

NEUROSCIENCES - QUESTIONS

Neuroanatomy

Describe types of axoplasmic transports according to direction and speed, their functions in the intact neuron and during axon regeneration, examples of transported molecules.

Glial cells in CNS and PNS and their function.

Describe trophic interactions amongst the neurons and target tissue during development and regeneration of the nervous system, neurotrophic factors and their characteristic features. Axon navigation.

Structural basis of the hematoencephalic barrier, its transport mechanisms and significance. Describe formation and absorption of cerebrospinal fluid and its function. Structures free of total hematoencephalic barrier, their localization and functional effects.

Ascending pathways for the nociceptive information from the skin of body and extremities, scheme and description.

Pathways for mydriatic and miotic pupillary reflex, scheme and its description.

Pathway that convey taste information to the upper structures of the CNS, scheme and description. Receptor cells – description, localization and innervation.

Pathways that convey visual information to the cortex and subcortical structures, scheme and description. Receptor cells – description and localization.

The pathways for hearing, scheme and its description. Receptor cells – description and localization.

Descending pathways from the cortex and brainstem - scheme and description.

Pathway for conscious sense of smell, scheme and description. Receptor cells – description and localization.

Reactions of neurons and glial cells to injury of nervous tissue. Regeneration of axons in PNS.

Pathways that convey viscerosensory information. Structure and connections of enteric nervous system.

Reflexes in motor control. Stretch reflex and inverse myotatic reflex, scheme and its description.

Neurophysiology

Smell, taste and hearing – describe stimuli and mechanisms of their transduction.

Specialization of the hemispheres. Language and speech, aphasias.

Control of feeding behaviour. Control of fluid intake. Approach and avoidance brain systems.

Describe transduction of light signal in photoreceptors.

Electroencephalography and evoked potentials.

Synapses – structure and function, types according to released transmitters. Describe structural and functional differences between electrical and chemical transmission at synapses.

Resting potential of the neuron. Equilibrium potential for sodium, potassium and chloride.

Sleep-waking periodicity. Sleep cycles (EEG and vegetative correlates).

Action potential and its conduction. Ionic basis of membrane potential changes. Nerve fibre classification – fibre diameter and conduction velocity.

Neuromuscular junction – describe structure and function, mechanisms of neurotransmitter release and its inactivation.

Excitatory and inhibitory postsynaptic potentials, temporal and spatial summation of membrane potentials.

Receptor (generator) potential - mechanisms of generation. Coding of sensory information – intensity, duration and modality.

Learning and memory.

Eye movements - basic types and their function, eliciting stimuli. Electrooculography.

Integrated questions

The basal ganglia - describe structures of the basal ganglia. Draw and describe basic block scheme of afferent, efferent, and internal connections in basal ganglia. Role of the basal ganglia in motor control. Examples of the basal ganglia impairments in humans.

Sense of balance - description of stimuli and receptor cells. Detection of head position due to gravity. Detection of angular and linear acceleration. Draw and describe a simple scheme illustrating position, localization and connections of neurons that convey vestibular information to brainstem.

Cerebellum - structural-functional compartments of the cerebellum (horizontal and longitudinal divisions). Describe connections of the vestibular cerebellum, the spinal cerebellum, the pontocerebellum and their functional involvements in motor control. Effects of cerebellar lesions - examples.

Control of locomotion - spinal pattern generators, basic stepping pattern and its modulation by afferent information. Describe function of main CNS structures involved in locomotion. Scheme and description of proprioceptive pathways from the lower extremity.

Optical system of the eye - optical apparatus of the eye. Common defects of the image-forming mechanism. Adaptation to different light intensities. Accommodation. Draw and describe simple scheme illustrating position, localization and connections of neurons involved in accommodation.

Control of posture - functions of postural system. Describe corresponding muscle groups, essential afferent information and CNS structures. Draw and describe simple scheme of motor pathways and pathways that convey proprioceptive information involved in control of posture.

Voluntary movement of upper extremities - essential afferent information and CNS structures. Draw and describe a simple scheme of motor pathways that control voluntary movements of upper extremity. Scheme and description of corresponding proprioceptive pathways.

Nociception and pain - stimuli, receptors, physiological significance. Classification of pain, nerve fibres. Referred pain. Draw and describe a simple scheme of ascending pathways that convey the nociceptive information from the skin of face part of the head (trigeminal system). Describe structures for endogenous analgesic system and its functional significance.

Skin sensation from the body - stimuli, receptors and their distribution. Draw and describe a simple scheme illustrating position, localization and connections of neurons that convey 1) crude sensation and temperature sense and 2) discriminative skin sensation from the body to cortex.

Skin sensation from the facial part of the head (trigeminal system) - stimuli, receptors and their distribution. Draw and describe a simple scheme illustrating position, localization and connections of neurons that convey 1) crude sensation and temperature sense and 2) discriminative skin sensation and proprioceptive information from the ventral part of the head to cortex.

Central system of emotion and stress - major structures and pathways of limbic forebrain including amygdala. Sensory afferent inputs to the limbic forebrain, information processing and modification of information meaning. Projections of the limbic forebrain to effector systems. Components of a defensive response.

Parasympathetic compartment of the autonomic nervous system - localization of preganglionic and postganglionic neurons, neurotransmitters (synthesis and inactivation) and their receptors at parasympathetic junctions. Responses of effector organs to parasympathetic stimulation.

Vision – analysis of colour, shape and movements of objects - information processing in the retina. Receptive fields of neurons in corresponding visual pathways. Mechanisms of colour, shape and movement analysis. Draw and describe simple scheme illustrating position, localization and connections of neurons for pathways that convey visual information about 1) colour and shape and 2) movement of objects to cortex.

Sympathetic compartment of the autonomic nervous system - localization of preganglionic and postganglionic neurons, neurotransmitters (synthesis and inactivation) and their receptors at sympathetic junctions. Responses of effector organs to sympathetic stimulation.