Lecture #01 Neurons, Glia, Meninges, Brain

Question 1: Which is most likely to be a local interneuron?

a) A neuron that releases the neurotransmitter acetylcholine onto a muscle fiber

b) A pyramidal neuron of cerebral cortex layer 5

c) An astrocyte

d) An oligodendrocyte

e) A granule neuron of cerebral cortex layer 4

HINT:

Local interneurons are smaller neurons that have short axonal processes

EXPLANATION:

Local interneurons or Golgi type II neurons are ubiquitous. In the neocortex they are found mainly in layers 2 and 4 and are generally stellate or granular in morphology. They contrast with projection neurons that are larger, have long axons, and are found largely in layers 3, 5, and 6.

ANSWER: ['A granule neuron of cerebral cortex layer 4']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 2: Which meningeal tissue provides the toughest physical barrier to protect the brain?

a) Pia mater

b) Dura Mater

c) Area Postrema

d) Arachnoid

e) Astrocyte

HINT:

The outer meningeal layer is the toughest

EXPLANATION:

The dura mater or hard mother meningeal layer is a thick, leathery bi-layer. The dura has periosteal and meningeal subdivisions. The dura provides the primary physical barrier for the brain.

ANSWER: ['Dura Mater']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 3: At which location is the blood brain barrier most easily penetrated?

a) Dura Mater

b) Arachnoid

c) Area Postrema

d) Astrocyte

e) Pia mater

HINT:

A major function of leaky blood-brain barriers is to allow neurons to sense toxins in the blood

EXPLANATION:

The area postrema is one of the major circumventricular organs. It detects blood toxins such as excessive alcohol and initiates the emetic (vomiting) reflex via axonal projections to the dorsal motor nucleus of the vagus nerve.

ANSWER: ['Area Postrema']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 4: Which glial cell type participates in the glutamate-glutamine cycle (or shuttle)?

a) Oligodendrocyte

b) Satellite cell

c) Astrocyte

d) Microglial cell

e) Schwann cell

HINT:

The glial cell that takes part in the glutamine shuttle is a very populous one that has many functions

EXPLANATION:

Astrocytes participate in neurotransmitter recycling as well as blood-brain isolation, immune responses, structural integrity, and developmental migration.

ANSWER: ['Astrocyte']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 5: Where are the axons in the middle cerebellar peduncle going?

a) To the internal capsule

b) To the cerebral cortex

c) To the cerebellum

d) To the lateral horn of the spinal cord

e) To cranial nerve nuclei III through VI

HINT:

The axons of the middle cerebellar peduncle are the transverse, crossing fibers of the ventral pons

EXPLANATION:

The middle cerebellar peduncle is the largest input to the cortico-cerebellum or cerebellar hemispheres. The middle cerebellar peduncle is axons of pontine nuclei neurons that relay information from layer 5 of neocortex and is one of the largest pathways in the brain, consisting of perhaps 20 million axons.

ANSWER: ['To the cerebellum']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 6: What is stained by the Golgi stain?

a) gray matter but not cell bodies or neuropil

b) a small percentage of neurons in their entirety

c) unmyelinated axons but not myelinated axons

d) cell bodies of cells with unmyelinated but not myelinated axons

e) both cell bodies and myelin

HINT:

The Golgi stain was the main tool used by Cajal to trace the neurons and wiring of the brain

EXPLANATION:

By mechanisms still unclear, the Golgi silver stain darkens a select small percentage of neurons in their entirety, revealing the extent of all their processes so that their morphology and connections can be traced. If all neurons were stained, the tissue would be too completely dark to explore.

ANSWER: ['a small percentage of neurons in their entirety']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 7: What is the special role of capillary endothelial cells in the brain?

a) Release of neuromodulators

b) Location lateral to the sulcus limitans

c) Retention of synaptic vesicles

d) Absence of blood-brain barrier

e) Blood-brain barrier

HINT:

Endothelial cells surround the capillaries

EXPLANATION:

Capillary endothelial cells over the body in general have fenestrae, pinocytosis, and loose junctions that allow substances to escape. In the brain, capillary endothelial cells have tight junctions and very limited transport of substances. This is the major blood-brain barrier. Astrocytes also contribute to the blood-brain barrier.

ANSWER: ['Blood-brain barrier']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 8: Into which structure(s) does the metencephalon develop?

a) Pons and cerebellum

b) midbrain

c) Medulla

d) Rhombencephalon

e) Thalamus and hypothalamus

HINT:

The metencephalon lies between myelencephalon and the mesencephalon during development

EXPLANATION:

Early in nervous system development, the prosencephalon, mesencephalon, and rhombencephalon subdivide, with the rhombencephalon becoming the myelencephalon and metencephalon, which in turn develop respectively into the medulla and into the pons and cerebellum.

ANSWER: ['Pons and cerebellum']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 9: Which is most likely to be a projection neuron?

a) A stellate neuron of cerebral cortex layer 4

b) A pyramidal neuron of cerebral cortex layer 5

c) A neuron that releases the neurotransmitter GABA

d) An astrocyte

e) An oligodendrocyte

HINT:

Projection neurons have long axons and predominate in certain cortical layers

EXPLANATION:

Long axon projection neurons in the cerebral neocortex are found mainly in layers 2, 3, 5, and 6. Short axon local neurons are found mainly in layers 2 and 4, though they occur in layers 2-6.

ANSWER: ['A pyramidal neuron of cerebral cortex layer 5']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 10: Where are the axons of Brodmann's area 4 giant Betz cells going?

a) To cranial nerve nuclei III through VI

b) To the ventral horn of the spinal cord

c) To the lateral horn of the spinal cord

d) To the cerebral cortex

e) To the hippocampus

HINT:

Brodmann's area 4 is found just anterior to the central sulcus on the precentral gyrus

EXPLANATION:

Brodmann's are 4 is the primary motor cortex of the precentral gyrus of the frontal lobe. Its very thick layer 5 contains the upper motor neurons that project axons contralaterally to the lower motor neurons of the spinal cord ventral (anterior) horn. The largest of the upper motor neurons are the giant Betz cells, which can have cell bodies over 50 microns in diameter. They control mainly the contralateral leg.

ANSWER: ['To the ventral horn of the spinal cord']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 11: Disynaptic pathways?

a) Have only a single set of interneurons between sensory and motor neurons

b) Use only the neurotransmitter GABA

c) Include the motor cortex and frontal and temporal language areas

d) Would involve only sensory neurons and motor neurons, but do not exist in mammals

e) Were first shown by the demonstration of active brain areas by fMRI

HINT:

Disynaptic pathways are the next step in complexity after the monosynaptic stretch reflex

EXPLANATION:

Only the stretch reflex, also called the knee-jerk reflex, myotatic reflex, deep tendon reflex, and monosynaptic reflex, has no necessary intervening neurons between sensory and motor neurons. Other reflexes such as the vestibulo-ocular and vestibulo-spinal reflexes may have only a single necessary interneuron between sensory and motor neuron, and these are called disynaptic reflexes.

ANSWER: ['Have only a single set of interneurons between sensory and motor neurons']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 12: Which glial cell type is most important for isolating neurons from blood-borne toxins?

a) Schwann cell

b) Microglial cell

c) Pyramidal cell

d) Oligodendrocyte

e) Astrocyte

HINT:

Blood-brain isolation is one of several functions of this most populous glial cell type

EXPLANATION:

Astrocyte end feet surround blood vessels and contribute to the blood-brain barrier that is primarily made by the capillary endothelial cells. Astrocytes also participate in the glutamate shuttle neurotransmitter recycling system and have immune, structural, and other functions.

ANSWER: ['Astrocyte']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 13: Which -polar classification best fits the sensory receptive neurons of the dorsal root ganglia?

a) Pyramidal-polar

b) Multipolar

c) Pseudounipolar

d) Bipolar depression

e) Stellate-polar

HINT:

Dorsal root ganglion neurons have a central and peripheral process extending from a common brnch point

EXPLANATION:

A short, single axonal process extends from the dorsal root ganglion neuron, but it soon splits into two bipolar branches, one of which travels to the periphery to receive input, and the other of which travels centrally to carry action potential signals into the central nervous system.

ANSWER: ['Pseudounipolar']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 14: The thalamus has which major function?

a) It is the primary input to the basal ganglia

b) It relays inputs from many parts of the brain to the cerebral cortex

c) It is the primary input to the cerebellum

d) It inhibits the brain via the neurotransmitter GABA

e) It is the primary output from the cerebral cortex

HINT:

The thalamus is the largest structure in the diencephalon, lying between the brainstem and cerebrum

EXPLANATION:

Almost all information that is sent to the cerebral neocortex must pass through a thalamic relay. Specific nuclei within the thalamus relay information from specific systems, for example the ventral posterior thalamic nuclei relay somatic sensations and the lateral and medial geniculate nuclei relay vision and hearing, respectively.

ANSWER: ['It relays inputs from many parts of the brain to the cerebral cortex']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 15: What do axon terminals and dendritic spines have in common?

a) They are parts of glial cells, not neurons

b) They form parts of synapses

c) They are typically uniform in diameter along their length

d) They are found within the perikaryon of the neuron

e) They contain the nucleus

HINT:

Both are slender processes that extend from the neuron cell body

EXPLANATION:

An axon originates at the neuron cell body axon hillock and extends to other neurons. An axon terminates in branches that have presynaptic specializations which release neurotransmitter when an action potential is conducted to them. Often, many dendrites extend from the neuron cell body and branch widely to receive axon terminal neurotransmitter at their postsynaptic specializations, which contain receptors and channels that respond to the neurotransmitter release by an axon terminal.

ANSWER: ['They form parts of synapses']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 16: Which glial cell type is most important for myelinating peripheral nervous system axons?

a) Schwann cell

b) Satellite cell

c) Astrocyte

d) Oligodendrocyte

e) Microglial cell

HINT:

Different glial cell types myelinate central versus peripheral axons

EXPLANATION:

Schwann cells are the most prominent of the peripheral glial cells. Each Schwann cell wraps many times around a single peripheral axon segment, insulating the axons so that action potentials are conducted roughly six times faster and at much lower metabolic cost. Demyelinating diseases are a major pathology of the nervous system, both peripherally and centrally.

ANSWER: ['Schwann cell']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 17: The carotid arteries send blood directly into which artery or arteries?

a) Posterior cerebral

b) Basilar

c) Middle cerebral

d) Anterior communicating

e) Carotid(s)

HINT:

The carotid arteries are the origin of the anterior cerebral circulation

EXPLANATION:

The two internal carotid arteries are the origin of the anterior cerebral circulation. They ascend and branch at the circle of Willis at the base of the brain. Their largest extensions are the middle cerebral arteries, and they branch forward as the anterior cerebral arteries, which connect at the midline anterior communicating artery to complete the circle of Willis.

ANSWER: ['Middle cerebral']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 18: The vertebral arteries send blood directly into which artery or arteries?

a) Basilar

b) Anterior cerebral

c) Posterior cerebral

d) Carotid(s)

e) Middle cerebral

HINT:

The vertebral arteries are the origin of the posterior cerebral circulation

EXPLANATION:

The posterior cerebral circulation begins with the two vertebral arteries ascending and joining to form the basilar artery at the base of the ventral surface of the pons.

ANSWER: ['Basilar']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 19: The coordinate direction anterior is the same as which other coordinate directions?

a) Rostral in the cerebrum, ventral in the spinal cord

b) Posterior in the cerebrum, dorsal in the spinal cord

c) Posterior in the cerebrum, ventral in the spinal cord

d) Dorsal in the cerebrum, ventral in the spinal cord

e) Caudal in the cerebrum, dorsal in the spinal cord

HINT:

The dorsal-ventral coordinates bend along with the axis of the brain as it ascends from spinal cord to cerebrum

EXPLANATION:

In the cerebrum rostral=anterior, caudal=posterior, dorsal=superior, ventral=inferior. In the spinal cord rostral=superior, caudal=inferior, dorsal=posterior, ventral=anterior.

ANSWER: ['Rostral in the cerebrum, ventral in the spinal cord']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 20: Looping brain pathways likely serve what purpose(s)?

a) Extension of motor commands and formation of memories

b) Interconnecting the basal ganglia and the cerebellum

c) Prevention of negative and positive feedback

d) Monosynaptic reflexes

e) Relaying to the cerebral cortex and bypassing the thalamus

HINT:

Major brain loops include the corticopontocerebellar, cortico-basal ganglia, and corticolimbic.

EXPLANATION:

Each major brain loop consists of many parallel interconnected loops that run parallel to each other. Information may reverberate in a loop and move to different parallel pathways within it as motor commands play out or other prolonged or elaborate brain functions take place.

ANSWER: ['Extension of motor commands and formation of memories']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 21: Which glial cell type is most important for myelinating central nervous system axons?

a) Astrocyte

b) Schwann cell

c) Satellite cell

d) Oligodendrocyte

e) Microglial cell

HINT:

Different glial cell types myelinate central versus peripheral axons

EXPLANATION:

Oligodendrocytes are the glial cells that myelinate central axons. Each oligodendrocyte can myelinate segments of many axons, unlike the peripheral Schwann cells, each of which myelinates only one axonal segment.

ANSWER: ['Oligodendrocyte']

Lecture #01 Neurons, Glia, Meninges, Brain

Question 22: Which is most likely to send an axon to subcortical brain locations?

a) An oligodendrocyte

b) An astrocyte

c) A granule neuron of cerebral cortex layer 4

d) A pyramidal neuron of cerebral cortex layer 5

e) A neuron that releases the neurotransmitter acetylcholine onto a muscle fiber

HINT:

Projection neurons are found in distinct neocortical layers

EXPLANATION:

Layer 5 can be called the major neocortical output layer. Many layer 5 neurons project to distant areas, including the superior colliculus, ventral pons, basal ganglia, limbic system, spinal cord, and other parts of the central nervous system.

ANSWER: ['A pyramidal neuron of cerebral cortex layer 5']