

BASICS OF NEUROBIOLOGY

Midterm Test

9th November 2017

Name:

Points: 100 /

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Signature of examiner

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Signature of examinee
(Sign upon acceptance of correction)

NEURONAL MORPHOLOGY AND FUNCTION (15 POINTS)

Decide whether the following statements are true or false. Explain your answer. (10)

Cells are capable of structural plasticity. T _____

Facilitated diffusion requires energy (ATP). F _____

Nucleoli are mainly present in cells that are under intense protein synthesis. T _____

RER takes part in lipid synthesis. F _____

Golgi hydrolase vesicles fuse with endosomes to make the digestion of proteins possible. T _____

The resolution of light microscopy is sufficient to investigate most of the subcellular organelles in the human body. F _____

The nucleolus contain circular DNA. F _____

Macromolecules cannot traffic between the nucleus and the cytoplasm because the nucleoplasm is surrounded by a double membrane. F _____

Ribosomes are attached to the outer surface of the SER.

F _____

SER is abundant in liver cells.

T _____

Give the name of the appropriate part of a neuron to the functions listen below. (5)

1. it has extensive branching: _____ axon _____
2. it receives most of the incoming information: _____ dendritic spine _____
3. ensures protein production: _____ perykarion _____
4. integrate intrinsic and extrinsic signals: _____ axon hillock _____
5. it shows high density of voltage-dependent sodium channels: _____ axon hillock _____

GLIAL MORPHOLOGY AND FUNCTION (10 POINTS).

Render the different glial cell types to the properties listed below. Multiple choice is possible.

A = astrocyte O = oligodendroglia S = Schwann cell M = microglia E = ependyma

1. The blood-brain barrier is established by it. ____A____
2. They regulate the extracellular potassium level. ____A____
3. They develop from the neuroepithel cells. __A,O,S,E____
4. They can be found on the surface of the choroid plexus. ____E____
5. They contain GFAP. ____A____
6. Tanocytes are specialized type of them. ____E____
7. They are coupled by gap junctions. ____A____
8. They develop from the mesoderm. ____M____
9. They act as the resident immune cells in the CNS. ____M____
10. They may host dozens of axons. ____O,S____

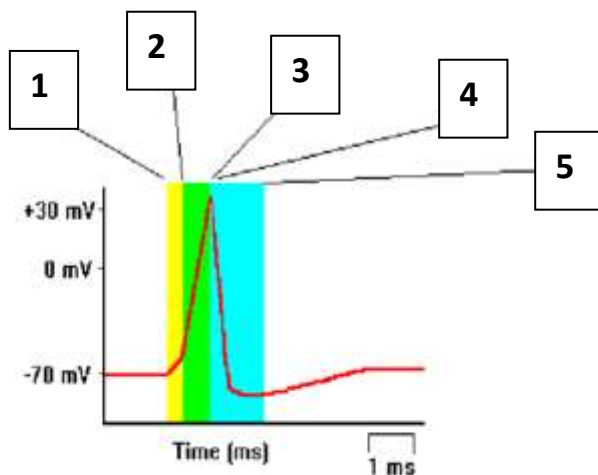
NERVE ENDINGS (9 POINTS)

Complete the text below.


__Muscle spindle__ is a capsulated receptor in the belly of the muscle, composed of thin __striated muscle__ fibers and embedded among __extrafusal muscle__ fibers, that are innervated by __alpha motoneurons__. The receptor is innervated by __gamma__ motoneurons and gets __sensory__ innervation too. This is the receptor of the __spinal stretch__ reflex, which is a __monosynaptic__ reflex providing automatic regulation of the __length__ of skeletal muscles.

SYNAPTIC TRANSMISSION (10 POINTS)

Identify the ion channel operations involved in the generation of action potential at the marked time frames. (5)



1. __sodium channels open__
2. __more sodium channels open (voltage dependent)__
3. __sodium channels close__
4. __potassium channels open__
5. __potassium channels close__

Draw a scheme (by using  pictograms) demonstrating a simple neuronal circuit allowing feed-back inhibition. Indicate whether the synapse is excitatory or inhibitory (+, -) and the direction of the information flow. (5)

NEUROTRANSMITTERS AND RECEPTORS (20 POINTS)

Complete the text below. (9)

The __NMDA__ receptor plays a major role in long term potentiation, synaptic plasticity and memory. It is a(n) __ionotropic__ (functional type) receptor. Although it is primarily activated by the binding of its ligand: __glutamate__, it allows current flow only after the __magnesium ion__ is removed by the depolarization of the post-synaptic membrane. When it is activated, it allows the __inflow__ (direction of flow) of __potassium__ and __sodium__ ions and the __outflow__ (direction of flow) of __chlorid__ ions.

Complete the text below. (11)

The main excitatory neurotransmitter in the peripheral nervous system is __acetylcholine__, which also play important role in learning, memory, aging and Alzheimer's disease. This is an __amine__ type neurotransmitter that is synthetized by the enzyme: __choline acetyltransferase__ from the __ester of acetic acid__ and __choline__. One of its receptors is the __nicotinic ACh__ receptor, which is a(n) __ionotropic__ (type) receptor, while its __metabotropic__ (type) receptor is the __muscarinic ACh__ receptor. When it binds to the former receptor its main function is: __excitatory__. When it activates the latter receptor its function is: __inhibitory__.

DEVELOPMENT AND ORGANIZATION OF THE NERVOUS SYSTEM (21 POINTS)

Underline the correct phrase. (5)

Epithelial cells of the skin develop from the ectoderm/mesoderm.

The neural crest/notochord is responsible for the formation of neural folds.

The cranial/caudal part of the neural tube develops more intensively.

The marginal/mantle layer around the neural canal forms the grey matter.

The alar/basal plate gives rise to the cellular constituents of the somato-motor horn of the grey matter.

Mark and name the secondary vesicles of the developing brain. Give an example derivative brain region to each. (10)

Secondary brain vesicles

Its derivative



piros: Telecephalon - Cerebral hemispheres

rózsaszín: Diencephalon - Thalamus

kék: Mesencephalon - Midbrain

zöld: Metencephalon - Pons

Myelencephalon - Medulla

Answer the following questions about the spinal cord. (6)

Define the spinal cord segment. _____

What is the epidural space? _____

Define the term dermatome. _____

What is the function of the dorsal root? _____

What kind of stimulus does the I. Lamina of the spinal cord grey matter responds to? _____

What does the Lamina IX of the spinal cord gray matter contain? _____

PARAMETERS CHARACTERIZING THE NERVOUS SYSTEM (5 POINTS)

Give the value and the unit.

Diameter of the perikaryon: ___100 μm ___

Change in the membrane potential during action potential: ___120 mV_____

Synaptic delay by the chemical synapse: ___0,3-0,5 ms_____

Conduction velocity of naked axons: ___0,5-2 m/s_____

Number of spinal cord segments: _____31_____

EXPERIMENTAL APPROACHES (10 POINTS).

(A) Define the following terms. (4)

Immortalized cell lines: _____

PCR: _____

cDNA: _____

Fluorescent molecule: _____

(B) What kind of technique would you apply to ... (6)

1. get high-resolution microscopic images with 3D appearance: _____

___Scanning electron microscopy (, confocal microscopy?)_____

2. study the level of gene expression in a tissue: _____

_____northern blot, western blot_____

3. study membrane particles in replicas: _____

__freeze-fracture replica immunogold labelling, electron microscopy_____

4. detect neuronal paths: _____retrogradely transported neural tracers and anterogradely transported neural tracers_____

5. demonstrate whether two neurons are electrically coupled (by gap junctions): _____

__Lucifer Yellow transneuronal tracer + Fluorescent Microscopy_____

6. image synaptic release in vivo: _____

_____FIHC (Fluorescent Immunohistochemistry)_____