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Neuqua Valley Anatomy and Physiology Test

1) Action potentials
    a) The neuron at resting potential has a high intracellular concentration of one cation and a high extracellular concentration of another. What are they?

    b) What is the absolute value of the voltage across the ideal resting neuronal membrane?

    c) What is meant by the depolarization of a neuronal membrane?

    d) When enough depolarization occurs to cause a certain voltage change at the axon hillock, what channels open? What is the name for the event that happens? How does this event progress through the axon?

    e) When the event that occurs reaches the end of the axon, what chemicals are released? Where are they released?

2) Wires are covered in insulation in order to prevent current loss. What is the analogue to this in the nervous system? What types of cells make it up? What makes it different than wire insulation?

a) What disease can autoimmune destruction of these cells cause?

3) A heart attack is often prefaced by shoulder pain. Explain why the pain is at the shoulder.

4) Divisions of the Nervous System
   a) What are the two main divisions of the nervous system?

   b) One of the above has two more divisions. Name them and discuss their function.

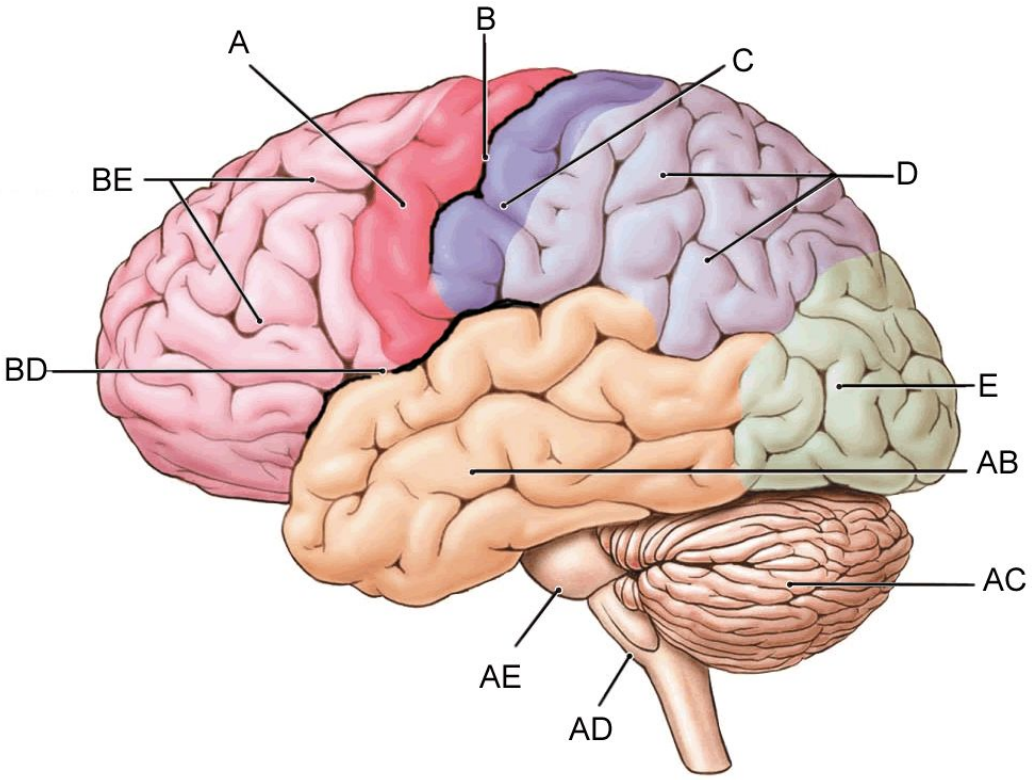
   c) One of the above has two more divisions. Name them and discuss their function.

5)
   a) Describe the physiology behind the absolute and relative refractory period following neuronal depolarization.

b) Describe an evolutionary advantage for this.

6) In 1953, Henry Molaison underwent a lobotomy that removed portions of his medial temporal lobes to mitigate his epilepsy. Speculate as to the possible effect this could have had on his memory.

a) What letters represent the temporal lobe on the diagram below?



7) Under which meningeal layer is most cerebrospinal fluid located?

8) Describe the location and function of the general interpretive area of the cortex.

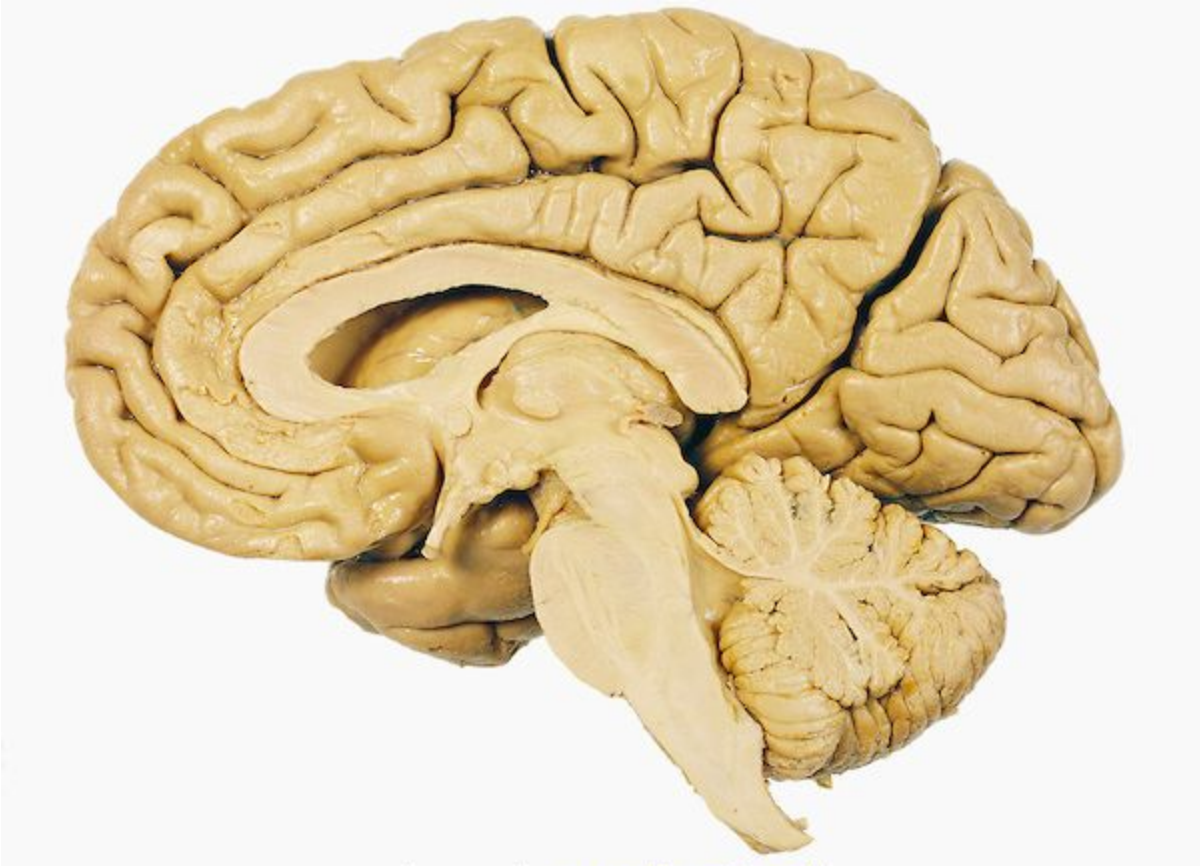
9) I poke you in the left arm with a pencil.
    a) What are the two types of fibers that carry pain, and what are the differences in their myelination? How do these differences account for different types of pain caused by an injury?

    a) What type of spinal tract does information regarding the pain go through to get to the brain?

    a) What area of the diencephalon will the information be transmitted to?

        i) Draw a circle on that part of the brain below (need not cover whole part)
    b) What cortical area is responsible for the sensation of pain? Be specific!

        i) Draw an x on that part of the brain below



c) The lobe that the answer to c is located in has an association function. What is this function?

10) In response to being rudely poked with a pencil, you slap me.

a) What part of the cortex was involved in making this decision? Be as specific as possible!

b) What part of the cortex will signal your arm to slap me? Be as specific as possible!

c) What type of spinal tract will this information mainly go through?

d) Describe the process by which a neuronal impulse reaches a muscle fiber. You only need to discuss what occurs at the synapse between the two.

11) I go to my doctor for a routine flu shot. He messes up and manages to bisect my corpus callosum through its sagittal plane and lesion my left somatosensory cortex. When I return, Richard manages to launch a crossbow bolt into my left palm.
    a) Can I feel it? Why?

    b) Can I say anything about it? Why? Reference cortical areas in your answer.

12) It is now 2:31 AM. The reason I am up so late writing this test because I made the grave mistake of drinking a cappuccino at 10PM.
    a) Describe the action of caffeine. What neuromodulator does it affect?

b) Extra credit: How does this neuromodulator accumulate?

13) During a boxing match, I get a nice right hook to the eye from John Cena.

a) Around the left eye, innervation to the superior oblique and lateral rectus muscles is severed. Which way will the eye tend to move? What cranial nerves were probably severed?

b) What is the white part of the eye called?

c) The injuries cause thickening and swelling of the cornea and lens. What condition will result, and why?

d) The doctor I keep visiting decides an injection of rhodopsin into the central depression of the retina will be a good idea.

i) What, biochemically, does rhodopsin do? What cells is it located in?

ii) What is the center of the retina called? Why would injecting rhodopsin there not have as much effect as expected?

e) Since I cannot really see out of my left eye, what parts of my cortex will stop working?

14) Olfaction is a weird sense.
    a) What type of receptors are responsible for olfaction?
        A. Chemoreceptors
        B. Nociceptors
        C. Mechanoreceptors
    b) What structural types of neurons are used to first sense stimuli, in general?

        i) Which type is used to sense olfactory stimuli?

        ii) Name the small projections of olfactory sensory neurons that actually pick up incoming stimuli

    c) What is weird about how olfactory signals are processed compared to other senses?

    d) Extra credit: What is weird about the neurons which first receive olfactory input?

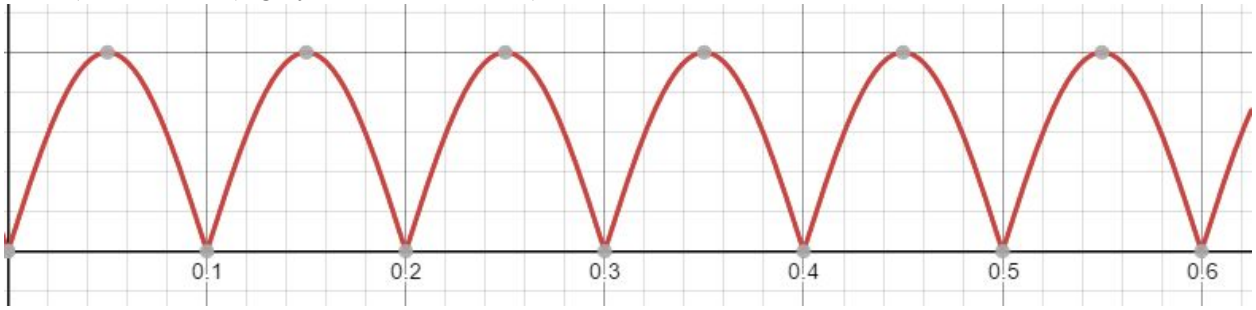
15) In the video game *Mortal Kombat,* Sub-Zero's fatality attack involves pulling out his opponent's spinal cord. One day, he pulls out some poor guy's spine, but goes to look at it in the local anatomy lab.
    a) He sees two processes coming out below each vertebrae on each side. One has a bulge near the vertebrae. What is the bulge called?

    b) He then notices that the processes continue into long tendrils, but some of them, specifically above and below the chest, seem to tangle. What are these tangles called (general term)?

c) Extra Credit: Using his microscope, Sub-Zero takes a look at the sympathetic trunk of his victim. He noticed that within the paravertebral ganglia, proteins on the postsynaptic membrane are phosphorylated and have a different shape than any other such proteins he has seen before. He knows that his opponent was a heavy smoker. Explain the phenomenon he is observing.

16) I have a rare mutation which causes me to have fewer lamellated corpuscles. My girlfriend has a rare mutation that causes her to have fewer Merkel's discs. If we have children, what two sensations may they feel less?

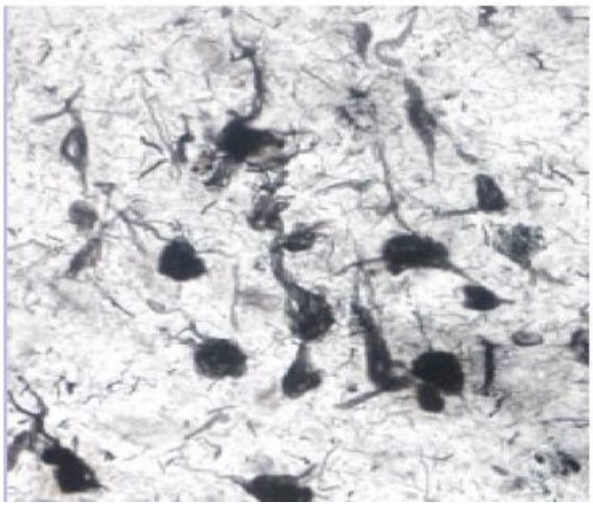
17) Below is a (highly fake and idealized) brain wave with the x-axis in seconds

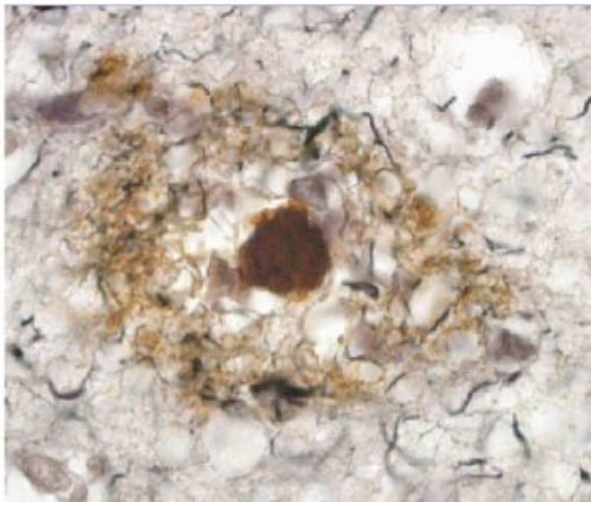


Based on the frequency, identify the wave type and select a situation it would occur in:

A. Beta wave, resting with eyes closed
B. Beta wave, REM sleep
C. Alpha wave, resting with eyes closed
D. Alpha wave, REM sleep

18) In the hippocampus of an Alzheimer's disease patient the following images are taken:





Name the left and right features and describe what proteins they are composed of.

19) I have this terrible headache, so I go to this doctor that I probably should be suing for malpractice by now. He takes out a snail-shaped structure in my head and announced that I was infected by a snail. I can't hear him. Discuss the role of this structure in hearing.

20) What is the difference between plexuses and ganglia?

21. What is the difference between the nervous system and the endocrine system? Which system's signals generally last longer?

22. What are the two classes of steroid hormones?

23. Where are the receptors for non-steroid peptide hormones located? Why are they there?

24. Chemically, are hormones generally more amino-acid based or cholesterol based?

25. What does the hypothalamus regulate?

26. What is the HPA Axis?

27. What is the purpose of hormone cascades?

28. Why does the pancreas have both exocrine and endocrine tissue?

29. What type of cells does the thymus aid with the differentiation of?

30. Which gland produces the hormone melatonin? What does melatonin do?

31. Describe the differences in structure between the anterior pituitary and the posterior pituitary.

32. A student is sky diving. When in the air, his parachute would not deploy. His pupils dilate and his heart and breathing rate go up. He tries one more time and the parachute finally works. No harm befalls the lucky student. What type of endocrine system stimulus did he receive that caused the eye dilation and breathing and heart rate increase?

33. What hormones are responsible for the fight-or-flight response? Where are they released from?

34. Describe two differences between diabetes type 1 and 2.

35. Ayusha, a 25 year old woman, has been extremely anxious for the past three years. She has lost weight without changing her diet or exercise regime and feels her heart beating irregularly. Her eyes have become puffy and she has not menstruated in two years. What diagnosis would you give Ayusha? What causes her disease?

36. Robert Wadlow was the tallest person in history, having a recorded height of 8’11” . This was due to hyperplasia in his pituitary gland. Speculate what hormone imbalance caused this abnormal growth, how this hormone works, and three of its functions.