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 modified extracellular 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, $GABA_A$ Receptors, and glycine Receptors. The equilibrium potential for chloride ions is -70 millivolts, the equilibrium potential for potassium ions is -80 millivolts, and the equilibrium potential for sodium ions is +60 millivolts.
    A. The addition of GABA to the physiological saline will lead an increase in chloride conductance.
    B. The addition of GABA and glutamate to the physiological saline will lead to an increase in the amount of intracellular sodium, a decrease in the amount of intracellular potassium, and an increase in the amount of intracellular chloride.
    C. The addition of glycine to the physiological saline will lead to an increase in the amount of intracellular chloride.
    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 after an increase in the length of the right knee extensor muscle that happens after a quick tap is applied to the right patellar tendon?
    A. An increase in the amount of ACh (acetylcholine) released from the central axon terminals of IA muscle-spindle stretch receptor neurons that synapse directly upon right knee extensor skeletal muscle fibers.
    B. An increase in the amount of potassium conductance in the plasma membranes of the peripheral axon terminals of IA muscle-spindle stretch receptor neurons whose peripheral terminals are in the right knee extensor muscle.
    C. A decrease in the amount of calcium in the sarcoplasmic reticulum of muscle fibers in the right knee extensor muscle.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

3. The SA node of a mammalian heart is destroyed. All other parts of the heart are normal and healthy.
    A. The firing rate of cells in the Bundle of His will be equal to the firing rate of ventricular muscle cells.
    B. The firing rate of atrial muscle cells will be greater than the firing rate of ventricular muscle cells.
    C. The firing rate of AV node cells will be equal to the firing rate of atrial muscle cells.
    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 processes in capillaries near body cells in the leg assist in the removal of carbon dioxide from the body?
    A. Formation of carbonic acid from carbon dioxide and water by carbonic anhydrase in red blood cells.
    B. Net flux of bicarbonate from red blood cells into blood plasma.
    C. Net flux of carbon dioxide from blood plasma into 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.

5. Which of the following is true?
    A. The blood plasma levels of bicarbonate in the pulmonary artery are lower than the blood plasma levels of bicarbonate in the pulmonary vein.
    B. The partial pressure of oxygen in the blood plasma in the pulmonary artery is lower than the partial pressure of oxygen in the blood plasma in the pulmonary vein.
    C. The percent Hemoglobin saturation (percent of oxygen-binding sites in Hemoglobin that have oxygen bound) in the red blood cells in the pulmonary artery is higher than the percent Hemoglobin saturation in the red blood cells in the pulmonary vein.
    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 processes help bring oxygen to the body cells that are in a leg?
    A. An increase in hydrogen ion concentration in the cytosol of red blood cells in the body capillaries in the leg.
    B. Binding of oxygen to hemoglobin in red blood cells in the body capillaries in the leg in response to a high partial pressure (concentration) of oxygen in the body capillaries in the leg.
    C. Net flux of oxygen from interstitial space into blood plasma in the capillaries in the leg.
    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 is a controlled variable in a negative feedback system?
   A. Levels of vasopressin in the blood plasma in capillaries of the kidney medulla.
   B. Levels of erythropoietin (EPO) in the blood plasma in capillaries near bone marrow cells.
   C. Levels of hydrogen ions in the blood plasma in 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 is true for red blood cells?
   A. Carbonic anhydrase is a spanning protein in the plasma membrane of red blood cells responsible for the net flux of bicarbonate across the plasma membrane.
   B. Anion Exchanger 1 (AE1) is an enzyme in the cytosol of red blood cells responsible for formation of carbonic acid from hydrogen ions and bicarbonate.
   C. Hemoglobin is a spanning protein in the plasma membrane of red blood cells with binding sites for oxygen on the extracellular portion of the protein.
   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 true for ventilation?
   A. When the pressure within the alveoli is less than atmospheric pressure, there will be expiration of air from the lungs into the atmosphere.
   B. The problems with ventilation induced by injection of curare occur because of the drug's binding to Nicotinic Acetylcholine Receptors (nAChRs) in the membranes of the sarcoplasmic reticulum in the respiratory muscles (the diaphragm and the rib-cage muscles).
   C. An increase in the hydrogen ion concentration in the interstitial spaces of the brainstem leads to a decrease in the duration of the respiratory cycle (duration of respiratory cycle equals duration of inspiration plus duration of expiration).
   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 are involved in the long-term regulation of the oxygen-carrying capacity of the blood?
   A. Changes in the total amount of red blood cells in the blood.
   B. Secretion of the hormone erythropoietin (EPO) from peritubular interstitial cells (PIC) of the renal cortex in response to low partial pressure levels of oxygen in the interstitial spaces of the renal cortex.
   C. Changes in the amount of red blood cells produced by bone marrow cells in response to EPO binding to EPO Receptors in the plasma membranes of the bone marrow cells.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

11. Which of the following cells serve as both a sensor and a controller, or contain both a sensor and a controller, for a negative feedback system?
    A. Bone marrow cells.
    B. Beta islet cells of the pancreas.
    C. Peritubular interstitial cells (PIC) of the renal cortex.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

12. In epithelial cells of the small intestine, which of the following are involved in processes that contribute to the absorption of glucose from the lumen of the small intestine into the blood plasma?
    A. Net flux of sodium across the basolateral membranes of the epithelial cells from intracellular spaces to interstitial spaces via sodium-potassium ATPase pumps.
    B. Net flux of glucose across the basolateral membranes of the epithelial cells from intracellular spaces to interstititial spaces via SGLT1 transporters (sodium-glucose transporters 1).
    C. Net flux of glucose across luminal membranes of the epithelial cells from intracellular spaces to luminal spaces via GLUT2 transporters.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

13. Which of the following is true?
    A. Trypsinogen is produced in the pancreas and is secreted into the lumen of the small intestine. It is converted into trypsin by enterokinase. Enterokinase is located in the membranes of cells in the walls of the small intestine. In the lumen of the small intestine, trypsin breaks proteins down into small chains of amino acids.
    B. Pancreatic amylase is produced in the pancreas and is secreted into the lumen of the small intestine. In the small intestine, it breaks down carbohydrates into double sugars.
    C. Pepsinogen is produced by cells in the walls of the small intestine and is secreted into the lumen of the small intestine. It is converted into pepsin by HCl in the lumen of the small intestine. In the small intestine, it converts triglycerides into monoglycerides and fatty acids.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

14. Which of the following is true for the epithelial cells of the early proximal tubule of the kidney?
    A. The GLUT2 transporter in the basolateral membrane is responsible for the net flux of glucose from interstitial space to intracellular space.
    B. The sodium-potassium ATPase pump in the basolateral membrane is responsible for the net flux of sodium from interstitial space to intracellular space.
    C. The SGLT2 cotransporter in the luminal membrane is responsible for the net flux of glucose from intracellular space to luminal space.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

15. Healthy Person P takes a drug that produces a condition with a strong effect on the epithelial cells of the kidney medullary collecting duct within one hour and lasts for one week after taking the drug. There is no direct effect of the drug on other cells in the body. One day after taking the drug, which of the following drugs will produce a condition with the symptoms of diabetes insipidus in Healthy Person P?
    A. Drug X that stimulates exocytosis of AQP2 and blocks endocytosis of AQP2 for one week in the epithelial cells of the kidney medullary collecting duct.
    B. Drug Y that is an antagonist at V2 receptors that remains bound to V2 receptors in the basolateral membranes of the epithelial cells of the kidney medullary collecting duct for one week.
    C. Drug Z that produces a condition in which the amounts of cytosolic cAMP in the epithelial cells of the kidney medullary collecting duct are very high 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.

16. You are presented with patient X who has a genetic disease. You discover a mutation in all aquaporin2 (AQP2) channels manufactured in the epithelial cells of the collecting duct so that there is no increase in water permeability when the mutated channels are inserted into the luminal membrane in response to vasopressin binding to the V2 Receptor. Patient X will
    A. produce urine with a very high concentration of dissolved solutes.
    B. benefit from injections of vasopressin into the blood plasma.
    C. produce low 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.

17. Which of the following is true for the plasma membranes of epithelial cells in the ascending limb of the Loop of Henle of the kidney?
    A. Sodium-potassium-ATPase pump molecules are located in the basolateral membranes of epithelial cells in the ascending limb of the Loop of Henle.
    B. AQP1 (Aquaporin 1) molecules are located in the basolateral membranes of epithelial cells in the ascending limb of the Loop of Henle.
    C. NKCC2 (sodium-potassium-2chloride co-transporter) molecules are located in the luminal membranes of 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.

18. 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 medullary collecting duct in the kidney. The defective molecules associated with this rare mutation are **NOT** located in the epithelial cells of the kidney medullary collecting duct; the defective molecules are located in other cells of the kidney. The epithelial cells of the kidney medullary collecting duct are all normal. 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 the
    A. water permeability of the luminal membranes of the medullary collecting duct epithelial cells.
    B. net flux of water from the luminal spaces of the medullary collecting duct to the interstitial spaces of the kidney medulla.
    C. amount of water that is reabsorbed into the blood plasma from the lumen of the medullary collecting duct.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

19. From March 1 to March 31, Healthy Person W ate a normal diet with normal amounts of food and water. From April 1 to April 30, Healthy Person W was on a diet that consisted of normal amounts of food and very small amounts of water.
    A. April 15 values of the concentration of dissolved solutes in W's urine were lower than March 15 values of the concentration of dissolved solutes in W's urine.
    B. April 15 values of W's water permeability across the luminal membranes of the medullary collecting duct epithelial cells were lower than March 15 values of W's water permeability across the luminal membranes of the medullary collecting duct epithelial cells.
    C. April 15 values of W's blood plasma levels of vasopressin were higher than March 15 values of W's blood plasma levels of vasopressin.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

20. Healthy Person P takes a new drug that is a member of a drug family that results in a condition in which there are constant very high levels of cytosolic cyclic AMP (cAMP) in one and only one cell type in the body. A single dose of each member of the new drug family works within one hour to produce this condition and the condition lasts for one week. Which of the following is true for P two days after taking a specific member of the new drug family? Compare the situation two days after taking the drug with the situation prior to taking the drug.
    A. Consider the situation that P takes Drug X that results in a condition in which the levels of cytosolic cAMP in the cells of the liver are constant at a very high level. For this situation, ignore any effects related to insulin binding to insulin receptors in the liver. The amount of glycogen in P's liver cells two days after taking Drug X will be lower than the amount of glycogen in P's liver cells prior to taking Drug X.
    B. Consider the situation that P takes Drug Y that results in a condition in which the levels of cytosolic cAMP in the SA node cells of the heart are constant at a very high level. The firing rate of action potentials in P's SA node cells two days after taking Drug Y will be higher than the firing rate of action potentials in P's SA node cells prior to taking Drug Y.
    C. Consider the situation that P takes Drug Z that results in a condition in which the levels of cytosolic cAMP in the epithelial cells of the medullary collecting duct of the kidney are constant at a very high level. The amount of net flux of water from luminal spaces to intracellular spaces across the luminal membranes of these cells in P two days after taking Drug Z will be lower than the amount of net flux of water from luminal spaces to intracellular spaces across the luminal membranes of these cells in P prior to taking Drug Z.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

21. 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 5 PM on April 2, X takes a dose of Y that opens all the ATP-sensitive potassium channels in X's beta-islet cells of the pancreas for 12 hours. Person X has a normal dinner at 6 PM on April 2 and then does not eat for 12 hours. For this question, ignore any effects due to alpha-islet cells of the pancreas.
    A. At 8 PM on April 2, the glucose permeability of X's skeletal muscle cells will be higher than the glucose permeability of X's skeletal muscle cells at 8 PM on April 1.
    B. At 8 PM on April 2, X's blood plasma levels of glucose will be higher than X's blood plasma levels of glucose at 8 PM on April 1.
    C. At 8 PM on April 2, X's blood plasma levels of insulin will be higher than X's blood plasma levels of insulin at 8 PM on April 1.
    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 serves as an actuating signal, or as part of an actuating signal, in a negative feedback system?
    A. Blood plasma levels of glucose.
    B. Blood plasma levels of glycogen.
    C. Blood plasma levels of insulin.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

23. 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 from vesicular membranes into the plasma membrane of the skeletal muscle cell.
    B. beta-islet cell of the pancreas will lead to an increase in exocytosis of GLUT4 Transporters from vesicular membranes into the plasma membrane of the beta-islet cell.
    C. liver cell will lead to an increase in amount of GLUT2 transporters in the plasma membrane of the liver cell.
    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 is correct?
    A. An increase in cAMP levels in the cytosol of a liver cell leads to an increase in the levels of glycogen in the cytosol of that liver cell.
    B. An increase in glucagon binding to Glucagon Receptors in the plasma membrane of a liver cell leads to an increase in the exocytosis of GLUT4 molecules from intracellular vesicles into the plasma membrane of the liver cell.
    C. An increase in glucagon binding to Glucagon Receptors in the plasma membrane of a liver cell leads to an increase in the levels of cAMP in the cytosol of that liver cell.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

25. Patient X has complete destruction of all of the beta-islet cells of the pancreas. Prior to receiving treatment, Patient X will
    A. have high levels of insulin in the blood plasma.
    B. have glucose in the urine.
    C. have high blood plasma levels of glucose.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.