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. Consider Neuron B in the frog central nervous system whose plasma membrane has a newly discovered ligand-gated ionotropic receptor, named the LGD receptor. The channel in the same molecular complex as the LGD receptor is termed the LGD receptor channel and is a monovalent cation channel that, when open, is permeable to both sodium and potassium. The Nernst equilibrium potential for sodium in Neuron B is +60 mV, and the Nernst equilibrium potential for potassium in Neuron B is -90 mV. The threshold for an action potential in Neuron B is -65 mV and the resting potential for Neuron B is -75 mV. LGD is an agonist for the ligand-gated ionotropic receptor. When LGD binds to its binding site, there is an increase in conductance of both sodium and potassium in the LGD receptor channel. Neuron A synapses onto Neuron B. Neuron A's transmitter is LGD.
    A. Consider the situation that when the LGD receptor channel is open in Neuron B, its potassium conductance equals 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 LGD receptor channel is open in Neuron B, its potassium conductance equals four 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.
    C. Consider the situation that when the LGD receptor channel is open in Neuron B, its potassium conductance equals nine 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.

2. Which of the following is an agonist that binds to a receptor site that is part of a ligand-gated ionotropic receptor?
    A. GABA.
    B. AMPA.
    C. NMDA.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

3. Consider a system that contains two neurons and one cardiac SA node cell in a culture dish bathed in normal physiological saline. All three cells are healthy. Neuron A synapses onto Neuron B. Neuron B synapses onto the SA node cell. Neuron A has glycine in its synaptic vesicles. Neuron B has acetylcholine (ACh) in its synaptic vesicles. The only ligand-gated channels in the plasma membrane of Neuron A are AMPA receptors. The only ligand-gated channels in the plasma membrane of Neuron B are glycine receptors. Both neurons have no metabotropic receptors in their plasma membranes. Neuron A, Neuron B, and the SA node cell each have a chloride equilibrium potential of -80 millivolts, a potassium equilibrium potential of -86 millivolts, and a sodium equilibrium potential of +60 millivolts. The threshold for an action potential in all 3 cells is -55 millivolts. The SA node cell has its usual set of molecules. At 1:00 AM, Neuron A's action potential firing rate is 100 Hz, Neuron B's action potential firing rate is 100 Hz, and the SA node cell's action potential firing rate is 1.00 Hz. Which of the following will lead to a decrease in the SA node cell's action potential firing rate?
   A. At 1:01 AM, glutamate is added to the bath.
   B. At 1:01 AM, strychnine is added to the bath.
   C. At 1:01 AM, acetylcholine (ACh) 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.

4. Which of the following is true?
   A. Erythropoietin (EPO) acts by increasing the production of red blood cells by cells in the kidney.
   B. Erythropoietin (EPO) is secreted by peritubular interstitial cells of the bladder.
   C. Erythropoietin Receptors (EPORs) in the blood plasma serve as an actuating signal in a long-term negative feedback loop that controls the amount of oxygen in the peritubular interstitial spaces of the kidney cortex.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

5. Which of the following are true for ventilation?
   A. The problems with ventilation induced by injection of curare occur because of the drug's direct action on nicotinic ACh Receptors (nAChRs) in the plasma membranes of the respiratory muscles (the diaphragm and the rib-cage muscles).
   B. An increase in the hydrogen ion concentration in the interstitial spaces of the brain stem leads to an increase in the duration of the respiratory cycle (duration of respiratory cycle equals duration of inspiration plus duration of expiration).
   C. When the pressure within the alveoli is greater than atmospheric pressure, there will be inspiration of air into the lungs.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

6. Which of the following serves as a controlled variable in a negative feedback system?
   A. Blood plasma levels of hydrogen ions in the carotid artery.
   B. Blood plasma levels of erythropoietin (EPO).
   C. Levels of hydrogen ions in the interstitial spaces of the brainstem.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

7. Which of the following serves as an actuating signal, or as part of an actuating signal, in a negative feedback system?
   A. Action potentials in the fibers of the diaphragm muscle.
   B. Action potentials in motor neurons that release glutamate as their neurotransmitter and synapse upon the diaphragm muscle.
   C. Action potentials in peripheral hydrogen-ion-sensitive chemoreceptor neurons whose peripheral processes are located in the walls of the carotid artery.
   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 processes in capillaries in a leg assist in the removal of carbon dioxide from the body?
   A. Net flux of carbon dioxide from red blood cells into plasma.
   B. Net flux of bicarbonate from plasma into red blood cells.
   C. Formation of carbonic acid by carbonic anhydrase in red blood cells.
   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 processes occur in the lung?
   A. Removal of oxygen from hemoglobin in response to high levels of hydrogen ions in red blood cells in the lung.
   B. Binding of oxygen to hemoglobin in response to high partial pressures of oxygen in red blood cells in the lung.
   C. Net flux of oxygen from red blood cells into the plasma in capillaries of the lung.
   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 serves as an effector, or as part of an effector, in a negative feedback system?
    A. Myosin molecules in rib cage inspiratory muscles.
    B. Insulin Receptors in the diaphragm muscle.
    C. Dihydropyridine Receptors (DHPRs) in the diaphragm muscle.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

11. During ventilation in a human,
    A. the volume of the lung can be changed by the movements of skeletal muscles that are inside the lung.
    B. the diaphragm muscle contracts normally even in the absence of action potentials in the motor neurons that innervate the diaphragm muscle.
    C. the volume of the lung can be changed by movements of the diaphragm muscle.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

12. Two compartments of equal volume of physiological saline are separated by a membrane permeable only to oxygen. At 1:00 AM, equal amounts of oxygen are dissolved into both left and right compartments. At 3:00 AM, healthy red blood cells are prepared so that they contain no oxygen. At 3:05 AM, these cells are placed into the right compartment. For this question, ignore effects of cellular respiration in the red blood cells.
    A. At 4:00 AM, the amount of extracellular oxygen in the right compartment will be less than the total amount of oxygen in the right compartment at 2:00 AM.
    B. At 4:00 AM, the total amount of oxygen in the left compartment will be equal to the amount of extracellular oxygen in the right compartment at 4:00 AM.
    C. At 4:00 AM, the total amount of oxygen (extracellular, intracellular bound, and intracellular unbound oxygen) in the right compartment will be greater than the total amount of oxygen in the left compartment at 4:00 AM.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

13. Healthy Person P takes a drug that produces a strong effect on the epithelial cells of the kidney collecting duct within one hour and lasts for one week after taking the drug. One day after taking the drug, which of the following will produce a condition with the symptoms of diabetes insipidus in Healthy Person P?
    A. Drug A that blocks endocytosis of AQP2 for one week.
    B. Drug B that results in continuous very low levels of intracellular cyclic AMP (cAMP) for one week.
    C. Drug C is an antagonist at V2 receptors and it remains bound to V2 receptors for one week.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

14. Consider the case of a rare mutant in which the concentration of solutes in the kidney medulla interstitial spaces is equal to the concentration of solutes in the liquid in the lumen of the collecting duct. The defective molecules associated with this rare mutation are **NOT** located in the epithelial cells of the kidney collecting duct; the defective molecules are located in other cells of the kidney. In this rare mutant, an increase in the amount of vasopressin that binds to V2 receptors in the kidney will lead to an increase in
    A. the net flux of water from the luminal spaces of the collecting duct to the interstitial spaces of the kidney medulla.
    B. the water permeability of the luminal membranes of the collecting duct epithelial cells.
    C. the amount of water that is reabsorbed into the blood plasma from the lumen of the collecting duct.
    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 processes assist in the maintenance of high levels of dissolved solutes in the interstitial spaces of the kidney medulla?
    A. Net flux of sodium ions from intracellular spaces to interstitial spaces via sodium-potassium-ATPase pumps located in the basolateral membranes of the epithelial cells in the ascending limb of the Loop of Henle.
    B. Net flux of sodium from interstitial spaces to intracellular spaces via the sodium-potassium-2chloride co-transporters located in the basolateral membranes of the epithelial cells in the ascending limb of the Loop of Henle.
    C. Net flux of sodium ions from luminal spaces to intracellular spaces via the sodium-glucose co-transporters located in the luminal membranes of the epithelial cells in the ascending limb of the Loop of Henle.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

16. Which of the following is true for the epithelial cells of the kidney proximal tubule?
    A. The sodium-glucose co-transporter in the basolateral membrane is responsible for the net flux of glucose from intracellular space to interstitial space.
    B. The sodium-potassium pump in the basolateral membrane is responsible for the net flux of sodium from interstitial space to intracellular space.
    C. The GLUT4 transporter in the basolateral membrane is responsible for the net flux of glucose from intracellular space to interstitial space.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

17. Patient X is no longer able to produce vasopressin. All parts of X's kidney are normal. X is continuously given high doses of vasopressin directly into X's blood plasma. While X is on these high doses,
    A. X will have a high water permeability in the luminal membranes of X's medullary collecting ducts.
    B. X will need to drink large amounts of water to survive.
    C. X will produce small volumes of urine.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

18. A new drug named AGON-V2R has been developed that is a V2 receptor agonist. When AGON-V2R binds to a V2 receptor, there is activation of G proteins that are normally activated by binding of vasopressin to that V2 receptor. AGON-V2R will help relieve some of the problems for which of the following patients?
    A. A patient with neurogenic diabetes insipidus who produces no vasopressin.
    B. A patient with nephrogenic diabetes insipidus caused by a mutation in the AQP2-channel gene.
    C. A patient whose blood plasma vasopressin (ADH) levels are always very high due to a tumor whose cells are vasopressin-containing neurosecretory cells that continuously secrete high levels of vasopressin into the blood plasma.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

19. Healthy Person Z takes a new drug named CAMPCOLLDUCTUP that results in continuous very high values of cyclic AMP (cAMP) in medullary collecting duct epithelial cells. A single dose of the new drug works within one hour and lasts for one week. Which of the following is true for Z one day after taking the new drug?
    A. The total amount of AQP2 channels stored in Z's intracellular vesicles of collecting duct epithelial cells will be higher than pre-drug levels.
    B. Z's urine will be very similar to the urine of a patient with nephrogenic diabetes insipidus.
    C. Water permeability of Z's luminal membranes of collecting duct epithelial cells will be lower than pre-drug levels.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

20. Which of the following is true for the G.I. (Gastro-Intestinal) system?
    A. Smooth muscles directly control the movement of substances at the entrance of the G.I. system.
    B. Skeletal muscles control the movement of substances in the small intestine.
    C. The external anal sphincter is a skeletal muscle that helps control the timing of removal of solid waste products from the G.I. system.
    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?
    A. Pancreatic amylase is produced in the pancreas and secreted into the small intestine; in the small intestine, it breaks down proteins into small chains of amino acids.
    B. Trypsinogen is produced in the pancreas and secreted into the small intestine; in the small intestine, it is converted into its active form by the enzyme enterokinase; the enzyme enterokinase is located in the membranes of cells in the walls of the small intestine.
    C. Pepsinogen is produced by cells in the stomach and is converted into its active form by HCl in the lumen of the stomach.
    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 is true?
    A. Glycogen binding to Glycogen Receptors in the plasma membranes of liver cells leads to an increase in the exocytosis of GLUT2 Transporters into the plasma membrane of liver cells.
    B. Glycogen production in the liver increases in response to an increase in blood plasma levels of insulin.
    C. Glycogen is secreted by alpha-islet cells of the pancreas.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

23. Person W is a healthy human who has volunteered to take experimental drug Z. Person W has a normal dinner at 6 PM on May 1 and then does not eat for 12 hours. At 6 AM on May 2, W takes a dose of Z that completely blocks the net flux of glucose via all GLUT2 transporters in the beta-islet cells of the pancreas for 24 hours. Drug Z has no effect on any other cells. Person W has a normal dinner at 6 PM on May 2 and then does not eat for 12 hours.
    A. At 8 PM on May 2, W's blood plasma levels of glucose will be much higher than W's blood plasma levels of glucose at 8 PM on May 1.
    B. At 8 PM on May 2, the potassium conductance of the ATP-sensitive potassium channels in W's beta-islet cells will be higher than potassium conductance of the ATP-sensitive potassium channels in W's beta-islet cells at 8 PM on May 1.
    C. At 8 PM on May 2, the glucose permeability of W's skeletal muscle cells will be much higher than the glucose permeability of W's skeletal muscle cells at 8 PM on May 1.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

24. Person X is a healthy human who has volunteered to take experimental drug Y. Person X has a normal dinner at 6 PM on April 1 and then does not eat for 12 hours. At 2 AM on April 2, X takes a dose of Y that closes all the ATP-sensitive potassium channels in X's beta-islet cells of the pancreas for 6 hours. For this question, ignore any effects due to alpha-islet cells of the pancreas.
    A. At 3 AM, X's blood plasma levels of insulin will be lower than X's blood plasma levels of insulin at 1 AM.
    B. At 3 AM, X's blood plasma levels of glucose will be higher than X's blood plasma levels of glucose at 1 AM.
    C. At 3 AM, the glucose permeability of X's skeletal muscle cells will be higher than the glucose permeability of X's skeletal muscle cells at 1 AM.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

25. Insulin binding to insulin receptors in the plasma membrane of a
    A. skeletal muscle cell will lead to an increase in exocytosis of GLUT4 Transporters into the plasma membrane of the skeletal muscle cell.
    B. liver cell will lead to an increase in the intracellular amounts of cAMP in the liver cell.
    C. beta-islet cell of the pancreas will lead to an increase in the glucose permeability of the plasma membrane of the beta-islet cell.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.