
Last Name, First Initial

October 3, 2013

Be sure to read all instructions and questions carefully.

Be brief in your answers.

Write clearly.

Backs of pages will not be graded.

Honor Pledge

All students are required, when requested, to attach the following statement to any material turned in for a grade in any course at Georgia Institute of Technology:

On my honor, I pledge that I have neither given nor received inappropriate aid in the preparation of this assignment.

KEY

Signature

Name (Printed clearly)

Circle the best answer (2 pts ea)

1. Saltatory conduction velocity in axons is **FASTER** or SLOWER than in unmyelinated axons.
2. Nerve fibers that carry noxious stimuli are usually MYELINATED or **UNMYELINATED**.
3. During a lab experiment with an isolated leg prep, you electrically stimulate a frog leg nerve and watch the leg muscle contract. Then you stimulate the leg muscle and watch the leg muscle contract. To the naked eye, which scenario appears faster? Stimulating the:
MOTOR NERVE or **LEG MUSCLE**
4. During a lab experiment you open the chest cavity of an anesthetized frog and observe the beating heart. You apply a solution of acetylcholine to the heart. Predict the effect on heart contractility:
INCREASE or **DECREASE** or STAY THE SAME
5. If a toxin reduces the affinity for Ach to Ach receptors in skeletal muscle, the application of an acetylcholinesterase inhibitor will have which effect on muscle contractility?
INCREASE or DECREASE or NO EFFECT
6. You are an emergency medicine doctor and must be able to rapidly figure out at what level a person with a suspected spinal cord injury may be injured before calling your neurosurgery resident. You standard test is to stimulate each foot and each hand with a tuning fork (vibration stimulus) or a sharp pin (painful stimulus). Predict whether the following patients can sense each of the stimuli (1pt ea):

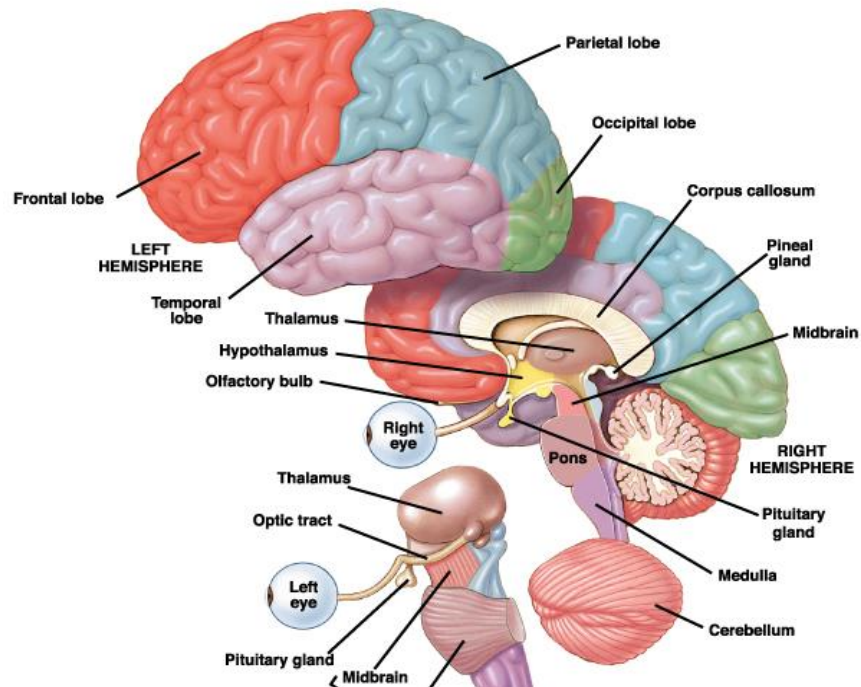
Patient injury	Vibration left foot	Vibration left hand	Pin prick left foot	Pin prick left hand
C4 right side lesion	YES NO	YES NO	YES NO	YES NO
L2 left side lesion.	YES NO	YES NO	YES NO	YES NO

7. When a sensory signal comes into the nervous system what is the order that the signal follows? (number from 1-7) (6 pts)

order	location of signal
7	motor neurons
2	primary sensory areas
1	sensory information
4	association areas
5	higher-order motor areas
3	higher-order sensory areas
6	primary motor cortex

Question 7 dropped, add 6 points to all grades.

8. Label the following diagram (12 pts):



9. When the nervous system has an afferent signal that blood flow needs to be increased, one of the possible responses is to increase heart rate.

What is the integrating center in this reflex loop (specific brain region)?

Medulla

What part of the nervous system carries the efferent signal (specific division)?

Sympathetic

Which neurotransmitter is responsible for acting on the target?

Norepinephrine

On which receptor does this neurotransmitter act?

β_1 adrenergic

What type of receptor is it? Circle correct one.

Adrenergic receptor are G-protein coupled.

Ionotropic? or Metabotropic?

10. Draw the sensory pathway from the skin to the brain that carries a touch stimulus from the hand, including each neuron and the relevant anatomy. (10 pts)

No drawing – up to 1 pt additional off

Stimulus → mechanoreceptor (1 pt for correctly identifying/drawing receptor as mechanoreceptor; did not require specific subtype)

Afferent fiber is A β - fiber (1 pt) This is the 1st (primary) neuron in the 3-neuron chain to the cortex.

Enter on dorsal side of spinal cord (dorsal horn)

Primary neuron in 3- neuron chain travels up the spinal cord in the dorsal (or anterolateral) column (1 pt)

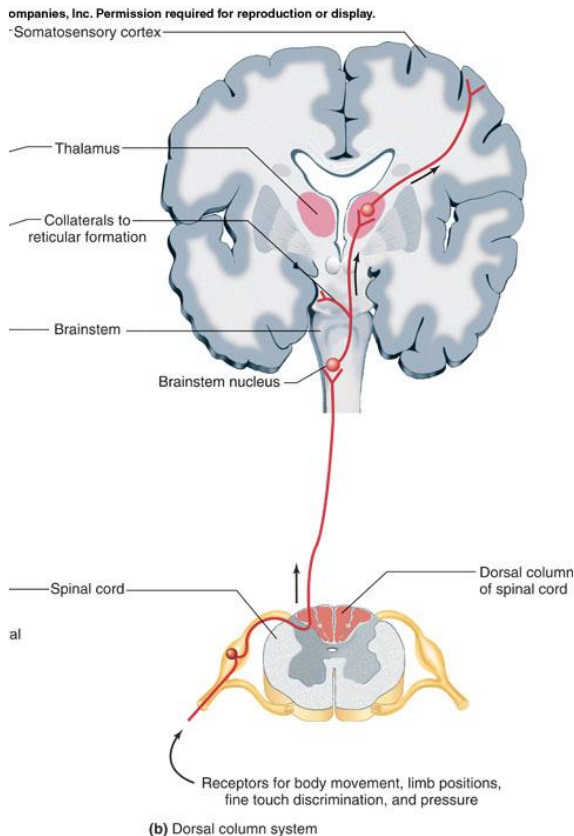
Primary neuron synapses in medulla (1 pt) and crosses over in the pyramids of the medulla (1 pt)

The secondary neuron (2nd neuron in 3-neuron chain) goes from medulla to thalamus (1 pt)

The tertiary neuron goes from thalamus to the somatosensory cortex (1 pt)

4th neuron is the cortical pathway from the primary sensory cortex to the association areas.

3 neuron chain (3 pts, even if location of synapses was wrong / missing)



11. If the arm is amputated and the person can still “feel” touch stimuli, explain how this can happen. (6 pts)

Because the somatosensory cortex reorganizes. The somatosensory cortex is organized somatotopically, and each region receives sensory input from a specific area on the body (somatosensory). When the input from an amputated arm is missing, activity in the corresponding brain region is reduced, and adjacent areas more easily receive input from other body part. When these body parts are stimulated, the person “perceives” touch from the missing limb.

BMED 3100 Systems Physiology Test 2

11. a) Draw a concept map for the reflexive motion that takes place when you are walking barefoot and step on a piece of sharp glass. b) Add a concept map that explains the perception or stepping on sharp glass. (20 pts)

a) 12 pts:

stimulus at skin – 1

receptor type (nociceptor) – 1

afferent nerve name (c-fiber) – 1

spinal cord anatomy (in dorsal side / horn, out ventral side / horn) – 2

spinal cord as integrating center / spinal reflex – 1

spinal cord – interneurons – 2

4 muscles with correct action – 2

b) 8 pts:

neuron chain (primary, secondary, tertiary with synapses in correct location) – 3

correct cross over point – 1

ascending path (anterolateral tract) – 2

thalamus as relay point (credit if named regardless of 3-neuron chain) – 1

sensory cortex (where perception begins) - 1

BMED 3100 Systems Physiology Test 2

12. For the situation in #11, explain what is happening to the muscle spindles in the ipsilateral flexor muscle during the reflex using a concept map with just the following terms (you do not need to use all and you can use them more than once if needed) + linker words that you select. (9 pts)

Extrafusal fiber
Intrafusal fiber
Alpha motor neuron
Gamma motor neuron
Group 1a afferent nerve
Spinal cord
Action potential
Synapse
Interneuron

13. For the situation in #11, explain what is happening to a typical sarcomere in the ipsilateral flexor muscle during the action using a concept map with just the following terms (you do not need to use all and you can use them more than once if needed) + linker words that you select. (9 pts)

Calcium
Troponin
Tropomyosin
ATP
Sarcoplasmic reticulum
Actin
Myosin
ADP, Pi
Action potential
T-tubule