatively charged and contains more sodium
- D. positively charged and contains more sodium



3 Na<sup>+</sup> in  
2 K<sup>+</sup> out

(2) 2. ✓

Which statements apply to the parasympathetic division of the nervous system?

- A. It is dominant during "resting and digesting."
- B. Its ganglia are nearby, within or on their target organs.
- C. Epinephrine is the primary neurotransmitter of the parasympathetic division.
- D. A and B
- E. A, B and C

Epinephrine ↑  
rate & contract  
sympathetic to

3. ✓

If a neuron were experimentally placed in conditions where intracellular potassium were depleted, which of the following is a logical consequence?

- 1. The neuron would hyperpolarize. 7324
- 2. There would be a reduction in the membrane potential. - membrane
- 3. The neuron would spontaneously "fire."

- A. 1 only
- B. 2 only
- C. 3 only
- D. 1 and 3

4. ✓

The spinal cord has grey matter on the:

- A. outside, white matter on the inside, and a dorsal motor root
- B. inside, white matter on the outside, and a ventral motor root
- C. inside, white matter on the outside, and a dorsal motor root
- D. outside, white matter on the inside, and a ventral motor root

5. ✓

The brainstem consists of the:

- A. cerebrum, pons, midbrain, and medulla
- B. midbrain, medulla, and pons
- C. pons, medulla, cerebellum, and midbrain
- D. midbrain only
- E. diencephalon, midbrain and medulla



6. ✓

The ion needed to initiate the release of acetylcholine into the synaptic cleft is:

- A. sodium
- B. potassium
- C. calcium
- D. chloride
- E. HCO<sub>3</sub><sup>-</sup>

7. ✓

On which lobe would one expect to find the primary sensory cortex?

- A. Frontal
- B. Parietal
- C. Occipital
- D. Temporal

8. ✓

Sensory receptors that monitor the position of joints are called:

- A. nociceptors
- B. baroreceptors
- C. chemoreceptors
- D. proprioceptors
- E. thermoreceptors

9. ✓ The outermost connective tissue covering of spinal nerves is the:  
 (8) A. endoneurium B. endomysium C. perineurium **(D) epineurium**

10. ✓ An <sup>inhibitory</sup> IPSP is associated with:  
**(B)** A. a change in sodium ion permeability.  
 B. hyperpolarization  
 C. opening of voltage-gated channels  
 D. lowering the threshold for an action potential to occur

endo  
peri  
epi

11. ✓ In the autonomic nervous system:  
 A. The sympathetic division is composed of short preganglionic and long postganglionic fibers.  
 B. The parasympathetic division is composed of short preganglionic and long postganglionic fibers.  
**A** C. The pre and postganglionic fibers are of equal length in the sympathetic and parasympathetic divisions.  
 D. The pre and postganglionic fibers are of equal length in the sympathetic division only.

12. ✓ If the cell membrane were suddenly to become permeable to sodium ions for a brief moment:  
**\* D** A. The cell would be hyperpolarized.  
 B. The cell would lose positive charges.  
**(C)** C. The internal concentration of Na<sup>+</sup> would decrease appreciably.  
 D. The membrane potential would become less negative.

13. ✓ A second nerve impulse cannot be generated until:  
**A** A. The membrane potential has been reestablished.  
 B. The Na ions have been pumped back into the cell.  
 C. The K ions have been pumped back out of the cell.  
 D. All of the above are correct.

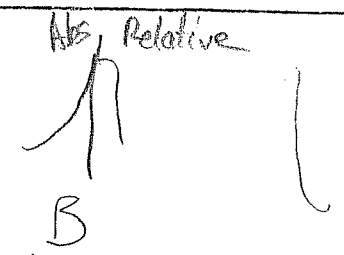
14. ✓ Which of these effectors is **NOT** directly controlled by the autonomic nervous system?  
**C** A. smooth muscle B. cardiac muscle  
**(C)** C. skeletal muscle D. most glands

FNS  
Somatic ANS - Para  
Syr

15. ✓ The difference between electronic and saltatory conduction is that:  
**A** A. Saltatory conduction requires the presence of myelin.  
 B. During electronic conduction only subthreshold depolarizations are conducted.  
 C. Saltatory conduction is a graded event.  
 D. In electronic conduction the amplitude of the signal gets smaller.  
 E. Saltatory conduction only occurs near the cell body.

Match each with its function (Questions 16 to 17):

- A. Action potential
- B. Depolarization
- C. Absolute refractory period
- D. Repolarization
- E. Relative refractory period



**(E)** 16. ✓ The interior of the cell becomes less negative due to an influx of sodium ions.

**(E)** 17. ✓ The specific period during which potassium ions diffuse out of the neuron due to a change in membrane permeability.

18. ✓ Branches that sometimes occur along the length of an axon are called:  
**C** A. telodendria B. synaptic knob  
 D. hillock E. synapse **(C) collaterals**

19. In which of the following would the rate of impulse conduction be the greatest?

- 18 ✓
- A. a myelinated fiber 20 microns in diameter
  - B. a nonmyelinated fiber 20 microns in diameter
  - C. a myelinated fiber 2 microns in diameter
  - D. a nonmyelinated fiber 2 microns in diameter
  - E. a nonmyelinated fiber 25 cm long

19 20. ✓ Major centers concerned with autonomic control of breathing, blood pressure, heart rate, and digestive activities are located in the

- A. medulla oblongata      B. pons      C. mesencephalon  
D. diencephalon      E. cerebellum

20 21. ✓ Graded potentials

- A. produce an effect that increases with distance from the point of stimulation  
B. produce an effect that spreads actively across the membrane surface  
C. may involve either depolarization or hyperpolarization  
D. are all-or-none  
E. involve repolarization

22. ✓ The larger the receptive field, the:

- A. larger the stimulus needed to stimulate a sensory receptor  
B. fewer sensory receptors there are  
C. harder it is to discriminate the exact point of stimulation  
D. larger the area of the somatosensory cortex in the brain that deals with the area  
E. closer together the receptor cells

21 23. ✓ The subdural space

- A. separates the arachnoid mater from the pia mater  
B. separates the pia mater from the dura mater  
C. separates the dura mater from the brain  
D. contains cerebrospinal fluid  
E. is between the vertebrae and the dura mater

Dura  
Pia  
Arach

22 24. ✓ If the ventral root of a spinal nerve were cut, what would be the result in the tissue or region that nerve supplies?

- A. complete loss of sensation  
B. a complete loss of voluntary movement  
C. loss of neither sensation nor movement but only autonomic control  
D. a complete loss of sensation and movement

123 25. ✓ The role of acetylcholinesterase is to:

- A. act as a transmitting agent  
B. amplify or enhance the effect of ACh  
C. destroy ACh a brief period after its release by the axonal endings  
D. Stimulate the production of acetylcholine

24 26. ✓ The auditory cortex is located in the

- A. frontal lobe      B. parietal lobe      C. temporal lobe  
D. occipital lobe      E. limbic lobe

25 27. ✓ Select the statement that is most correct:

- A. Ganglia are collections of neuron cell bodies in the CNS that are associated with efferent fibers.  
B. Efferent ganglia can be associated with the autonomic system.  
C. The dorsal root ganglion is a motor only structure.  
D. The cell bodies of afferent ganglia are located in the spinal cord.

located:  
Damage to the pyramidal cells of the cortex that lead to the corticospinal tract would directly affect

- 26 ✓
- A. understand written words
  - B. perceive pain
  - C. performance of voluntary motor activity
  - D. hearing
  - E. both A and C

brain stem → feet

2729. ✓ The all-or-none principle states that

- (B)
- A. all stimuli will produce identical action potentials
  - B. all stimuli great enough to bring the membrane to threshold will produce identical action potentials
  - C. the greater the magnitude of the stimuli, the greater the intensity of the action potential
  - D. only sensory stimuli can activate action potentials
  - E. only motor stimuli can activate action potentials

28 30. ✓ Sympathetic fibers leave the spinal cord in the:

- \* D
- A. Craniosacral regions, and the postganglionic fibers secrete norepinephrine.
  - B. Thoracolumbar region and the post ganglionic fibers secrete acetylcholine.
  - C. Craniosacral region and the postganglionic fibers secrete acetylcholine.
  - D. Thoracolumbar region and the post ganglionic fibers secrete norepinephrine.

29 31. ✓ In a condition known as hypocalcemia, the level of calcium ions in the blood and interstitial fluid is lower than normal. How would this condition affect the function of the nervous system?

- C
- A. cholinergic synapses would be more active
  - B. neurons would generate action potentials spontaneously
  - C. less neurotransmitter would be released in response to an action potential
  - D. depolarizing events would occur more frequently at the postsynaptic membrane
  - E. potassium channels would fail to open

Ca ↓

Match each with its function (Questions 32 to 35):

- A. This is a true statement only for the sympathetic division of the nervous system
- B. This is a true statement only for the parasympathetic division of the nervous system
- C. This is a true statement only for both of these divisions of the nervous system
- D. This is not true for either of these divisions of the nervous system

(30) 32. ✓ The targets include smooth muscle, cardiac muscle, many exocrine glands, a few endocrine glands and some adipose tissue. *autonomic NS sympathetic and parasympathetic*

(31) 33. ✓ Contains cholinergic neurons. *both sympathetic and parasympathetic ACh*

(32) 34. ✓ Pathways have a single neuron originating in the CNS and projecting its axon to the target tissue. *somatic NS*

(33) 35. ✓ All axons are myelinated. *none*

36. ✓ The cranial nerves that are involved in controlling eye movements are: *II, III, VI*

- \* D B
- A. I, II, and III
  - B. III, IV, and VI
  - C. II, III, and IV
  - D. II and VI
  - E. III and V

37. ✓ General properties of sensory reception include all of the following EXCEPT:

- A
- A. stimulus artifact
  - B. receptor
  - C. transducer
  - D. afferent pathway
  - E. integrating center

38. ✓ The special senses include all of the following, EXCEPT:

- A
- A. pain
  - B. sight
  - C. gustation
  - D. equilibrium
  - E. olfaction

9. Rapid anterograde transport of a neurotropic substance in a sensory nerve from the hand to the cell body (a distance of 40 cm) will take how long?

- A. 1 hour  
D. 4 months

B. 2 days  
E. 6 months

C. 3 weeks

40. If a somatic motor neuron fires an action potential, then \_\_\_\_\_

- A. acetylcholine is released from the axon terminal  
B. a skeletal muscle is triggered to contract  
C. the response is always excitatory  
D. A and B  
E. A, B and C

400 mm/day

800 mm

Match each with its function (Questions 41 to 43):

- A. Dura mater  
B. Pia mater  
C. Arachnoid  
D. Subarachnoid space  
E. Ventricles

41. The innermost layer of the meninges, delicate, contains many blood vessels.

42. Normally, the cerebrospinal fluid flows freely from the ventricle, then into the \_\_\_\_\_.

43. The weblike, spidery middle meningeal layer.

Pia mater  
Subarachnoid space  
Arachnoid

44. Which of the following is a change that may be caused by a hormonal stimulus?

- A. a change in the membrane potential  
B. the stimulation of genetic even resulting in protein synthesis  
C. an increase in enzymatic activity  
D. All of the above

45. Receptors on postganglionic neurons of the sympathetic nervous systems are?

- A. muscarinic  
D. adrenergic  
B. nicotinic  
E. acetylcholine

C. Both A and B

46. Sensory receptors that respond to changes in blood pressure are called:

- A. nociceptors  
D. proprioceptors  
B. baroreceptors  
E. thermoreceptors

C. chemoreceptors

47. Each of the following is a function of the nervous system, **EXCEPT**:

- A. providing sensation of the internal and external environments  
B. integrating sensory information  
C. coordinating voluntary and involuntary activities  
D. directing activities that continue for extended periods such as growth and pregnancy  
E. regulating or controlling peripheral structures and systems

48. Lystra is in an automobile accident and injures her spinal cord. She has a swelling in spinal cord. Which part of the spinal cord is likely to be compressed?

- A. the anterior gray horns  
B. the gray commissure  
C. an ascending tract  
D. a descending tract  
E. the anterior white commissure

49.

The following are the steps involved in a reflex arc

1. activation of a sensory neuron
2. activation of a motor neuron
3. response by an effector
4. arrival of a stimulus and activation of a receptor
5. information processing

The proper sequence of these steps is:

- A. 1, 3, 4, 5, 2  
 B. 4, 5, 3, 1, 2  
 C. 4, 1, 5, 2, 3  
 D. 4, 3, 1, 5, 2  
 E. 3, 1, 4, 5, 2

39

50. ✓

When two or more graded potentials arrive at the trigger zone of a neuron's axon, their effects are additive and summation occurs.

*spatial  
 summation  
 or  
 temporal  
 summation*



**DIRECTIONS:**

Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is **BEST** in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points. **YOU DO NOT HAVE TO ATTEMPT ALL THE QUESTIONS TO EARN 100 POINTS.**

1. Membrane potential:  
A. refers to a separation of charges across the membrane or to a difference in the relative number of + and - charges in the ECF and ICF.  
B. is measured in units of millivolts with the sign always designating the charge on the outside  
C. is less at the equilibrium potential for  $K^+$  than at resting membrane potential  
D. cannot be measured easily  
E. All of these answers
2. At resting membrane potential:  
A. the membrane is more permeable to  $K^+$  than to  $Na^+$   
→ B. the membrane is more permeable to  $Na^+$  than to  $K^+$   
C.  $Cl^-$  is at its equilibrium potential  
D. both A and C above  
E. Both B and C above
3. Which term below best describes an excitable tissue when a resting membrane potential is present?  
→ A. polarized  
B. depolarized  
C. hyperpolarized  
D. repolarized  
E. nonpolarized
4. The spinal cord has grey matter on the:  
→ A. outside, white matter on the inside, and a dorsal motor root  
→ B. inside, white matter on the outside, and a ventral motor root  
C. inside, white matter on the outside, and a dorsal motor root  
D. outside, white matter on the inside, and a ventral motor root
5. The brainstem consists of the:  
→ A. cerebrum, pons, midbrain, and medulla  
B. midbrain, medulla, and pons  
C. pons, medulla, cerebellum, and midbrain  
D. midbrain only  
E. diencephalon, midbrain and medulla
6. The ion needed to initiate the release of acetylcholine into the synaptic cleft is:  
A. sodium  
D. chloride  
B. potassium  
E.  $HCO_3^-$   
C. calcium
7. Which of the following statements concerning hormones is **INCORRECT**?  
A. A single endocrine gland may produce multiple hormones  
B. A single target cell may be influenced by more than one hormone  
C. A single hormone can influence only one type of target cell  
D. An endocrine organ may exert nonendocrine functions in addition to secreting hormones  
E. The same hormone may be secreted by more than one endocrine gland
8. Astrocytes:  
A. induce formation of the blood-brain barrier  
B. are important in the repair of brain injuries and in neural scar formation  
C. take up excess  $K^+$  from the brain ECF  
D. physically support neurons
9. Graded potentials:  
A. are local changes in membrane potential that occur in varying degrees of magnitude  
B. serve as short-distance signals  
C. serve as long-distance signals  
D. both A and B  
E. both A and C

An IPSP is associated with:

- ☒ A. a change in sodium ion permeability
- ☐ B. hyperpolarization
- ☐ C. opening of voltage-gated channels
- ☐ D. lowering the threshold for an action potential to occur
- ☐ E. All of these are correct answers.

11. On which lobe would one expect to find the primary sensory cortex?

- A. Frontal
- ☒ B. Parietal
- C. Occipital
- D. Temporal

12. A second nerve impulse cannot be generated until:

- ☒ A. the membrane potential has been reestablished
- ☐ B. the Na<sup>+</sup> ions have been pumped back into the cell
- ☐ C. the K<sup>+</sup> ions have been pumped back out of the cell
- ☐ D. All of the above are correct.

13. Hormones are classified into the following types:

- ☒ A. amines, peptides, and steroids
- ☐ B. amines, steroids and phospholipids
- ☐ C. amines, free fatty acids, and peptides
- ☐ D. free fatty acids, peptides, and steroids
- ☐ E. amines, phospholipids, and steroids

14. The difference between electronic and saltatory conduction is that:

- ☐ A. saltatory conduction requires the presence of myelin
- ☐ B. during electronic conduction only subthreshold depolarizations are conducted
- ☒ C. saltatory conduction is a graded event
- ☐ D. in electronic conduction the amplitude of the signal gets smaller
- ☐ E. saltatory conduction only occurs near the cell body

15. Which of the following statements concerning peptide hormones is **INCORRECT**?

- ☐ A. Peptides hormones are synthesized by the endoplasmic reticulum-Golgi complex system.
- ☒ B. Peptides hormones circulate largely bound to plasma proteins.
- ☐ C. Peptides hormones bind to surface receptors of their target cells.
- ☐ D. Peptides hormones exert their effect largely by means of second-messenger systems.
- ☐ E. Peptides hormones are released by exocytosis upon appropriate stimulation.

16. Graded potentials:

- ☐ A. produce an effect that increases with distance from the point of stimulation
- ☐ B. produce an effect that spreads actively across the membrane surface
- ☒ C. may involve either depolarization or hyperpolarization
- ☐ D. are all-or-none

17. The role of acetylcholinesterase is to:

- ☐ A. act as a transmitting agent
- ☐ B. amplify or enhance the effect of ACh
- ☒ C. destroy ACh a brief period after its release by the axonal endings
- ☐ D. stimulate the production of acetylcholine
- ☐ E. inhibit the release of acetylcholine

18. In which of the following would the rate of impulse conduction be the greatest?

- ☒ A. a myelinated fiber 20 microns in diameter
- ☐ B. a nonmyelinated fiber 20 microns in diameter
- ☐ C. a myelinated fiber 2 microns in diameter
- ☐ D. a nonmyelinated fiber 2 microns in diameter
- ☐ E. a nonmyelinated fiber 25 cm long

19. Somatomedins are released from the liver in response to:

- ☐ A. increased plasma growth hormone levels
- ☒ B. increased plasma somatostatin levels
- ☐ C. decreased plasma growth hormone levels
- ☐ D. decreased plasma somatostatin levels
- ☐ E. elevated levels of blood sugar

20. During the rising phase of the action potential:
- A.  $K^+$  permeability is much greater than  $Na^+$  permeability
  - ☒ B.  $Na^+$  permeability is much greater than  $K^+$  permeability
  - C.  $K^+$  permeability is the same as  $Na^+$  permeability
  - D.  $Na^+$  efflux occurs
  - E. Two of these answers are correct.

Match each with its function (Questions 21 to 22):

- A. Action potential
- B. Depolarization
- C. Absolute refractory period
- D. Repolarization
- E. Relative refractory period

21. The interior of the cell becomes less negative due to an influx of sodium ions.
22. The specific period during which potassium ions diffuse out of the neuron due to a change in membrane permeability.

23. Branches that sometimes occur along the length of an axon are called:
- |                |                   |                |
|----------------|-------------------|----------------|
| A. telodendria | B. synaptic knobs | C. collaterals |
| D. hillock     | E. synapse        |                |
24. The subdural space
- A. separates the arachnoid mater from the pia mater
  - B. separates the pia mater from the dura mater
  - C. separates the dura mater from the brain
  - D. contains cerebrospinal fluid
  - E. is between the vertebrae and the dura mater
25. If the ventral root of a spinal nerve were cut, what would be the result in the tissue or region that nerve supplies?
- A. complete loss of sensation
  - ☒ B. a complete loss of voluntary movement
  - C. loss of neither sensation nor movement but only autonomic control
  - D. a complete loss of sensation and movement
26. The posterior pituitary:
- A. is composed of nervous tissue
  - ☒ B. stores anterior pituitary hormones, which are released into the blood upon hypothalamic stimulation
  - ☒ C. synthesizes and secretes vasopressin and oxytocin
  - D. Both A and C above are correct.
  - E. All of these are correct answers.
27. Select the statement that is most correct.
- A. Ganglia are collections of neuron cell bodies in the CNS that are associated with efferent fibers.
  - B. Efferent ganglia are not associated with the autonomic system.
  - C. The dorsal root ganglion is a motor only structure.
  - ☒ D. The cell bodies of afferent ganglia are located in the spinal cord.
  - E. Ganglia exist outside the spinal cord.
28. In the process of negative feedback:
- A. TSH inhibits thyroid hormone secretion by the thyroid gland
  - B. thyroid hormone inhibits TSH secretion by the anterior pituitary
  - C. thyroid hormone directly inhibits further thyroid hormone secretion by the thyroid gland
  - D. TRH inhibits TSH secretion by the anterior pituitary
29. Myelinated axons conduct impulses much faster because:
- ☒ A. the myelin insulates the axon
  - ☒ B. channels only have to open at the nodes
  - ☒ C. voltage is not lost through and along myelinated areas
  - ☒ D. of saltatory conduction
  - E. All of these answers are correct

The all-or-none principle states that:

- A. all stimuli will produce identical action potentials
- B. all stimuli great enough to bring the membrane to threshold will produce identical action potentials
- C. the greater the magnitude of the stimuli, the greater the intensity of the action potential
- D. only sensory stimuli can activate action potentials
- E. only motor stimuli can activate action potentials

31. In a condition known as hypocalcemia, the level of calcium ions in the blood and interstitial fluid is lower than normal. How would this condition affect the function of the nervous system?

- A. Cholinergic synapses would be more active.
- B. Neurons would generate action potentials spontaneously.
- C. Less neurotransmitter would be released in response to an action potential.
- D. Depolarizing events would occur more frequently at the postsynaptic membrane.
- E. Potassium channels would fail to open.

32. Which of the following nerve fibers will have the highest conduction velocity?

- A. an unmyelinated nerve fiber with conduction velocity = 0.35 m/sec
- B. an unmyelinated nerve fiber smaller than the nerve fiber in A
- C. a myelinated nerve fiber the same size as the nerve fiber in A
- D. a myelinated fiber larger than the nerve fiber in A
- E. it is impossible to determine with the information provided

33. The cranial nerves that are involved in controlling eye movements are:

- A. I, II, and III
- B. III, IV, and VI
- C. II, III, and IV
- D. II and VI
- E. III and V

34. Because of the presence of both activation and inactivation gates, voltage-gated  $\text{Na}^+$  channels can:

- A. be closed but capable of opening
- B. Be activated
- C. be closed and not capable of opening
- D. All of the above answers are correct.
- E. None of these answers.

35. An IPSP is:

- A. produced by increased  $\text{Na}^+$  permeability and  $\text{K}^+$  permeability
- B. produced by increased  $\text{K}^+$  permeability or increased  $\text{Cl}^-$  permeability
- C. a depolarization of the postsynaptic cell
- D. Both A and C
- E. Both B and C

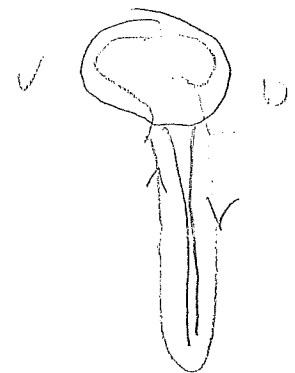
36. If a somatic motor neuron fires an action potential, then

- A. acetylcholine is released from the axon terminal
- B. a skeletal muscle is triggered to contract
- C. the response is always excitatory
- D. A and B
- E. A, B and C

SMA → Ach

37. Which statement regarding CSF production and flow is correct?

- A. CSF is produced along the spinal cord
- B. CSF is produced by meningeal cells
- C. CSF enters the meningeal layer through the cerebral aqueduct
- D. CSF flows inferiorly along the dorsal subarachnoid space of the spinal cord
- E. CSF does not flow through the meningeal layers



38. Hormone secretion from the anterior pituitary gland is controlled:

- A. by hypophysiotropic hormones from the hypothalamus
- B. directly by neural innervation of anterior pituitary cells
- C. by negative-feedback action of target-tissue hormones
- D. Both A and C above
- E. All of these answers

39. Major centers concerned with autonomic control of breathing, blood pressure, heart rate, and digestive are located in the

- A. medulla oblongata  
D. diencephalon

- B. pons  
E. cerebellum

C. mesencephalon

40. The specificity of hormones is due to:

- A. specialized hormone secretion  
B. molecular rearrangement at the site of action  
C. specific binding of hormones to plasma proteins  
D. specialization of target-cell receptors  
E. inactivation of hormones by the kidneys

41. Which of the following is a change that may be caused by a hormonal stimulus?

- A. a change in the membrane potential  
B. the stimulation of genetic even resulting in protein synthesis  
C. an increase in enzymatic activity  
D. mitosis  
E. All of the above

42. Each of the following is a function of the nervous system, EXCEPT:

- A. providing sensation of the internal and external environments  
B. integrating sensory information  
C. coordinating voluntary and involuntary activities  
D. directing activities that continue for extended periods such as growth and pregnancy  
E. regulating or controlling peripheral structures and systems

43. Which of the following represent long-loop negative feedback in the CRH-ACTH-cortisol system?

- A. cortisol inhibits CRH secretion  
B. CRH inhibits ACTH secretion  
C. ACTH inhibits CRH secretion  
D. ACTH inhibits cortisol secretion  
E. CRH inhibits cortisol secretion

Match each with its function (Questions 44 to 45):

- A. Dura mater  
C. Arachnoid  
E. Ventricles

- B. Pia mater  
D. Subarachnoid space

44. The innermost layer of the meninges, delicate, contains many blood vessels.

Pia

45. The weblike, spidery middle meningeal layer.

Arach

46. Interneurons:

- A. are found only in the central nervous system  
B. carry only sensory impulses  
C. carry only motor impulses  
D. only connect motor neurons to other motor neurons  
E. are found between neurons and their effectors

47. How does blocking the ability for retrograde flow in an axon affect the activity of a neuron?

- A. The neuron is unable to produce neurotransmitters.  
B. The neuron is unable to produce action potentials.  
C. The soma is unable to export products to the synaptic knobs.  
D. The soma is unable to respond to changes in the distal end of the neuron.  
E. The neuron is unable to depolarize when stimulated.

48. Each peripheral nerve provides \_\_\_\_\_ innervation to specific structures

- A. motor  
D. A and/or B

- B. sensory  
E. B and/or C

C. tactile

49. A/B - T/F Aldosterone is a mineralocorticoid produced in the adrenal gland and the most abundant.

F

50. A/B - T/F ACTH, FSH, and ADH are secreted by the adenohypophysis.

## Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!

You can use the back of the last page to continue any question. Number them, please!!

51. List the anatomic and functional categories of neurons. (5 points)

Anatomic

Somatic sensory neuron

Somatic motor neuron

Bipolar

Pseudounipolar

Anatomic

Multipolar

Functional

motor (efferent)

sensory (afferent)

Intermedial neuron

52. Case Study - 1 (8 points)

An 18-year-old woman was well until 3 years ago, when she suddenly lost sight in her right eye. Her vision then gradually improved. Then 2 years ago, she developed a hearing loss in her right ear lasting 3 weeks. A month later, she experienced numbness and tingling in her right leg, which improved over 2 weeks. A neurological examination revealed no significant abnormalities. However, 2 months later, she developed blurred vision and on examination, had weakness of the adductor muscles of the left eye and nystagmus. Some 6 months ago she became weak in the left leg. Currently, she is experiencing normal eye movements but a left-sided weakness, a left-sided facial weakness, and hyperactive phasic stretch reflexes in the left arm and leg; Babinski's sign was elicited on the left. The results of blood and spinal fluid chemical analysis were normal.

Which nervous system cell type is most likely to be affected in this patient?

Circle your answer.

A.  
D.

astrocyte  
pyramidal cell

B. motor neuron  
E. Schwann cell

C. oligodendrite

Explain your answer to the above.

What is the basic defect caused by disrupted function of this cell type?

A.  
B.  
C.  
D.  
E.

abnormal axonal transport  
blockade or slowed conduction velocity of axons  
chromatolysis  
failure of synaptic transmission  
degeneration