Lecture #02 Nerves and Spinal Cord

Question 1: A knife wound to the back has caused the loss of sensation in the right leg. Where did the knife most likely enter?

a) Into a ventral root

b) The left cervical spine

c) The left lumbar spine

d) The right cervical spine

e) The right lumbar spine

HINT:

Identify the spinal levels that relate most closely to the legs, not the arms

EXPLANATION:

Spinal loss of sensation is mostly ipsilateral, because sensory information has not crossed yet, except when second order pain and temperature afferents are involved. Cervical levels serve the arms, lumbar levels serve the legs.

ANSWER: ['The right lumbar spine']

Lecture #02 Nerves and Spinal Cord

Question 2: The A beta axons carry which signals?

a) Sharp, pricking painful sensations

b) Proprioception

c) Distressing painful sensations

d) Temperature

e) Touch, pressure, vibration

HINT:

A beta fibers are almost the largest of the sensory axons; only the muscle spindle afferent axons are larger

EXPLANATION:

The smallest of the spinal sensory axons are the unmyelinated C fibers. They are sensory axons that carry distressing pain signals. Slightly larger A delta myelinated axons carry sharper but more manageable pain sensations. The larger A beta fibers carry touch, pressure, vibration, and position sense and ascend ipsilaterally. Autonomic nervous system fibers include B fibers.

ANSWER: ['Touch, pressure, vibration']

Lecture #02 Nerves and Spinal Cord

Question 3: Which is a characteristic of sensory axons of the dorsal column system?

a) They are divided into lateral (propriospinal) axons that represent the ipsilateral lower limb and medial (gelatinosa) axons that represent the contralateral upper limb

b) They are divided into medial (gracile) axons that represent the ipsilateral lower limb and lateral (cuneate) axons that represent the ipsilateral upper limb

c) They enter the cord relatively dorsolaterally and cross to the contralateral side

d) They are among the smallest axons of the spinal cord

e) They enter the cord ventrally and cross to the contralateral side

HINT:

The dorsal column system is the large fiber somatic sensory system

EXPLANATION:

The large axons of the dorsal column system carry touch, pressure, vibration, and position sensations.

they enter the spinal cord dorsomedially and ascend ipsilaterally in the nearby dorsal column. They ascend ipsilaterally up to synapse in the dorsal column nuclei of the medulla, the gracile and cuneate nuclei, where the second order neurons are located.

ANSWER: ['They are divided into medial (gracile) axons that represent the ipsilateral lower limb and lateral (cuneate) axons that represent the ipsilateral upper limb']

Lecture #02 Nerves and Spinal Cord

Question 4: How does spinal segment T5 compare to segment L5?

a) L5 is near the rostral junction with the medulla, T5 is near the caudal extreme of the spinal cord

b) T5 innervates the leg, L5 the arm

c) L5 lies below the cauda equina, T5 does not

d) L5 has Clarke's Nucleus (Nucleus Dorsalis), T5 has an enlarged substantia gelatinosa

e) L5 has large ventral horns, T5 has small ventral horns

HINT:

Cervical segments control the upper body, lumbar segments the legs

EXPLANATION:

There are two ventral horn enlargements, the cervical enlargement for control of the arms, and the lumbar (or lumbosacral) enlargement for control of the legs. All the thoracic segments below about T2 have very small ventral horns because they control little complex musculature.

ANSWER: ['L5 has large ventral horns, T5 has small ventral horns']

Lecture #02 Nerves and Spinal Cord

Question 5: Which capacity is most intact in the Brown-Sequard (or cord hemi section) syndrome?

a) Ipsilateral mechanoreception and proprioception

b) Ipsilateral motor function below the segment of the lesion

c) Ipsilateral motor function at the segment of the lesion

d) Ipsilateral pain and temperature sense

e) Contralateral pain and temperature sense

HINT:

Which sensory pathway decussates near its level of entry to the spinal cord

EXPLANATION:

Brown-Sequard syndrome results from transection of one side of the spinal cord. This disables the ipsilaterally descending corticospinal motor axons, the ipsilaterally ascending large primary afferent sensory axons, and the contralaterally ascending small secondary afferents that carry pain and temperature. Ipsilateral pain and temperature is intact, as are contralateral motor and large sensory axon systems.

ANSWER: ['Ipsilateral pain and temperature sense']

Lecture #02 Nerves and Spinal Cord

Question 6: Which is a characteristic of the entry of large sensory axons into the spinal cord?

a) They enter the cord ventrally and cross to the contralateral side

b) They enter the cord relatively dorsomedially and remain on the ipsilateral side

c) They enter the cord relatively dorsolaterally and remain on the ipsilateral side

d) They enter the cord relatively dorsomedially and cross to the contralateral side

e) They enter the cord relatively dorsolaterally and cross to the contralateral side

HINT:

The large axons enter closest to the fiber bundles in which they travel up the neuraxis

EXPLANATION:

There is a medial to lateral organization of large to small sensory fibers at the entry into the dorsal spinal cord. The largest axons enter nearest to the dorsal columns, in which they travel ipsilaterally up to synapse in the dorsal column nuclei of the medulla, the gracile and cuneate nuclei.

ANSWER: ['They enter the cord relatively dorsomedially and remain on the ipsilateral side']

Lecture #02 Nerves and Spinal Cord

Question 7: What explains the cauda equina?

a) Sparse innervation of the lower body

b) Length of the spine compared to the spinal cord

c) Trauma that affects the central spinal cord

d) Unilateral spinal cord trauma

e) Dorsal location of large sensory afferents vs ventral location of small afferents

HINT:

The cauda equina or tail of the horse is named for its appearance in the vertebral column

EXPLANATION:

Spinal segments are named for the vertebra at their entry or exit, not the point of entry or exit into or from the spinal cord. The caudal end of the spinal cord is at about L2. A lumbar puncture to sample cerebrospinal fluid is safe from spinal cord injury if done at L4-L5. As one descends the spinal cord, entering and exiting nerves travel increasingly far to reach their corresponding spinal segments. Caudal to the end of the spinal cord the extended dorsal and ventral roots comprise the cauda equina.

ANSWER: ['Length of the spine compared to the spinal cord']

Lecture #02 Nerves and Spinal Cord

Question 8: Which results from damage to the spinal cord ventral (anterior) commissure at lamina X?

a) Bilateral loss of pain and temperature sense

b) Contralateral loss of pain and temperature sense

c) Contralateral loss of touch, pressure, vibration, and proprioception

d) Ipsilateral loss of pain and temperature sense

e) Ipsilateral loss of touch, pressure, vibration, and proprioception

HINT:

Second order axons of small fiber somatic sensations cross at lamina X

EXPLANATION:

Large axon touch, pressure, vibration, and position sense primary afferents ascend ipsilaterally to the medulla. Small axon pain and temperature sense primary afferents synapse in the ipsilateral dorsal horn and the secondary neuron axons then cross in lamina X. Lamina X contains both left and right side afferents, so pain and temperature deficits from lamina X damage are bilateral.

ANSWER: ['Bilateral loss of pain and temperature sense']

Lecture #02 Nerves and Spinal Cord

Question 9: How do the smallest spinal axons differ from large ones?

a) They are unmyelinated

b) They enter the spinal cord more medially than large axons

c) They leave the spinal cord via the ventral roots

d) They conduct more rapidly

e) They carry transient signals rather than tonic ones

HINT:

The smallest fibers are the type C fibers

EXPLANATION:

Only the smallest spinal axons are unmyelinated. They conduct much more slowly than larger axons. The very smallest are the unmyelinated C fibers, which are sensory axons that carry distressing pain signals. Slightly larger A delta myelinated axons carry sharper but more manageable pain sensations. The larger A beta fibers carry touch, pressure, vibration, and position sense and ascend ipsilaterally.

ANSWER: ['They are unmyelinated']

Lecture #02 Nerves and Spinal Cord

Question 10: What is (are) the most notable exception(s) to the overall laterality of the spinal cord?

a) Dorsal spinocerebellar tract

b) Anterolateral system

c) Alpha motor neurons

d) Lateral corticospinal tract

e) Dorsal columns

HINT:

Which ascending pathway is second order neuron axons?

EXPLANATION:

The spinal cord has mostly ipsilateral neuronal systems. The large axons of the dorsal column system carry touch, pressure, vibration, and position sensations. They enter the spinal cord dorsomedially and ascend ipsilaterally in the nearby dorsal column. They ascend ipsilaterally up to synapse in the dorsal column nuclei of the medulla, the gracile and cuneate nuclei, where the second order neurons are located. Small axon pain and temperature sense primary afferents enter ipsilaterally more laterally and synapse in the ipsilateral dorsal horn. Their secondary neuron axons then cross in lamina X to become the main contralateral signals of the spinal cord. The descending corticospinal tracts are ipsilateral, having decussated at the spinomedullary junction.

ANSWER: ['Anterolateral system']

Lecture #02 Nerves and Spinal Cord

Question 11: A syringomyelia, or central cord syndrome, presents which clinical picture?

a) Ipsilateral loss of proprioception and mechanoreception on the body corresponding to and below the segment of the lesion and less extensive contralateral loss of pain and temperature sense below the lesion

b) Contralateral flaccid paralysis at and below the segment of the lesion

c) Obstruction of CSF flow within the lateral ventricles

d) Bilateral loss of pain and temperature sense in a patch corresponding to the segments of the lesion

e) Unilateral, ipsilateral loss of proprioception, mechanoreception, and pain and temperature sense on the body corresponding to and below the segment of the lesion; flaccid paralysis over approximately the same extent

HINT:

The initial effects of a syrinx are due to compression of axons near its location

EXPLANATION:

A syrinx is a swelling of the central canal of the spinal cord, often at cervical levels. It initially compresses axons in lamina X, the ventral or anterior commissure. Small axon pain and temperature sense primary afferents synapse in the ipsilateral dorsal horn and the secondary neuron axons then cross in lamina X. Lamina X contains both left and right side afferents, so pain and temperature deficits from lamina X damage are bilateral. A syrinx initially affects only the spinal segments near the level of the swelling, but it can expand to compress the ventral horns and ultimately axons passing in descending tracts.

ANSWER: ['Bilateral loss of pain and temperature sense in a patch corresponding to the segments of the lesion']

Lecture #02 Nerves and Spinal Cord

Question 12: Small afferent fibers enter the cord most ----- near the -----?

a) Contralaterally, Rexed lamina IX

b) Medially, Rexed lamina X

c) Laterally, alpha motor neurons innervating the trunk

d) Medially, spinocerebellar tracts

e) Laterally, substantia gelatinosa

HINT:

Afferents to the spinal cord enter near to their next destination

EXPLANATION:

There is a medial to lateral organization of large to small sensory fibers at the entry into the dorsal spinal cord. The largest axons enter nearest to the dorsal columns, in which they travel ipsilaterally up to synapse in the dorsal column nuclei of the medulla, the gracile and cuneate nuclei. The smallest axons enter near the substantia gelatinosa, in which some of them terminate or synapse with pain and temperature information.

ANSWER: ['Laterally, substantia gelatinosa']

Lecture #02 Nerves and Spinal Cord

Question 13: Where is the propriospinal tract?

a) in the spinal cord next to the gray matter

b) in the cerebellum

c) in a muscle nerve or mixed peripheral nerve

d) in the telencephalon beneath the cortex

e) in the spinal white matter running from the spinal cord to the cerebellum

HINT:

The propriospinal tract is conveniently located for coordinating diverse spinal segments

EXPLANATION:

Reflexes often involve coordination across many body parts and spinal segments. This is done by the propriospinal tract, which lies against the spinal gray matter and interconnects widespread spinal segments.

ANSWER: ['in the spinal cord next to the gray matter']

Lecture #02 Nerves and Spinal Cord

Question 14: How does a spinal segment C7 compare to segment T5?

a) C7 lies in the cauda equina, T5 does not

b) C7 is nearer the caudal extreme of the spinal cord, T5 near the rostral junction with the medulla

c) C7 has large ventral horns, T5 has small ventral horns

d) C7 has Clarke's Nucleus (Nucleus Dorsalis), T5 has an enlarged substantia gelatinosa

e) C7 innervates the leg, T5 the arm

HINT:

Cervical segments serve the upper body

EXPLANATION:

The cervical enlargement of the ventral horns is prominent at C7, where lower motor neurons that control the hand are located. The segmental groups from caudal lower body to rostral upper body are 1 coccygeal segment, 5 sacral, 5 lumbar, 12 thoracic, and 8 cervical segments.

ANSWER: ['C7 has large ventral horns, T5 has small ventral horns']

Lecture #02 Nerves and Spinal Cord

Question 15: What is the role of the propriospinal tract?

a) synapses within the dorsal root ganglia

b) the monosynaptic reflex (myotatic or deep tendon reflex)

c) complex reflexes

d) cerebellar efferent copy signals

e) cerebellar afferent signals

HINT:

The propriospinal tract is located adjacent to the spinal gray matter

EXPLANATION:

Reflexes often involve coordination across many body parts and spinal segments. This is done by the propriospinal tract, which lies against the spinal gray matter and interconnects widespread spinal segments.

ANSWER: ['complex reflexes']

Lecture #02 Nerves and Spinal Cord

Question 16: When a syringomyelia, or central cord syndrome lesion, expands beyond the ventral commissure, which function is generally lost first?

a) Unilateral, ipsilateral motor function at and below the segment of the lesion

b) Bilateral proprioception and mechanoreception corresponding to and below the segment of the lesion

c) Unilateral, contralateral motor function at and below the segment of the lesion

d) Unilateral, ipsilateral proprioception and mechanoreception corresponding to and below the segment of the lesion

e) Bilateral motor function at and below the segment of the lesion

HINT:

A syrinx expands from the somewhat ventrally located central canal to affect the closest structures first

EXPLANATION:

An expanding syrinx can block blood circulation to most of the spinal cord bilaterally, except for the dorsal columns, which are supplied by the dorsally located posterior spinal arteries. The expansion first disables motor function near the level of the syrinx, then the descending axons of the corticospinal tracts in the dorsolateral white matter. The syrinx has then effectively blocked the areas served by the midline anterior spinal artery and there is a descending paralysis or severe paresis of all lower body parts.

ANSWER: ['Bilateral motor function at and below the segment of the lesion']

Lecture #02 Nerves and Spinal Cord

Question 17: The smallest diameter axons carry which signals?

a) Intrafusal fiber contraction to desensitize spindles

b) Fast motor unit contraction

c) Proprioception

d) Length of muscle spindles

e) Distressing painful sensations

HINT:

The C fibers are the smallest axons

EXPLANATION:

The smallest of the spinal sensory axons are the unmyelinated C fibers. They are sensory axons that carry distressing pain signals. Slightly larger A delta myelinated axons carry sharper but more manageable pain sensations. The larger A beta fibers carry touch, pressure, vibration, and position sense and ascend ipsilaterally. Autonomic nervous system fibers include B fibers.

ANSWER: ['Distressing painful sensations']

Lecture #02 Nerves and Spinal Cord

Question 18: How do the functions or content of the spinal cord anterior commissure and spinal cord ventral commissure differ?

a) The anterior commissure contains proprioceptive and touch fibers; the ventral commissure contains pain and temperature fibers

b) The anterior commissure contains proprioceptive and touch fibers; the ventral commissure contains motor fibers

c) The anterior commissure contains sensory fibers; the ventral commissure contains motor fibers

d) They are the same commissure, which carries pain and temperature information

e) The anterior commissure contains motor fibers; the ventral commissure contains sensory fibers

HINT:

The anterior commissure is Rexed lamina X

EXPLANATION:

Ventral and anterior are the same direction in the spinal cord, so the ventral and anterior commissure are the same white matter, located at lamina X. Small axon pain and temperature sense primary afferents synapse in the ipsilateral dorsal horn and the secondary neuron axons head ventrally then cross in lamina X, directly anterior to the central canal. Lamina X contains both left and right side afferents, so pain and temperature deficits from lamina X damage are bilateral.

ANSWER: ['They are the same commissure, which carries pain and temperature information']

Lecture #02 Nerves and Spinal Cord

Question 19: Which are C fibers?

a) Myelinated pain and temperature afferents

b) Tendon organ afferents

c) Autonomic nervous system preganglionic fibers

d) Unmyelinated pain and temperature afferents

e) Autonomic nervous system preganglionic fibers

HINT:

The sensory fiber classification system proceeds in alphabetical order from large to small axons

EXPLANATION:

The smallest of the spinal sensory axons are the unmyelinated C fibers. They are sensory axons that carry distressing pain signals. Slightly larger A delta myelinated axons carry sharper but more manageable pain sensations. The larger A beta fibers carry touch, pressure, vibration, and position sense and ascend ipsilaterally. Autonomic nervous system fibers include B fibers.

ANSWER: ['Unmyelinated pain and temperature afferents']

Lecture #02 Nerves and Spinal Cord

Question 20: What is a spinal segment?

a) A part of the spinal cord associated with a sensory and motor pair of nerves and related to a dermatome and myotome

b) A length of a dorsal root

c) A length of a ventral root

d) The rostro caudal extension of gray matter tracts from coccygeal through cervical levels

e) The nerve fiber link between the primary sensory or motor neuron in the ventral or dorsal horn and the secondary neuron of the same pathway

HINT:

Each rostro-caudal part of the spinal cord, coccygeal, sacral, lumbar, thoracic, cervical, has several segments

EXPLANATION:

There are 31 spinal segments, each relating to a single sensory dermatome and motor myotome, 1 coccygeal, 5 sacral, 5 lumbar, 12 thoracic, and 8 cervical.

ANSWER: ['A part of the spinal cord associated with a sensory and motor pair of nerves and related to a dermatome and myotome']

Lecture #02 Nerves and Spinal Cord

Question 21: What levels of the spinal cord contain the most spinal nerve segments?

a) Sacral

b) Coccygeal

c) Thoracic

d) Cervical

e) Lumbar

HINT:

Which levels have the largest number of the 31 spinal segments

EXPLANATION:

The segmental groups from caudal lower body to rostral upper body are 1 coccygeal segment, 5 sacral, 5 lumbar, 12 thoracic, and 8 cervical segments.

ANSWER: ['Thoracic']