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ENGLISH MEDIUM

UNIT 05

Animal Form and Function

Peripheral Nervus System

SAMPATH LANKADHEERA
B.Sc. (Hons), M.Sc.

MCQ Aid Answers

(1) 2	(2) 4	(3) 3	(4) 5	(5) 3	(6) 2	(7) 4	(8) 3	(9) 3	(10) 3
(11) 2	(12) 5	(13) 4	(14) 5	(15) 2	(16) 3	(17) 3	(18) 3	(19) 4	(20) 3
(21) 2	(22) 3	(23) 3	(24) 4	(25) 3	(26) 3	(27) 3	(28) 4	(29) 3	(30) 4
(31) 3	(32) 3	(33) 2	(34) 5	(35) 3	(36) 4	(37) 2	(38) 3	(39) 3	(40) 4

18. This pump uses ATP to actively transport these ions.
19. An action potential occurs due to a change in membrane potential above a threshold value due to a stimulus.
20. The action potential has the following phases: depolarization, repolarization and hyperpolarization.
21. Depolarization: A change in the cell 's membrane potential such that the inside of the membrane is made less negative relative to the outside.
22. Depolarization results due to Na + inflow in response to a stimulus.
23. Repolarization: Sodium channels close blocking Na+ inflow.
24. However most Potassium channels open permitting K+ outflow.
25. This makes the inside of the cell negative.
26. Hyperpolarization: Sodium channels are closed but potassium channels are opened.
27. As a result the inside of the membrane is more negative.
28. Refractory period is the short time immediately after an action potential in which the neuron cannot respond to another stimulus, owing to the inactivation of sodium channels.
29. This prevents the reverse conduction of an impulse in an axon.
30. A series of action potentials that move along an axon is defined as a nerve impulse.
31. An action potential is generated due to Na+ inflow (depolarization) at one location in the axon
32. This axon potential spreads to the neighboring location while the initial location repolarizes.
33. This depolarization-repolarization process is repeated through the axon.

(Any 30x5 =150)

Model/Answer

3. What are neurotransmitters. State main different types of neurotransmitters present in human body.

(a) Neurotransmitters

1. Neurotransmitters are the molecules
2. that are released from the synaptic terminals of presynaptic neuron
3. and diff use across the synaptic cleft,
4. bind to the receptors at the postsynaptic membrane, triggering a response. Common neurotransmitters are;
5. Acetylcholine
6. Some amino acids
7. Biogenic amines
8. Neuropeptides
9. Some gases

(b) Explain the mechanism of transmission of impulses through chemical synapse.

10. An action potential at an axon terminal depolarizes the plasma membrane of presynaptic cell.
11. Depolarization at the presynaptic terminal causes Ca^{2+} to diffuse into the terminals.
12. The rise in Ca^{2+} causes binding of synaptic vesicles containing neurotransmitters to the presynaptic membrane.
13. This results in the release of the neurotransmitters into the synaptic cleft.
14. Neurotransmitters diffuse across the synaptic cleft.
15. Neurotransmitters bind and activates specific receptors in the postsynaptic cell membrane.
16. If acetylcholine is taken for example, the binding of neurotransmitters to the post synaptic membrane allows Na^{+} and K^{+} to diff use across the post synaptic membrane.
17. Depolarization takes place in the post synaptic membrane and it reaches the action potential.
18. After passing the nerve impulse to the postsynaptic cell, the signal is terminated either by:
19. Enzymatic hydrolysis of neurotransmitters.
20. Recapture of neurotransmitter into the presynaptic terminals.

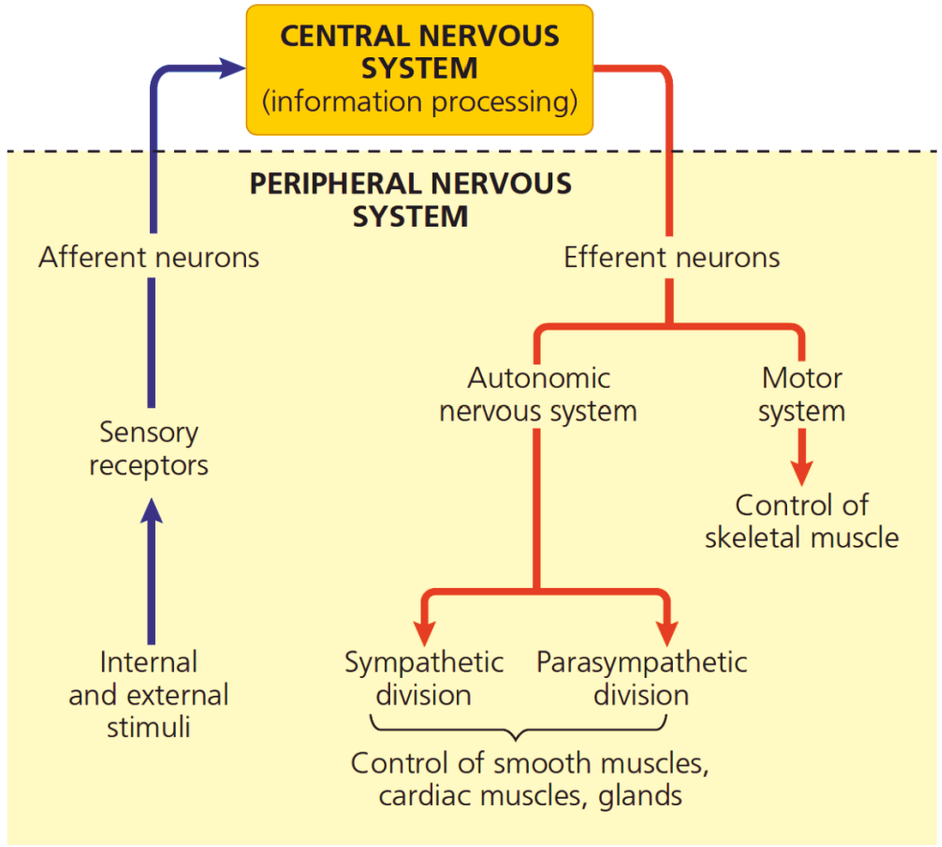
(c) What is reflex arc. Briefly describe the arrangement of components of a reflex arc.

21. Reflex arcs are the functional unit of
22. the vertebrate nervous system.
23. Typically a reflex arc consists of three neurons. They are
24. Afferent/Sensory neuron
25. Interneuron
26. Efferent/Motor neuron
27. A sensory neuron transmits impulses from a sensory receptor to the central nervous system where
28. it synapses with an associated neuron called interneuron.
29. This impulse is transmitted to a motor neuron.
30. The motor neuron conveys the signal to effector tissues/organs.

(Any 30x5 =150)

Peripheral nervous system (PNS)

Peripheral nervous system is made up of …… ……..., ……... nerves and autonomic nervous system (with ganglia). It transmits impulses to and from CNS regulating both an animal's movement and its internal environment.



Sensory information from sensory receptors reaches the CNS along PNS neurons referred to as …….... (sensory neurons). Within the CNS this information is processed and instructions are transmitted to effector tissues/organs (……., ……... and ……. cells) along PNS neurons referred to as ……... (motor neurons).

PNS consists of two efferent components;

- The motor system - ……

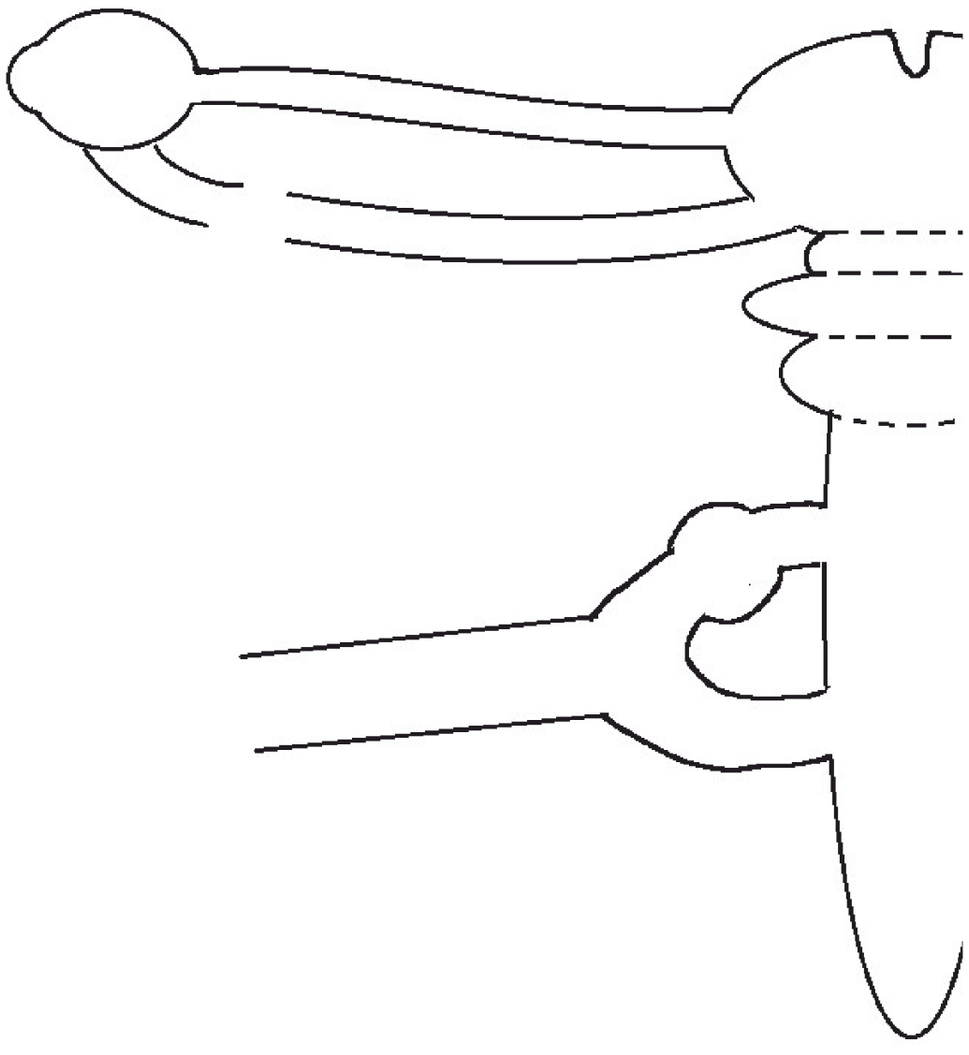
  ……

- Autonomic nervous system - ……

  ……

  ……

  ……



AL 2012 old/Answer

(a) What is autonomic nervous system?

1. Part of the peripheral nervous system
2. controlling involuntary activities of the body.

(b) Describe the organization of the autonomic nervous system of man.

3. Consist of ganglions,
4. preganglionic neurons/fibers and
5. post ganglionic neurons/fibers.
6. Preganglionic neurons/fibers originate from central nervous system/leaves central nervous system.
7. Post ganglionic neurons/fibers innovate effectors, which are
8. Smooth muscles,
9. heart muscles and
10. glands.
11. Consist of sympathetic nervous system and
12. and parasympathetic nervous system.
13. In sympathetic nervous system preganglionic fibers/neurons originate in the thoracic lumber region of the central nervous system.
14. In parasympathetic system preganglionic fibers / neurons originate in the cranial and
15. sacral region of central nervous system.
16. In the sympathetic nervous system preganglionic neurons/fibers are short,
17. post ganglionic neurons are long.
18. And ganglion form a chain
19. parallel to the spinal cord.
20. In the parasympathetic nervous system preganglionic/fiber are long,
21. post ganglionic fibers/neurons are short and
22. Ganglions are located close to effectors.

- Diagram

(c) Giving suitable examples explain how the autonomic nervous system regulates the functioning of the human body.

23. The effects is produced by the sympathetic system usually oppose those produced by the parasympathetic system.
24. heart rate of heart beat slowed down by parasympathetic nervous system and increased by sympathetic system.
25. Strength of heart beat is decreased by parasympathetic system and it is increased by sympathetic system.
26. Parasympathetic system dilates arteries and sympathetic constricts arterioles.
27. Regulating blood pressure
28. And controlling blood flow
29. Parasympathetic system constricts bronchioles/ decreases ventilation rate and sympathetic system dilates bronchioles/increasing ventilation rate.
30. Regulating the entry of air/amount of air entered in to the respiratory tract/lungs.
31. Parasympathetic system constricts pupils and sympathetic system dilates pupil,
32. Regulating the entry of light into eye/retina.
33. Parasympathetic system speeds up gut movements/peristalsis and sympathetic system slows down movements/peristalsis.
34. Parasympathetic system stimulate secretion of alimentary juices and sympathetic system inhibits its secretion of alimentary juices.
35. Regulating digestion and
36. Absorption of digestive end products
37. Parasympathetic system relaxes urinary bladder sphincter and sympathetic system contract/close urinary bladder sphincter,
38. Regulating urination.
39. parasympathetic nervous system relaxes anal sphincter and sympathetic system contracts/ closes anal sphincter
40. Regulating defecation. (Marks any 38 x 4 =152)

Model / Answer

1. **Explain how nerve impulses are generated and transmitted**
2. In neurons, ions are distributed unequally between the cell interior and exterior.
3. Generally the inside of the cell is negatively charged whereas the exterior is positively charged.
4. These opposite charges are attracted across the plasma membrane
5. and as a result it creates a voltage difference across the membrane that is referred to as membrane potential.
6. When a neuron is at rest, the membrane potential is called the resting potential.
7. In a non-conducting neuron the resting potential is typically between -60 mV and -80 mV.
8. The resting membrane potential is maintained by;
9. Distribution of ion concentrations inside and outside of the neuron.
10. In a non conducting neuron the concentration of K+ is higher inside the cell while concentration of Na+ is higher outside.
11. In addition there are Cl- and other large anions (proteins) inside the cell.
12. As a result a neuron has a negative charge inside the cell and positive charge outside the cell.
13. There are potassium channels and sodium channels, which are membrane bound proteins that are able to open or close in response to stimuli.
14. Potassium channels allows only K+ ions to pass whereas sodium channels allow only Na+ to pass.
15. These channels allow K+ and Na+ to diffuse according to their concentration gradient.
16. However there are more potassium channels open than sodium channels. As a result there is a net negative charge inside the cell.
17. Sodium-potassium pump- helps to maintain Na+ and K+ gradient across the membrane by transporting three Na+ out of the cell for every two K+ that it transports in.

(vii) What is the role of myelin in the conduction of nerve impulses?

.....

.....

Essay AID

AL 2012 old

1. (a) What is autonomic nervous system?
   (b) Describe the organization of the autonomic nervous system of man
   (c) Giving suitable examples explain how the autonomic nervous system regulates the functioning of the human body.

Model

2. Explain how nerve impulses are generated and transmitted.

Model

3. (a) What are neurotransmitters. State main different types of neurotransmitters present in human body.
   (b) Explain the mechanism of transmission of impulses through chemical synapse.
   (c) What is reflex arc. Briefly describe the arrangement of components of a reflex arc.

Structured Essay AID Answers

1. A. (i) Cranial nerves, spinal nerves, autonomic nervous system with ganglia (ii) (a) Sensory information from environment (b) Central nervous system (iii) (a) Motor commands to muscles and glands (b) Somatic and autonomic nervous systems (iv) Controls involuntary functions through sympathetic and parasympathetic divisions
B. (i) (a) Accelerates heart rate (b) Slows heart rate (ii) Sympathetic inhibits, parasympathetic stimulates digestion (iii) Sympathetic dilates, parasympathetic constricts pupils (iv) Sympathetic: norepinephrine; Parasympathetic: acetylcholine
C. (i) Sensory neuron, interneuron, motor neuron (ii) (a) Sensory receptor (b) Effector organ (iii) Processes and relays information between sensory and motor neurons (iv) Provides rapid, automatic response to harmful stimuli

2. A. (i) -60 to -80 mV (ii) (a) High K+, large anions (b) High Na+, Cl- (iii) Exchanges 3 Na+ out for 2 K+ in using ATP (iv) Ion concentration gradients and selective membrane permeability
B. (i) (a) Na+ ions (b) Stimulus above threshold (ii) K+ outflow restores negative charge (iii) Membrane becomes more negative than resting potential (iv) Period when neuron cannot generate new action potential
C. (i) Synaptic vesicles, synaptic cleft, pre/postsynaptic membranes (ii) (a) Through voltage-gated channels (b) Vesicle fusion with membrane (iii) Acetylcholine, amino acids, biogenic amines, neuropeptides (iv) Enzymatic breakdown and reuptake

3. A. (i) Dopamine (ii) (a) Tremor, rigidity, bradykinesia (b) Speech problems, poor balance (iii) Substantia nigra, basal ganglia (iv) Medication, physical therapy, sometimes surgery
B. (i) Memory loss, confusion, behavioral changes (ii) (a) Minor memory problems, confusion (b) Complete dependence, loss of basic functions (iii) Cerebral cortex, hippocampus (iv) Age, genetics, environmental factors
C. (i) Mood changes, sleep disturbance, loss of interest, fatigue (ii) (a) Dopamine dysfunction (b) Hallucinations, delusions, disorganized thinking (iii) Medications, therapy, combination approaches (iv) Both have significant genetic components but require environmental triggers

2019 Old Paper: (i) (a) Acetylcholine is the neurotransmitter released from motor neurons in humans./(b) Diameter of the axon, Presence of myelinated axon

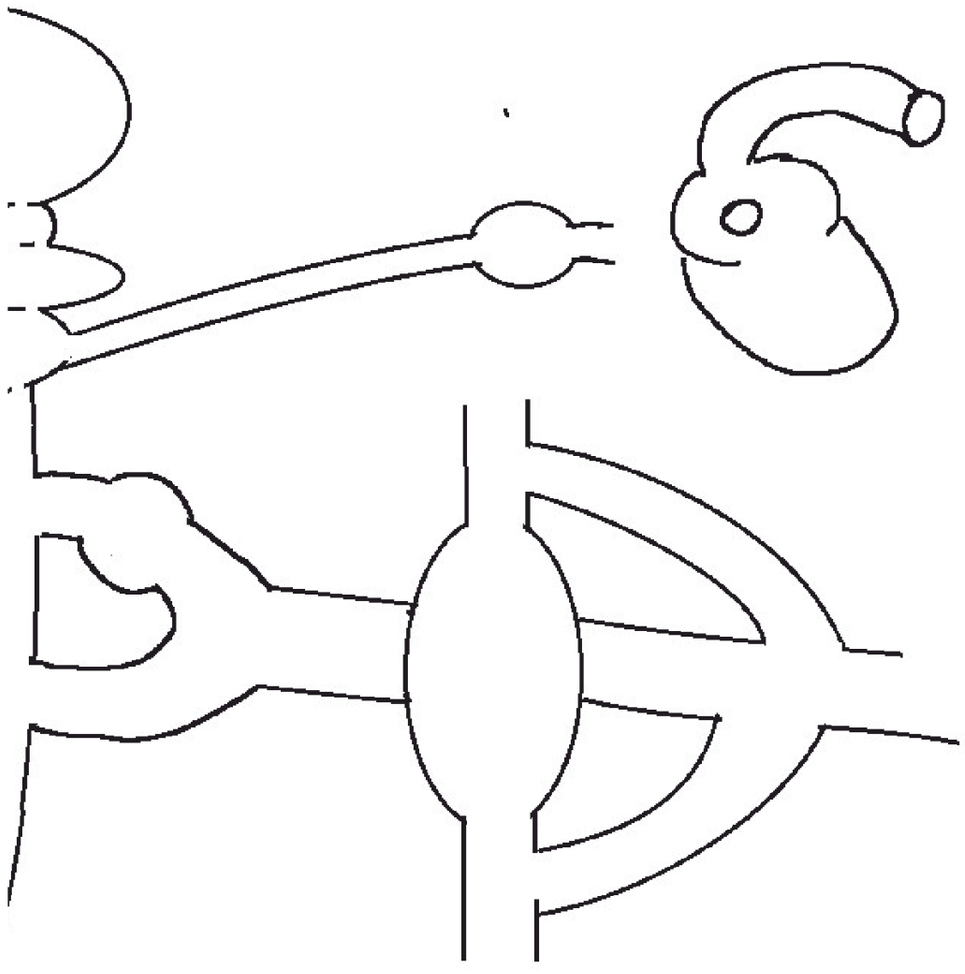
Past Paper Answers:(i) Neurotransmitters are molecules that are released from synaptic terminals of presynaptic neurons and diffuse across the synaptic cleft, bind to receptors at the postsynaptic membrane, triggering a response. (ii) (a) Acetylcholine (b) Some amino acids (iii) Hormones travel through blood and neurotransmitters released by nerve endings. (iv) An action potential occurs due to a change in membrane potential above a certain value (threshold value) due to a stimulus. It has phases of depolarization, repolarization and hyperpolarization. (v) Na+ (sodium) ion. (vi) A nerve impulse is a series of action potentials that move along an axon. (vii) Increase the speed of impulse transmission.
2022 AL: (a) Carries nerve impulses to skeletal muscles/effector organs
(b) Distribution of ion concentrations inside and outside of the neuron /Selective permeability of the plasma membrane/ Sodium-potassium pump.
2021 AL: (a)

Sympathetic division	Parasympathetic division
• Nerve exit only from spinal cord	• Nerve exit only from brain and spinal cord
• Prepare body for exciting/stress, energy generating situations/fight or flight	• Promote calmimg/return to normal condition
• Main neuro transmitter norepinephrine/noradrenalin	• Main neuro transmitter acetylcholine
• Preganglion fiber short	• Preganglion fiber long

(b) Alzheimer's disease
2020 New: (i) The refractory period prevents reverse conduction of an impulse in an axon. (ii) Parkinson's disease

Autonomic nervous system consists mainly of two divisions:

1. ……..
2. ……..



Sympathetic and parasympathetic nervous system

The majority of the body organs are supplied by both sympathetic and parasympathetic nerves which have …… (opposite) functions. Sympathetic stimulations prepare the body to deal with exciting/ stressful situations and energy generating situations (fight or flight). Parasympathetic division causes opposite responses that promote ……. or a return to …… functions (rest and stimulate digestion and food absorption).

		CNS	
Motor system			
Autonomic system	Parasympathetic		
	Sympathetic		

Structured Essay

2022 AL

1.(a) State functions of motor neurons in peripheral nervous system of man

……
……

(b) State factors that are important in maintaining resting membrane potential of man

……
……

2021 AL

(a) State two differences between sympathetic and parasympathetic divisions of the autonomic nervous system.

Sympathetic division	**Parasympathetic division**
……	……
……	……
……	……
……	……
……	……
……	……

(b) Name the disease that causes severe mental deterioration characterized by confusion and memory loss in man.

2020 New

(i) What is importance of refractory period of a neuron.

……
……

(ii) Name the progressive motor disorder of the nervous system that leads to lack of coordination and control of muscle movements in elderly people.

……
……

2019 Old

(i) (a) Name the neurotransmitter released from motor neurons in humans.

……
……

(b) State two factors that increase the speed of propagation of nerve impulses along a neuron.

……
……

Past Paper

1. (i) What are neurotransmitters?

……
……

(ii) Name **two** neurotransmitters.
(a) ……
(b) ……

(iii) Why is a neurotransmitter not considered is a hormone

……
……

(iv) What is a nerve action potential?

……
……

(v) What ion is responsible for the de polarization phase of the action potential?

……
……

(vi) Define a nerve impulse.

……
……

(ii) Explain the role of calcium in neurotransmitter release
(a)How does calcium enter?
……...
(b) What does it trigger?
……...
(iii) Name four types of neurotransmitters
……...
(iv) How is the synaptic signal terminated?
……

3. A. (i) What neurotransmitter is affected in Parkinson's disease?
……...
(ii) List four main symptoms of Parkinson's disease
(a) Motor symptoms
……...
(b) Non-motor symptoms
……...
(iii) Which brain areas are affected?
……...
(iv) What treatment options exist?
……

B. (i) What are the primary symptoms of Alzheimer's disease ?
……
……

(ii) Explain the progression (a) Early stages (b) Late stages
……
……

(iii) Which brain areas are primarily affected?
……

(iv) What factors contribute to its development?
……

C. (i) List major symptoms of depression
……
……

(ii) Describe the basis of schizophrenia
(a)Neurotransmitter involvement
……

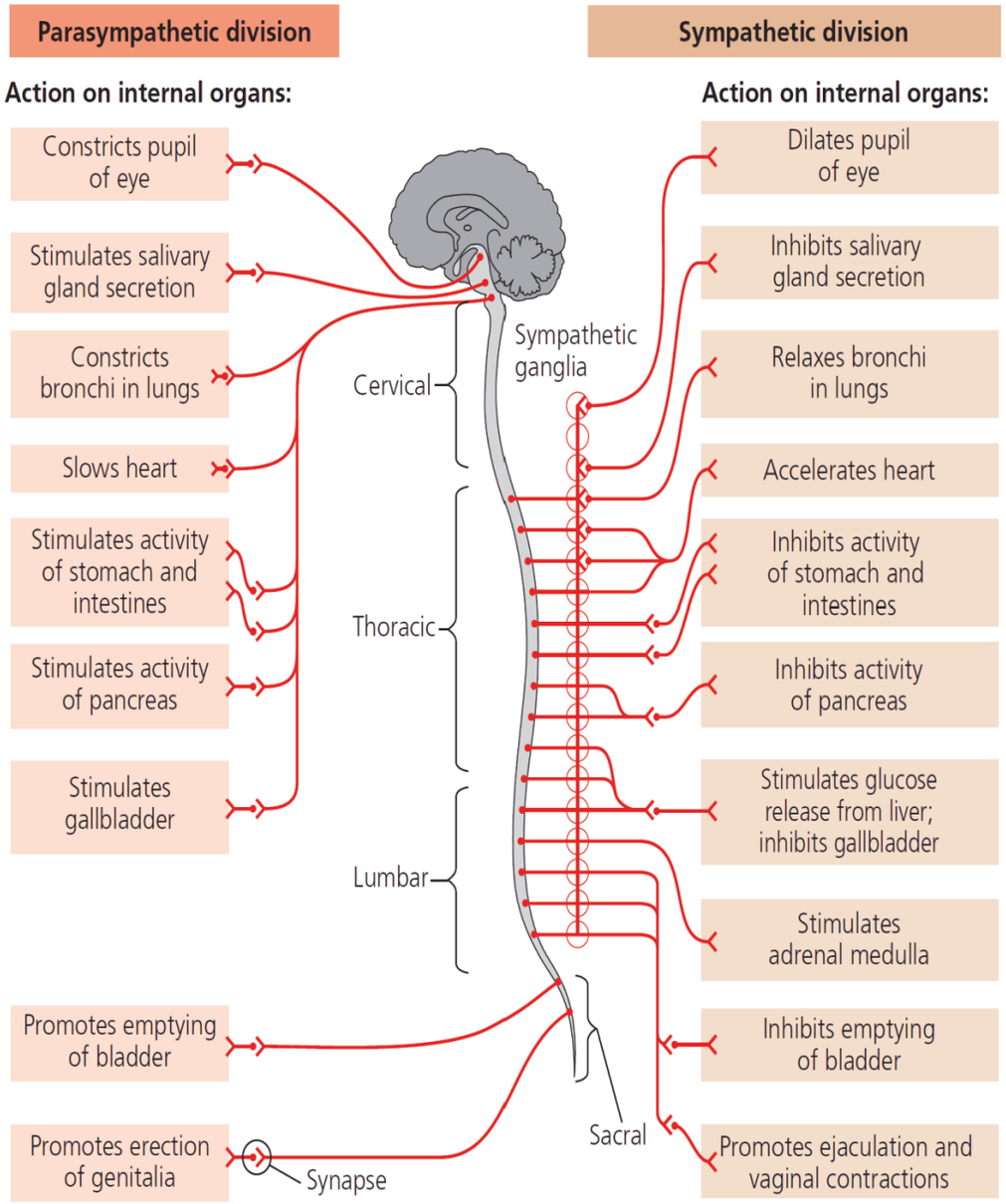
(b) Main symptoms
……
……

(iii) Compare treatment approaches
……

(iv) What role do genetics play in both conditions?
……
……
……

- The two divisions differ in overall ……..., …….. and the signal released. Parasympathetic nerves exit the CNS at the base of the brain or the spinal cord as cranial nerves or spinal nerves respectively
- On the other hand sympathetic nerves exit only from the spinal cord.
- Different neurotransmitters enable the two systems to bring about two opposite effects in different organs such as lung, heart, intestine and bladder.

	Effector organ



(b) Parasympathetic effect
.....

(ii) Describe their effects on the digestive system
.....

(iii) Explain their influence on the pupil of the eye
.....

(iv) What neurotransmitters are involved in each division?
.....

C. (i) Name the three neurons involved in a typical reflex arc
.....

(ii) Explain the pathway of a reflex action
(a)Starting point
.....
(b) Ending point
.....

(iii) What is the role of the interneuron?
.....
(iv) Why are reflexes important for survival?
.....

2. A. (i) What is the typical value of resting potential?
.....

(ii) Describe ion distribution across the membrane
(a)Inside the cell
.....
(b) Outside the cell
.....

(iii) Explain the role of the sodium-potassium pump
.....

(iv) What maintains the resting potential?
.....

B. (i) Define depolarization
(a)What ions are involved?
.....
.....
(b) What triggers it?
.....
.....
(ii) Explain repolarization
.....
.....
(iii) What is hyperpolarization?
.....
.....
(iv) Describe the refractory period
.....
.....

C. (i) List the components of a chemical synapse
.....

32. The autonomic nervous system affects:
(1) Only skeletal muscles (2) Only smooth muscles
(3) Glands, cardiac muscle and smooth muscles (4) Only cardiac muscles (5) Only glands

33. A sensory receptor:
(1) Generates hormones (2) Converts stimulus energy to membrane potential changes
(3) Only responds to chemical stimuli (4) Only responds to mechanical stimuli
(5) Produces neurotransmitters

34. Efferent neurons are:
(1) Voluntary (2) Sensory neurons (3) Involuntary (4) Interneurons (5) Motor neurons

35. After reaching the postsynaptic cell, the nerve impulse:
(1) Always continues at the same speed (2) Always increases in strength
(3) Always decreases in strength (4) Can be modified by the postsynaptic cell
(5) Stops completely

36. The central nervous system:
(1) Consists of all nerves (2) Only processes sensory information
(3) Only controls motor functions (4) Processes information and controls responses
(5) Only controls automatic functions

37. For a sensory stimulus to generate a response it must:
(1) Be continuous (2) Be above threshold level (3) Be chemical in nature
(4) Last for a specific time (5) Be physical in nature

38. The sodium-potassium pump:
(1) Is passive transport (2) Requires no energy (3) Uses ATP for active transport
(4) Only works during action potentials (5) Only moves sodium ions

39. Parasympathetic nerves exit from:
(1) Only spinal cord (2) Only brain (3) Base of brain or spinal cord
(4) Only through cranial nerves (5) Only through spinal nerves

40. Sympathetic nerves exit from:
(1) Only brain (2) Only cranial nerves (3) Base of brain or spinal cord (4) Only spinal cord
(5) No specific location

Structured Essay AID

1. A. (i) What are the main components of the PNS?
……...
(ii) (a) What type of information do afferent neurons carry?
……...

(b) Where do they terminate?
……

(iii) What type of information do efferent neurons carry?
……...

(b) Name the two major divisions they form
……

(iv) How does the autonomic nervous system regulate internal organs?
……...

B. (i) Compare sympathetic and parasympathetic effects on the heart
(a) Sympathetic effect
……...

- For example, When the neurotransmitter secreted by the parasympathetic division is acetylcholine, the sympathetic division secretes norepinephrine.

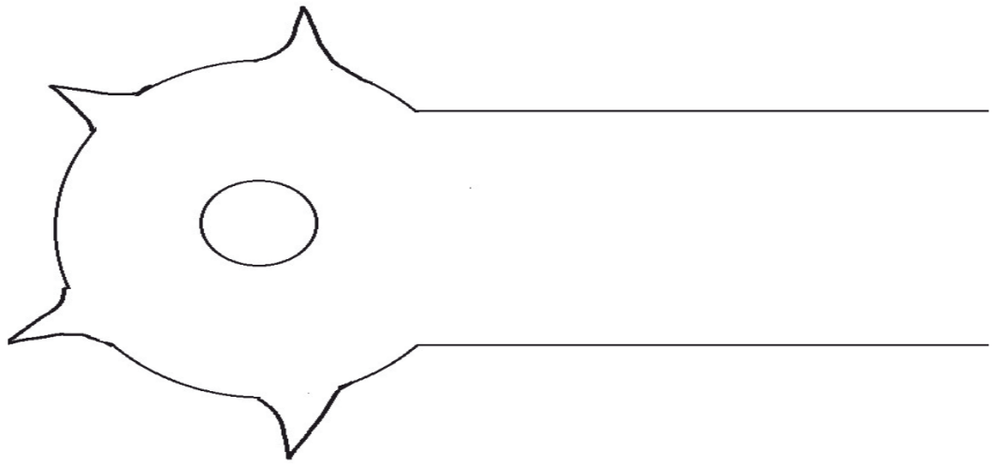
How nerve impulses are generated and transmitted

- In all cells including neurons, ……... are distributed ……. between the cell ……... and ……... (extra cellular fluid).
- Generally the inside of the cell is …… charged whereas the exterior is …….. charged.
- These opposite charges are attracted across the plasma membrane and as a result it creates a voltage difference across the membrane that is referred to as membrane potential.

Resting potential

When a neuron is at …….. (when not sending a signal/non conducting), the membrane potential (voltage difference across the membrane) is called the resting potentials In a non-conducting neuron the resting potential is typically between ……... mV and …… mV. The resting membrane potential is maintained by;

- Distribution of ion concentrations inside and outside of the neuron. In a non conducting neuron the concentration of K+ is higher inside the cell while concentration of Na+ is higher outside. There are large anions (proteins) inside the cell in addition to some Cl- ions. As a result a neuron has a negative charge inside the cell and positive charge outside the cell.
- Selective permeability of the plasma membrane to K+ and Na+ ions. There are leaky potassium channels and sodium channels, which are membrane bound proteins. Potassium channels allows only K+ ions to pass whereas sodium channels allow only Na+ to pass. These channels are leaky and allow K+ and Na+ to diffuse according to their concentration gradient. However there are more leaky potassium channels open than sodium channels. These Potassium channels allow net outflow of Potassium due to chemical concentration gradient. However Sodium ions and other ions can not readily cross the membrane. As a result there is a net negative charge inside the cell.
- Sodium -potassium pump - This pump helps to maintain Na+ and K+ gradient across the membrane by transporting three Na+ out of the cell for every two K+ that it transports in. This pump uses ATP to actively transport these ions.



17. High speed conduction in mammals is due to:
(1) Giant axons (2) Body temperature (3) Myelin sheath (4) Low resting potential
(5) Na-K pump efficiency

18. The outer surface of an inactive neuron is:
(1) Negatively charged (2) Neutral (3) Positively charged (4) Without any charge
(5) Same as inner surface

19. The parasympathetic nervous system:
(1) Dilates pupil (2) Decreases salivation (3) Accelerates heart rate (4) Constricts pupil
(5) Relaxes bronchi

20. During repolarization:
(1) Na+ channels open (2) Na+ flows in (3) K+ flows out (4) K+ flows in (5) No ion movement

21. In chemical synapses, neurotransmitters are stored in:
(1) Synaptic cleft (2) Synaptic vesicles (3) Cell membrane (4) Ion channels
(5) Receptor proteins

22. The refractory period:
(1) Increases conduction speed (2) Allows bidirectional conduction
(3) Prevents reverse conduction (4) Increases neurotransmitter release
(5) Maintains resting potential

23. The speed of nerve impulse conduction depends on:
(1) Only axon diameter (2) Only myelin sheath (3) Both axon diameter and myelination
(4) Only number of synapses (5) Only neurotransmitter type

24. The resting membrane potential is maintained by:
(1) Equal ion distribution (2) Only Na+ movement (3) Only K+ movement
(4) Unequal ion distribution and Na-K pump (5) Only protein movement

25. Sensory receptors:
(1) Only detect external stimuli (2) Only detect internal stimuli
(3) Detect both internal and external stimuli (4) Only respond to chemical stimuli
(5) Only respond to physical stimuli

26. Types of sensory receptors include:
(1) Chemoreceptors only (2) Thermoreceptors only
(3) Chemoreceptors, thermoreceptors, photoreceptors, mechanoreceptors and pain receptors
(4) Photoreceptors only (5) Pain receptors only

27. The sequence of events in an action potential is:
(1) A, D, B, C (2) B, C, A, D (3) B, D, A, C (4) C, A, D, B (5) D, B, C, A
Where A: K+ channels open and K+ outflow, B: Na+ channels open and Na+ inflow, C: Membrane becomes repolarized, D: Membrane becomes depolarized

28. The peripheral nervous system consists of:
(1) Only cranial nerves (2) Only spinal nerves (3) Only autonomic system
(4) Cranial nerves, spinal nerves and autonomic nervous system (5) Only brain and spinal cord

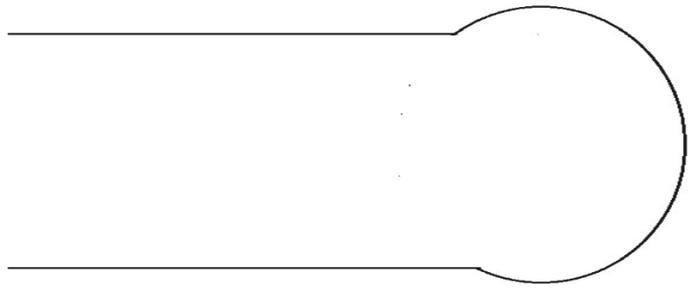
29. Parasympathetic effects include:
(1) Inhibits salivation (2) Dilates pupil (3) Stimulates pancreas activity (4) Inhibits digestion
(5) Inhibits bladder emptying

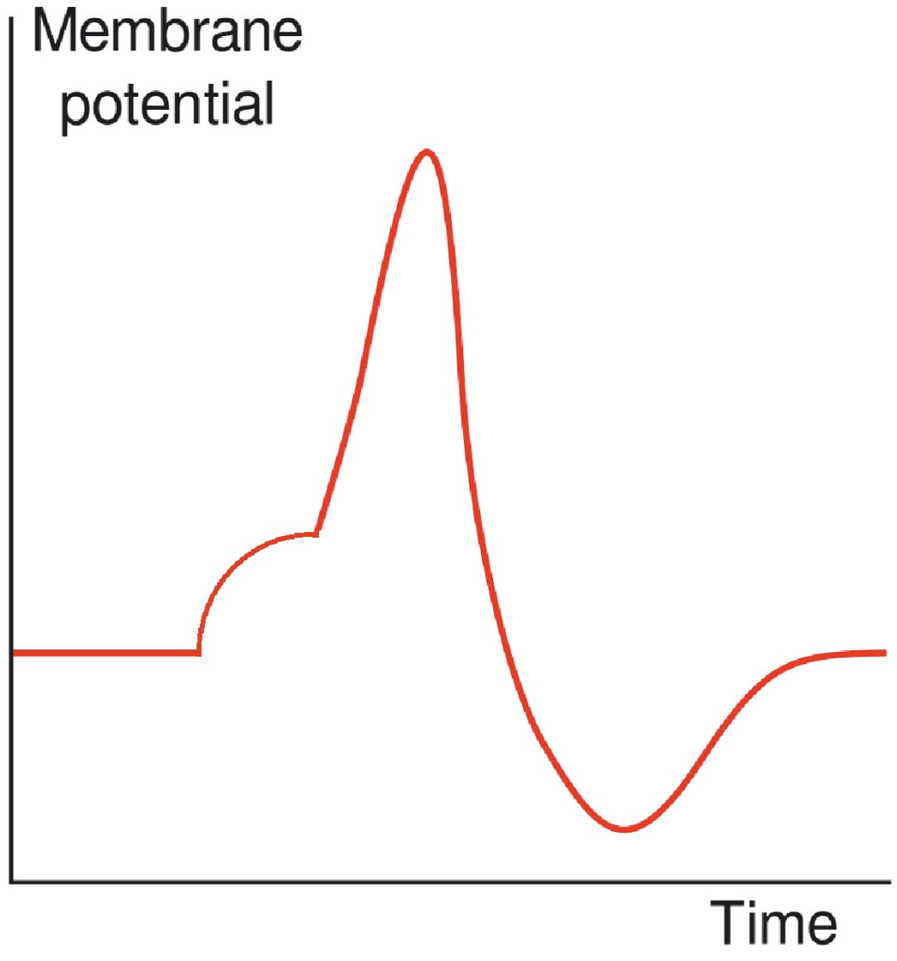
30. The sympathetic division:
(1) Stimulates salivation (2) Constricts pupil (3) Slows heart rate (4) Inhibits activity of stomach and intestines (5) Promotes digestion

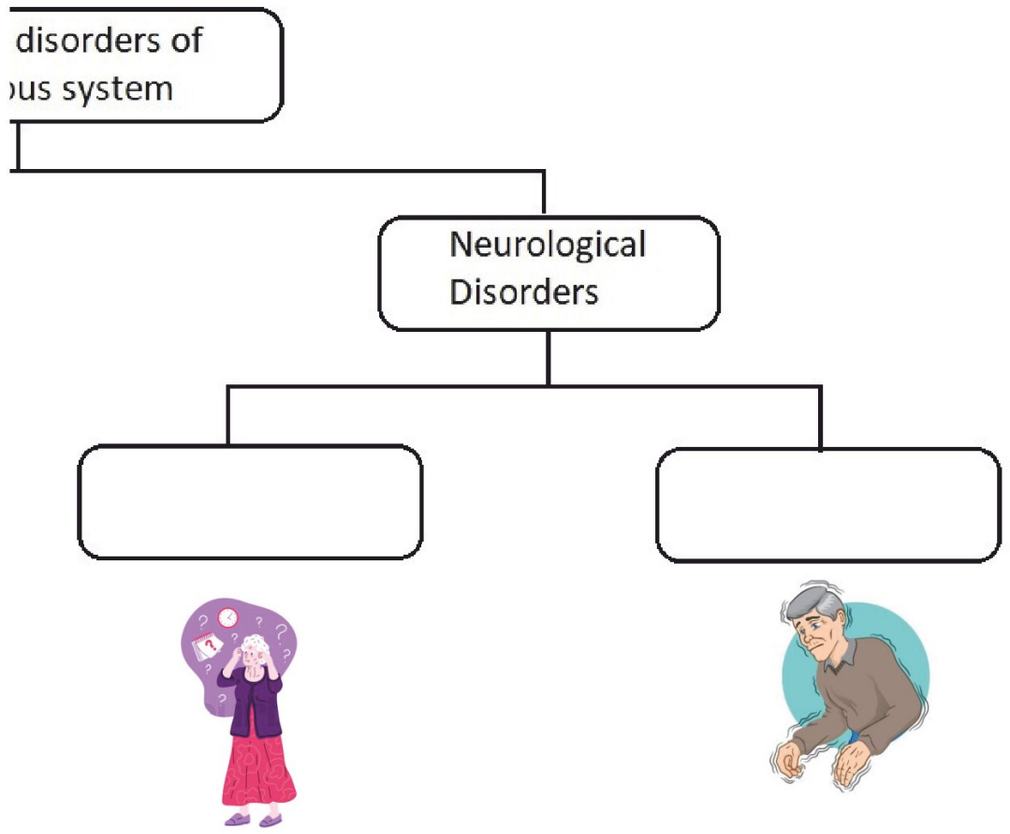
31. During hyperpolarization:
(1) Na+ channels open (2) K+ channels close (3) The inside becomes more negative
(4) Na+ flows in (5) No ion movement occurs

MCQ AID

1. The spinal cord structure consists of:
   (1) White matter in the center surrounded by grey matter
   (2) Grey matter in the center surrounded by white matter
   (3) Equal distribution of grey and white matter (4) Only white matter (5) Only grey matter
2. Functions of the spinal cord include:
   (1) Only motor control (2) Only sensory processing (3) Only reflex coordination
   (4) Links CNS to sensory/motor neurons and coordinates reflexes (5) Only autonomic control
3. The resting membrane potential in a non-conducting neuron is:
   (1) 0 mV (2) +60 to +80 mV (3) -60 to -80 mV (4) -40 to -50 mV (5) +40 to +50 mV
4. Which is a direct effect of parasympathetic stimulation?
   (1) Dilates pupil of eye (2) Inhibits salivation (3) Increases heart rate
   (4) Constricts bronchi in lungs (5) Promotes emptying of bladder
5. During an action potential, depolarization occurs due to:
   (1) K+ outflow (2) Na+ outflow (3) Na+ inflow (4) Cl- inflow (5) K+ inflow
6. The sodium-potassium pump:
   (1) Moves 2 Na+ out for 3 K+ in (2) Moves 3 Na+ out for 2 K+ in
   (3) Moves equal amounts of Na+ and K+ (4) Only moves Na+ out (5) Only moves K+ in
7. The sympathetic nervous system causes:
   (1) Constriction of pupil (2) Decreased heart rate (3) Increased salivation (4) Dilation of pupil
   (5) Increased digestion
8. A synapse is where:
   (1) Axons connect to other axons only (2) Dendrites connect to other dendrites
   (3) A neuron communicates with another cell across a narrow gap
   (4) Neurons fuse together (5) Action potentials are generated
9. Neurotransmitters include:
   (1) Glucose only (2) Proteins only (3) Acetylcholine and amino acids (4) Only biogenic amines
   (5) Only gases
10. The autonomic nervous system consists of:
    (1) Only sympathetic division (2) Only parasympathetic division
    (3) Sympathetic and parasympathetic divisions (4) Only somatic nerves (5) Only motor nerves
11. In sensory receptors, adaptation means:
    (1) Increased sensitivity with continuous stimulation
    (2) Decreased responsiveness with continuous stimulation
    (3) Complete loss of function (4) Increased threshold permanently (5) Changed type of sensation
12. Node of Ranvier is found between:
    (1) Interneurons (2) Axons (3) Dendrites (4) Dendrons (5) Myelin sheaths
13. The reflex arc consists of:
    (1) Only sensory neuron (2) Only motor neuron (3) Sensory and motor neurons
    (4) Three neurons: sensory, inter and motor (5) Only interneuron
14. Sympathetic stimulation results in:
    (1) Decreased heart rate (2) Constricted pupil (3) Increased salivation (4) Relaxed bronchi
    (5) Accelerated heart rate
15. The main function of calcium in synaptic transmission is:
    (1) Maintaining resting potential (2) Causing neurotransmitter release
    (3) Breaking down neurotransmitters (4) Generating action potential (5) Closing ion channels
16. Neurotransmitter signal at synapse is terminated by:
    (1) Opening more channels (2) Closing all channels (3) Enzymatic breakdown or reuptake
    (4) Continued release (5) Opening new synapses

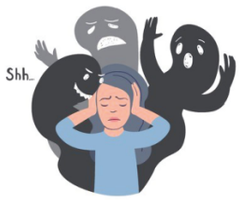



Membrane
potential
Time


disorders of
us system
Neurological
Disorders

Common
the Nervo

Mental/Psychotic Disorders



Action potential

An action potential occurs due to a change in membrane potential above a certain value (threshold value) due to a stimulus. The action potential has the following phases: depolarization, repolarization and hyperpolarization.

Depolarization: A change in the cell's membrane potential such that the inside of the membrane is made less negative relative to the outside. Depolarization results due to Na+ inflow from the Sodium channels bound to plasma membrane in response to a stimulus.

Repolarization: ..……..

……....

Hyperpolarization: ……

……...

Refractory period

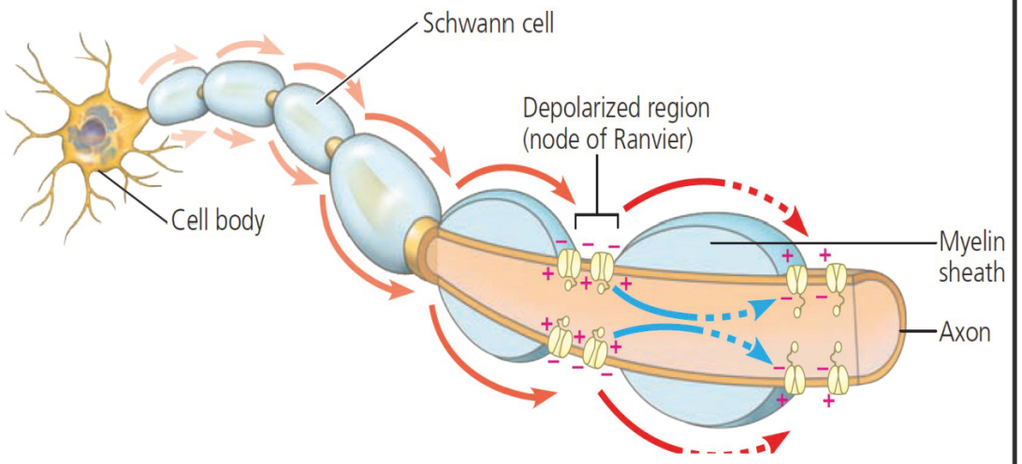
- Refractory period is the short time immediately after an action potential in which the neuron cannot respond to another stimulus, owing to the inactivation of sodium channels.
- This prevents the reverse conduction of an impulse in an axon.

Conduction of action potential (nerve impulse)

- A series of action potentials that move along an axon is defined as a nerve impulse.
- An action potential is generated due to Na+ inflow (depolarization) at one location in the axon.
- This axon potential spreads to the neighbouring location While the initial location repolarizes.
- This depolarization-repolarization process is repeated through the axon.

The speed of conduction depends on:

- Diameter of the axon - The conduction speed increases with the increase in axon diameter.
- Presence of myelinated axon (in myelinated neuron, axon potential jumps from one node of Ranvier to the next)



- **Depression:** Depression is likely to be due to a complex combination of factors tha include: Changes in neurotransmitter levels in the brain, genetics, psychological, social, environmental factors. People who are suffering from this disorder show depressed mood, abnormalities in sleep, appetite and energy level, In some conditions once enjoyable activities are no longer pleasurable or interesting. Some conditions involve extreme mood swings. Effective therapies are available to increase activity of some neurotransmitters in the brain

- **Alzheimer's disease:** This is a severe mental deterioration (dementia) characterized by confusion and memory loss. Patients are gradually becoming less able to dress, bathe and feed themselves. They lose their ability to recognize people including their immediate family members. Cause of the disease is due to progressive and irreversible degeneration of neurons in the brain especially in cerebral cortex. With deteriorating mental functioning. The disease affects elderly people. Genetic factors may be involved, So far, there is no cure for this disease.

- **Parkinson disease:** This is a progressive motor disorder that leads to lack of control and coordination of muscle movements. The patients show slowness of movements, difficulty in initiating movements, poor balance; fixed muscle tone causing lack of facial expression; speech problems and muscle tremor of extremities: eg. shaking a hand, fingers in one hand, shaking head. This disease is associated with gradual degeneration of dopamine neurotransmitter releasing neurons in the brain (mid brain, basal ganglia). The disease is common in the elderly people. Genetic factors may be involved. Disease can be treated but not cured.

Common neurotransmitters are;

Acetylcholine 2. Some amino acids

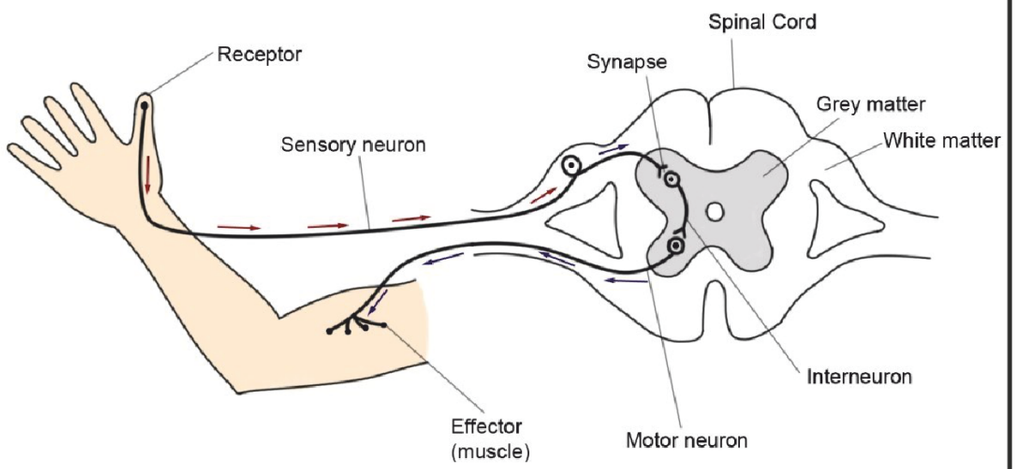
3. Biogenic amines 4. Neuropeptides 5. Some gases

Reflex arc

Reflex arcs are the functional unit of the vertebrate nervous system. Typically a reflex arc consists of three neurons, They are

1. Afferent/ Sensory neuron
2. Inter neuron
3. Efferent/ Motor neuron

A sensory neuron transmits impulses from a sensory receptor to the central nervous system where it synapses with an associated neuron called interneuron. This impulse is transmitted to a motor neuron. The motor neuron conveys the signal to effector tissues/organs.



Common disorders of the nervous system

Common disorders of the nervous system are Schizophrenia, Depression, Alzheimer's disease and Parkinson's disease.

- **Schizophrenia:** This is a severe mental disturbance characterized by psychotic episodes in Which patients have a distorted perception of reality. They experience voices that only they can hear. They think that others are plotting to harm them. Evidence suggests that this disorder affects neural pathways that use dopamine as a neurotransmitter

Synapses

A synapse is the …….. where a neuron (presynaptic cell) communicates with another cell (postsynaptic cell) across a …… ……... (synaptic cleft). Postsynaptic cell may be another neuron, muscle cell or secretory cell. This junction where one neuron …… with the next cell using a …….. (neurotransmitter) is called a chemical synapse. Some neurons can also communicate through direct electrical connections (…….. synapse).

Mechanism of transmission of nerve impulses through chemical synapses

- An action potential at an axon terminal depolarizes the plasma membrane of presynaptic cell.
- Depolarization at the presynaptic terminal causes Ca^{+2} to diffuse into the terminals.
- The rise in Ca^{+2} causes binding of synaptic vesicles containing neurotransmitters to the presynaptic membrane.
- This results in the release of the neurotransmitters into the synaptic cleft.
- Neurotransmitters diffuse across the synaptic cleft.
- Neurotransmitters bind and activates specific receptors in the postsynaptic cell membrane.
- If acetylcholine is taken for example of a neurotransmitter, the binding of neurotransmitters to the post synaptic membrane allows Na^{+} and K^{+} to diffuse across the post synaptic membrane.
- Depolarization takes place in the post synaptic membrane and it reaches the action potential
- After passing the nerve impulse to the postsynaptic cell, the signal at the presynaptic terminals is terminated either by:
  - Enzymatic hydrolysis of neurotransmitters
  - Recapture of neurotransmitter into the presynaptic terminals

Neurotransmitters

……

……

……

……