

NEUROBIOLOGY EXAM I.

08-01-2019

Name:

Points:

(Maximum: 100 points)

.....
Examiner's signature

.....
Student's signature

List the names of characteristic membranes/compartments of mitochondria under A! Define the coupled function/s in B! 4 points

A.

outer membrane

inner membrane

matrix

intermembranous space

B.

transport, fatty acid metabolism

oxidative phosphorylation, ATP production

pyruvate and fatty acid oxidation, Krebs cycle, storage of calcium

proton pool

Define the following terms!

6 points

Rough endoplasmic reticulum The ribosome bearing part of the endomembrane system of the cell.

Euchromatin The form of chromatin that is lightly packed. Site of transcription.

Microtubule The 20 nm diameter tubes, which are part of the cytoskeleton.

Exon An exon is a coding region of a gene that contains the information required to encode a protein.

Active transport A kind of transport through membranes, which requires carrier proteins and energy (ATP).

Golgi hydrolase vesicle Primary vesicle derived from the Golgi apparatus.

5 points

Complete the sentences!

Structurally the human body is composed of..... *organ systems* The voluntary movement is maintained predominantly by the interacting *musculo-skeletal* and *nervous* systems. The executing neuronal command is transmitted via the *PNS or axons of α and γ motoneurons* ... to the target structures.

Make 3 simple drawings depicting the essence of A: feedback inhibition, B: feed forward inhibition and C: lateral inhibition!

3 points

A

B

C

Define the structural (A) and trophic (B) entities of the neuron doctrine!

2 points

- A. *Neurons are individual entities, totally covered by cell membrane, 15-20 nm wide interneuronal space separates them.*
- B. *The cell body provides the genetic code and the diverse biochemical machineries that maintain the trophic needs of the long processes. Nissl bodies are indicative of the active protein synthesis in neurons.*

Complete the text below!

3 points

At the periphery, nerve fibers conducting at high speed (over 100m/s) belong to the *A α* category. The lipid-rich insulation of the axon is provided by *Schwann cells* cells. The *Ranvier nodes* serve as structural platform for the saltatory propagation of action potential.

Complete the sentences below!

3 points

Excitatory neuronal inputs establish the *asymmetric* type of synapses in the CNS. The inhibitory axon terminals are rich in *ellipsoidal* -shaped synaptic vesicles. In addition to chemical synapses, neuronal elements also use *electrical synapses* for communication.

Make a drawing portraying the muscle spindle! Identify and provide the names of the two different muscle fiber receptors and three distinct types of nerves communicating with elements of the muscle spindle!

5 points

Nuclear bag

Nuclear chain

Fibers of α motoneurons ($A\alpha$)

Fibers of γ motoneurons ($A\gamma$)

Fibers of spinal ganglia cells ($A\alpha$ & $A\beta$)

Write four true statements about oligodendroglia!

4 points

1.
2.
3.
4.

Complete the text below!

5 points

Noradrenaline is a (catechol)amine type neurotransmitter. It is synthesized by the enzyme DBH.
..... The transmitter is filled into synaptic vesicles within axon terminals by VMAT2.
..... The re-uptake of the neurotransmitter from the synaptic cleft is ensured by NET. It has an inhibitory action on adenylyl cyclase action via G-protein coupled receptor alpha 2 in the CNS.

Complete the sentences with the proper terms!

5 points

The pro-opiomelanocortin hormone is cleaved further resulting in neuropeptide transmitters that all act through GPCRs. A powerful endogenous opioid peptide is B-endorphins that acts via the μ -type opioid receptor. Its synthetic analogue, the morphine, causes analgesia. Activation of its receptors opens potassium ion channels and inhibits neurotransmitter/neuropeptide release.

5 points

Define the following terms belonging to synaptic vesicle trafficking!

1. Synaptic web. It is a hexagonal array of electron dense particles attached to the cytoplasmic face of the presynaptic membrane.
2. Synaptobrevin. A protein in the membrane of synaptic vesicles, which acts during vesicular fusion
3. T-SNARE proteins. The snare protein superfamily (snap-(soluble nsf attachment protein) receptors) is composed of dozens of peptides. A pivotal role of snare proteins is to assist the docking, fusing and emptying of synaptic vesicles.
4. Docking. The process of insertion of synaptic vesicles into the presynaptic grid and establishing contact with the presynaptic membrane is called docking
5. Recycling. In order to ensure the proper releasable pool of vesicles in the terminal both the synaptic vesicle membrane and the transmitter substance undergo recycling

5 points

Complete the sentences with the proper terms!

The spinal cord rostrally is in continuity with the medulla oblongata/brain stem. Caudally it terminates at the level of L1-L2 vertebra/e. It receives sensory information from afferent fibers / pseudomotor neurons of spinal ganglia. The lower motoneurons reside in it's Ventral horn/columns Developmentally, it is a derivative of the neural tube

6 points

Complete the sentences with the proper terms!

The telencephalic vesicles develop from the forebrain. The cavity of the telencephalic vesicle establishes the lateral ventricles. From the dorsally proliferating part of the telencephalic vesicle derives the cerebral cortex, while from its ventral part develops the (the diencephalon) basal ganglia. Its main fiber pathway wedged between the striatum / lentiform / claustrum and the thalamus is called the internal capsule

The human cerebral cortex. Add the missing information!

4 points

Each cortical column displays about 5000 neurons. The specific afferents derive from well-defined nuclei of the Thalamus and terminate in layer IV The commissural efferent fibers cross the midline forming the Corpus callosum.

Make a drawing portrait:

Name specific tract/s of the spinal cord that are predominantly associated with the following physiological processes/functions. **4 points**

1. Vibration sense: *Fasciculus gracilis and cuneatus*
2. Processing pain and crude touch: *Spinothalamic tract*
3. Unconscious proprioception: *Ventral and dorsal spinocerebellar tracts*
4. Main provider of upper motoneuron control: *Primary somatomotor cortex* *Tr. corticospinalis*

5 points

Characteristics of the jaw reflex. Add the missing information!

This reflex operates in muscles of *mastication*. The adequate stimulus of the receptors is *muscle stretch/elongation*. The afferent fibers convey the information to neurons residing in the *mesencephalic* nucleus of the *V.* nerve. The efferent fibers originate from the *motor nucleus of V.*

Complete the following statement addressing the cerebellar machinery!

5 points

1. Vestibulo-cerebellum is composed of: *Flocculo-nodular lobe*
2. Climbing fibers originate from the: *Inferior olive nucleus*
3. Parallel fibers establish synapses with: *Dendrites of Purkinje cells, Golgi cells and stellate cells*
4. The cerebellar glomerulus is formed by: *Dendrites of granule cells, axon terminals of Golgi cells and mossy fibers*
5. The neuronal output of the dentate nucleus targets the: *Red nucleus and thalamus*

The picture depicts the cross section of the medulla oblongata taken through its closed part. Identify the structures labeled by numbers!

5 points



1. *For* Nucleus gracilis
2. *For* Nucleus cuneatus
3. Nucleus & Tractus spinalis nervi V.
4. Decussatio lemniscorum
5. Pyramids *Pyramidal tracts*

Complete the sentences below!

3 points

From nociceptors of the head/face region the information is conveyed to Nucleus tractus spinalis nervi V.
..... This nucleus relays the message via the Trigeminal lemniscus
..... to the VPM nucleus of the thalamus for further processing.

Identify subunits of thalamus that process sensory information from organs of special senses! 2 points

1. Processing of visual information: Lateral geniculate body
2. Acoustic information processing: Medial geniculate body

Make a drawing depicting the tri-synaptic neuron circuit of the hippocampal formation! Give the names of the participating axons/collaterals and their receiving neurons! 3 points

1. synapse: Perforant pathway to granule cells dendrite
2. synapse: Mossy fibers to apical dendrite of CA3 pyramidal cells
3. synapse: Schaffer collaterals to apical dendrite of CA1 pyramidal cells

The corticospinal tract. Add the missing information!

4 points

The tract takes its origin from layer V. of the Primary somatomotor cortex. The descending tract runs medial to the globus pallidus within the Internal capsule. The majority of the pyramidal fibers cross the midline in the Medulla oblongata part of the brain stem. At the level of spinal segments, they terminate on 20% α motoneurons and 80% interneurons neurons.

The posterior funiculus sensory system of the spinal cord. Complete the statements below! 4 points

- 1 It carries axons of neurons located within the Dorsal root ganglia
2. The second order neurons give rise to the crossed Medial lemniscus system.
3. The system is important in identifying objects via 2 point discrimination/ proprioception
4. The final processing of the thalamus-relayed information takes place in the Postcentral gyrus of the cerebral cortex.