

9.01 Exam #1
September 27, 2004

30 multiple choice questions of equal weight. Choose one answer per question.
Please indicate your choices in CAPITAL LETTERS on the provided answer sheet, NOT on the exam pages.

- 1) The neuron doctrine states that
 - a) Neurites are fused together to form a continuous network
 - b) Neurites are not continuous and communicate by contact
 - c) Neurons must contain a soma, an axon, and dendrites
 - d) DNA is transcribed to mRNA which is translated into protein
- 2) On September 13, 1848, Phineas Gage was the unfortunate victim of an explosion that sent a tamping iron through his head. (This tamping iron was 3'7" long, 1.25" in diameter, and weighed 13.5 lbs.) He miraculously survived the incident. Which glial cells might have played a large role in his defiance of death?
 - a) Schwann cells
 - b) oligodendrocytes
 - c) microglia
 - d) astrocytes
- 3) Knowing what you know about phospholipid bilayers, if you wanted to build your own membrane protein, what would your amino acids need to have in order to stay in the membrane?
 - a) hydrophobic groups
 - b) hydrophilic groups
 - c) ionic selectivity
 - d) heptanary structure
- 4) Golgi and Ramon y Cajal disagreed over the neuron doctrine; their argument was not resolved until the advent of the electron microscope because:
 - a) Synapses are destroyed by the fixation process used for light microscopy; fixatives used for the more sensitive electron microscopy technique preserve the synapse.
 - b) The limit of resolution of the light microscope is 100 nm, whereas the electron microscope has a limit of resolution of 0.1 nm.
 - c) The Golgi stain only stains a small percentage of neurons, and even then not completely; the chances of finding a pair of interconnected neurons is too small to determine whether neurons communicate by contact, not continuity.
 - d) The Nissl stain, which is necessary to resolve synapses, can only be used with the electron microscope.
 - e) The Golgi stain, which is necessary to resolve synapses, can only be used with the electron microscope.
- 5) There are two types of neurites: axons and dendrites. Which of the following is true about these neurites:
 - a) Dendrites are relatively short in length (about 2mm), have a uniform diameter along their entire length, and act as the antennae of the neuron to receive incoming signals or input.
 - b) Axons are relatively long (can be over a meter), if they branch at all, they do so at right angles, and act like "wires" that carry the output of the neurons.
 - c) The power of the Golgi stain is that, unlike the Nissl stain, it reveals the elaborate dendritic structure of the neuron; nevertheless, neither stain fills the axon.
 - d) ALL OF THE ABOVE ARE TRUE
- 6) Charles Bell and Francois Magendie cut dorsal and ventral spinal roots in experimental animals; what were they able to show with these experiments?

- a) That nerves contain a mixture of many nerve fibers, some that carry sensory information from the skin and others that carry motor information to the muscles.
 - b) That sensory and motor information is carried bidirectionally in the same nerves from the skin and to the muscles.
 - c) That the central and peripheral nervous systems are functionally distinct subdivisions, which have no anatomical correlates.
 - d) That ventral roots and dorsal roots carry nerves that primarily supply the autonomic nervous system.
 - e) That ventral roots and dorsal roots carry nerves that primarily supply the somatic nervous system
- 7) Oligodendrocytes and Schwann cells differ in what way:
- a) Oligodendrocytes are found in the central nervous system, whereas Schwann cells are found in the peripheral nervous system.
 - b) Oligodendrocytes are myelinating glia, whereas Schwann cells are microglia
 - c) One oligodendrocyte will surround one axon, whereas each Schwann cell affiliates with several axons.
 - d) Oligodendrocytes form nodes of Ranvier, while Schwann cells do not.
- 8) Kinesin and dynein are proteins that bind microtubules. Which of the following is FALSE?
- a) They convert chemical energy contained in phosphate bonds into mechanical energy.
 - b) They establish plasma membrane composition at the axon terminal by selectively moving different receptor subtypes into and out of the terminal.
 - c) They mediate gene transcription by carrying signaling proteins at the terminal back to the nucleus
 - d) Kinesin is involved in retrograde transport, while dynein is involved in anterograde transport.
 - e) Their function can be hijacked by viruses and neuroscientists to serve their own purposes
- 9) Which of the following is TRUE about ribosomes?
- a) They are necessary for transcription
 - b) They are found dotting the surface of smooth ER
 - c) They are not found in glia
 - d) They bind mRNA
- 10) Which of the following is TRUE about axons?
- a) They are only found in neurons
 - b) They contain rough ER so proteins can be synthesized throughout their length
 - c) You can show retrograde transport of proteins in axons by injecting a cell's soma with radioactive amino acids.
 - d) A & B are true
 - e) B & C are true
- 11) Which of the following values is unnecessary when finding the equilibrium potential of an ion using the Nernst equation?
- a) The temperature
 - b) The ratio of external and internal ion concentrations
 - c) The charge of the ion
 - d) The permeability of the ion channel
- 12) Weaver mice have difficulty maintaining posture and moving normally. This defect has been attributed to a defect in some potassium channels that allows Na^+ as well as K^+ to pass through the channel. Increasing the sodium permeability will have what effect on the membrane potential of the neuron?
- a) The membrane potential will become more negative.
 - b) The membrane potential will become less negative.
 - c) There will be no change in membrane potential.
 - d) There is not enough information to answer this question.

- 13) Assume that Cl^- is more concentrated on the outside of the cell than on the inside of the cell, and that the membrane is selectively permeable to Cl^- . Then we know that:
- The inside of the cell will have a positive voltage at equilibrium.
 - The inside of the cell will have a negative voltage at equilibrium.
 - The inside of the cell will have a voltage of 0 at equilibrium.
 - There is not enough information to answer the question.
- 14) Which of the following gives the ordering of ions in terms of their ionic concentration inside the typical neuron, from highest to lowest?
- K^+ , Na^+ , Ca^{++}
 - Na^+ , K^+ , Ca^{++}
 - Ca^{++} , Na^+ , K^+
 - Ca^{++} , K^+ , Na^+
- 15) The resting membrane potential is close in value to the Nernst equilibrium potential for _____ because _____
- Na^+ / there is a leakage of Na^+ ions through the membrane channels
 - K^+ / there is a leakage of Ca^{++} ions through the membrane channels
 - K^+ / the membrane is very permeable to K^+ ions at rest
 - Na^+ / due to its large driving force
 - Cl^- / because it's the only negatively charged ion
- 16) What effect does an intravenous injection of KCl have on behavior of neurons?
- Extracellular $[\text{K}^+]$ decreases and therefore the membrane potential gets closer to Na^+ equilibrium potential.
 - The membrane potential becomes more negative and it becomes more difficult to generate action potentials.
 - Extracellular $[\text{K}^+]$ increases and therefore the membrane potential gets closer to Na^+ equilibrium potential.
 - None of the above is true
- 17) Photoreceptors in the retina have special channels that are open to Na^+ in the dark. When light hits photoreceptors, these special channels close. What can you conclude from this?
- Photoreceptors depolarize to light.
 - Photoreceptors hyperpolarize to light.
 - Photoreceptor voltage does not change in the presence of light.
 - None of the above
- 18) What constituent of the neuron is responsible for briefly increasing the Na^+ permeability of the membrane during the rising phase of the nerve impulse?
- the sodium-potassium pump
 - the delayed rectifier potassium channel
 - the voltage-gated sodium channel
 - the omniscient consciousness of the neuron
- 19) In class, we saw the Keep on Truckin' man step on a tack. What was the first step (no pun intended) in transferring sensory information about the tack to the brain?
- mechanically sensitive channels in the sensory receptors open in response to membrane deflection, and the neuron is depolarized
 - an action potential happens
 - neurotransmitter is released
 - kinesin molecules are activated
- 20) Which of the following is true about the conduction of action potentials?
- Thicker axons are faster because there is more leakage on thicker axons
 - Myelin speeds conduction because the glial cells add voltage gated Na^+ channels to the

neuron

- c) Nodes of Ranvier prevent the action potential from degrading
 - d) Neurons that don't have myelin sheaths undergo saltatory conduction
- 21) Some have compared the "all or none" action potential to flushing a toilet. The absolute refractory period (when no amount of pressing the lever will produce another flush) is set by:
- a) the inactivation of voltage insensitive potassium channels
 - b) the inactivation of voltage gated calcium channels
 - c) the inactivation of voltage gated delayed rectifier potassium channels
 - d) the inactivation of voltage gated sodium channels
 - e) C and D ARE TRUE
- 22) Some have compared the "all or none" action potential to flushing a toilet. The relative refractory period (when the water level in the tank is below what it is at rest) is set by:
- a) the opening of voltage insensitive potassium channels
 - b) the opening of voltage gated calcium channels
 - c) the opening of voltage gated delayed rectifier potassium channels
 - d) the opening of voltage gated sodium channels
 - e) C and D ARE TRUE
- 23) The reversal potential of acetylcholine receptor channels is close to zero because:
- a) opening of the channel at any given voltage leads to zero current flow
 - b) opening of the channel at resting membrane potential leads to zero current flow
 - c) the channel is a non-selective monovalent cation channel, so the reversal potential is somewhere in between the equilibrium potential for potassium and sodium
 - d) the channel is selectively permeable to potassium, whose equilibrium potential is very close to zero.
- 24) The difference between the neuromuscular junction (NMJ) and most central nervous system synapses is:
- a) The NMJ primarily uses glutamate as a neurotransmitter, whereas CNS synapses do not because they do not have the enzyme required for its synthesis.
 - b) The NMJ is characterized by junctional folds which serve to sequester neurotransmitter away from the receptors; in the CNS synapse the glia perform this function.
 - c) Almost all NMJ synapses have a neurotransmitter release probability close to one (to ensure reliability of transmission) whereas most central synapses have a release probability much less than one (to ensure the integration of many signals).
 - d) All are true
 - e) B and C are true
- 25) In comparing metabotropic and ionotropic receptors which of the following is true:
- a) Both metabotropic and ionotropic receptors undergo a conformational change when they bind the appropriate neurotransmitter.
 - b) Both metabotropic and ionotropic receptors are ion channels.
 - c) For both metabotropic and ionotropic receptors a conformational change leads to hydrolysis of a molecule of GTP.
 - d) All are true
 - e) None are true
- 26) In his pioneering work, Otto Loewi discovered:
- a) Gap junction between cortical cells
 - b) NMDA receptors
 - c) Chemical synaptic transmission
 - d) G-protein coupled receptors
 - e) Presynaptic vesicle release mechanism

- 27) Which of the following statements best characterizes gap junctions?
- a) Gap junctions only allow one-way transmission
 - b) As a rule, chemical transmission is faster than gap junction transmission
 - c) Gap junctions are not permeable to ions
 - d) A gap junction consists of connexons, which are composed of connexins.
 - e) C and D
- 28) Norepinephrine is synthesized from dopamine. Similarly:
- a) Glycine is synthesized from glutamate.
 - b) Glutamate is synthesized from dopamine.
 - c) GABA is synthesized from glutamate.
 - d) Glutamate is synthesized from GABA.
- 29) Vesicular transporters
- a) Move vesicles from the reserve pool to the active zone
 - b) Fill vesicles with neurotransmitter
 - c) Snare vesicles to the membrane
 - d) Return vesicle membranes from the active zone after neurotransmitter release
- 30) Dale's principle states that
- a) Neurotransmitter release is quantal.
 - b) GABA mediates synaptic inhibition in the CNS.
 - c) NMDA receptors act as coincidence detectors.
 - d) A neuron has only one neurotransmitter.
 - e) None of the above

9.01 Exam #1 Answer Sheet

NAME:

RECITATION SECTION (circle one): M T W Th

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