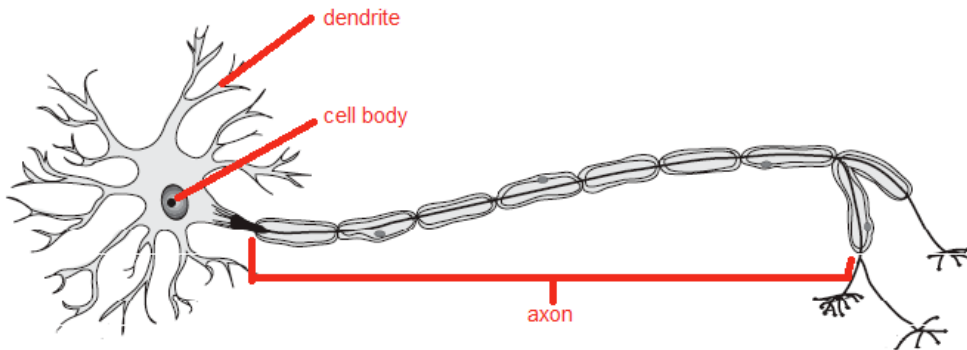


Section 3 Workbook (Unit 7 ANSWERS)

Name: KEY

Nervous System: C11. Analyze the transmission of nerve impulses

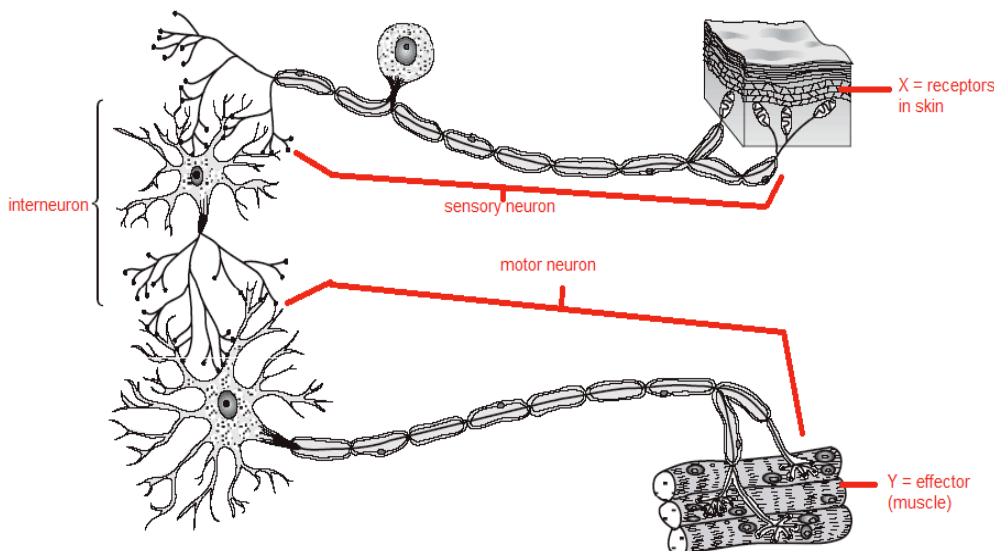
1. Identify the 3 main parts of the neuron (dendrite, cell body, axon).




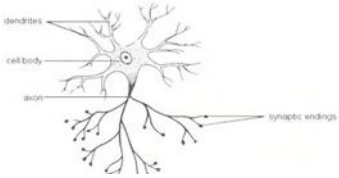

2. Complete the table.

Name of Structure	Function
dendrite	Receives signal and conduct the nerve impulse <u>TOWARDS</u> the cell body
cell body	Controls and maintains the cell because it contains the nucleus
axon	Conducts the nerve impulse <u>AWAY</u> from the cell body

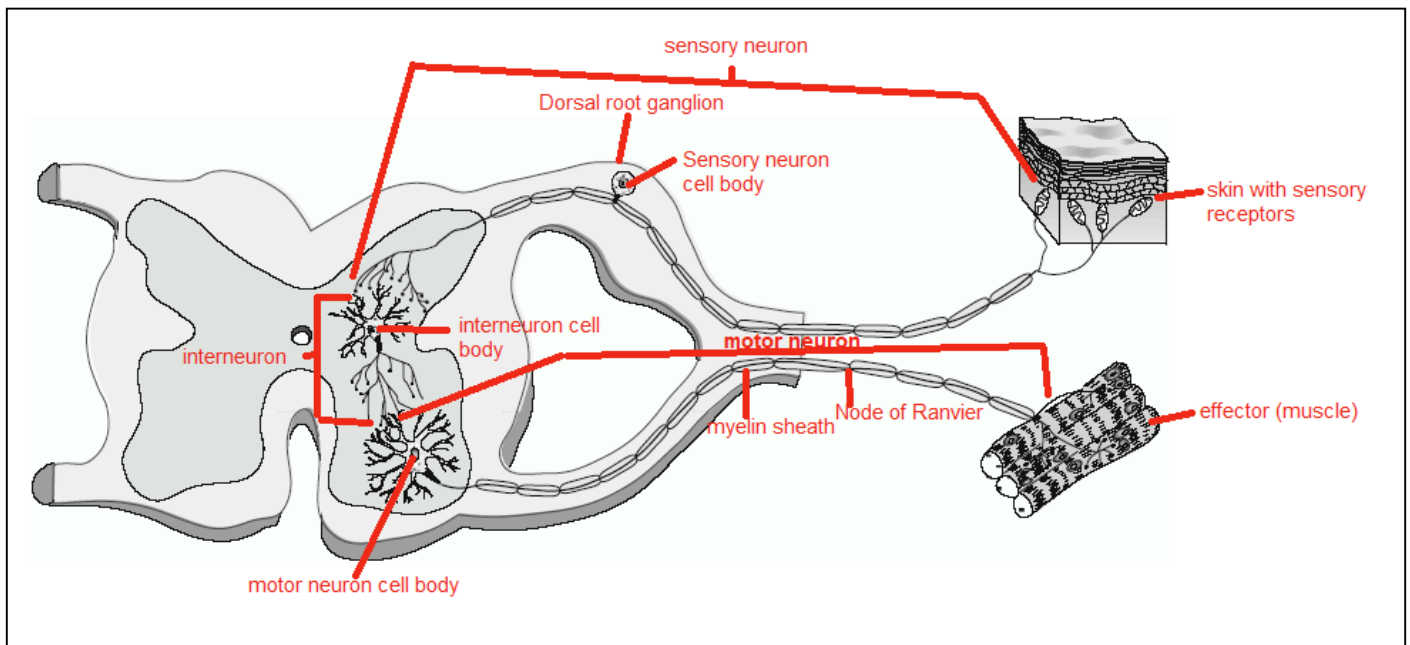
3. Identify the 3 types of neurons as well as X & Y in the diagram.



4. Differentiate among sensory, motor, and interneuron by completing the table.

Name of Neuron	Diagram	Location	Function
Sensory neuron	 <p>Long dendrite, short axon</p>	Peripheral nervous system (PNS) and Central nervous system (CNS)	Carries the message (nerve impulse) from the sensory receptor to the CNS
Interneuron	 <p>Short dendrite, long or short axon</p>	CNS only	Receives the nerve impulse from the sensory neuron and sends the impulse to the brain and motor neuron.
Motor neuron	<p>Draw a motor neuron</p>  <p>Short dendrite, long axon</p>	CNS & PNS	Carries the nerve impulse / message from the interneuron to an effector (muscle or gland)

5. Identify the parts of the reflex arc in the diagram and explain what a reflex is.



A reflex is an involuntary, automatic response to a large stimulus. It just happens; there is no need to think about it.

6. What is a dorsal-root ganglion?

A collection of sensory neuron cell bodies that are located along the vertebral column by the spine

7. Relate the structure of a myelinated nerve fibre to the speed of impulse conduction, with reference to myelin sheath, Schwann cell, node of Ranvier, and saltatory transmission.

- Myelin is a fatty substance wrapped around some nerve fibres to form what is called the myelin sheath. Myelin is produced by Schwann cells (a neuroglia cell).
- The myelin sheath speeds up the nerve impulse by causing saltatory conduction / transmission to occur where the impulse jumps from one node of Ranvier to the next node of Ranvier.
- The nodes of Ranvier is a place on the nerve fibre where there is no myelin and are the points between Schwann cells.

Action Potential

8. Explain the transmission of a nerve impulse through a neuron, using the following terms:

resting and action potential *depolarization and repolarization* *axoplasm*
refractory period *sodium and potassium gates* *polarity*
sodium-potassium

Nerve impulse = resting potential + action potential

Resting Potential: outside of the neuron is positive, the inside of the neuron (axoplasm) is negative due to the distribution of Na^+ , K^+ , and negative ions.

- At rest, there is more K^+ inside and more Na^+ outside of the neuron.
- At rest, sodium and potassium gates are closed so these ions cannot move

Depolarization: If the stimulus reaches the threshold level of -40mV , the sodium gates open and Na^+ enters the neuron and joins K^+ in the axoplasm.

- There are now more positive ions than negative ions inside the axoplasm so the polarity changes to positive inside and negative outside.

Repolarization: When the voltage reaches $+40\text{mV}$, the K^+ gates open and K^+ leaves the neuron and goes to the outside.

- The polarity now changes again and the axoplasm goes back to being negative and the outside of the neuron is positive again.
- The Na^+ gates are closed during repolarization.

Refractory Period: recovery phase. The Na^+ & K^+ voltage gated ion channels close during the refractory period.

- The sodium- potassium pump resets the neuron for the next nerve impulse by pumping K^+ back into the axoplasm and Na^+ back outside of the neuron.
- The neuron has now re-established the resting condition so the neuron can receive another nerve impulse.

9. What is the sodium-potassium pump? In what phase of the action potential is it active?

It is a form of active transport requiring ATP. There is a carrier protein that actively moves Na⁺ outside of the cell and K⁺ into the cell. This restores the original conditions of the resting potential.

It occurs during the refractory period

10. What is diffusion?

The movement of a substance from high to low concentration

11. What is an oscilloscope?

A voltmeter that measures the potential difference across the axomembrane of a neuron.

12. What is an action potential?

A rapid change in the polarity across an axomembrane as the nerve impulse is conducted along the neuron

13. What are sodium gates? When do the sodium gates open?

Sodium gates are proteins that allow Na⁺ to move across the axomembrane. The sodium gates open during depolarization (-65mV to +40 mV).

14. What are potassium gates? When do the potassium gates open?

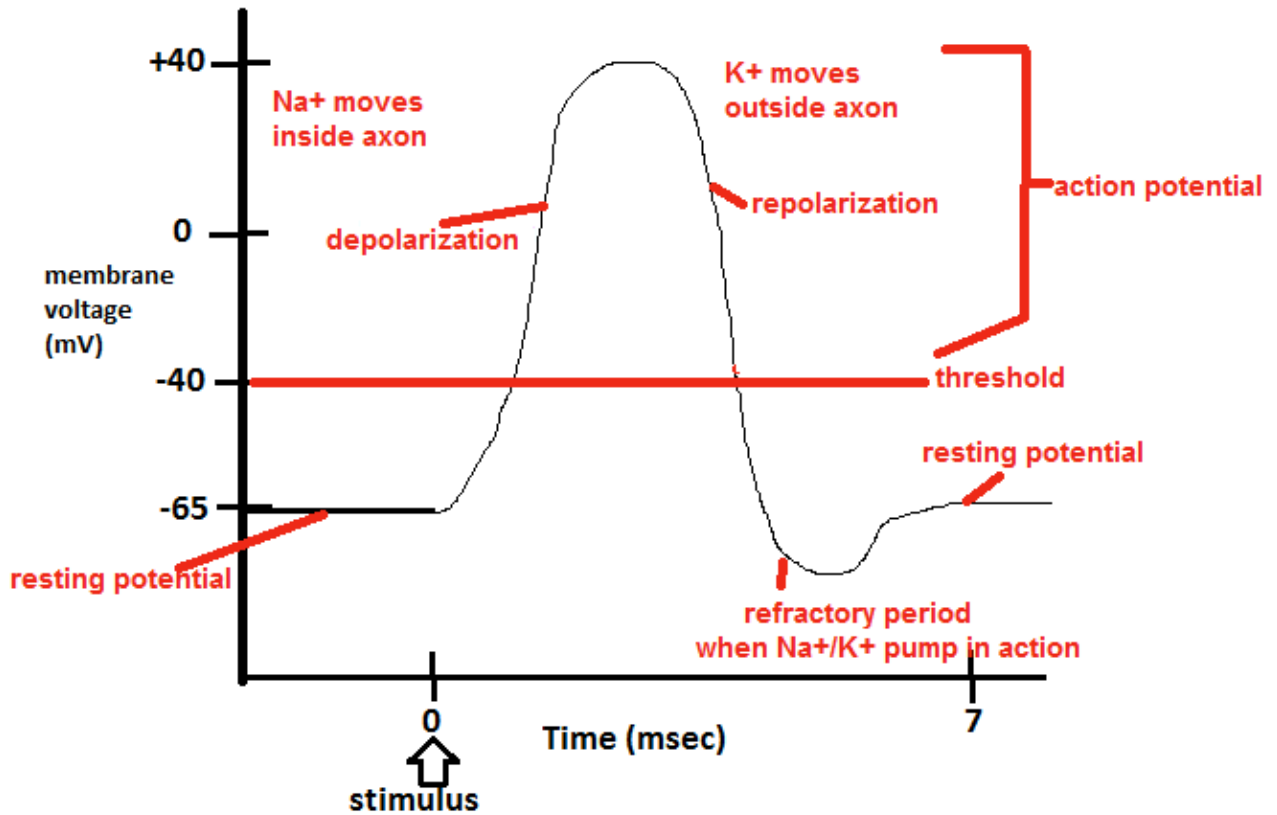
Potassium gates are proteins that allow K⁺ to move across the axomembrane. The potassium gates open during repolarization (+40mV to -70mV).

15. Nerve impulse – Action potential

	Range of mV	Charge inside the neuron	Charge outside the neuron	Describe Na ⁺ and K ⁺ concentrations or movement
Resting potential	-65 mV	Negative	Positive	Na ⁺ greater outside the neuron K ⁺ greater inside the neuron
Depolarization	-65 mV to +40 mV	Positive	Negative	Na ⁺ moves inside neuron and joins K ⁺ still inside the neuron
Repolarization	+40 mV to -65 mV	Negative	Positive	Na ⁺ stays inside the neuron K ⁺ moves outside of the neuron
Refractory period	-70 mV to -65 mV	Negative	Positive	Na ⁺ greater outside the neuron K ⁺ greater inside the neuron

16. On the following nerve impulse label:

- a) Threshold
- b) Resting potential
- c) Depolarization
- d) Repolarization
- e) Action potential
- f) Refractory period
- g) When sodium ions move inside
- h) When potassium ions move outside
- i) When Na⁺/K⁺ pump in action



17. During the refractory period, why are the sodium and potassium gates unable to open for a brief amount of time?

So the action potential cannot move backwards

18. Put the following statements in proper order.

- 3 Membrane is depolarized
- 4 Potassium gates open
- 6 Sodium-potassium pump restores resting potential
- 5 Sodium is inside neuron, potassium is outside
- 1 Sodium is outside neuron, potassium is inside
- 2 Sodium gates open

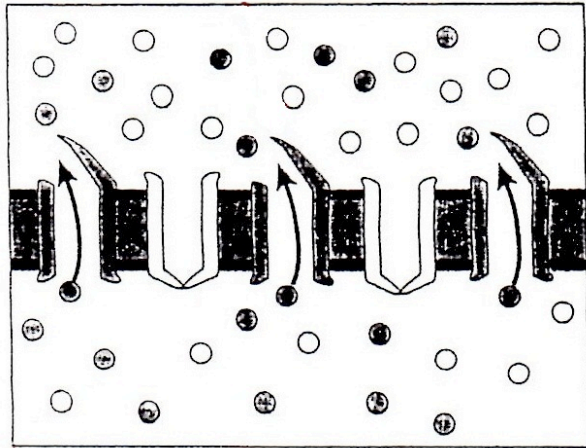
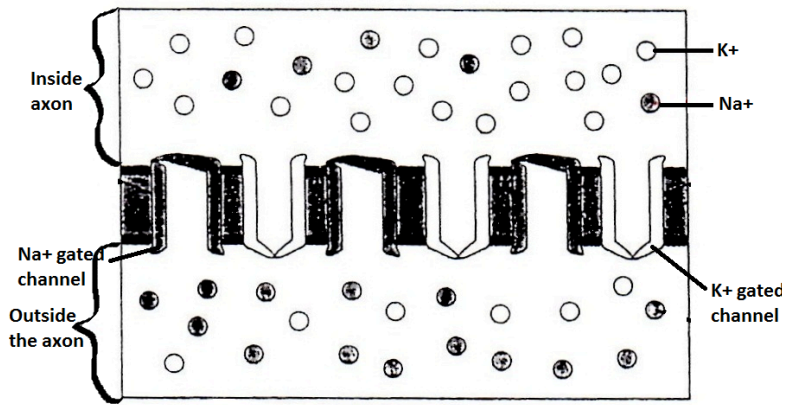
19. Explain what is happening in the following diagrams

Explanation:

Resting potential:

No nerve impulse therefore, no movement of ions.

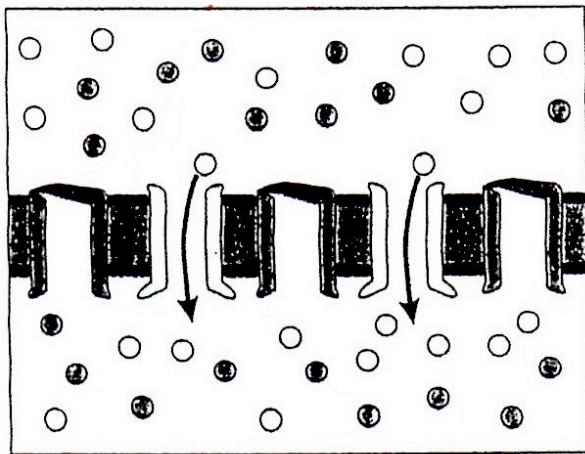
Na⁺ greater outside the neuron while K⁺ is greater inside the neuron.



Sodium gates open:

The membrane potential changes to +40 mV inside the axon (axoplasm).

This causes depolarization to occur



Potassium gates open:

The membrane potential goes back to -65 mV inside the axon.

This causes repolarization to occur

Synaptic Transmission:

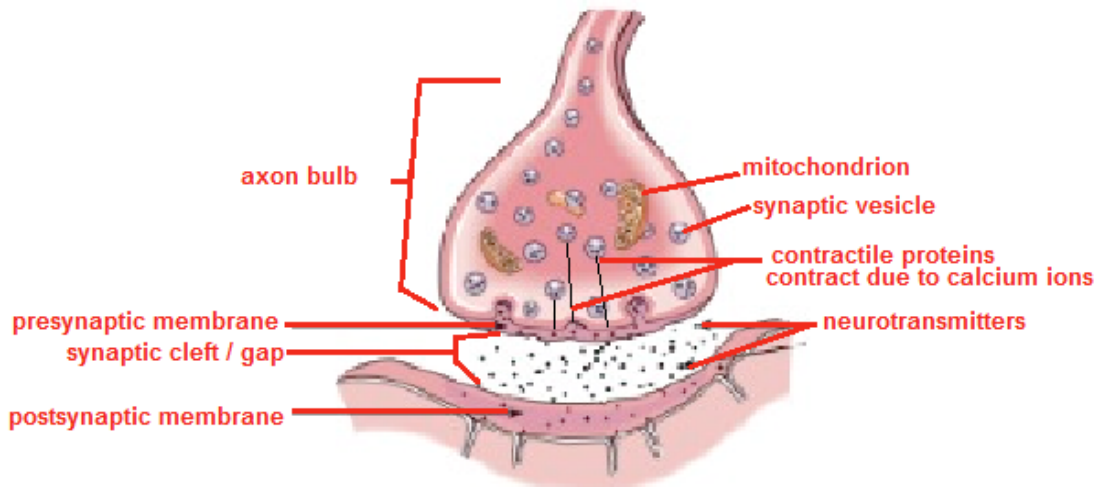
20. What is a synapse?

- Space / area where an axon bulb of one neuron and the postsynaptic cell (dendrite, muscle or gland) are close together but not touching.
- It allows the nerve impulse (electrical) to be transmitted to the next neuron (chemically with neurotransmitters).

21. Explain the concepts of threshold, 'all or none' response, inhibitory and excitatory neurotransmitters, and summation as they relate to synaptic transmission.

- **Threshold** = the minimum amount of stimuli required to produce a nerve impulse. All the excitatory and inhibitory signals on the dendrite (from inhibitory and excitatory neurotransmitters) are integrated (summed up) to determine if the neuron will fire or not.
- As long as the threshold stimulus of -40 mV has been reached, there will be an impulse. So, the neuron fires or not. There is no half impulse created. The impulse is always the same size. This is the all or none response

22. Label these major components of a synapse: presynaptic membrane, postsynaptic membrane, synaptic cleft, synaptic vesicle, axon bulb, neurotransmitter, calcium ions and contractile proteins



23. What is a neurotransmitter?

Molecules / chemicals stored in the axon bulb that are responsible for synaptic transmission (linking nerve impulse to next neuron)

24. Number the following events for synaptic transmission in the correct order

- ___ 6 ___ An action potential is stimulated at the postsynaptic membrane and impulse travels down dendrite
- ___ 7 ___ An enzyme cleaves the neurotransmitter substance and clears out the synaptic cleft
- ___ 1 ___ Impulse reaches synapse from the axon
- ___ 2 ___ Impulse stimulates synaptic vesicles to move to presynaptic membrane
- ___ 4 ___ Neurotransmitter substance diffuses across the cleft
- ___ 5 ___ Neurotransmitter substance fits into receptor sites on postsynaptic membrane
- ___ 3 ___ Synaptic vesicles dump neurotransmitter substance into synaptic cleft

25. What is exocytosis? Where does it occur in synaptic transmission?

- **Where a vesicle, inside the neuron's axon bulb, fuses with the plasma membrane and releases its contents outside of the cell and into the synaptic cleft / gap.**
- **Exocytosis occurs in the axon bulb.**

26. A) Name the enzyme that breaks down acetylcholine

Acetylcholinesterase (AChE)

B) Name the enzyme that breaks down norepinephrine/noradrenalin

Monoamine oxidase

27. If the neurotransmitter is not broken down by an enzyme, what happens to it?

It is rapidly reabsorbed by the presynaptic membrane and recycler molecules can be involved to help with this process

28. Why is a neurotransmitter in the synaptic cleft for only a short period of time?

It is broken down by enzymes or taken back up by endocytosis by the presynaptic cell

It prevents constant stimulation of the postsynaptic membrane.

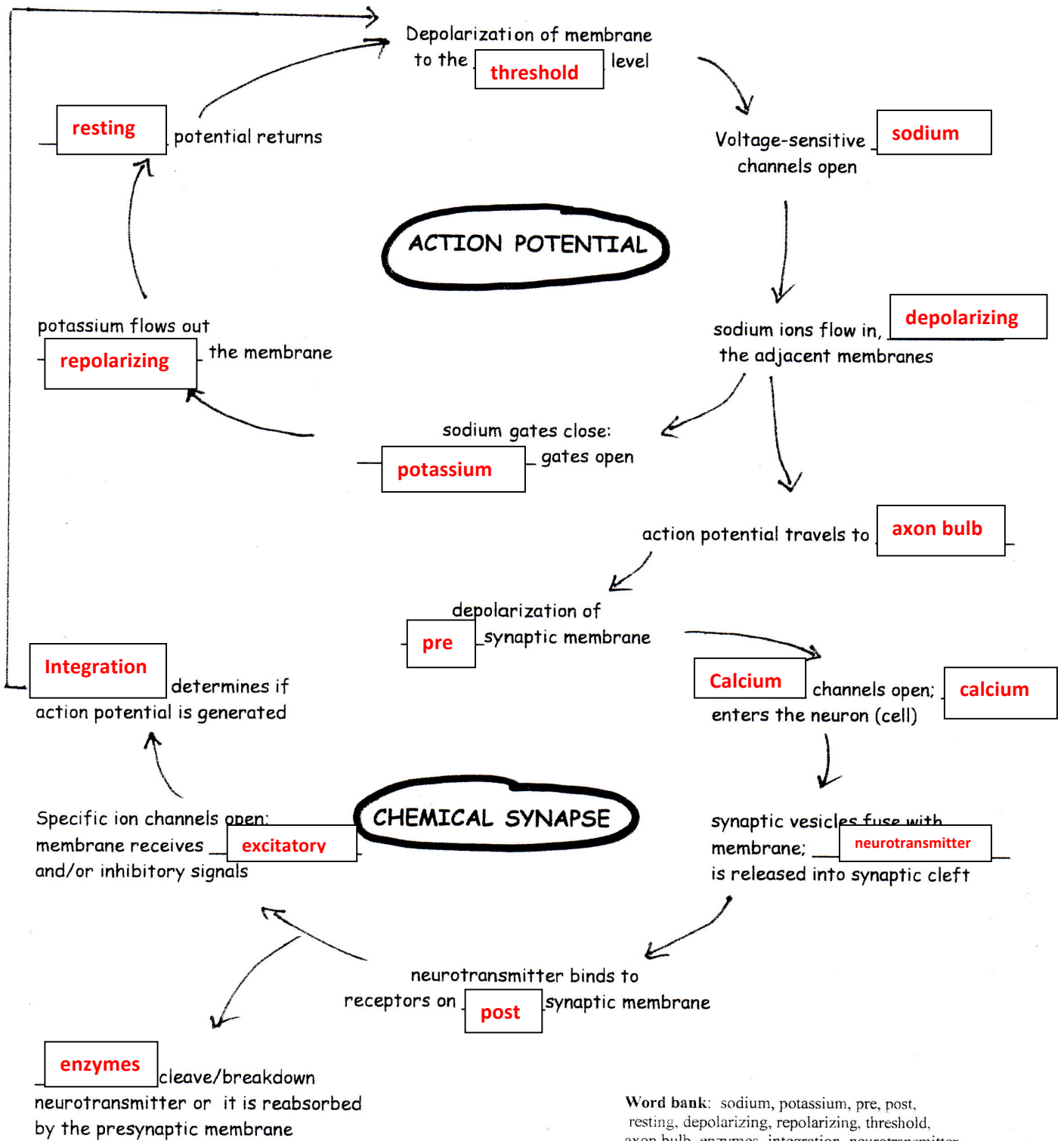
29. Why would the axon bulb have mitochondria?

- **Exocytosis = active transport and therefore need ATP. ATP is made by the mitochondria. Therefore, the axon bulb also has lots of mitochondria.**
- **Calcium ions are also returned by active transport so cell needs ATP**

30. How does the design of a synapse ensure nerve impulses travel in one direction?

Because the neurotransmitter is only released from the presynaptic membrane (axon bulb) and the receptors for the neurotransmitter are only on the postsynaptic membrane (dendrite). This ensures that the nerve impulse travels in only one direction.

Transmission of a Nerve Impulse



Word bank: sodium, potassium, pre, post, resting, depolarizing, repolarizing, threshold, axon bulb, enzymes, integration, neurotransmitter, excitatory, calcium (used 2 X)

C12. Analyze the functional inter-relationships of the divisions of the nervous system

31. What are the two main divisions of the nervous system and describe their function(s)?

- **Central nervous system (CNS)- control centre, integrates sensory information and formulates response**
- **Peripheral nervous system (PNS) – gathers stimuli, relays it to CNS, and relays response to appropriate effector**

32. What are the two main parts of the central nervous system?

Brain and spinal cord

33. What is the job of the central nervous system?

Control centre – receives the sensory input from the PNS and integrates / formulates the response(s) (if any) to the stimuli detected

34. What is the function of the peripheral nervous system?

- **Carries information between the CNS and the body; gathers stimuli, relays it to CNS, and relays response to appropriate effector**

35. Complete the chart to compare the effects of the sympathetic and parasympathetic divisions of the autonomic nervous system.

Autonomic Nervous System		
Body Function	Sympathetic NS	Parasympathetic NS
heart rate	Increases	Decreases
breathing rate	Increases	Decreases
pupil size	Dilate	Constrict
digestion	Decreases / stops	Increases / starts
neurotransmitter	Noradrenalin	Acetylcholine
overall response	“fight or flight”	relaxed state

36. What is the source gland for adrenalin? Explain its role in the “fight or flight” response.

- **Adrenal gland makes adrenalin**
- **Adrenalin is involved in the “fight or flight” response by increasing the activity of the receiving cells / tissues/ organs (except the digestive system)**
- **Examples – increase heart rate, breathing rate, blood pressure, decreases digestion.**

The Brain

37. What are ventricles?

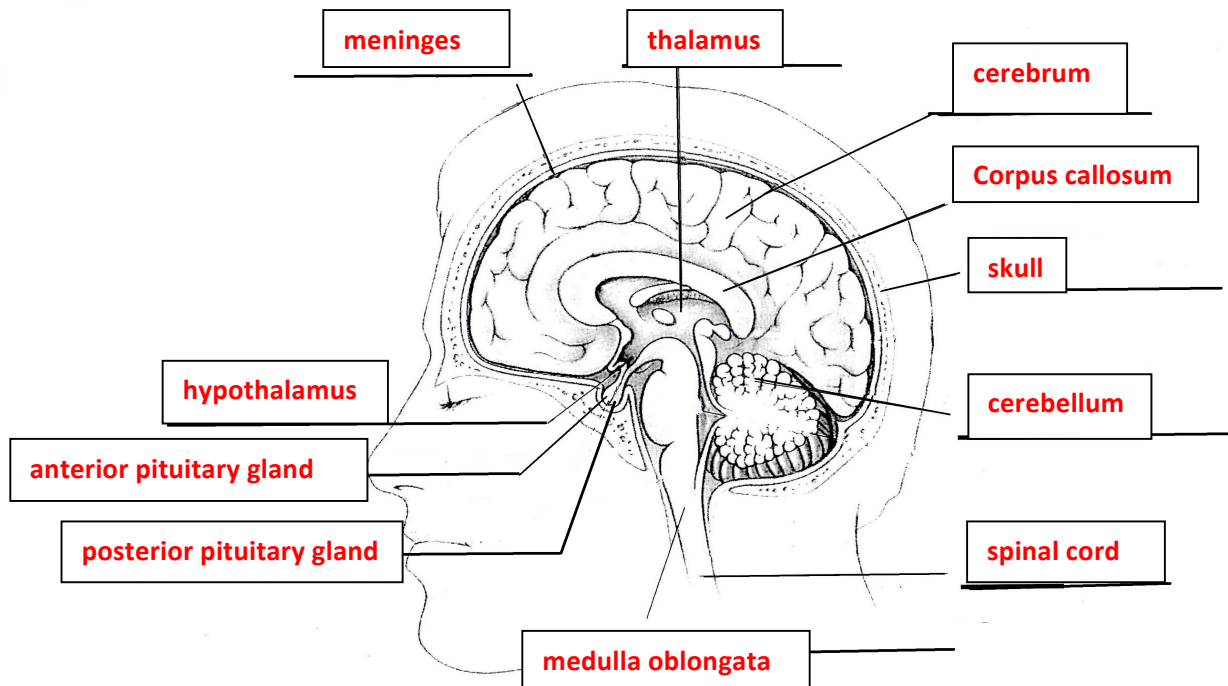
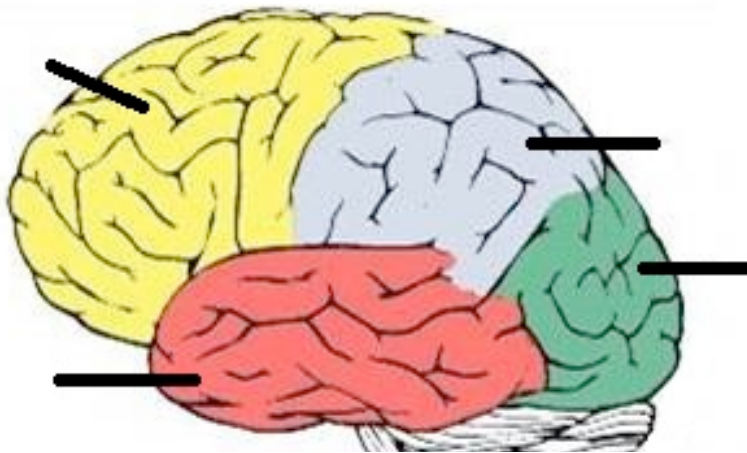
Spaces / cavities in the brain that are connected which produce and store cerebral spinal fluid. There are 4 of them.

38. What is the function of the midbrain?

It acts as a relay station for tracts passing to the cerebrum and spinal cord / cerebellum. It also has the reflex centres for vision, hearing (auditory), and tactile responses.

39. Complete the table and identify the parts on the diagram.

Parts of the Brain	
Structure	Function
medulla oblongata	Vital centres – regulates heartbeat, breathing & vasoconstriction. Has reflex centres for vomiting, coughing, sneezing, hiccupping & swallowing.
cerebrum	Responsible for consciousness and higher level mental function. Receives sensory input and carries out integration and coordinates responses.
thalamus	“sorting centre” that directs input to the proper region of the brain for interpretation.
cerebellum	Maintains muscle tone, posture, balance and coordination, body temperature and hormones). It also directly
	. It has some control over
	tonin, FSH, LH and PRL.
	such as ADH & oxytocin.
	es). It allows
	es.
	at protect and cushion



41. Explain how the hypothalamus and pituitary gland interact as the neuroendocrine control centre.

- The hypothalamus is the part of the brain that has control over the internal organs.
- It samples the blood that travels through it and causes the anterior & / or posterior pituitary glands to release hormones to influence and regulate other organs of the body.

42. Label the lobes

