Biological Foundations of Psychology Fall 2009 Dr. Daniel A. Levy Course Code: 8051
Duration of exam: 2.5 hours. No study materials may be used

131

83 + 11 = 94

Part A – Multiple Choice (20 points) – circle the letter of the correct answer

✓ 1. Which of these is *not* a catecholamine neurotransmitter?
a. Dopamine
[✓ b.] Serotonin
c. Epinephrine
d. Norepinephrine

✓ 2. For an NMDA receptor channel to open
a. Both GABA needs to be present and the membrane needs to be depolarized
b. Both GABA needs to be present and the membrane needs to be hyperpolarized
[✓ c.] Both glutamate needs to be present and the membrane needs to be depolarized
d. Both glutamate needs to be present and the membrane needs to be hyperpolarized

✓ 3. The process of transcription
[✓ a.] is from DNA to RNA, and occurs in the nucleus
b. is from DNA to RNA, and occurs in the ribosome
c. is from RNA to protein, and occurs in the nucleus
d. is from RNA to protein, and occurs in the ribosome

✓ 4. RNA
a. is double stranded
[✓ b.] is single stranded
c. is found only in the nucleus
d. is always a template for protein synthesis

✓ 5. The phenotype
a. will always be guided by recessive alleles
b. express the genotype only
c. will be guided by dominant alleles only if heterozygous
[✓ d.] is affected by both nature and nurture

X 6. Crossing over
a. creates new combinations of maternal and paternal genes on any given chromosome
b. describes the situation when axons from different neurons meet but each continues to a different direction (as in traffic junctions)
c. is when the information in a postsynaptic cell from one neuron is being displaced by the information from another neuron
[✓ d.] is a process in which chromosomes exchange equivalent segments of DNA during mitosis

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✓ 7. Contralateral structures are
a. one is caudal to the other (which is rostral to the first)
[✓ b.] on opposite sides of the midline
c. lateral to each other
d. one is proximal and the other is distal

✓ 8. The blood–brain barrier
a. is a part of the immune system, involving the release of antibodies to protect the brain from infectious agents.
[✓ b.] is a property of the closely packed cells that build the walls of brain capillaries, preventing large molecules from entering the brain.
c. is a property of the blood vessels of the brain that prevents the diffusion of water into the tissue of the brain.
d. is a property of neurons that prevents them from accidentally releasing their neurotransmitters into the blood circulation.

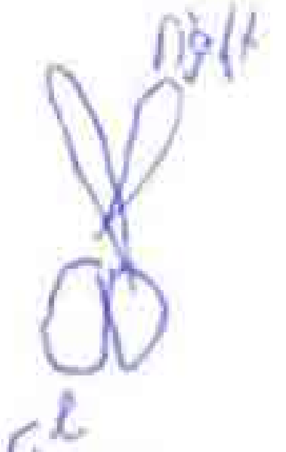
→ ✓ 9. Which of the following is *Wrong* regarding opiates
a. there are opioid receptors in the periaqueductal gray
b. endogenous substances which activate receptors for opiates are called endorphins
→ [✓ c.] THC-9 is synthesized from opium
[✓ d.] at high doses, opiates depress respiration

✓ 10. Which of the following is ~~*Wrong*~~ regarding MRI images
a. Under specific magnetic and radio conditions, different tissues with different physical traits react differently
b. Differences in physical reactions of tissues are translated into different colors
c. The strength of commonly used MRI scanners is at least 30,000 times the earth's magnetic field
[✓ d.] In a strong magnetic field hydrogen atoms are randomly aligned

→ ✓ 11. fMRI
a. measures electrical neural activity directly
b. is based on the fact that a local increase in neural activity demands increased glucose
[✓ c)] is based on the Blood Oxygenation Level Dependent signal
d. uses a radioactive tracer injected into the bloodstream in order to see changes in neurovascular coupling

✓ 12. Cocaine
a. is mainly a serotonin agonist
[✓ d.] especially blocks the reuptake of dopamine
c. mainly affects the sympathetic system directly
d. can produce schizophrenia-like symptoms

✓ 13. Split-brain patients:
[✓ a.] have difficulty to verbally describe stimuli presented in the left-visual-field
b. have difficulty to verbally describe stimuli presented in the right-visual-field
c. both a and b
d. neither a or b



✓ 14. In which part of the neuron are synaptic vesicles found?
a. Cell body
b. Dendritic spines
c. Axon hillock
[✓ d.] Axon terminals

✓ 15. The major function of Schwann cells is
a. transmission of nutrients to neurons.
[✓ b.] myelination of peripheral nerve fibers.
c. scavenging of cellular debris.
d. myelination of axons in the brain.

→X 16. The sodium–potassium pump is responsible for
a. removing three sodium ions for every two potassium ions from the cell membrane.
b. initiating the action potential.
c. returning the membrane potential to the resting state.
[✓ d.] Both a and c

✓ 17. ACh is the main transmitter used at mammalian
a. cerebral cortical synapses.
b. spinal cord synapses.
[✓ c.] neuromuscular junctions.
d. visual system synapses.

✓ 18. The specialized presynaptic membrane receptors that remove molecules of transmitter from the synapse are called
a. translators
b. transponders
[✓ c.] transporters
d. ligand-gated channels

✓ 19. Which of the following is *not* a consequence of parasympathetic activation?
a. Increased salivation
[✓ b.] Increased heart rate
c. Decreased blood pressure
d. Increased digestion

✓ 20. In its common usage, the term *stroke* refers to
[✓ a.] brain lesions caused by a reduction or blockage of blood flow to the brain.
b. brain lesions caused by leakage of cerebrospinal fluid.
c. brain injury due to head trauma.
d. any process that causes a sudden intellectual deterioration.

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Part B – Short Answer (40 points)

✓ 1. What disease is related to the degeneration of the substantia nigra?

Parkinson

s

✓ 2. During their absolute refractory period, neurons don't fire an action potetiol

✓ 3. What characteristic of the neural membrane is responsible for the differential concentrations of ions inside and outside the neuron?

~~hydrolipid (fat)~~ semi- ↓ permeable

✓ 4. The neural membrane must become positive relative to its resting membrane potential in order for an action potential to occur.

leitu geschw

✗ 5. Conduction velocity of action potentials is increased in axons with

small diameters.

✓ 6. True or false? Metabotropic receptors liberate chemical second messengers.

True

~~carbon monoxyd~~

✓ 7. A gas that is a neurotransmitter is Nitrid oxyd .

✓ 8. One important way that alcohol alters the functioning of the brain is as an

agonist of GABA receptors.

✓ 9. Serotonergic neurons are located in the raph nucleus.

✓ 10. Mitochondria is the cellular organelle is responsible for cellular respiration.

✗ 11. The processes of cell division for growth is called Meiosis.

✓ 12. A sequence of 3 nucleotides coding for 1 amino-acid is called a

codon.

✗ 13. How many neurons does the human brain contain? 23 million.

✓✗ 14. Cells with numerous branching dendrites are called multiple neurons.

✓ 15. The choroid plexus produces the cerebral spinal fluid.

✓ 16. The primary visual cortex is in the occupicial lobe.

½ ✓✗ 17. Receptors that contain channels for sodium or chlorine, e.g., are

ionotropic recepters ✓; those without channels are pumps ✗ (sodium-potassium pumps)

✓ 18. Norepinepherine is produced from dopamine, and

Epinepherine is produced from Norepinephrine.

✓ 19. fMRI temporal resolution is in the order of 1-3 seconds

✓ 20. The degree of chemical attraction between a ligand and a receptor is called

affinity.

34,5
40

Part 3 – Essay Questions (25 points)

Answer 5 out of the following 8 questions (5 points each = 25 points).
You may also answer one more question for 5 bonus points.
At the beginning of your answer, write the number of the question you are answering.
You may continue on the other side of the page if needed.

1. Name four types of glial cells, and describe three important functions that glial cells perform.

2. Compare and contrast at least three different human brain imaging technologies through discussion of their technical bases and the types of information each provides.

3. Explain temporal and spatial summation of IPSPs and EPSPs.

4. List 5 characteristics (properties) of a substance necessary for it to be considered a neurotransmitter.

5. Describe up to 5 ways that medicinal drugs or drugs of abuse may affect post-synaptic processes.

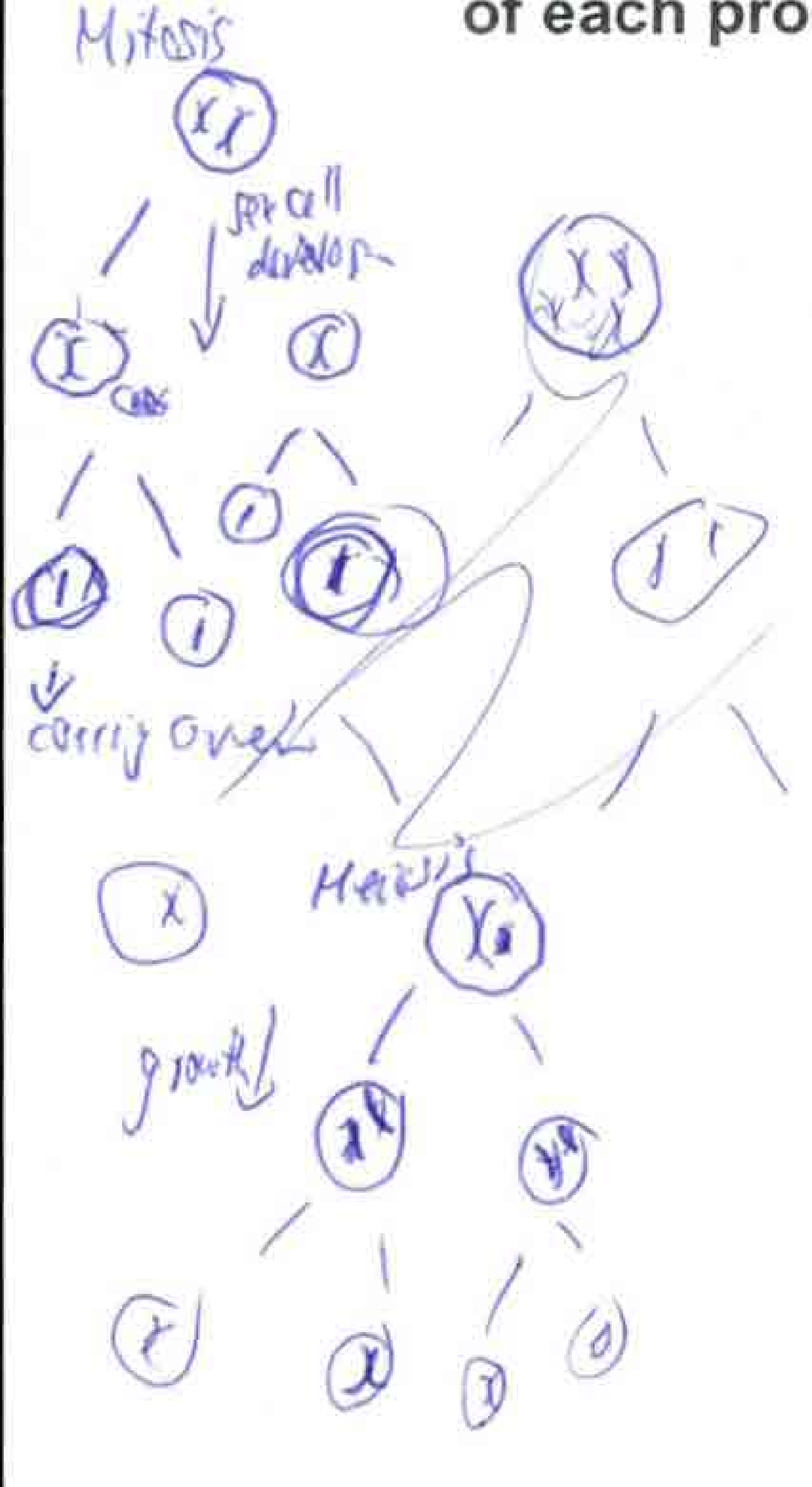
→ at synthesis way (TH → AMPT) (more carbohydrat → thyrosin → serotonin)
→ at storing (ritalin → storage of dop.?)
→ at release
black widow venom → ↑ } ACh
toxin → ↓
→ receptors
(nicotine → ↑
curare → ↓)
→ Reuptake
(Amphetamine → ↓)
enzyme destroy
(

6. Describe the process leading from a gene to the creation of a mature protein – how is a gene recognized, which molecules are involved, what are the names of the sub-processes, where does each sub-process take place, how is the correct protein sequence created.

7. Describe the production, functions, and structures containing cerebrospinal fluid, and problems that can be caused when the CSF system malfunctions.

8. Describe mitosis and meiosis, when and in which cells does each one occur, and how many chromosomes are in each daughter cell by the end of each process.

↓
50% of mother & 50% of father
(23 + 23)



Ach → controls cerebral cortex & electrical rythm of hippocampus → learning & memory
Dopamin → motor control
→ Reinforcement, reward, learning

(Use this page to continue Essay answers if required)

0.5/5 ③ <u>temporal summation:</u>

The input of one neuron is strong enough to produce ~~the~~ an action potential at another neuron alone. ✗

<u>Spatial summation:</u>

Several EPSP and IPSP summed together, when there is enough depolarization to reach the threshold, the input leads to an action potential at the following neuron. what's the relation to spatial summation?

④ A neurotransmitter is a substance that is:

5/5

① produced <u>in</u> the presynaptic neuron ✓

② it's reliese has an effect on the possynaptic cell ✓
and <u>may</u> lead to an action potential (depolarization <u>or</u> hyperpolarization)

③ there are special receptors at the postsynaptic cell it can bind on ✓

④ there are mechanisms that stop the action of a neurotransmitter in the synapse ✓

⑤ the ~~acti~~ effect of a specific neurotransmitter at a postsynaptic cell can be showen experimentally ✓

2/5

⑤ Drugs may affect postsynaptic processes by interfering with the synthesis of a neurotransmitter. ✗
AMPT interferes with Th, so that L-dopa can not be build from Tyrosin and consequently dopamine can not be produced.
On the other hand drugs could increase the production of a neurotransmitter, e.g. by eating carbohydratic meals the contentration of Tryptophan is higher and thus more seretonin can be produced.

Drugs may interfere ~~wit~~ with the storage of a neurotransmitters into vesicles. Like ritalin interferes ~~with~~ with the storage of dopamine, so that dopamine cannot be stored and thus not relieced into the synaptic gap.

Drugs may interfere with the release of neurotransmitters into the synaptic gap. Like the black widow venom ~~blocks~~ increases the release of Acetylcholin (ACh). This leads to a higher concentration of Ach in the synaptic gap, too much ACh is toxic to ACh's receptors and lieds to convulsions. Sometimes it may outstrip the neurons ability to produce and store ACh, the neuron runs out of neurotransmitters what may lead to paralyses and death.
On the other hand toxins, like butolin toxin, stop the reliese of ACh, so that no ACh is present anymore in the synaptic gap, leads to botulism desease.

all of the above was <u>pre</u>synaptic

Drugs may interefere with the receptors ✓ of a neurotransmitter and either strengthening or reducing neurotransmitters influence on the receptor (agonists, antagonists). E.g. nicotine → Ach agonist and curare → Ach antagonist
Furthermore drugs may interfere with the reuptake ✓ of a neurotransmitter or destroy enzymes that clear it from the gap and thus increase its activity on the postsynaptic neuron. E.g. Amphetamine interferes with dapamines reuptake in the cell.

(Use this page to continue Essay answers if required)

DNA polimerase walks along the DNA strand.
5/5 ⑥ ~~The~~ DNA double helix becomes seperated and DNA polymerase reads the template strant. There is
a start codon that tells the polymerase where to start transcribing DNA into RNA (promoter).
DNA polymerase transcribes RNA into the same language of nucleotides (just thymine is replaced)
Transcription happens in the Nucleus. M-RNA can leave the nucleus through its porse
and travels to a ribosome where translation into a different chemical language of
amino acids takes place. t-RNA brings the amino acid and fits as an anti-
codon onto the m-RNA. The first t-RNA dogs on and the second, combines the
two amino acids and the first leaves and the third dogs on. Three nucleotides
code for one amino acids, there are 64 combinations of nucleotides but only 20 amino
acids thus some code for ~~[illegible]~~ one amino acid togeder. The protein leaves the
ribosom and becomes folded in the reticular formation and from there
it becomes transported to its place of action in the body.
Only 1,5 % of a gene code for proteins, in eucoriotic genes are exons and introns, introns
is junk RNA not used for protein synthesis and becomes cut out before Translation.
(splicing). The promotor tells were the start is and a stop codons ~~codon nucleotides~~ tells were the
stop is, genes can be spliced in different ways what leads to higher new combinations
of genetic information. very good!

Mieosis
⑧ ~~Mitoses~~ is the development of sex cells (eggs or sperm). ~~[illegible]~~ Daughter cells by the
end of the process contain 50% of the parental genetic information (~~88~~ 32 chromosomes)
4.5/5 The stem cell devides two times, so that in the end there are four daughter
cells, able to meet another sperm or egg cell, in order to get to a full set of chromosomes (~~[illegible]~~) (64)

Mitoses
~~Meioses~~ is the process of cellular growth in the end each daughter cell contains
to a 100% the same information as the parent cell. ~~The cell devides,~~ Chromosomes
seperate, the cell devides chromosomes douplicate and the cell devides again.

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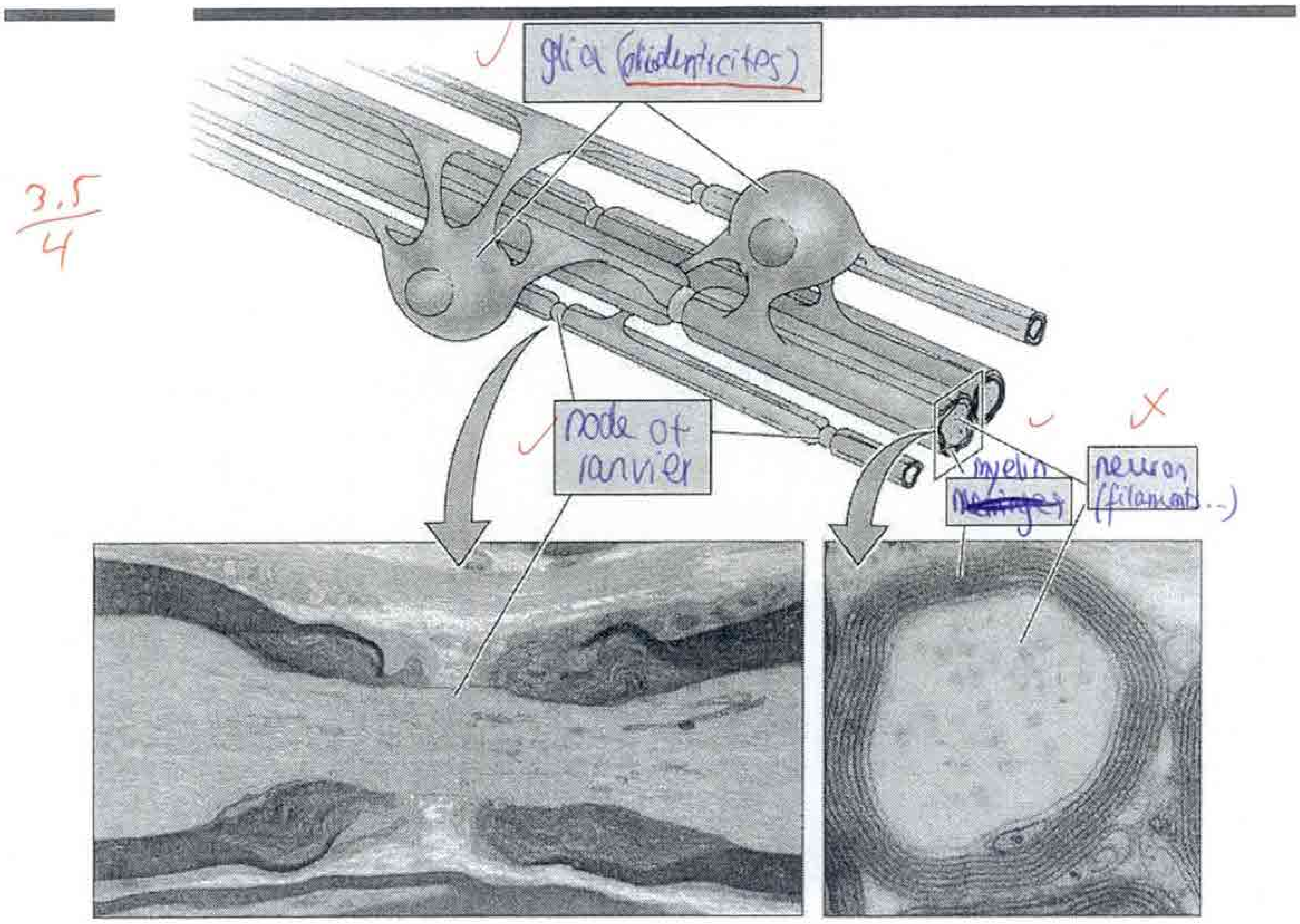
Part 4 – Labeling (15 points; 1 point for each label)

(4 points)

3.5/4



(6 points)

A. The white cross is positioned on the same structure in all the three planes.

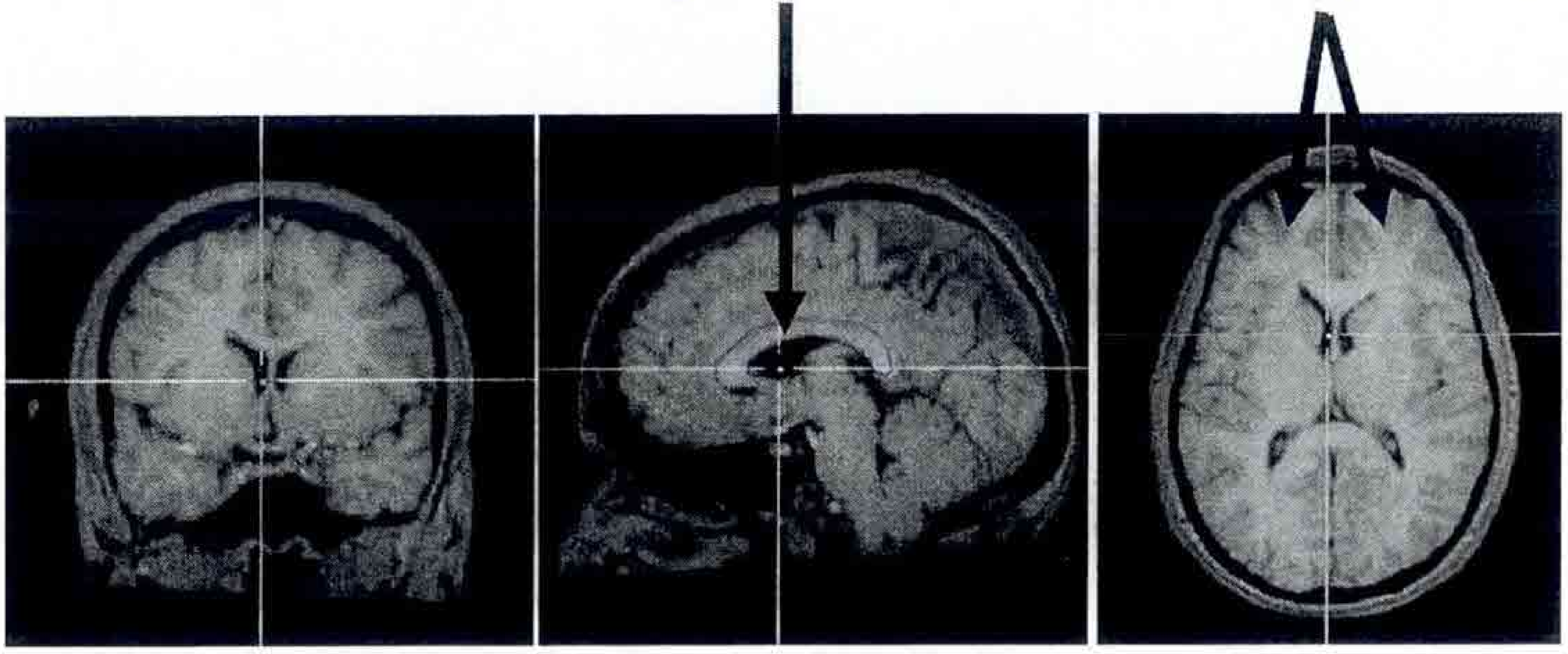
✓ This structure is the lateral ~~vesicle~~ ventricle.

5/6

Write the name of each plane under each figure, and fill the name of the structures marked by the arrows.

× cingulate cortex

✓ ~~left & right hemisphere~~ frontal lobe

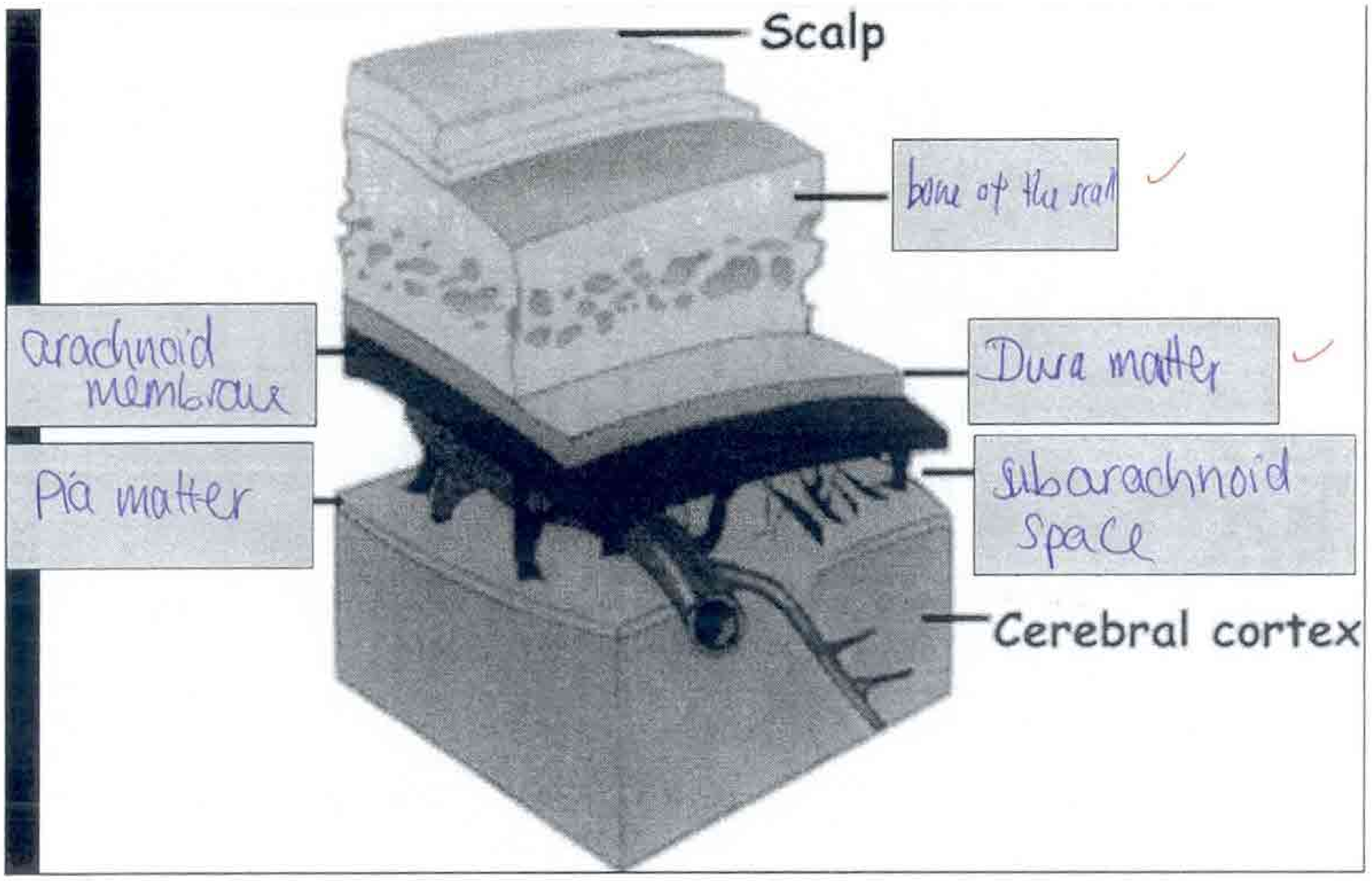


✓ coronal ✓ Sangatle ✓ horizontal

A brain surgeon, who needs to remove a tumor from a sub-cortical structure, will "meet" the following layers on the way:

(5 points)

5/5



13.5/15