There are 25 questions in this Biology 3058 exam.
All questions are "A, B, C, D, E, F, G, H" questions worth one point each.
There is a total of 25 points in this exam. Fill in your answers on the separate answer sheet.
The format for this exam is:
Fill in A if A is the only correct answer.
Fill in B if B is the only correct answer.
Fill in C if C is the only correct answer.
Fill in D if both A and B are correct (and C is NOT correct).
Fill in E if both A and C are correct (and B is NOT correct).
Fill in F if both B and C are correct (and A is NOT correct).
Fill in G if A and B and C are all correct.
Fill in H if none of the above is correct (A is NOT correct, B is NOT correct, and C is NOT correct).

ONLY MARK ONE LETTER PER QUESTION.

You may keep the question sheets.

Use a dark (black or blue) pencil or dark (black or blue) pen to fill in the answers.

DO NOT USE A RED PEN; DO NOT USE A RED PENCIL.

1. A complete motor neuron is removed from a frog and placed in a large volume of normal physiological saline. The neuron is healthy; it has a stable resting voltage of -70 millivolts. It is not producing any action potentials; its threshold for an action potential is -50 millivolts. The only ligand-gated Receptors in the neuron's plasma membrane are AMPA Receptors, $GABA_B$ Receptors, and glycine Receptors. The equilibrium potential for chloride ions is -70 millivolts, the equilibrium potential for potassium ions is -90 millivolts, and the equilibrium potential for sodium ions is +60 millivolts.
   A. The addition of GABA to the physiological saline will lead to an increase in the chloride conductance of the plasma membrane of the neuron.
   B. The addition of glycine and GABA to the physiological saline will lead to a decrease in the amount of intracellular chloride and a decrease in the amount of intracellular potassium.
   C. The addition of glycine and glutamate to the physiological saline will lead to an increase in the amount of intracellular chloride, an increase in the amount of intracellular sodium, and an increase in the amount of intracellular potassium.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

2. Which of the following occur in response to an increase in the length of the right knee extensors in response to a quick tap applied to the right patellar tendon? An increase in the amount of
   A. glutamate released from central axon terminals of IA muscle-spindle stretch receptor neurons whose peripheral axon terminals are in the right knee extensor muscle.
   B. glutamate bound to AMPA Receptors in the plasma membranes of the muscle fibers of the right knee extensor muscle.
   C. potassium conductance in the plasma membranes of dendrites of right knee extensor motor neurons located in the right side of the spinal cord.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

3. Consider Neuron B in the frog central nervous system whose plasma membrane has a previously unknown channel that is selectively conductive to a newly discovered trivalent anion named TVA with a valence of -3. The threshold for an action potential in Neuron B is -65 millivolts and the resting potential for Neuron B is -70 millivolts. The TVA channel in Neuron B is part of an ionotropic receptor with an extracellular binding site for the newly discovered ligand LGD. When LGD binds to its binding site, there is an increase in the TVA conductance of Neuron B. Neuron A synapses onto Neuron B. Neuron A's neurotransmitter is LGD.
    A. Consider the situation when the extracellular concentration of TVA is 10,000 times greater than the intracellular concentration of TVA. In response to an action potential in Neuron A, there will be: a decrease in the membrane voltage of Neuron B; an inhibitory postsynaptic potential in Neuron B; and an increase in the amount of intracellular TVA in Neuron B.
    B. Consider the situation when the extracellular concentration of TVA is 1,000 times greater than the intracellular concentration of TVA. In response to an action potential in Neuron A, there will be: an increase in the membrane voltage of Neuron B; an excitatory postsynaptic potential in Neuron B; and a decrease in the amount of intracellular TVA in Neuron B.
    C. Consider the situation when the extracellular concentration of TVA is 100 times greater than the intracellular concentration of TVA. In response to an action potential in Neuron A, there will be: an increase in the membrane voltage of Neuron B; an excitatory postsynaptic potential in Neuron B; and a decrease in the amount of intracellular TVA in Neuron B.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

4. Neuron A is a healthy neuron with all the usual ion channels. When at rest with a membrane voltage of R millivolts, neuron A produces no action potentials. The voltage threshold for an action potential in neuron A is T millivolts. T is greater than R; T is less than zero. In addition, neuron A's membrane includes the membrane-spanning molecule Z with an ion channel that opens when neurotransmitter Y binds to the Y receptor site on the extracellular surface of Z. The Nernst equilibrium potential for Z's ion channel is E millivolts. Neuron B synapses on neuron A; neuron B's neurotransmitter is neurotransmitter Y. Which of the following statements are true when neuron A is initially at rest and neuron B releases neurotransmitter Y?
    A. If the value of R is less than E, if the value of E is less than T, and if chloride is the only ion that passes through open Z channels, then Y's binding to its receptor site on Z in neuron A produces an increase in the amount of intracellular chloride ions in neuron A.
    B. If the value of E is zero and if both sodium ions and potassium ions pass through open Z channels, then Y's binding to its receptor site on Z in neuron A produces no change in the amount of intracellular sodium ions in neuron A.
    C. If the value of E is equal to R, and if chloride is the only ion that passes through open Z channels, then Y's binding to its receptor site on Z in neuron A produces no change in the amount of intracellular chloride ions in neuron A.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

5. Consider a system that contains three neurons in a culture dish bathed in normal physiological saline. All three neurons are healthy. Neuron A synapses onto Neuron B. Neuron B synapses onto Neuron C. Neuron A has glycine in its synaptic vesicles. Neuron B has GABA in its synaptic vesicles. The only ligand-gated receptors in Neuron A are AMPA channels. The only ligand-gated receptors in the plasma membrane of Neuron B are glycine receptors. The only ligand-gated receptors in the plasma membrane of Neuron C are $GABA_B$ receptors. All 3 neurons have no other ligand-gated receptors in their plasma membranes. All 3 neurons have a sodium equilibrium potential of +60 millivolts. All 3 neurons have a potassium equilibrium potential of -86 millivolts. All 3 neurons a chloride equilibrium potential of -80 millivolts. The threshold for an action potential in all 3 neurons is -55 millivolts. At 1:55 AM, glutamate is added to the physiological saline. At 2:00 AM, the action potential firing rate of each neuron is 100 Hz. Which of the following will lead to an increase in Neuron C's action potential firing rate?
   A. At 2:01 AM, glycine is added to the bath.
   B. At 2:01 AM, strychnine is added to the bath.
   C. At 2:01 AM, CNQX is added to the bath.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

6. Consider five culture dishes; each dish has one healthy neuron in it. Dish V has Neuron V in it; Dish W has Neuron W in it; Dish X has Neuron X in it; Dish Y has Neuron Y in it; and Dish Z has Neuron Z in it. At 1:00 AM: each neuron is bathed in normal physiological saline; all the neurons have the same properties; and each neuron is at rest with a resting potential of -70 millivolts. Each neuron has only three types of ionotropic ligand-gated receptors: AMPA Receptors, NMDA Receptors, and Glycine Receptors. None of the neurons have metabotropic receptors. Each neuron has a chloride equilibrium potential of +20 millivolts. At 1:55 AM, a large amount of TTX is added to the physiological saline in all five dishes. Ignore any effects due to voltage-gated calcium channels with S4 helices. At 1:58 AM, the amount of intracellular calcium in each neuron is the same as that of each other neuron. At 2:00 AM:
glutamate is added to the physiological saline of Dish V;
glutamate and APV are added to the physiological saline of Dish W;
glutamate and CNQX are added to the physiological saline of Dish X;
glutamate, CNQX, and glycine is added to the physiological saline of Dish Y;
glutamate, CNQX, glycine, and strychnine are added to the physiological saline of Dish Z.
   A. At 2:01 AM, the total calcium conductance in Neuron Y will be greater than the total calcium conductance in Neuron Z. In addition, the total calcium conductance in Neuron X will be less than the total calcium conductance in Neuron V.
   B. At 2:01AM, the total sodium conductance in Neuron X is less than the total sodium conductance in Neuron Y. In addition, the total sodium conductance in Neuron W is less than the total sodium conductance in Neuron V.
   C. For each neuron, MAXV is the maximum voltage that is reached by that neuron during the period from 2:00 AM to 2:02 AM. The MAXV in Neuron W is greater than the MAXV in Neuron X. In addition, the MAXV in Neuron Z is greater than the MAXV in Neuron Y.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

7. Consider Neuron B in the frog central nervous system whose plasma membrane has a newly discovered ligand-gated ionotropic receptor, named the LIGD receptor. The channel in the same molecular complex as the LIGD receptor is termed the LIGD receptor channel. The Nernst equilibrium potential for sodium in Neuron B is 0 mV, and the Nernst equilibrium potential for potassium in Neuron B is -100 mV. The threshold for an action potential in Neuron B is -60 mV and the resting potential for Neuron B is -75 mV. LIGD is an agonist for the ligand-gated ionotropic receptor. When LIGD binds to its binding site, there is an increase in conductance of the LIGD receptor channel. Neuron A synapses onto Neuron B. Neuron A's transmitter is LIGD.
    A. Consider the situation that when the LIGD receptor channel is open in Neuron B, it is permeable to both sodium and potassium. For this situation, when open, it is permeable to no other ions. For this situation, when open, its potassium conductance equals two times its sodium conductance. For this situation, in response to an action potential in Neuron A, then there will be a voltage increase and an excitatory postsynaptic potential in Neuron B.
    B. Consider the situation that when the LIGD receptor channel is open in Neuron B, it is permeable to sodium only. For this situation, when open, it is permeable to no other ions. For this situation, in response to an action potential in Neuron A, then there will be a voltage increase and an excitatory postsynaptic potential in Neuron B.
    C. Consider the situation that when the LIGD receptor channel is open in Neuron B, it is permeable to both sodium and potassium. For this situation, when open, it is permeable to no other ions. For this situation, when open, its potassium conductance equals three times its sodium conductance. For this situation, in response to an action potential in Neuron A, then there will be a voltage decrease and an inhibitory postsynaptic potential in Neuron B.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

8. Which of the following is an agonist that binds to a receptor site that is part of a ligand-gated metabotropic receptor?
    A. Muscarine.
    B. GABA.
    C. ACh (acetylcholine).
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

9. Which of the following is an antagonist that binds to a receptor site that is part of a ligand-gated ionotropic receptor?
    A. Curare.
    B. Muscarine.
    C. Strychnine.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

10. Which of the following is true for both the $GABA_A$ receptor and the $GABA_B$ receptor?
    A. Each type of receptor is always linked to its associated ion channel via a G-protein.
    B. GABA is an antagonist for each type of receptor.
    C. A chloride channel is associated with each type of receptor.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

11. A healthy skeletal muscle fiber is isolated and has no external forces on it. It has normal intracellular levels of ATP and is bathed in physiological saline. Which of the following occur in response to an action potential in the plasma membrane of the muscle fiber?
    A. An increase in the amount of calcium ions bound to troponin.
    B. An increase in the amount of Dihydropyridine (DHP) bound to DHP Receptors in the membranes of the sarcoplasmic reticulum.
    C. An increase in the calcium conductance of the channel associated with the Ryanodine Receptor in the membranes of the transverse tubules.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

12. Which of the following is true in a skeletal muscle?
    A. The binding of calcium to tropomyosin causes movement of troponin so that the troponin no longer blocks binding sites on actin for energized myosin heads.
    B. The head of a myosin molecule is activated (energized) during the hydrolysis of GTP (which is bound to the myosin head) to GDP and P_i.
    C. During rigor mortis, myosin heads that are already attached to actin molecules remain attached to the actin molecules due to no ATP or very low levels of ATP in the cytosol of the muscle.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

13. In the sarcomere of a skeletal muscle, there are
    A. myosin molecules in the I band.
    B. both tropomyosin and myosin molecules in the region of the A band that is not in the H zone.
    C. actin molecules in the H zone.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

14. An increase in the calcium conductance of all sarcoplasmic reticulum membranes of a skeletal muscle with no external forces on it leads to
    A. increased binding of calcium ions to tropomyosin.
    B. a decrease in the amount of ATP molecules in the cytoplasm of the muscle.
    C. a decrease in the amount of calcium ions in the sarcoplasmic reticulum.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

15. Which of the following is true for a skeletal muscle?
    A. During a shortening contraction of the muscle, there is an increase in the amount of calcium ions in the sarcoplasmic reticulum of every sarcomere of the muscle.
    B. During a lengthening contraction of the muscle, there is an increase in the length of the overlap region between the thick and thin filaments (= the region of the A band not in the H zone) in every sarcomere of the muscle.
    C. During a lengthening contraction of the muscle, the length of the H zone will decrease in every sarcomere of the muscle.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

16. When the overlap between the thin and thick filaments of a sarcomere in a skeletal muscle is decreasing,
    A. the length of the A band is constant in the sarcomere.
    B. the total length of the I band plus the length of the A band minus the length of the H zone is constant in the sarcomere.
    C. the total length of the I band minus the length of the H zone is constant in the sarcomere.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

17. Which of the following events occur at the same time, or nearly at the same time, during the cardiac cycle of a healthy person?
    A. The P wave of the EKG and decreases in membrane voltage of atrial muscle cells.
    B. The T wave of the EKG and decreases in membrane voltage of ventricular muscle cells.
    C. The QRS complex of the EKG and opening of the AV valves.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

18. Which of the following serves as an effector, or as part of an effector, in a negative feedback system?
    A. Action potentials in parasympathetic neurons that release ACh (acetylcholine) near SA node cells of the heart.
    B. Action potentials in ventricular muscle cells of the heart.
    C. Action potentials in SA node cells of the heart.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

19. At 1:00 AM, person X's blood pressure is equal to the blood pressure set point. At 1:01 AM, there is an increase in the firing rate of carotid artery baroreceptors.
    A. This will lead to a decrease in the amount of NE (norepinephrine) released near the SA node of the heart.
    B. This will lead to a decrease in the heart rate.
    C. This will lead to a decrease in the diameter of the arterioles.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

20. The axons of all the baroreceptors in the body were destroyed at 2 AM. All else is normal. Which of the following statements is true for the system at 2:10 AM when compared to their values at 1:50 AM?
    A. Blood pressure will decrease.
    B. Arteriolar diameter will decrease.
    C. The firing rate of parasympathetic neurons innervating the SA node of the heart will decrease.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

21. Which of the following is true for SA node cardiac muscle cells?
    A. An increase in the binding of norepinephrine to alpha-adrenergic receptors in SA node cells will lead to an increase in intracellular levels of cAMP in these cells.
    B. An increase in intracellular levels of cAMP in SA node cells will lead to an increase in the amount of time between two successive action potentials in SA node cells.
    C. An increase in the binding of acetylcholine to nicotinic ACh receptors in SA node cells will lead to a decrease in heart rate.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

22. Which of the following will lead to a decrease of total peripheral resistance?
    A. An increase in the diameter of every arteriole.
    B. A decrease of firing rate in all the sympathetic neurons that innervate smooth muscles that surround arterioles.
    C. A decrease in the firing frequency of all the carotid artery baroreceptors.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

23. A decrease in parasympathetic discharge to the heart leads to
    A. an increase in the conductance of F-channels in SA node cells.
    B. an increase in the conductance of potassium channels associated with muscarinic ACh receptors in SA node cells.
    C. an increase in the amount of ACh (acetylcholine) released near SA node cells of the heart.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

24. Which of the following are true for the SA node cardiac muscle cells?
    A. F-channel conductance will increase only when SA node cell membrane voltage is greater than -40mv.
    B. An increase in the binding of acetylcholine to nicotinic ACh receptors in the plasma membranes of the SA node cells will lead to a decrease in heart rate.
    C. An increase in the binding of norepinephrine to beta-adrenergic receptors in the plasma membranes of SA node cells will lead to an increase in heart rate.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

25. The AV node of a mammalian heart is destroyed.
    A. The firing rate of the cells in the right bundle branch will be the same as the firing rate of the cells in the left bundle branch.
    B. A depolarization in a cell in the left atrium will cause a depolarization of a cell in the left ventricle.
    C. The rate of ventricular contractions will be lower than the rate of atrial contractions.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.