

# Bio 30 Nervous System and Homeostasis

## Diploma Exam Questions

1. Which gland produces a hormone that directly increases blood supply to skeletal muscles and increases the rate of contraction of heart muscle?
  - A. Pancreas
  - B. Adrenal gland**
  - C. Thyroid gland
  - D. Pituitary gland
  
2. Sensory and motor neurons of the peripheral nervous system transmit impulses between muscles and the
  - A. parasympathetic nervous system
  - B. sympathetic nervous system
  - C. central nervous system**
  - D. endocrine system
  
3. Which sequence correctly shows the path of sound transmission in the ear?
  - A. Tympanic membrane → eustachian tube → semicircular canals → cochlea
  - B. Tympanic membrane → semicircular canals → eustachian tube → cochlea
  - C. Auditory canal → ossicles → tympanic membrane → organ of Corti
  - D. Auditory canal → tympanic membrane → ossicles → organ of Corti**
  
4. A person with a vitamin A deficiency may have night blindness. The glare from the headlights of an approaching car will temporarily reduce that person's visual capacity. The primary structures associated with this change are the
  - A. cornea and lens
  - B. retina and rod cells**
  - C. fovea and blind spot
  - D. choroid and cone cells
  
5. A person who occasionally experienced paralysis was examined and found to have very low levels of potassium in the blood and other tissues. The paralysis likely resulted because of the inability of
  - A. capillaries to provide adequate blood flow
  - B. axon terminals to break down acetylcholine
  - C. neurons to repolarize during the refractory period**
  - D. neurons to remove acetylcholine from the synapse

Use the following information to answer the next three questions.

More than 4 000 Gulf War veterans complain of illness (Gulf War Syndrome). The veterans' symptoms include joint pain, shortness of breath, attention and memory problems, and chronic fatigue. During the war, most of the veterans took anti-nerve-gas pills. These pills contain pyridostigmine bromide, a drug that inhibits cholinesterase. Pyridostigmine bromide is also used to treat patients with *myasthenia gravis*, an inherited disorder characterized by weakness of skeletal muscles.

6. The role of cholinesterase in neural transmission is to
  - A. increase the rate of nerve impulse transmission
  - B. promote the breakdown of a neurotransmitter**
  - C. increase the sensitivity of neural membranes
  - D. promote the synthesis of a neurotransmitter
  
7. Considering that the symptoms of Gulf War Syndrome include attention and memory problems, it is likely that pyridostigmine bromide has an effect on the
  - A. cerebrum**
  - B. cerebellum
  - C. hypothalamus
  - D. medulla oblongata
  
8. In *myasthenia gravis*, a malfunction of neuromuscular synapses occurs. The information presented above indicates that the muscular weakness associated with this disorder occurs because
  - A. axons secrete excess acetylcholine
  - B. axons secrete insufficient acetylcholine**
  - C. of increased permeability of membranes to sodium ions
  - D. of decreased permeability of membranes to potassium ions

Use the following information to answer the next question.

Scientists had long assumed that the brain could not produce new cells. However, two researchers at the University of Calgary have successfully produced new brain tissue by using an unspecialized brain cell known as a stem cell. This stem cell acts as a "mother" cell to produce healthy brain tissue, in vitro.

9. Before this research, the assumption that brain cells could **not** regenerate was based upon which characteristic of axons?
  - A. Axons of the peripheral nervous system are surrounded by a neurilemma.
  - B. Axons of the central nervous system are surrounded by a neurilemma.
  - C. Axons of the peripheral nervous system lack a neurilemma.
  - D. Axons of the central nervous system lack a neurilemma.**

Use the following information to answer the next question.

Certain compounds known as opiates (opium, morphine, and codeine) are addictive drugs. Scientists have found that opiates work by binding to specific sites in the brain that interpret perceptions of pleasure and pain.

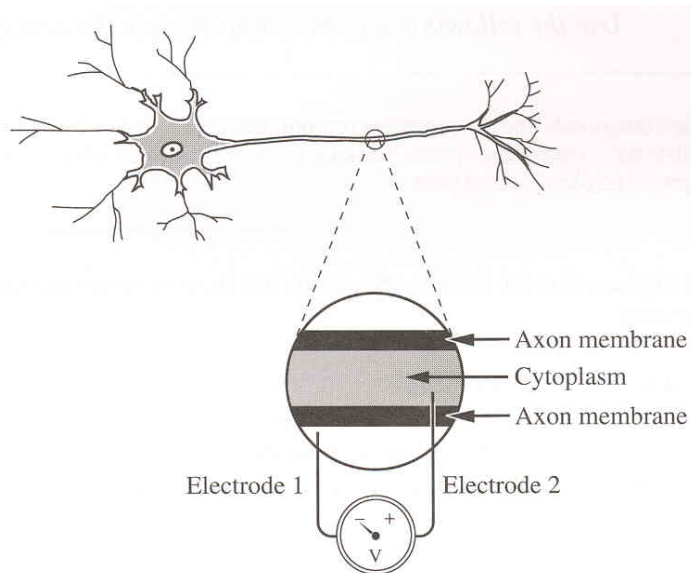
10. A likely explanation of how receptors in the human brain are stimulated by opiates is that opiates

- A. bind to neurotransmitters
- B. act in the same way as cholinesterase
- C. increase the strength of action potentials
- D. have molecular shapes similar to a neurotransmitter

Use the following information to answer the next three questions.

### Measuring the Membrane Potential of a Spinal Neuron

A microelectrode can be inserted into the axon of a neuron in order to measure the differences in charge between the outside and inside of the cell. A specialized, sensitive voltmeter is used to measure this difference. Electrode 1 is placed on the outside of the cell membrane and Electrode 2 is placed on the inside of the cell membrane.



11. The neuron in an experiment was taken from a spinal cord. The propagation of an action potential in the neuron was slower than the 24 m/s that is typical with sensory neurons. Why?

- A. Myelination was absent in this spinal neuron.
- B. Axon length is much longer in sensory neurons.
- C. The Nodes of Ranvier were absent in sensory neurons.
- D. The neurotransmitters were blocked in this spinal neuron.

18. The voltmeter showed a negative reading and the sodium ion concentration remained constant outside the axon. How could this be explained?

- A. The threshold for the neuron was not reached.
- B. The sodium pump had exhausted ATP reserves.
- C. The action potential was established and sustained.
- D. The dendrites were stimulated by the release of acetylcholine.

19. In a resting neuron, the outside of the cell membrane is

- A. positive, and the sodium ion concentration is greater in the fluid outside the axon than in the cytoplasm
- B. negative, and the sodium ion concentration is greater in the fluid outside the axon than in the cytoplasm
- C. positive, and the sodium ion concentration is greater in the cytoplasm than in the fluid outside the axon
- D. negative, and the sodium ion concentration is greater in the cytoplasm than in the fluid outside the axon

Use the following information to answer the next two questions.

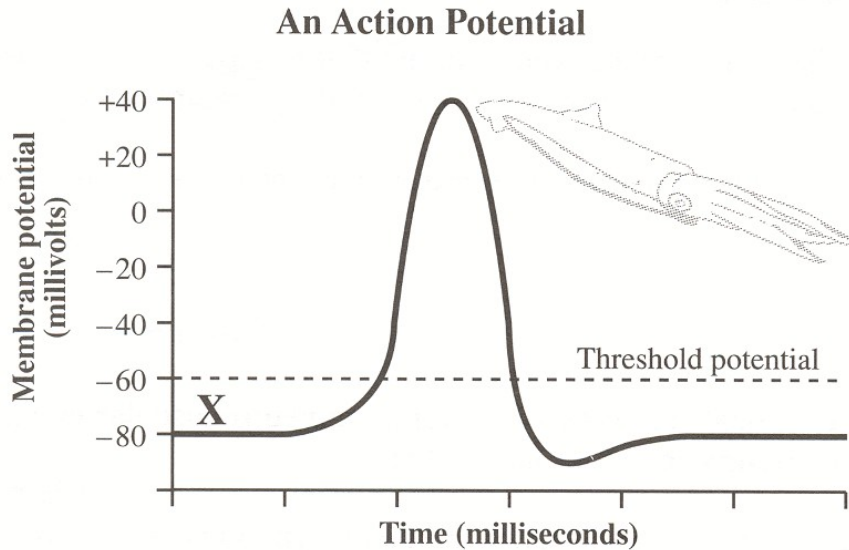
A mutation is the cause of fatal familial insomnia and Creutzfeldt/Jakob disease. One symptom of fatal familial insomnia is a drastically reduced heart rate. Individuals with Creutzfeldt/Jakob disease experience personality changes. Both diseases result from lesions or damage in the brain caused by the accumulation of abnormal clumps of prion proteins. Prion proteins are found in the brain tissue of humans. The mutation occurs in a gene coding for a prion protein. One nucleotide in DNA triplet 178 (CTG) is changed, resulting in a new triplet (TTG).

20. Which row correctly identifies the **most likely** location of lesions in each disease?

| Row | Location of lesions in fatal familial insomnia | Location of lesions in Creutzfeldt/Jakob disease |
|-----|--|--|
| A.  | cerebellum                                     | hypothalamus                                     |
| B.  | medulla oblongata                              | hypothalamus                                     |
| C.  | cerebellum                                     | cerebrum   |
| D.  | medulla oblongata                              | cerebrum   |

Use the following information to answer the next two questions.

*The [study of the squid, led] to an understanding of the nature of the nerve impulse.  
[Its] . . . nerves contain the giant axons used in all the early studies of the nerve impulse.”  
—from Curtis and Barnes*



Note: X denotes the electrical potential across the membrane of a particular resting neuron.

21. Which of the following statements is **true** of the threshold potential?
- A. It is the same electrical potential for all neurons.
  - B. It is the depolarization required to generate an action potential.**
  - C. It determines the time it takes for an action potential to be completed.
  - D. It determines the time it takes for an impulse to travel along the axon.
23. Relative to inside of a neuron, the extracellular fluid immediately outside a resting neuron's cell membrane is
- A. positive and the sodium ion concentration is less
  - B. negative and the sodium ion concentration is less
  - C. positive and the sodium ion concentration is greater**
  - D. negative and the sodium ion concentration is greater

Use the following information to answer the next two questions.

**Processes That Occur at a Neuromuscular Junction  
(A Type of Synapse)**

- 1 Muscle fibres contract when sodium gates open allowing sodium ions to diffuse into the muscle cytoplasm.
- 2 Acetylcholine is released from the axon terminal.
- 3 Acetylcholine binds to the receptors on the muscle cell.
- 4 Cholinesterase breaks down acetylcholine, and the sodium gates close.

—from *Guyton*

**Numerical Response**

**2.** An impulse arrives at an axon terminal that synapses with a muscle cell. Record the processes in the order that they occur at the synapse.

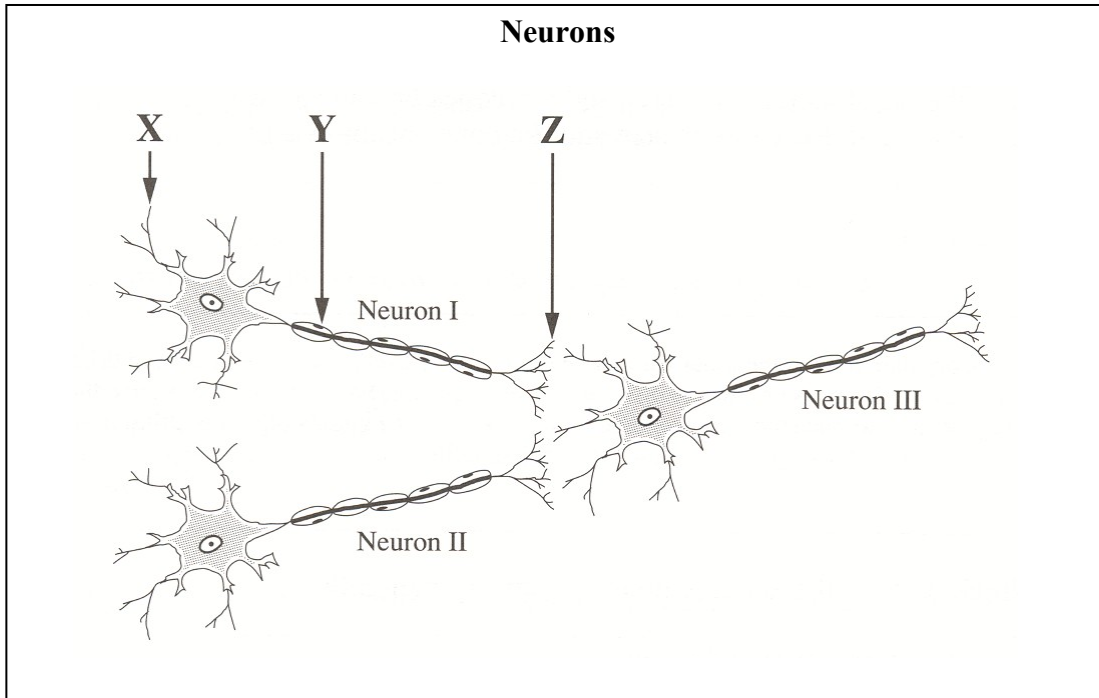
(Record your **four-digit answer** in the numerical-response section of the answer sheet.)

**Answer:** \_\_\_\_\_

---

24. Certain chemicals inhibit cholinesterase at neuromuscular junctions. The resulting muscular spasms occur because of the
- A. depletion of cholinesterase in the presynaptic neuron
  - B. depletion of acetylcholine in the neuromuscular junction
  - C. accumulation of cholinesterase in the presynaptic neuron
  - D. accumulation of acetylcholine in the neuromuscular junction**

Use the following information to answer the next three questions.



25. Neurotransmitters are released from

- A. site X
- B. site Z
- C. sites X and Y
- D. sites X and Z

26. If neurons I and II are interneurons, neuron III **cannot** be a

- A. parasympathetic neuron
  - B. sympathetic neuron
  - C. sensory neuron
  - D. motor neuron
- E. In a typical reflex arc, neuron III would be part of the
- A. effector
  - B. receptor
  - C. motor pathway
  - D. sensory pathway

*Use the following information to answer the next question.*

Sensory hair cells in the inner ear can be damaged by excessive noise or certain drugs. This may cause deafness or balance disorders. Research suggests that these cells have the ability to regenerate. In one study, the damaged inner ear tissue of guinea pigs was cultured in a dish. The damaged tissue produced new sensory hair cells.  
\_from *Gutin*

30. Which parts of the ear contain these sensory hair cells?

- A. Auditory nerve and cochlea
  - B. Eardrum and auditory nerve
  - C. Eustachian tube and eardrum
  - D. Cochlea and semicircular canals**
- 

*Use the following information to answer the next question.*

The disease myasthenia gravis causes a person to experience muscular weakness because of the failure of neuromuscular junctions to transmit signals from nerve fibres to muscle fibres. The weakness is due to a reduced sensitivity to acetylcholine, which is necessary to stimulate the muscle fibre. People suffering from this disease are often treated with neostigmine, an anticholinesterase drug, which can result in some normal muscular activity within minutes.  
—from *Guyton and Hall, 1996*

32. Neostigmine is effective in treating this disease because it

- A. binds with cholinesterase to form acetylcholine
- B. binds with cholinesterase to increase acetylcholine production
- C. reduces the amount of active cholinesterase, thereby increasing the amount of acetylcholine available to stimulate muscle contraction**
- D. increases the amount of active cholinesterase, thereby increasing the amount of acetylcholine available to stimulate muscle contraction



Use the following information to answer the next question.

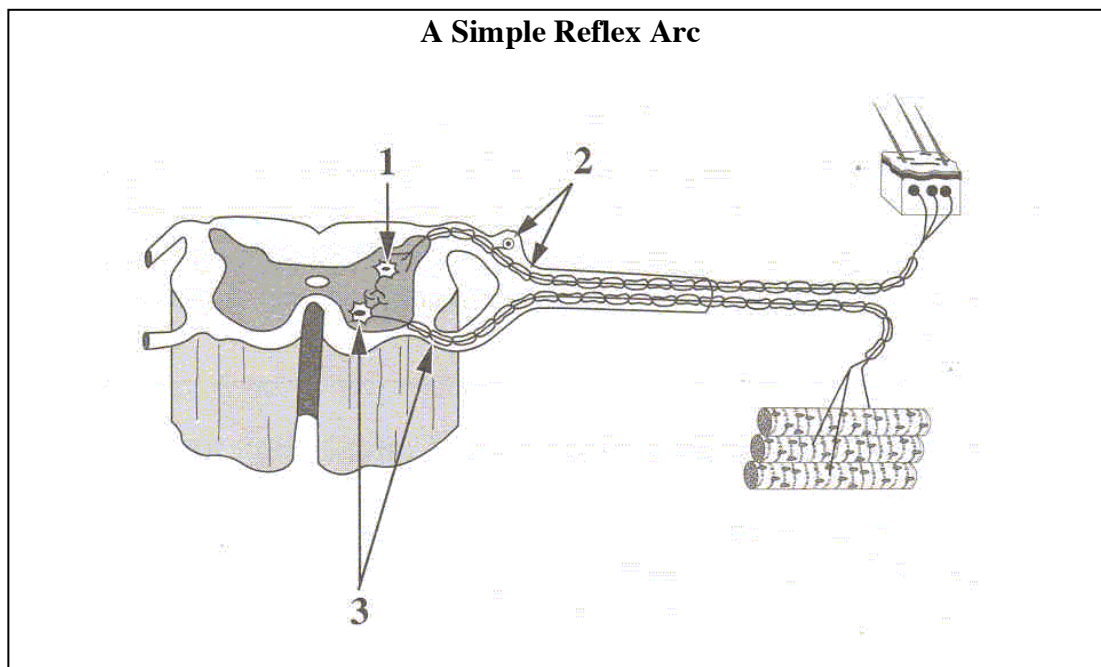
### Observations About a Synapse and Synaptic Transmission

1. Only axon terminals release neurotransmitters.
2. A neurotransmitter diffuses from an axon terminal across the synapse to the dendrites or cell body.
3. Many transmissions across a synapse in a short time may cause fatigue of synaptic transmission.
4. Electron micrographs of a synapse show that there is no direct connection between the axon terminal of a presynaptic neuron and the dendrites or cell body of a postsynaptic neuron.

33. The assumption that axon terminals contain a limited amount of neurotransmitter could account for observation

- A. 1
- B. 2
- C. 3
- D. 4

Use the following information to answer the next question.



34. S  
t

Structure 1 is an interneuron. Structures 2 and 3 are, **respectively**, a

- A. sensory neuron and a motor neuron
- B. motor neuron and a sensory neuron
- C. non-myelinated neuron and a myelinated neuron
- D. myelinated neuron and a non-myelinated neuron

Use the following information to answer the next question.

A tumour of the adrenal medulla is called pheochromocytoma. This tumour causes hypersecretion of epinephrine and norepinephrine, and a number of other symptoms.

35. Possible symptoms of pheochromocytoma include

- A. increased heart rate, increased blood sugar, increased metabolic rate
- B. decreased heart rate, increased blood sugar, increased metabolic rate
- C. increased heart rate, decreased blood sugar, decreased metabolic rate
- D. decreased heart rate, decreased blood sugar, decreased metabolic rate

Use the following information to answer the first two questions.

A group of psychologists wondered if inhaling pure oxygen could enhance a person's mental capacity. They tested forty-five students.

These students breathed through a face mask for one minute. They were either given pure oxygen or normal air, but they did not know which. Those receiving pure oxygen could recall twice as many words as those receiving normal air.

—from *Mihill, 1996*

52. The part of the brain that is directly responsible for the recall of previously learned words is the
- A. cerebrum
  - B. cerebellum
  - C. pituitary gland
  - D. medulla oblongata

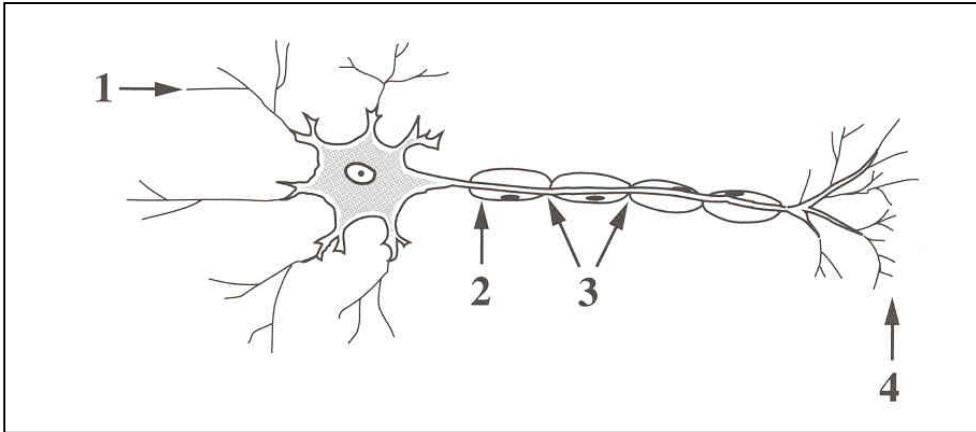
54. The part of the brain that controls the unconscious rate of breathing is the
- A. cerebrum
  - B. cerebellum
  - C. pituitary gland
  - D. medulla oblongata

Use the following information to answer the next two questions.

Movement of hair cells in normal ears opens tiny pores called ion channels in the nerve cell membrane. This process begins impulse transmission along the auditory nerve.

55. Nerve impulse transmission continues along the nerve cell membrane as
- A. a wave of depolarization
  - B. a negative feedback loop
  - C. a diffusing wave of summation
  - D. the active transport of an electrical potential
59. Jogging will cause heart rate to change because of
- A. increased sympathetic and decreased parasympathetic impulses
  - B. decreased sympathetic and increased parasympathetic impulses
  - C. increased sympathetic and decreased central nervous system impulses
  - D. decreased sympathetic and increased central nervous system impulses

Use the following information to answer the next question.



65. The part of the motor neuron that may release acetylcholine is labelled
- A. 1
  - B. 2
  - C. 3
  - D. 4

Use the following information to answer the next question.

Morphine is a drug obtained from the opium plant. It is routinely given to postoperative patients on a short-term basis for pain. At high doses, it causes breathing and heart contraction to become suppressed.

67. What area of the brain is affected by high doses of morphine?
- A. Pituitary
  - B. Cerebrum
  - C. Cerebellum
  - D. Medulla oblongata

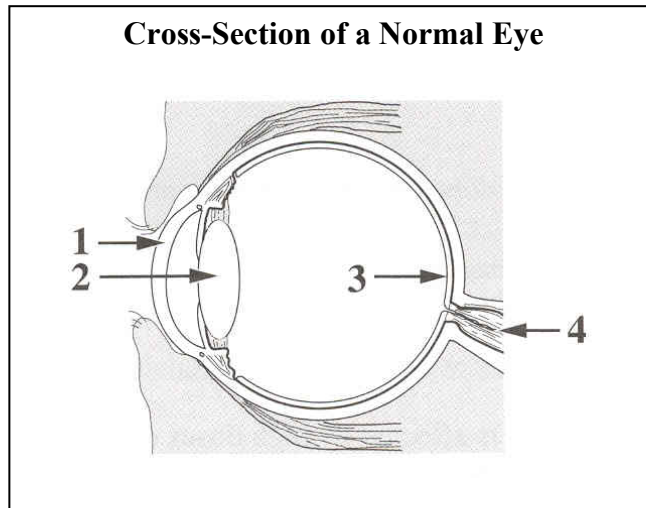
Use the following information to answer the next question.

A high percentage of purebred dogs have genetic defects. Some examples of these defects follow.

- 1 Hip dysplasia, a defect in the hip joints that can cripple a dog, occurs in 60% of golden retrievers.
- 2 Hereditary deafness, due to a recessive autosomal disorder, occurs in 30% of Dalmatians.
- 3 Retinal disease, which may cause blindness, occurs in 70% of collies.
- 4 Hemophilia, an X-linked recessive disorder, is common in Labrador retrievers. Dwarfism is also common in this breed of dog.

—from *Lemonick, 1994*

Use the following additional information to answer the next two questions.



68. The structure that degenerates and causes blindness in collies is

- A. 1
- B. 2
- C. 3
- D. 4

Use the following information to answer the next five questions.

Multiple sclerosis (MS), a disease of the nervous system, typically has symptoms of uncontrolled muscle responses, weakness, paralysis, and vision difficulties. Researchers believe that MS occurs as a result of the body's immune system destroying the myelin sheath that surrounds the axon of a nerve cell. The result is a scarring of brain tissue or of spinal cord tissue.

74. Damage to the myelin sheath of an optic neuron affects the speed of neural transmission to the visual centre, which is found in which lobe of the cerebrum?

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

### **Numerical Response**

**1.** Another symptom of MS is an exaggerated pupillary light reflex. Some of the events that occur during this reflex are listed below.

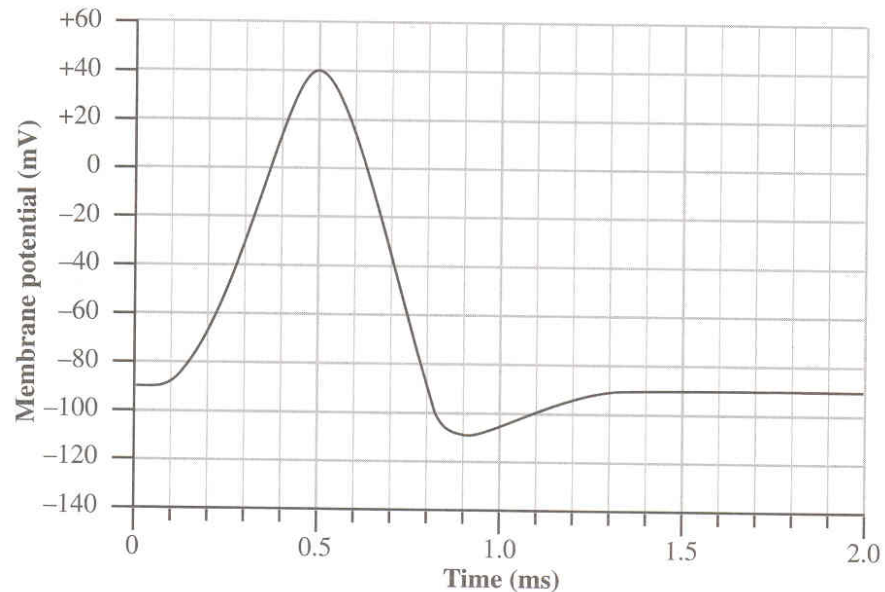
- 1 Motor neuron depolarizes
- 2 Sensory neuron depolarizes
- 3 Interneuron depolarizes
- 4 Light receptors stimulated

The order in which the events listed above occur during a pupillary light reflex is \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

*Use the following additional information to answer the next two questions.*

Stimulation of a sensory neuron produces an action potential. An abnormal pattern in this action potential can be used to detect MS in its early stages. The graph below illustrates the membrane potential of a normal neuron after stimulation.



75. Which of the following types of ion movement across an axon membrane would cause the action potential to change during the interval from 0.2 ms to 0.4 ms?
- A. Sodium ions moving into the axon
  - B. Sodium ions moving out of the axon
  - C. Potassium ions moving into the axon
  - D. Potassium ions moving out of the axon

76. On the graph, the period from 0.5 ms to 1.0 ms represents the neuron's
- A. refractory period, which is when repolarization occurs
  - B. refractory period, which is when minimum depolarization occurs
  - C. threshold period, which is when repolarization occurs
  - D. threshold period, which is when minimum depolarization occurs

*Use the following additional information to answer the next two questions.*

Serotonin stimulates the release of endorphins, and endorphins eventually cause the release of more dopamine. Studies of individuals involved in extreme sports have found that these people have lower-than-normal numbers of two of the five types of dopamine receptors.

—from *Zorpette, 1999*

80. When individuals participate in extreme sports, their neurons release more dopamine, which results in a pleasurable sensation because
- A. less serotonin is released from neurons
  - B. more dopamine receptors are produced
  - C. the fight-or-flight response is inhibited
  - D. a neuron containing dopamine receptors reaches threshold depolarization