



# **System: CNS**

## **PP & Test bank**

- **Subject: physiology**
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(وَقُلْ رَبِّ أَدْخِلْنِي مُدْخَلَ صِدْقٍ وَأَخْرِجْنِي مُخْرَجَ صِدْقٍ وَاجْعَلْ لِي مِنْ لَدُنْكَ سُلْطَانًا نَصِيرًا)

## Lecture 1,2 (Somatic Sensation)

### Past papers

**which of the following best describes somatic sensations?**

- a) The smaller the receptive field, the greater the discriminative ability
- b) Stimuli of the same intensity always result in receptor potentials of the same magnitude in the same receptor.
- c) labeled line principle is related to the intensity of a stimulus.
- d) Lateral inhibition means when type of receptor specialized to response one type of stimulus.
- e) Any stimulus of sensory receptor will be transmitted to the CNS Ans: A

**Which of the following sensations is mainly conducted through type C nerve fibers?**

- A)pressure
- B)vibration (high)
- C)vibration (low)
- D)tickle
- E)touch

Ans: D

**While examining a patient a patellar tendon reflex, a stretch reflex, which of the following is activated in this test?**

- a) Golgi tendon organ
- b) Nociceptors
- c) Excitation of interneuron
- d) Activation for static fibers without dynamic
- e) Stimulation of alpha & gamma motor neurons

Ans: E

**True statement about thermal sensation:**

- a) The small area the better thermal sensation
- b) Thermal sensation response markedly to change in temperature than steady state.
- c) Warm signals are transmitted by A-delta fibers
- d) The number of warm receptors is more than cold
- e) Transduction of warm through TRPM8

Ans: B

**Textbooks questions:**

**Which of the following best describes the concept of specificity in sensory nerve fibers that transmit only one modality of sensation?**

- A) Frequency coding principle
- B) Concept of specific nerve energy
- C) Singularity principle
- D) Labeled line principle

Answer: D) The association of one sensory modality with one type of nerve fiber is the basis for the labeled line theory.

**A 39-year-old neurosurgeon picks up a scalpel, which activates numerous sensory receptors in her hand. An increase in which of the following best describes the basis for transduction of the sensory stimuli into nerve impulses?**

- A) Activation of G protein
- B) Decreased ion permeability
- C) Decreased transmitter release
- D) Increased ion permeability
- E) Increased transmitter release
- F) Inhibition of G protein

Answer: D) Virtually all mechanical stimuli cause an increase in ion permeability (usually to sodium) in mechanoreceptors. If the membrane potential of the mechanoreceptor reaches a critical threshold value, an action potential is initiated. The G-protein "second messenger" system is typically involved with prolonged

postsynaptic neuronal excitation or inhibition; transduction in mechanoreceptors is rapid and transient.

### **Sensory receptor potentials**

- (A) are action potentials
- (B) always bring the membrane potential of a receptor cell toward threshold
- (C) always bring the membrane potential of a receptor cell away from threshold
- (D) are graded in size, depending on stimulus intensity
- (E) are all or none

The answer is D . Receptor potentials are graded potentials that may bring the membrane potential of the receptor cell either toward (depolarizing) or away from (hyperpolarizing) threshold. Receptor potentials are not action potentials, although action potentials (which are all-or-none) may result if the membrane potential reaches threshold.

### **Muscle stretch leads to a direct increase in firing rate of which type of nerve?**

- (A)  $\alpha$ -Motoneurons
- (B)  $\gamma$ -Motoneurons
- (C) Group Ia fibers
- (D) Group Ib fibers

The answer is C. Group Ia afferent fibers innervate intrafusal fibers of the muscle spindle. When the intrafusal fibers are stretched, the group Ia fibers fire and activate the stretch reflex, which causes the muscle to return to its resting length.

## **Lecture 3 (Somatosensory pathways)**

### **Past papers**

**A 66-year-old patient experienced sudden Right-side weakness, imaging showed an ischemic stroke affecting his left somatosensory area, which of the following is most likely for him to experience:**

A-loss of touch, pain, temperature, vibration, proprioception sensations in the right side

B- Loss of touch, vibration, proprioception sensations in the right side and pain and temperature sensations in the left side

C- loss of touch, vibration, proprioception sensations in the left side and pain and temperature sensations in the right side

D-loss of touch, pain, temperature, vibration, proprioception sensations in the left side

E- bilateral loss of all sensations in the upper limbs but the lower limbs are spared

Ans: A

**The somatic sensory modalities that ARE not transmitted through the Posterior column Medial Lemniscus Pathway are**

A)Pain

B)Temperature

C)Itch

D)Tickle

E)All of the above

ANSWER: E

**characteristics of Posterior Column Pathway are:**

ANSWER: conduction velocity is faster and high degree of spatial orientation

**characteristics of Anterolateral Spinothalamic Pathways are:**

ANSWER: the ability to transmit broad spectrum of sensory modalities and transmits signals that do not require highly discrete localization of signals

**Textbooks questions:**

**Which system conveys information concerning highly localized touch sensation and body position (proprio-ceptive) sensation?**

A)Anterolateral

B)Dorsal column-medial lemniscal

C)Corticospinal

D)Spinocerebellar

B) The sensations of highly localized touch and body position are carried in the dorsal column-medial lemniscal system.

**The pathway of which system crosses in the ventral white commissure of the spinal cord within a few segments of entry and then courses to the thalamus con-tralateral to the side of the body from which the signal originated?**

A)Anterolateral system

B)Dorsal column-medial lemniscal system

C)Corticospinal system

D)Spinocerebellar system

Answer:A) Fibers in the anterolateral system cross in the anterior white commissure within a few segments of their entry before ascending on the contralateral side. Signals ascending in the dorsal column-medial lemniscal system do not cross until they reach the dorsal column nuclei in the medulla.

## Lecture 4 (Pain)

### Past papers

**A patient with recurrent substernal chest pain for the last year, dull in nature, cardiac causes excluded, which of is considered as a true explanation about the case?**

A)Visceral pain from Lung parenchyma

B)stimulation of the somatic nociceptors in the partial pleura

C)Visceral pain from the Esophagus

D)Opioids usage increases the pain.

E)Inflammatory mediators increase the threshold of pain

Ans: C

**If a sharp pointed object touches the foot of a person, the foot is immediately withdrawn from the object involuntarily. This action involves the receptors :**

a)Free nerve endings.

- B) Ruffini's end organs.
- C) hair follicle receptors.
- D) Meissner's corpuscles.
- E) Pacinian corpuscles .

ANSWER: A

## Test bank

**In advanced diabetes, the withdrawal reflex may be delayed or absent due to:**

- A. Increased pain perception.
- B. Peripheral neuropathy.
- C. Overactive endogenous analgesia system.
- D. Increased localization of pain.

Answer: B

**Which of the following is true about visceral pain?**

- A. It is well-localized and sharp.
- B. It is transmitted via A-delta fibers.
- C. It is often referred to surface areas of the body.
- D. It is felt in the parenchyma of the liver.

Answer: C

**Referred pain occurs because:**

- A. Pain signals from the viscera and skin synapse on the same second-order neurons.
- B. Pain signals from the viscera are transmitted faster than those from the skin.
- C. Pain signals from the skin are blocked by visceral pain signals.
- D. Pain signals from the viscera are localized more precisely than those from the skin.

Answer: A

**The endogenous analgesia system is activated by:**

- A. Stress.
- B. Exercise.
- C. Both A and B.

Answer: C

**Which of the following methods can suppress pain signals?**

- A. Acupuncture.
- B. Lateral inhibition.
- C. Pharmacological methods.
- D. All of the above.

Answer: D

### Textbooks questions:

**Interneurons that utilize the neurotransmitter enkephalin to inhibit afferent pain signals are most likely to be found in which region of the central nervous system?**

- A) Dorsal horn of spinal cord
- B) Postcentral gyrus
- C) Precentral gyrus
- D) d-type A
- E) Type C fiber
- F) Ventral horn of spinal cord

Answer: A) Interneurons in the dorsal horn of the spinal cord use enkephalin as a transmitter substance that effectively inhibits pain transmission from tissues of the body. The somatosensory cortex is located in the post-central gyrus, and the primary motor cortex is located in the precentral gyrus; neither are thought to use enkephalin to inhibit pain transmission. Myelinated - type A fibers and unmyelinated type C fibers are not interneurons. Interneurons are physically short neurons that form a connection between other neurons that are usually close together. They are distinguished from "projection" neurons that project to more distant regions of the brain or spinal cord.

**Neurons located in which area release serotonin as their neurotransmitter?**

- A) Periaqueductal gray area
- B) Interneurons of the spinal cord



- C) Periventricular area
- D) Nucleus raphe magnus

Answer: D) Neurons of the nucleus raphe magnus release serotonin at their nerve endings. In the endogenous pain suppression system, the termination of these neurons is in the spinal cord on interneurons that in turn release enkephalin and block the incoming signals from the pain fibers.

## Lecture 5,6,7 (Vision)

### Past papers

#### **True regarding vision:**

- A) Ciliary muscles are relaxed, suspensory ligaments are tensed.
- B) More aqueous humor is produced than absorbed.
- C) Contraction of radial muscle cause pupil constriction
- D) Fovea has the best accuracy because the high density of rods & cons.
- E) Lens contributes more than any part at refractive power.

Ans: A

**70 years old suffers from a visual impairment where he can't see the central area, which of the following is most likely to be the cause for his impairment.**

- A) Cataract
- B) Impaired accommodation due to aging
- C) Elongated eyeball leading to light convergence before the retina.
- D) Degenerative changes in the macula

Ans: D

#### **Which of the following is true concerning vision:**

- A) Cones are the only receptors found in the fovea centralis and are wider than those found elsewhere
- B) Opsin is the light-sensitive chemical found in the photoreceptor
- C) 11- cis retinal cannot be reformed
- D) The vitreous humor is continually being formed and reabsorbed
- E) Light causes a hyperpolarizing receptor potential

ANSWER: E

### Textbooks questions:

**When compared with the cones of the retina, the rods**

- (A) are more sensitive to low-intensity light
- (B) adapt to darkness before the cones
- (C) are most highly concentrated on the fovea
- (D) are primarily involved in color vision

The answer is A. Of the two types of photoreceptors, the rods are more sensitive to low-intensity light and therefore are more important than the cones for night vision. They adapt to darkness after the cones. Rods are not present in the fovea. The cones are primarily involved in color vision.

**Cutting which structure on the left side causes total blindness in the left eye?**

- (A) Optic nerve
- (B) Optic chiasm
- (C) Optic tract
- (D) Geniculocalcarine tract

The answer is A. Cutting the optic nerve from the left eye causes blindness in the left eye because the fibers have not yet crossed at the optic chiasm.

**Cutting which structure on the right side causes blindness in the temporal field of the left eye and the nasal field of the right eye?**

- (A) Optic nerve
- (B) Optic chiasm
- (C) Optic tract
- (D) Geniculocalcarine tract

The answer is C . Fibers from the left temporal field and the right nasal field ascend together in the right optic tract.

**Which of the following is a step in photoreception in the rods?**

- (A) Light converts all-trans retinal to 11-cis retinal
- (B) Metarhodopsin II activates transducin
- (C) Cyclic guanosine monophosphate (cGMP) levels increase

- (D) Rods depolarize
- (E) Glutamate release increases

The answer is B. Photoreception involves the following steps. Light converts 11-cis retinal to all-trans retinal, which is converted to such intermediates as metarhodopsin II. Metarhodopsin II activates a stimulatory G protein (transducin), which activates a phosphodiesterase. Phosphodiesterase breaks down cyclic guanosine monophosphate (cGMP), so intracellular cGMP levels decrease, causing closure of Na<sup>+</sup> channels in the photoreceptor cell membrane and hyperpolarization. Hyperpolarization of the photoreceptor cell membrane inhibits release of the neurotransmitter, glutamate. If the decreased release of glutamate interacts with ionotropic receptors on bipolar cells, there will be inhibition (decreased excitation). If the decreased release of glutamate interacts with metabotropic receptors on bipolar cells, there will be excitation (decreased inhibition).

**Cutting which structure causes blindness in the temporal fields of the left and right eyes?**

- (A) Optic nerve
- (B) Optic chiasm
- (C) Optic tract
- (D) Geniculocalcarine tract

The answer is B . Optic nerve fibers from both temporal receptor fields cross at the optic chiasm.

A 6-year-old boy with albinism is taken to the ophthalmologist because of difficulty seeing.

Testing shows

that his visual acuity is reduced. Which of the following is the most likely cause of the decrease in visual acuity in this boy?

- A)Cataracts
- B)Hyperopia
- C)Myopia
- D)Photophobia
- E)Presbyopia

Answer:D) Photophobia is discomfort or pain to the eyes due to light exposure; it is a medical condition, not a fear or pho-bia. The lack of melanin (black pigment)

in the irises of the eyes makes them somewhat translucent, so they cannot block light effectively. The lack of melanin in the pigment layer of the retina causes light to scatter inside the globe of the eye, which decreases contrast and visual acuity.

**A 10-year-old boy looks at ants through a magnifying glass. He finds that the ants must be 10 centimeters from the convex lens to be in focus. Which value best describes the refractive power of the lens (in diopters)?**

- A) 0.1
- B) 1.0
- C) 10
- D) 100
- E) 1000

Answer:C) The refractive power of a lens (in diopters) = 1 meter/  
focal length; if the subject matter is in focus when a convex lens is 1 meter from the subject matter, the lens

has a refractive power of 1 meter/1 meter = 1 diopter.

Thus, there is an inverse relationship between focal length and refractive power; a thicker convex lens has a shorter focal length and a greater refractive power. In this problem, the lens must be 10 centimeters from the subject matter to be in focus (focal length = 100 millimeters); therefore, 1000 millimeters/100 millimeter = 10 diopters. Because the retina of the eye is about 17 millimeters behind the lens, the refractive power of the lens of the eye is about 59 diopters.

**During photoreception, all the following increase except**

- A)cGMP phosphodiesterase
- B)Transducin
- C)cAMP
- D)Metarhodopsin II
- E)Sodium influx into the outer segment of the rod

Answer:E) During photoreception, the active compound metarhodopsin is formed, which in turn activates a G protein called transducin. The transducin activates a cGMP phosphodiesterase that destroys cGMP. cGMP-dependent sodium channels close, and the influx of sodium ions into the outer segment of the photoreceptors decreases.

**Which of the following provides about two thirds of the 59 diopters of refractive power of the eye?**

- A) Anterior surface of the cornea
- B) Anterior surface of the lens
- C) Iris
- D) Posterior surface of the cornea
- E) Posterior surface of the lens

Answer:A) The principal reason why the anterior surface of the cornea provides most of the refractive power of the eye is that the refractive index of the cornea is markedly different from that of air.

## Lecture 8 (Gustation)

### Past papers

**True regarding gustation:**

- a) Bitter taste has highest threshold.
- b) Taste buds exist in other places than tongue, as pharynx
- c) Sensitivity of taste increases with aging
- d) Loss of taste during 8lu is due to destruction in taste buds on tongue.
- e) Injury to the facial nerve causes complete loss of taste.

Ans: B

**The reason why bitter taste induces rejection, and it has the lowest threshold among taste sensations, is that the body tries to protect itself from potential poisonous substances.**

- A)True
- B)False

ANSWER: A

### Textbooks questions:

**Which substance is responsible for the umami taste sensation?**

- A)Acetic acid

- B)Potassium tartrate
- C)Long-chained organic substances containing nitrogen
- D)Fructose
- E)Glutamate

Answer:E

**Which substance will elicit the sensation of bitter taste?**

- A)Aldehydes
- B)Alkaloids
- C)Amino acids
- D)Hydrogen ions
- E)Ketones

Answer: B) The taste sensation of bitter is caused by many organic substances that contain nitrogen, as well as by alkaloids.

**Which substance will elicit the sensation of sour taste?**

- A)Aldehydes
- B)Alkaloids
- C)Amino acids
- D)Hydrogen ions
- E)Ketones

Answer:D) The taste sensation of sour is proportional to the logarithm of the hydrogen ion concentration caused by acids. The taste sensation of sweet is caused by a long list of chemicals, including sugars, alcohols, aldehydes, ketones, and amino acids.

**Which type of papillae is in the posterior part of the tongue?**

- A) Circumvallate
- B) Foliate
- C) Fungiform
- D) Fungiform and circumvallate
- E) Papilla of Vater

Answer: A, Circumvallate papillae are located in the posterior part of the tongue, fungiform papillae in the anterior part of the tongue, and foliate papillae on the lateral part of the tongue. The papilla of Vater empties

pancreatic secretions and bile into the duodenum.

**The first central synapse for neurons transmitting the sweet taste sensation is in which structure?**

- A) Dorsal sensory nucleus of vagus nerve
- B) Nucleus of solitary tract
- C) Nucleus of olfactory nerve
- D) Nucleus of hypoglossal nerve
- E) Nucleus of facial nerve

Answer: B, The termination of taste fibers for all taste sensations is in the nucleus of the solitary tract in the medulla.

**A lesion of the chorda tympani nerve would most likely result in**

- (A) impaired olfactory function
- (B) impaired vestibular function
- (C) impaired auditory function
- (D) impaired taste function
- (E) nerve deafness

The answer is D. The chorda tympani (cranial nerve [CN] VII) is involved in taste; it innervates the anterior two-thirds of the tongue.

## Lecture 9 (Olfaction)

### Past papers

**True regarding olfaction?**

- a) Lesion in thalamus leads to complete loss of smell.
- b) Olfactory receptor cells are special cells communicate with 1<sup>st</sup> order neuron.
- c) Processing of salivation in response to smell mainly in medial olfactory area
- d) Any volatile substance activates olfactory receptors.

e) Olfactory receptor cannot regenerate.

Ans: C

**True about olfaction:**

- A) Medial pathway concerned with memory
- B) Lateral pathway bypass thalamus to the paleocortex
- C) Glomeruli are collection of mitral cells axons
- D) Olfactory receptors synapse with 1st order neurons

ANSWER: B

**Which tract is concerned with regulating the autonomic function in response to smell?**

- A) lateral olfactory tract
- B) medial olfactory tract

ANSWER: B

**Textbooks questions:**

**Olfactory receptor cells belong to which group of cells?**

- A) Bipolar neurons
- B) Fibroblasts
- C) Modified epithelial cells
- D) Multipolar neurons
- E) Pseudounipolar neurons

Answer: A, The receptor cells for the smell sensation are bipolar nerve cells derived originally from the central nervous system itself.

**After olfactory receptor cells bind odor molecules, a sequence of intracellular events occurs that culminates in the entrance of specific ions that depolarize the olfactory receptor cell. Which ions are most likely to be involved?**

- A) Calcium
- B) Chloride
- C) Hydrogen
- D) Potassium
- E) Sodium



Answer: E, Even the minutest concentration of a specific odorant initiates a cascading effect that opens extremely large numbers of sodium channels. This phenomenon accounts for the exquisite sensitivity of the olfactory neurons to even the slightest amount of odorant.

**. Which of the following statements about the olfactory system is true?**

- (A) The receptor cells are neurons
- (B) The receptor cells are sloughed off and are not replaced
- (C) Axons of cranial nerve (CN) I are A-delta fibers
- (D) Axons from receptor cells synapse in the prepiriform cortex
- (E) Fractures of the cribriform plate can cause inability to detect ammonia

The answer is A. Cranial nerve (CN) I innervates the olfactory epithelium. Its axons are C fibers. Fracture of the cribriform plate can tear the delicate olfactory nerves and thereby eliminate the sense of smell (anosmia); however, the ability to detect ammonia is left intact. Olfactory receptor cells are unique in that they are true neurons that are continuously replaced from undifferentiated stem cells.

## Lecture 10 (Hearing)

### Past papers

**A patient that has history of occupational noise exposure & difficulty in hearing, appeared that he has sensory neural hearing loss, audio gram test applied to the patient showed a significant loss of hearing at high frequency levels of sound, this due to?**

- a) Inflammation in middle ear
- b) Impairment of tympanic membrane
- c) Problem in the base of basilar membrane
- d) Destruction in auditory association area
- e) Attenuation reflex causes this type of sensory loss.

Ans: C

**Regarding Vestibular system, the true statement?**

- a) Hair cells within cupula detect linear motion.
- b) when head rotate cilia rotate to opposite direction
- c) Utricle and saccule detect rotational movement.
- d) Otolithics is fluid filled areas.
- e) Destruction of vestibular apparatus causes loss of balance mainly when eyes are opened.

Ans: B

**Textbooks questions:**

**Which of the following statements best describes the basilar membrane of the organ of Corti?**

- (A) The apex responds better to low frequencies than the base does
- (B) The base is wider than the apex
- (C) The base is more compliant than the apex
- (D) High frequencies produce maximal displacement of the basilar membrane near the helicotrema
- (E) The apex is relatively stiff compared to the base

The answer is A. Sound frequencies can be encoded by the organ of Corti because of differences in properties along the basilar membrane. The base of the basilar membrane is narrow and stiff, and hair cells on it are activated by high frequencies. The apex of the basilar membrane is wide and compliant, and hair cells on it are activated by low frequencies.

**Which brain stem structure plays a major role in determining the direction from which a sound originates?**

- A) Cochlear nucleus
- B) Inferior colliculus
- C) Lateral lemniscus
- D) Superior olivary nucleus
- E) Trapezoid

D) The superior olivary nuclei (see figure on the right) receive auditory information from both ears and begin the process of detecting the direction from which a sound comes. The lateral part of the superior

olivary nucleus does so by comparing the difference in intensities of sound reaching the two ears, whereas the medial part of the superior olivary nucleus detects time lag between signals entering both ears.

**The primary auditory cortex lies primarily in which lobe of the cerebral cortex?**

- A) Frontal
- B) Limbic
- C) Occipital
- D) Parietal
- E) Temporal

E) Most of the primary auditory cortex is in the temporal lobe, but the association auditory cortices extend over much of the insular lobe and even onto the lateral portion of the parietal lobe.

**Which event prompts the auditory system to interpret a sound as loud?**

- A) A decreased number of inner hair cells become stimulated
- B) A decreased number of outer hair cells become stimulated
- C) Hair cells excite nerve endings at a diminished rate
- D) The amplitude of vibration of the basilar membrane decreases
- E) The amplitude of vibration of the basilar membrane increases

E) The auditory system determines loudness in at least three ways. First, the amplitude of vibration of the basilar membrane increases so that hair cells excite nerve endings at more rapid rates. Second, more and more hair cells on the fringes of the resonating portion of the basilar membrane become stimulated. Third, outer hair cells become recruited at a significant rate.

تَمَّ يَغْدُو كُلِّ فِي سَبِيلِهِ...  
وَيَبْقَى مَا كَانَ لِلَّهِ

