MIDTERM ASSIGNMENT #1
PHYSIOLOGICAL & BIOLOGICAL PSYCHOLOGY

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UNIT 2 TOPIC:

A. The Nervous System
B. Central Nervous System
C. Autonomic Nervous System

SPECIFIC GUIDE QUESTIONS:

A. The Nervous system

1. Distinguish the difference between the central nervous system, peripheral nervous system, and autonomic nervous system.
    - The brain and spinal cord comprise the central nervous system, while nerves branching off from the spinal cord extend to all parts of the body comprise the peripheral nervous system. The autonomic nervous system is a branch of the peripheral nervous system that controls involuntary physiologic processes such as heart rate, blood pressure, respiration, digestion, and sexual arousal.
2. Describe the general structure of a neuron and describe ways of classifying neurons
    - A neuron is made up of three major components: dendrites, an axon, and a cell body or soma, which can be compared to the branches, roots, and trunk of a tree. A neuron receives input from other cells via a dendrite, which looks like a tree branch.
    - Neurons are functionally classified based on the direction of the signal in relation to the CNS. As a result of this classification, three types of neurons exist: sensory neurons, motor neurons, and interneurons.
3. Describe the formation of the myelin sheath.
    - In the PNS and CNS, myelin is formed by the innermost sheet-like glial process that comes into contact with the axon and spirals around it, spinning out multiple layers of overlapping membrane. Cytoplasm is expelled from all layers of the myelin sheath except the innermost and outermost.
4. Classify neuroglia and list the different types of neuroglia, including their location and function
    - In the CNS, neuroglia Within the central nervous system, four types of neuroglia can be found:
    - Astrocytes – keep the blood-brain barrier open and the chemical environment stable by recycling ions and neurotransmitters.
    - Oligodendrocytes – myelinate axons in the central nervous system and serve as a structural framework.
    - Ependymal cells line the ventricles (brain) and central canal (spine) and contribute to the production of cerebrospinal fluid.

- Phagocytosis is the process by which microglia remove cell debris, waste, and pathogens.
- Neuroglia in the PNS The peripheral nervous system contains two types of neuroglia:
- Schwann cells are peripheral nervous system myelinate axons.
- Satellite cells – regulate nutrient and neurotransmitter levels in ganglia around neurons.

5. Why are Microglia frequently considered part of the body's immune system?
6. Describe the resting membrane potential
   - The voltage across a cell membrane during rest is referred to as the resting membrane potential. The potassium concentration gradient across the cell membrane or the ratio of ICF to ECF potassium determines it primarily in neuromuscular tissues, nerves, cardiac and skeletal muscle.
7. Describe the chain of events associated with an action potential.
   - Depolarization, overshoot, and repolarization are the three stages of an action potential. The membrane potential has two more states that are related to the action potential. The first is hypopolarization, which occurs prior to depolarization, and the second is hyperpolarization, which occurs following repolarization.
8. Define synapse and synaptic transmission
   - A synapse is a connection between two neurons. Synaptic transmission, also known as neurotransmission, transports action potentials across the synapse. The neuron that sends the signal is known as the presynaptic neuron, while the neuron that receives the signal is known as the postsynaptic neuron.
9. Describe synaptic plasticity & synaptic Inhibition
   - Synaptic plasticity, which refers to the activity-dependent modification of the strength or efficacy of synaptic transmission at preexisting synapses, has been proposed for over a century to play a critical role in the brain's ability to incorporate transient experiences into persistent memory traces.
   - The two basic circuit configurations that mediate synaptic inhibition are feedback and feedforward. Feedback inhibition occurs when excitatory principal neurons synapse on inhibitory interneurons, which project back to the principal neurons and inhibit them in a negative feedback loop.

B. Central Nervous System

1. Describe the structure and functions of the central nervous system in general terms
   - The central nervous system (CNS) is made up of three major parts: the brain, the spinal cord, and neurons or nerve cells. Each component of the CNS is important in how the body functions, and the three CNS components work together to take in information and control how the body responds.
   - Many bodily functions, such as sensation, thought, movement, awareness, and memory, are controlled by the brain. The cerebral cortex refers to the surface of the brain. The grooves and folds in the tissue give the cortex's surface a bumpy appearance. A sulcus is a groove, and a gyrus is a bump.

- The spinal cord connects to the brain via the brain stem before running down through the spinal canal, which is located inside the vertebrae. The spinal cord transports information to and from the brain from various parts of the body.
- Neurons are the fundamental constituents of the central nervous system. Throughout the body, billions of nerve cells communicate with one another to produce physical responses and actions.
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2. Describe the embryonic development of the brain into the forebrain, midbrain, and hindbrain, and to explain how this correlates with the division of the brain into five mature regions derived from the three initial ones.
    - As the neural tube develops, the anterior end enlarges to form the primary vesicles that form the forebrain, midbrain, and hindbrain. These structures continue to develop throughout embryonic development and into adolescence. They form the foundation of the fully developed adult brain's structure.
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3. Describe the cerebrum and the functions of the cerebral lobes
    - The cerebrum is the brain's uppermost layer. It's divided into two halves by a central fissure. The cerebrum is home to the brain's major lobes and is in charge of receiving and interpreting information from the sense organs as well as controlling the body.
    - Each side of your brain has four lobes. The frontal lobe is important for cognitive functions as well as the control of voluntary movement or activity. The parietal lobe processes information about temperature, taste, touch, and movement, whereas the occipital lobe is primarily responsible for vision. Memories are processed by the temporal lobe, which integrates them with sensations of taste, sound, sight, and touch.
4. Describe the location and structure of the diencephalon and to explain the autonomic functions of its chief components—the thalamus, hypothalamus, epithalamus, and pituitary gland.
5. Describe the metencephalon
    - The pons and cerebellum are both part of the metencephalon. The open and closed medulla, sensory and motor nuclei, sensory and motor pathway projection, and some cranial nerve nuclei are all part of the myelencephalon (spinal cord-like). The spinal cord develops from the caudal end of the myelencephalon.
6. Describe the location and structure of the medulla oblongata and to state its functions
    - The medulla oblongata is at the base of the brain, where the brain stem connects the brain to the spinal cord. It is crucial in transmitting messages between your spinal cord and brain. It is also necessary for the proper functioning of your cardiovascular and respiratory systems.
7. Describe the protective meninges of the CNS.
    - The brain and spinal cord are protected by three layers of membranes known as meninges. The pia mater is the delicate inner layer. The arachnoid is the middle layer, a web-like structure filled with fluid that cushions the brain. The dura mater is the tough outer layer.

8. Describe the properties and functions of cerebrospinal fluid.
    - The tissue that lines the ventricles (hollow spaces) in the brain produces cerebrospinal fluid. It circulates in and around the brain and spinal cord, protecting it from injury and supplying nutrients.
9. Explain the importance of the blood–brain barrier in maintaining homeostasis within the brain.
    - The blood–brain barrier regulates the influx and efflux of biological substances required for metabolic activity and neuronal function in the brain. As a result, the BBB's functional and structural integrity is critical for maintaining brain microenvironment homeostasis.
10. List the common neurotransmitters of the brain, along with their functions.
    - Serotonin is a neurotransmitter that has an inhibitory effect. Serotonin is a neurotransmitter that helps regulate mood, sleep patterns, sexuality, anxiety, appetite, and pain. Seasonal affective disorder, anxiety, depression, fibromyalgia, and chronic pain are all disorders associated with serotonin imbalance.
    - Histamine controls bodily functions such as wakefulness, feeding behavior, and motivation. Asthma, bronchospasm, mucosal edema, and multiple sclerosis are all caused by histamine.
    - Dopamine is involved in your body's reward system, which includes sensations of pleasure, heightened arousal, and learning. Dopamine also aids in the development of focus, concentration, memory, sleep, mood, and motivation.
    - Epinephrine, also known as adrenaline and norepinephrine, is in charge of your body's "fight-or-flight response" to fear and stress.
    - Blood pressure and heart rate are increased by norepinephrine, also known as noradrenaline. It is best known for improving alertness, arousal, decision-making, attention, and focus.

11. Describe the structure of the spinal cord.
    - The spinal cord is a cylindrical structure that runs from your brainstem to your low back through the center of your spine. It's a delicate structure made up of nerve bundles and cells that transmit messages from your brain to the rest of your body. One of the most important parts of your nervous system is your spinal cord.

C. Autonomic Nervous System

1. Review the organization of the nervous system and to distinguish between the structural and functional divisions
2. Explain the Neural Control of Involuntary Effectors: Autonomic Neurons & Visceral Effectors Organ
3. Differentiate the divisions of the Autonomic Nervous System: Sympathetic & Parasympathetic

Sympathetic:

- Participating in the fight or flight response.

-The sympathetic nervous system prepares the body for any possible threat.

-Sympathetic system has shorter neuron pathways, hence a faster response time.

- Increases heartbeat, muscles tense up.

Parasympathetic:

-It aids in the maintenance of homeostasis and also allows for the rest and digest response.

- The parasympathetic nervous system aims to calm the body.

- Has comparatively longer neuron pathways, hence a slower response time

- Reduces heartbeat, muscles relaxes.

4. Compare the sympathetic and parasympathetic divisions of the ANS as to origin of preganglionic fibers, location of ganglia, and neurotransmitter substances.
5. Discuss the Functions of the Autonomic Nervous System in relation to:
    a. Adrenergic and Cholinergic Synaptic Transmission
    -Endogenous catecholamines and exogenous adrenergic drugs affect cholinergic synaptic transmission by activating various subtypes of adrenergic receptors. They can also act on motor nerve membranes and the extrasynaptic membrane of muscle fibers.
    b. Responses to Adrenergic Stimulation
    -Adrenergic receptors receive messages from epinephrine and norepinephrine that instruct your body on how to respond. These receptors are also influenced by adrenergic drugs. They have the ability to mimic epinephrine and norepinephrine and bind to receptors, causing fight or flight responses.
    c. Responses to Cholinergic Stimulation
    -Any of several drugs that inhibit, enhance, or mimic the action of the neurotransmitter acetylcholine, the primary transmitter of nerve impulses within the parasympathetic nervous system—that part of the autonomic nervous system that contracts smooth muscles, dilates blood vessels, increases bodily secretions, and slows the heart rate.
    d. Other Autonomic Neurotransmitters
    - The neurotransmitters involved in the ANS are acetylcholine, norepinephrine, and epinephrine
    e. Organs with Dual Innervation
    -Both sympathetic and parasympathetic fibers innervate the heart, glands, and smooth muscles (dual innervation). Furthermore, they are usually activated reciprocally, which means that when one division's activity increases, the activity of the other division decreases.
    f. Organs Without Dual Innervation
    -Certain effectors in your body do not have dual innervation. Only sympathetic nerves innervate sweat glands, arrector pili muscles, the adrenal medula, the liver, adipocytes, lacrymal glands, the radial muscle of the iris, the juxtaglomerular apparatus, the uterus, and the majority of vascular smooth muscles.
    g. Control of the Autonomic Nervous System by Higher Brain Centers

6. Discuss what is cranial nerves and spinal nerves
    - In contrast to spinal nerves, cranial nerves are nerves that emerge directly from the brain (including the brainstem) (which emerge from segments of the spinal cord). Cranial nerves transmit information from the brain to various parts of the body, primarily to and from the head and neck.
7. Identify the 12 pairs of cranial nerves and their functions.
8. Locate and describe the spinal nerves.
    - Spinal nerves are relatively large nerves that run parallel to the spinal cord and spine. The spine is a vertebral column that protects the spinal cord. These spinal nerves are large because they are formed by the union of sensory and motor nerve roots.
9. Explain the five components in a typical reflex arc
    - Components of the Reflex Arc. The five main components of most reflex arcs are receptors, sensory neurons, interneurons, motor neurons, and muscles. However, interneurons are not used in all reflexes. Some do not use interneurons and connect sensory neurons directly to motor neurons.
10. Distinguish further between the ANS and the somatic system
    - The somatic nervous system contains both sensory and motor pathways, whereas the autonomic nervous system contains only motor pathways. The autonomic nervous system is in charge of internal organs and glands, whereas the somatic nervous system is in charge of muscles and movement.