

**Benha University**  
**Faculty of Medicine**  
**Physiology Department**  
**Second year second semester exam.**  
**May 2013**

**Time allowed 1.5 hours.                      Number of papers 9 papers**

**Central Nervous System .....( 37.5 marks)**

**Question No 1 .....( 17.5 marks)**

**A-.....( 3.5 marks )**

Mechanoreceptors are stimulated by mechanical forms of energy so they detect mechanical deformation of either the receptors or tissues surrounding them . The following table show different types of mechanoreceptors , fill there sites and function

Receptor	Site	Function	Degree
1-Touch receptor	<b>Present in the skin and subcutaneous tissues.</b>	<b>Detect touch pressure of the skin</b>	( 0.5 mark )
2-Paroreceptor	<b>present in the carotid sinus and aortic arch</b>	<b>they detect changes in arterial blood pressure</b>	( 0.5 mark )
3-Proprioreceptor	<b>present in the muscles , tendons, ligaments</b>	<b>they detect movements, and position of the joints e.g muscle spindle and golgi tendon organ</b>	( 0.5 mark )
4-Auditory receptors	<b>Present in the inner ear</b>	<b>They detect sound waves</b>	( 0.5 mark )
5-Vestibular receptors	<b>in the inner ear ( Macula and crista ampularis )</b>	<b>They detect changes in the equilibrium</b>	( 0.5 mark )
6-Pressor receptors	<b>In the skin and deeper</b>	<b>Detect pressure changes in the skin</b>	( 0.5 mark )

	structures e.g pacinian corpuscles		
7-Stretch receptors	In the wall of alveoli , urinary bladder and right atrium	They detect the degree of stretch of these structures	

**B-.....( 2.5 marks)**

Explain the relationship of the amplitude of the receptor potential to nerve impulse rate.

- ❖ A) The receptor potential is conducted passively with a decrease in its amplitude to the first node of Ranvier producing depolarization which when reaches the firing level it produces a propagated action potential along the nerve fiber.
  
- ❖ B)The action potential occurring at the first node of Ranvier does not affect the generator potential which persist as long as the effective stimulus is applied and so the node of Ranvire is depolarized again after its repolorization so a train of action potentials are conducted along the afferent nerve fiber.
  
- ❖ C) The frequency of action potentials conducted along the afferent nerve fiber is directly proportional to Logarithm the intensity of the stimulus applied to the receptor and this is called (Weber-Fechner Law) i.e when the intensity of the stimulus increases 100 folds the frequency of impulses along the afferent nerve fiber increases only 2 folds.

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**C-.....( 1.5 marks)**

Termination of synaptic transmission occurs when neurotransmitter is removed from the synaptic cleft by.

- 1) Re-uptake of the neurotransmitter into the presynaptic terminal by  1   
.an active transport mechanism
- .2) By enzymatic degradation inside the cleft
- 3) By diffusion of the transmitter out of the synaptic cleft into the   
.surrounding interstitial fluid

**D-.....( 2.5 marks)**

Define the following.

1- Sense of tension

**It is the sense of degree of muscle contraction (muscle tension)**

2-Kinesthetic sensation

**It is the conscious perception of the orientation of the different parts of the body with respect to each other as well as the rates of movement of the different parts of the body.**

3-Clonus

**Oscillated tendon jerk occurring when the tendon of the muscle is suddenly stretched and the stretching force is maintained**

4-Muscle tone

**It is a mild maintained contraction of the skeletal muscle during rest.**

5-Flexor withdrawal reflex.

**Application of an injurious stimulus to a limb Leads to reflex contraction of flexor muscles i.e withdrawal of the limb away from the injurious stimulus**

**E-.....( 7.5 marks )**

1-Characters of deep pain are .....( 1 mark )

**1-It is a dull aching pain which is not localized.**

**2-It is accompanied by autonomic changes in the form of bradycardia, drop of arterial blood pressure, nausea and vomiting.**

**3-Frequently it initiates reflex contraction of the nearby skeletal muscles.**

2-Causes of deep pain are .....( 1 mark )

**1-Trauma of the deep structures as that occurs in athletes during competitions.**

**2-Bone injury (e.g due to fracture or inflammation) which stimulate the pain receptors in the periosteum.**

**3-Muscle ischemia due to decreased blood supply to the skeletal muscle.**

3-Example of referred pain is gall bladder pain ( Explain ) .....( 1 mark )

**Irritation of the diaphragm by the inflamed gall bladder, the diaphragm is supplied by the right phrenic nerve that transmit pain impulses and enter the spinal cord along with nerve roots of third, fourth, and fifth cervical segments which transmit pain impulses from the right shoulder .so pain from gall bladder is transmitted through the phrenic nerve and irritate 3, 4, 5 posterior roots that radiate pain to the above areas.**

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4-Explain gate theory of pain .....( 1 mark )

**The cells of the SG of rolandi in layer II of the cord gray matter act as a gate through which pain impulses reach the lateral spinothalamic tract.**

**The gate may be closed by.**

❖ **1-Impulses along collaterals from the large myelinated A beta fibers.**

❖ **2-Impulses descending in the dorsolateral funiculus**

❖ **3-Impulses along A delta fibers.**

5-Enumerate causes of intracranial headach .....( 1 mark )

1-Headache of meningitis.

2-Headache from meningeal trauma.

3-Headache from brain tumor.

4-Headache caused by low C.S.F pressure.

5-Headache caused by arterial hypertension.

6-Migraine headache.

7-Alcoholic headache.

8-Constipation headache.

6-.....( 1 mark )

As regard muscle spindle ,it is capsulated structure present in **the fleshy part** Of the muscle ,and formed of 8 – 10 intrafusal muscle fibers which are

**a-Less developed.**

**b-smaller than ordinary skeletal muscle fibers.**

**c-central part in non contractile**

**d-the peripheral part is contractile**

7-Removal of calcium from the knobs occurs by .....( 1.5 marks)

**.A-binding by proteins in the cytosol**

**.B-pumping into the cavity of calcium storage cisterns**

**C-extrusion into the extracellular space by  $Ca^{++}/ Na +$  exchange**

**.transmitter located in the knob membrane**

**Question NO 2 .....( 10 marks )**

**A-.....( 2 marks )**

1-.....( 1 mark )

Polysynaptic reflexes include polysynaptic somatic reflexes which are either Superficial as

**A-Withdrawal reflex**

**B-Crossed extensor reflex.**

**C-Planter reflex.**

**D-Abdominal reflex.**

and deep reflexes

**Inverse stretch reflex**

2-.....( 1 mark )

While examples of polysynaptic autonomic reflexes include.

**A-Micturation**

**B-defection**

**C-Erection.**

**B-As regard Renshaw cells .....( 1 mark )**

- They are inhibitory neurons located in **the anterior horn.**

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And its function **It allows the phenomenon of lateral inhibition to the place in order to focus or sharpen the stimulated area.**

**C – Describe dynamic stretch reflex .....( 2 marks )**

**A-When the muscle is suddenly stretched, the primary endings increases its rate of discharge**

**B-The impulses enter the spinal cord along the posterior root and enter directly to anterior motor neurons stimulating them leading to muscle contraction.**

**C-Muscle contraction leads to relieve of muscle stretch and decreased rate of impulse discharge from the muscle spindle leading to muscle relaxation.**

**This means that dynamic stretch reflex means rapid contraction followed by rapid relaxation, and this is the bases of deep reflexes or tendon jerks.**

**D-.....( 5 marks )**

a- Brocus area .....( 1 mark )

**Site area 44 and 45 anterior to motor area and immediately above the lateral sulcus.**

**Function It is the motor center for spoken speech, so its damage prevents vocalization i.e causes aphasia.**

b-Eye movement area .....( 1 mark )

**Site Immediately above Broca,s area and it is connected to the visual centers in the occipital lobe.**

**Function It controls the movements of the eye and eye lids > its damage prevents voluntary movements of the eye toward different objects.**

c-Effect of lesions in area 6 are.....( 1 mark )

**1-Muscle parases (weakness) in the opposite side.**

**2-Increased muscle tone and muscle spasticity.**

**3-Exaggerated tendon jerks.**

**4-Autonomic disturbances.**

**5-Motor aphasia.**

**6-Motor apraxia.**

**7-Agraphia due to damage of the writing center.**

d-Function of the pyramidal tract .....( 1 mark )

**1-Control mainly fine skilled movements done by the distal parts of the body**

**2-Facilitatory to the stretch reflex.**

e-Function of extrapyramidal tract .....( 1 mark )

**1-Control mainly gross postural movements done by proximal parts of the body.**

2-Some are facilitatory; others are inhibitory to the stretch reflex.

**Question No 3 .....( 10 marks )**

A-.....( 3 marks )

1- As regard mode of action of semicircular canals , explain this mode of action at the start of rotation .....( 1.5 marks)

**The endolymph does not move as fast as the S.C.Cs due to its inertia (=resistance to movement) thus it lags behind the moving canal and move in the opposite direction i.e from right to left, this results in bending of the cupula of the Rt S.C.Cs to ward the utricle and that of the left S.C.Cs away from it, Thus the right crista is stimulated while the left is inhibited leading to increased discharge of impulses from the right crista and decreased discharge from the left.**

**This unbalanced discharge from both cristae gives the person a sensation of rotation to the right in the horizontal plane.**

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2- While as regard the mode of action of semicircular canals at stopping of rotation .....( 1.5 marks )

**The endolymph by its momentum ( =force keeping it moving ) continue to flow in the same direction i.e Left to right ----- leads to bending of left cupula toward the utricle i.e stimulation and that of right cupula away from the utricle leading to inhibition. So the rate of impulse discharge from left cupula is increased, and that from the right is decreased, giving a sensation of rotation to the left. This sensation is a false sensation since the head is not actually rotating. This false sensation of rotation is Vertigo.**

B-.....( 1 mark )

Chorea is due to lesion in **caudate nucleus**.. And characterized by

i-**Involuntary rapid purposeless dancing movements.**

ii-**Hypotonia**

C-.....( 1 mark )

Athetosis is due to lesion in **a lesion in lentiform nucleus**.and characterized by

1 -**Involuntary spasmodic slow twisting movements affecting mainly the upper limbs..**

2- **High degree of hypertonia**

D-.....( 2.5 marks )

In the following table compare between static and kinetic tremors.

	static tremors	Kinetic tremors	Mark
1	Occur in parkinsonism	In neocerebellar syndrome	(0.5 mark)
2	Associated with muscle rigidity ( hypertonia )	Associated with hypotonia.	(0.5 mark)
3	Occur during rest	Occur during voluntary movements	(0.5 mark)
4	Disappear during voluntary movement	Disappear during rest	(0.5 mark)
5	Disappear during sleep and increased by emotions	Disappear during sleep and increased by emotions	(0.5 mark)

F-.....( 2.5 marks )

Define the following

1-Memory

**It is the ability of the person to recall past events.**

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2-Speech

**It is the ability to express the form of words in response to visual and auditory stimuli.**

**Words may be spoken or written.**

3-Aphasia

**Inability to express in the form of words in absence of vision or hearing defect or disorders of muscles of speech.**

4-Learning

**It is a change in the inborn response to a given stimulus based on past experience.**

5-Nystagmus

**Oscillatory eye movements consisting of slow and fast components to fix the objects in the visual field.**

**II- Special Senses.....( 17.5 marks)**

**Question No 4.....(17.5 marks)**

**A-.....( 2.5 marks)**

**Define**

1- Light wavelength

**It is the distance from any point on a wave to the corresponding point in the adjacent wave**

2-Presbyopia

**Decreased elasticity of the lens resulting in defective accommodation to the near vision**

3-Aphakia

**Absence of the eye lense which may be congenital or due to surgical removal of the lense**

4-Pupillary light reflex

**Exposure of one eye to light results in reflex pupillary constriction in that eye )direct light reflex) and in the other eye (indirect light reflex)**

5-Cataract

**Common type of abnormality occur mainly in old age due to denaturation of lens proteins leading to opacity of the lense**

**B- .....( 5 marks)**

**a-.....( 1 mark )**

Causes of corneal transparency are.

1- **the parallel arrangement of corneal epithelium and corneal fibers**

2-**absense of keratin layer on the surface epithelium**

3-**corneal cells and fibers has the same refractive index**

4-**absense of blood vessels and mylenated nerve fibers**

5-**relative dehydration state of corneal tissues**

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**b- Functions of the cornea are .....( 1 mark )**

1-**protective function**

2-**transparent: allowing light entry to the eye**

3-**convergence of light rays**

**c-Causes of cataract are.....( 1 mark )**

1-**congenital**

2-**senility**

3-**DM**

4-**prolonged exposure to UVRs**

**d-Functions of tears are.....( 1 mark )**

1-moistening of the cornea

2-antiseptic function

3-nutrition of the outer layers of the cornea via diffusion of O<sub>2</sub> and nutrients

**e-Causes of conductive deafness are.....( 1 mark )**

1-plugging of the external auditory canal by wax or a foreign body

2-perforation or thickening of the ear drum

3- Destruction or calcification of the middle ear ossicles

4- Abnormal rigidity of the attachment of stapes to the oval window

**C-.....( 5 marks )**

**a-The following table compares between rods and cones .**

**Fill the following table .....( 3.5 marks)**

	Rods	Cones	Mark
1-Number	<b>125 millions in each eye</b>	<b>5.5 millions in each eye</b>	(0.5 mark)
2-Retinal distribution	<b>Concentrated in the peripheral part, less in middle area and absent in fovea centralis</b>	<b>Concentrated in the central parts (especially fovea),less in the surrounding area and absent in peripheral parts</b>	(0.5 mark)
3-Connection	<b>High convergence, 300:1 ratio in peripheral parts</b>	<b>Low convergence, 1:1 ratio in fovea</b>	(0.5 mark)
4-Photopigment	<b>rhodopsin</b>	<b>3 color photopigments</b>	(0.5 mark)
5-Visual sensitivity	<b>High</b>	<b>low</b>	(0.5 mark)
6-Visual accuracy	<b>low</b>	<b>High</b>	(0.5 mark)
7-Function	<b>Dim light (night) vision Black and white vision</b>	<b>Bright light Color vision</b>	(0.5 mark)

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**B-.....( 1.5 marks)**

On going from light environment into darker one there is gradual increase in retinal sensitivity allowing dimmer light to be seen , this occurs by increasing the synthesis of photo pigments in rods and cones called cone adaptation and rod adaptation

Explain

1-Cone adaptation

**This occurs rapidly (within 5-10 minutes) as the synthesis of cone photopigments takes short times**

**Cone adaptation results in a limited increase in retinal sensitivity**

2-Rod adaptation

**Synthesis of rodopsin takes longer time, so rod adaptation is complete within 30 minutes**

**Rod adaptation results in marked increase in retinal sensitivity**

3-Light adaptation

**This is a much faster process that occurs when going from a dark environment into a lighter one**

**Light adaptation results from bleaching of photopigments**

**D-.....( 5 marks)**

1-Explain the mechanism of stimulation of hair cells in the inner ear (3 marks)

- **Up and down motion of the hair cells causes their hairs to shear back forth against the tectorial membrane**
- **bending of the hairs towards the kinocillium depolarizes the hair cell , and bending them in the opposite direction hyperpolarizes it**
- **Movement of stereocilia towards the kinocilia causes opening of mechanosensitive K channels. This allows rapid movement of K into the hair cells causing its depolarization**
- **Depolarization of the hair cells opens voltage gated Ca channels at the base of the hair cells leading to Ca influx, which results in release of the chemical transmitter which stimulates the cochlear nerves at their bases.**

2-Explain the mechanism of stimulation of taste receptors .....( 2 marks)

**There are four mechanisms by which chemicals cause increased transmitters release from taste receptors:**

- 1- **Direct passage of ions through ion channels**
- 2- **blockage of ionic channels**
- 3- **Opening of ionic channels**
- 4- **activation of second messenger system through ligand interaction with membrane receptors**

**III-Metabolism .....( 7.5 marks)**

**A-Define.....( 2.5 marks)**

1-Calorie

**It is the unit used for expressing the quantity of energy released from the different food or by the functional processes of the body**

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2-Respiratory quotient

**It is the ratio between the volume of CO<sub>2</sub> produced and the volume of O<sub>2</sub> consumed during the same time of metabolism**

3-Basal Metabolic rate

**It is the energy production in unit time (one hour) under basal condition**

4-Specific dynamic action of food

**It is the power of the food to increase the MR**

5-Energy balance

**The total amount of energy input in the body over a period of time must be equal to the energy output from the body over the same time interval**

**B-.....( 5 marks)**

a-Factors increasing respiratory quotient are .....( 1 mark )

- 1- **early phase of severe muscle exercise due to lactic acid**
- 2- **hyperventilation**

**3-metabolic acidosis due to hyperventilation**

**4- fever**

**5- conversion of carbohydrate to fat**

b-Pathological factors that increase basal metabolic rate are .....( 1 mark )

**1- Hyperthyroidism**

**2- Hyperpituitarism**

**3- hyperadrenalism**

**4- Fevers**

**5- polycythemia, heart failure, DI**

C-Blood changes during starvation include .....( 1 mark )

**1- Blood volume , RBCs count and HV all are decreased**

**2- Plasma protein is decreased leading to oedema**

**3- Blood glucose and blood amino acid levels are constant**

**4- ketonemia**

**5- decreased alkali reserve**

**6- PH is constant as long as resp and renal buffers are efficient**

d-what is heat stroke ? .....( 1 mark )

**This is condition occurs during exposure to hot humid environment**

**leads to loss of all mechanisms of heat loss so body temp starts to rise**

**leading to breakdown of function of heat regulatory center which further**

**increase in body temp causing more breakdown of function of the**

**center and a vicious circle develops**

5- What is the treatment of heat stroke? .....( 1 mark )

**1- Rapid cooling of the body by cold immersion or ice water or alcohol**

**2- antipyretic drugs e.g ASPIRIN**

**3- I.v fluids and sodium chloride**