

Part A

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

- ✓ 1. The speed with which the largest-diameter (20 mm) myelinated axons in mammals conduct action potentials is:
- a. 120 mm/s.
 - ✓ (b.) 120 m/s.
 - c. 1 m/s.
 - d. 100 m/s.
- ✓ 2. An afterpotential is:
- ✓ (a.) A brief hyperpolarization that follows an action potential (“undershoot”).
 - b. A brief depolarization that follows an action potential (“overshoot”).
 - c. A brief hyperpolarization that follows an EPSP (“undershoot”).
 - d. The portion of an action potential between 0 and +30 mV.
- ✓ 3. The absolute refractory period refers to the brief period of time:
- ✓ (b.) After a neuron has fired an action potential, during which the same neuron cannot fire another action potential.
 - a. During which a postsynaptic receptor cannot bind another neurotransmitter after it has been open.
 - c. After exocytosis and before the release of more neurotransmitter from the presynaptic neuron.
 - d. All of the above.
- ✓ 4. Which plane divides the brain from front to back (parallel to the face)?
- ✓ (c.) Coronal.
 - a. Sagittal.
 - b. Frontal.
 - d. Horizontal.
- ✓ 5. The brain and spinal cord are wrapped in protective membranes known collectively as the:
- ✓ (d.) Meninges.
 - a. Dura mater.
 - b. Pia mater.
 - c. Myelin.
- ✓ 6. Not a part of the cytoskeleton:
- ✓ (b.) Golgi apparatus.
 - a. Microfilaments (Actin).
 - c. Microtubules.
 - d. Intermediate filaments. *neurofilaments.*



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7. Not a part of the Astrocytes' functions:

- ☒ a. Myelination of axons.
☒ b. Structural and nutritional support for neurons.
c. Isolation of the synapse.
d. Blood brain barrier.

8. The term metabotropic refers to:

- a. Electrical synapses.
b. Fast synapses.
☒ c. Ligand-gated ion channels.
☒ d. Slow synapses.

9. Inhibitory postsynaptic potentials differ from excitatory postsynaptic potentials most significantly in their:

- ☒ a. Direction of membrane polarization. *hyper/de*
b. Degree of capacitance.
☒ c. Ease of elicitation.
d. Overall amplitude.

10. Most IPSPs are attributable to the:

- a. Opening of sodium channels. +
b. Closing of potassium channels.
☒ c. Opening of chloride channels. +
☒ d. None of the above.

11. Not a part of the Peripheral Nervous System (PNS):

- ☒ a. The autonomic nervous system. ✓
☒ b. The spinal cord.
c. The cranial nerves.
d. The sympathetic nervous system. ✓

12. Which structure does not contain any parts of the reticular formation?

- ☒ a. Tectum.
☒ b. Forebrain.
c. Hindbrain.
d. Medulla.

13. Functionally, cranial nerves carry which kind of information?

- ☒ a. Motor and sensory.
b. Motor.
c. Sensory.
d. None of the above.

14. The sympathetic nervous system stimulates:

- ☒ a. Digestion.
b. Penile erection.
c. Salivation.
☒ d. Faster heartbeat.

15. Opium contains:

- ☒ a. Morphine.
- b. Heroin.
- c. Naloxone.
- d. All of the above.

16. Why would we want to inhibit neural activity?

- a. Treatment after synaptogenesis.
- b. Sharpening focus of perceptions.
- c. Synchronization of firing.
- ☒ d. b and c.

17. Which technique does not provide information about the *activity* of brain regions?

- a. PET.
- ☒ b. CT.
- c. fMRI.
- d. Autoradiography.

18. The structures of the limbic system are particularly implicated in:

- ☒ a. Emotion and learning.
- b. Sensation.
- c. Motor control.
- d. Sympathetic nervous system control.

19. In most of the population:

- a. All language properties are lateralized to the left-hemisphere. ✓
- b. All language properties are lateralized to the right-hemisphere.
- ☒ c. Most language properties are lateralized to the left-hemisphere, prosody and musical perception are lateralized to the right-hemisphere. ✓
- d. Most language properties are lateralized to the right-hemisphere, prosody and musical perception are lateralized to the left-hemisphere.

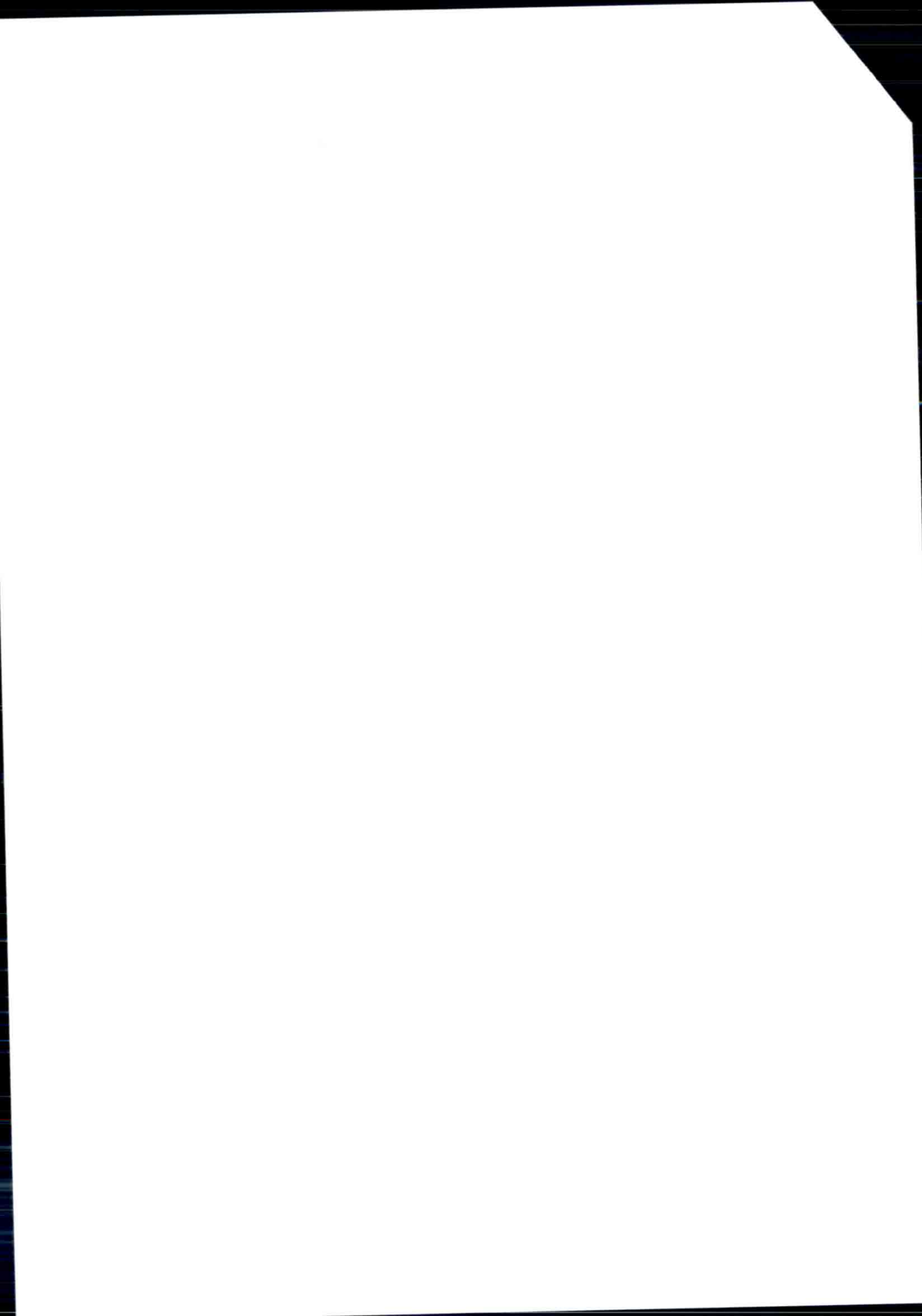
20. Not a neuropeptide:

- a. Vasopressin.
- b. Cholecystokinin
- ☒ c. Nitric oxide.
- d. Substance P.

Part B
Short Answer (40 points)

27/40

- ✓ 1. The cell organelles in which proteins are synthesized: ER.
- ✓ 2. interneuron serve as a bridge between sensory and motor neurons.
- ✗ 3. Nitric oxide performs a type of signaling between neurons and is also involved with the maintenance of smooth blood pressure membrane.
- ✗ 4. Noncompetitive ligands bind to a different modulatory site on the receptor.
- ✓ 5. Benzodiazepines affect the frequency of channel opening in GABA_A receptors.
- ✓ 6. GABA_A receptor is iono tropic, producing inhibitory effects, with a chlorine channel, causing hyper polarization.
- ✓ 7. GABA is cleared from the synapse by reuptake ^{reuptake} and by diffusion.
- ✓ 8. Glycine is an excitatory inhibitory neurotransmitter (circle the correct answer) found in the spinal cord brain (circle the correct answer).
- ✓ 9. Curare and Atropine are Acetylcholine Glutamate (circle the correct answer) agonists/antagonists (circle the correct answer).
- ✗ 10. One brain structure in which Acetylcholine is produced is the raphe nucleus nucleus basalis of mynert.
- ✓ 11. Increased intake of foods containing tryptophan increases / decreases (circle the correct answer) Serotonin production.
- ✓ 12. Black widow venom increases / decreases (circle the correct answer) Acetylcholine release.
- ✓ 13. An fMRI image measures neuronal activity directly indirectly (circle the correct answer).
- ✗ 14. In MRI, the assumption is that different tissues have different relaxation reaction times, creating different signals.
↳ after you take off radio frequency and they go back to pointing to the magnet.

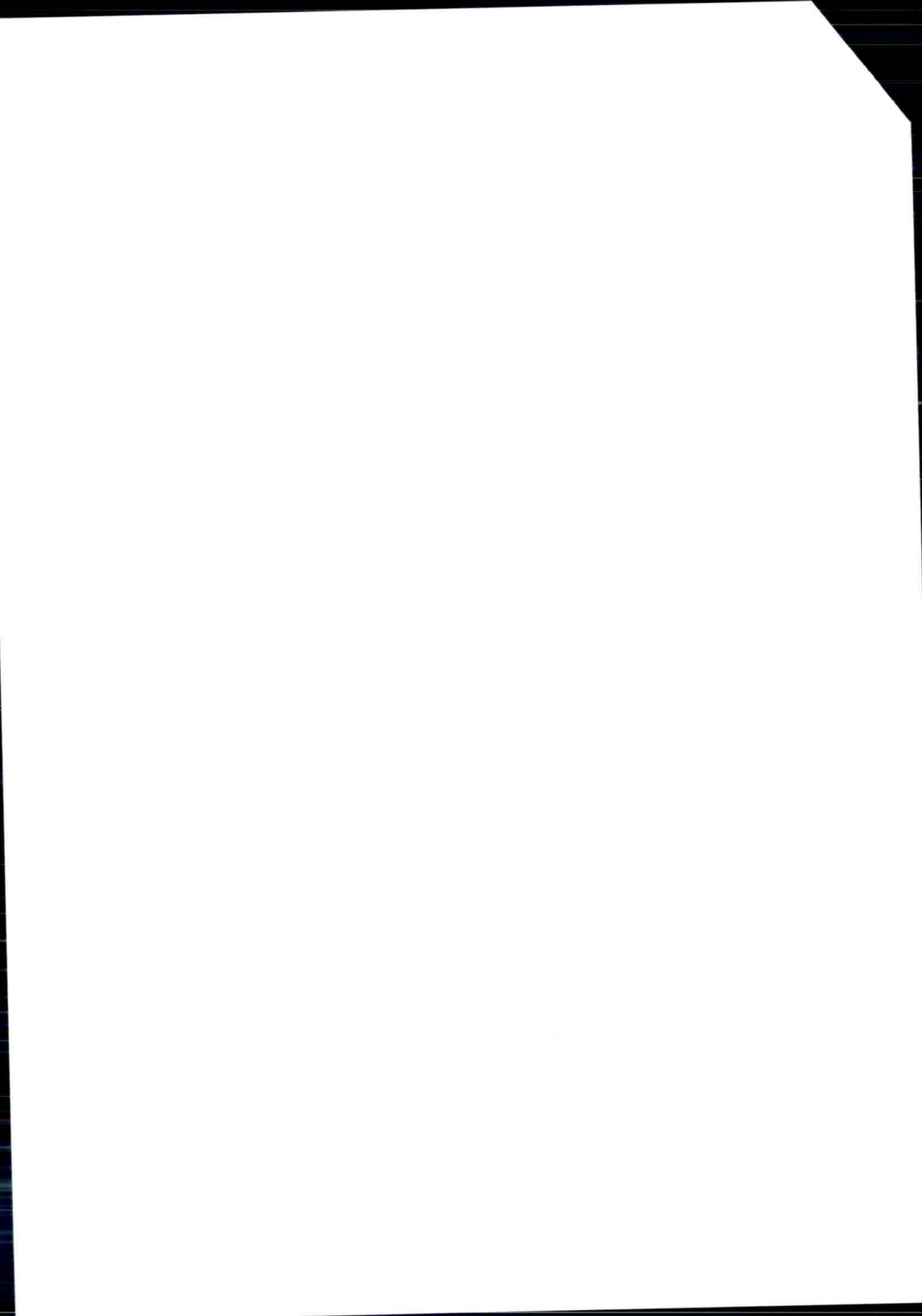


15. The ~~reticular~~ ^{area postrema} formation is a brainstem area, in which the blood-brain-barrier is more permeable, the area triggers vomiting in response to detection of circulating toxins.
16. The cerebral cortex is a structure located at the Hindbrain/Midbrain/Forebrain (circle the correct answer).
17. Broca's area is located near the primary motor cortex in the frontal lobe; it participates in speech production.
18. Parkinson's disease is related to the degeneration of the ~~neurofilaments~~ ^{neurofilaments} ~~neurofibrils~~ (that keep the neuron intact). substantia nigra
19. For an NMDA receptor channel to open, Glutamate neurotransmitter needs to be present, and the membrane needs to be depolarized.
20. The enzyme responsible for breaking down molecules of transmitters such as dopamine, norepinephrine, and serotonin is microglia.
MAO

Part C
Essay Questions (25 points) – answer 5 of 8

25
25
(curare)

- ① Name 5 different exogenous antagonists and describe their function.
2. What is meant by the method of "cognitive subtraction" in functional neuroimaging research? What problems does this method face?
- ③ Describe the causes, process and effects of an action potential.
4. Describe the Cholinergic pathways in the brain and their effects.
- ⑤ Name and explain three fates that can happen to neurotransmitter after it finishes binding to a receptor.
6. Name 3 different brain imaging techniques and compare their temporal and spatial resolutions. Mention the pros and cons.
- ⑦ Name 3 drugs that act on the dopaminergic system and describe their behavioral effects. Cocaine.
- ⑧ Define tolerance and withdrawal, and describe two mechanisms leading to them.



(Use this page for Essay answers. Continue on back if required)

3. An action potential is produced when ~~the~~ the post-synaptic neuron receives enough EPSP. It starts at the axon hillock because it is where sodium-potassium pumps start to appear. Usually the neuron is -70mV when resting and, when an action potential occurs, the intracellular fluid depolarises letting sodium ions in and potassium out of the cell. If the axon is myelinated, the action potential will have a saltatory effect from a node of Ranvier to the other until it arrives to the axon terminal in the form of neurotransmitters in synaptic vesicles that travelled on microtubules. The effect each action potential has on the post-synaptic cell is different depending on what type of neurotransmitter has been sent (e.g. GABA will send an inhibitory effect, glutamate will have an excitatory effect). $\frac{5}{5}$
5. After the neurotransmitter has finished binding to a receptor, three things can happen:
- ① Diffusion - the neurotransmitter diffuses in the extracellular fluid.
 - ② Debris clean-up - Enzymes will clean up the neurotransmitter from the synaptic gap. $\downarrow$ break down
 - ③ Reuptake - transporters bring the neurotransmitter back into the pre-synaptic neuron (might break ~~down~~ down the neurotransmitter) where they are put back into the synaptic vesicles to be used again. (The ones that are broken down will travel back up the axon to the cell to be created as a whole and be used again). $\frac{5}{5}$
8. Tolerance occurs when the body adapts to the drug that is being used by up-down regulation, or the ~~intere~~ organs has become tolerant meaning that you need to consume more of the drug to cause the initial effect. (Up-down regulation = when receptors at the dendrites of the post-synaptic cell diminish (down) or increase in number (up) according to the effect of the drug).

Withdrawal occurs once the person stops using a drug. There are not enough receptors, or too many (depending on the drug) left so that the receptors have to up-down regulate once more to meet with the body's needs. Also, the organs might crave for the drug once it is stopped. Usually, opposite effects, from what the drug used to create, occur.

1. The function of antagonists is to block the normal functioning of a certain receptor. Exogenous means that it has been created outside the body.

- Curare is the antagonist for nicotinic receptors.
 - Atropine is the antagonist for muscarinic receptors.
 - Naloxene is the antagonist of opioide receptors.
 - Marijuana is the antagonist for Glutamate receptors.
 - ~~Cocaine~~ Ecstasy is the antagonist of GABA receptors.
- } Acetylcholine.

7. Dopamine increases the sense of pleasure one feels.

Cocaine blocks reuptake of dopamine so that there is more dopamine resulting in the synaptic gap.

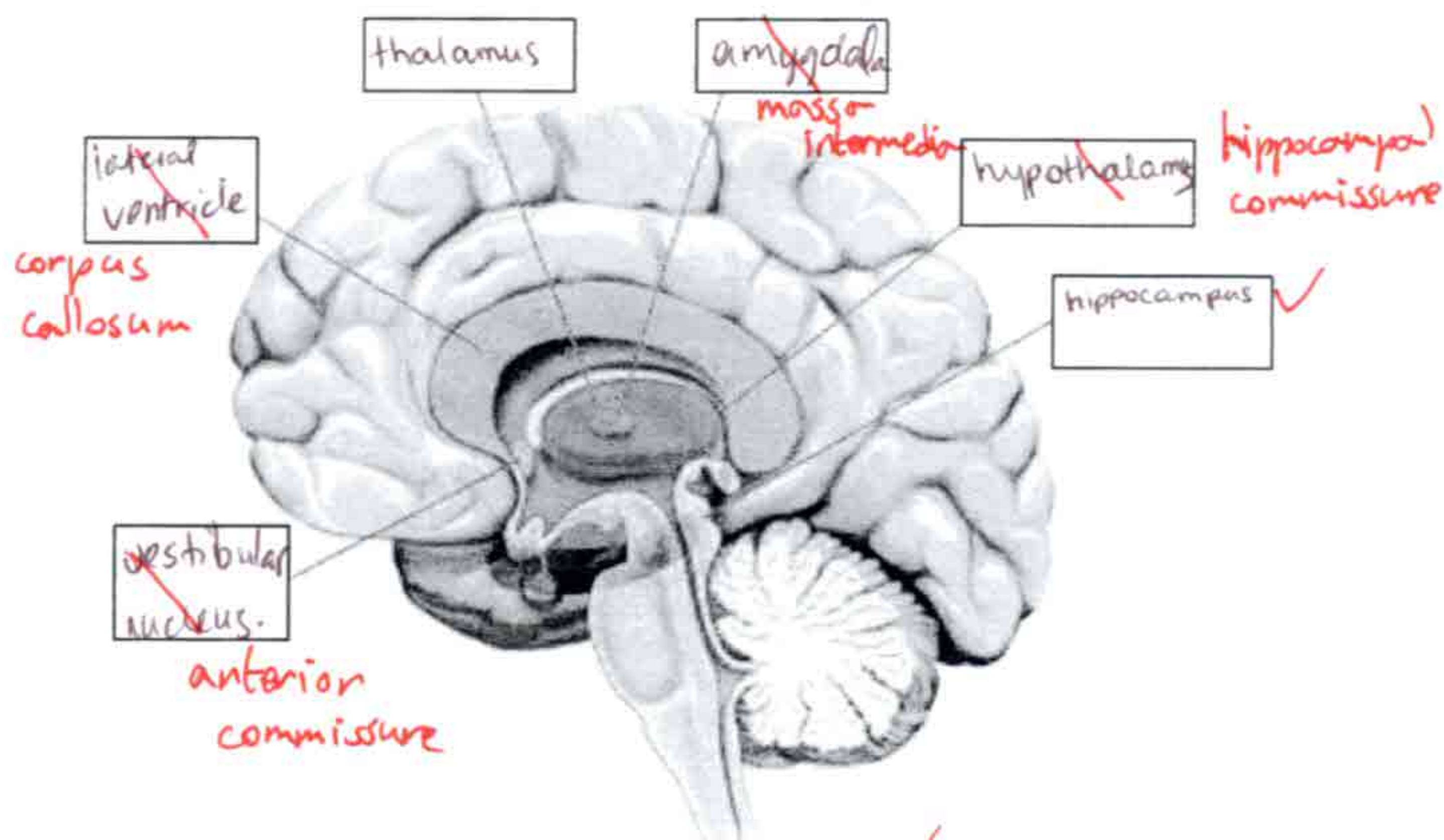
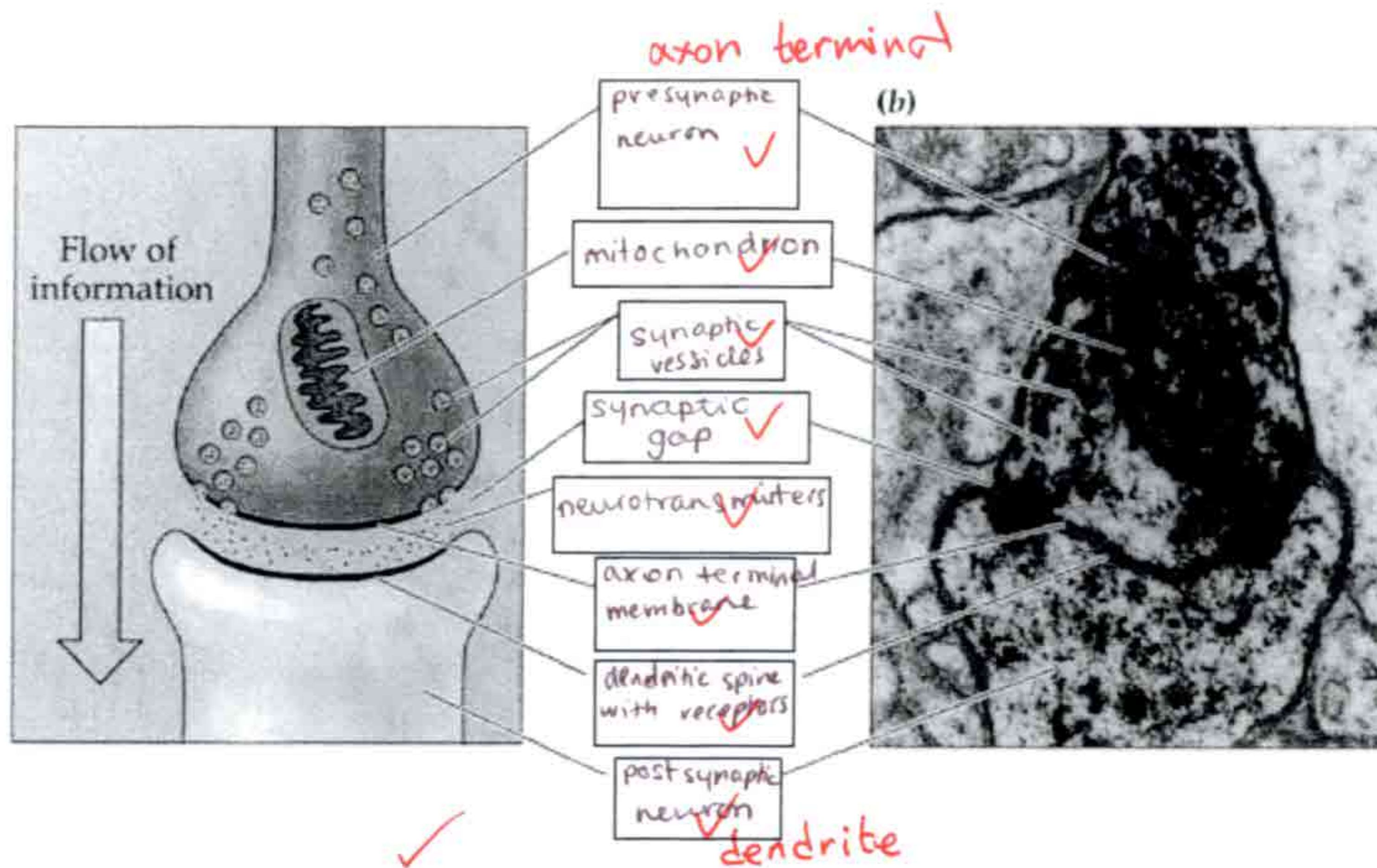
Ecstasy is a dopamine agonist.

Marijuana is a dopamine agonist.

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

11/15



The plane of section in Figure 2 is Sagittal.

