

**STEIN IN-TERM EXAM -- BIOLOGY 3058 -- APRIL 16, 2009 -- PAGE 1 of 8**

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. 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 insulin.
  - C. Blood plasma levels of glycogen.
  - 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 serves as an effector, or as part of an effector, that functions in a negative feedback system?
  - A. Glucagon Receptors in the plasma membranes of alpha-islet cells of the pancreas.
  - B. Insulin Receptors in the plasma membranes of beta-islet cells of the pancreas.
  - C. GLUT2 Transporters in the plasma membranes of fat cells.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.
  
3. 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 erythropoietin.
  - B. Levels of intracellular ATP in beta-islet cells of the pancreas.
  - C. Levels of cyclic AMP (cAMP) in epithelial cells located in the collecting duct of the kidney.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.

4. 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 GABA in its synaptic vesicles. Neuron B has glycine 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 GABA<sub>B</sub> receptors. The only ligand-gated receptors in the plasma membrane of Neuron C are glycine 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 have a chloride equilibrium potential of -20 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 a decrease in Neuron C's action potential firing rate?
- A. At 2:01 AM, GABA is added to the bath.
  - B. At 2:01 AM, CNQX is added to the bath.
  - C. At 2:01 AM, strychnine 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.
5. 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 SA node cell each have a chloride equilibrium potential of -20 millivolts and a potassium equilibrium potential of -86 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, muscarine is added to the bath.
  - B. At 1:01 AM, glutamate is added to the bath.
  - C. At 1:01 AM, strychnine 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. An increase 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. a decrease 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.
7. 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 muscarinic ACh receptors 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 less 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.
8. In a red blood cell, which of the following will lead to a decrease in the percentage of hemoglobin that has oxygen bound to it?
- A. A decrease in the amount of HbRH (Hemoglobin Releasing Hormone) that is bound to HbRH Receptors in the plasma membrane of the red blood cell.
  - B. A decrease in the concentration of dissolved oxygen in the red blood cell.
  - C. An increase in the concentration of hydrogen ions in the red blood cell.
  - 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 in capillaries in the lung assist in the removal of carbon dioxide from the body?
- A. Net flux of bicarbonate from plasma into red blood cells.
  - B. Formation of carbonic acid by carbonic anhydrase in red blood cells.
  - C. Net flux of carbon dioxide from 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.

10. Erythropoietin
- A. acts by stimulating the production of red blood cells by the peritubular interstitial cells of the kidney cortex.
  - B. is secreted by cells in the bone marrow.
  - C. levels in the blood plasma serve as a controlled variable in a long-term negative feedback loop that controls the total amount of oxygen carried in the blood.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.
11. Two compartments of equal volume of physiological saline are separated by a membrane permeable only to oxygen. At 1 AM, equal amounts of oxygen are dissolved into both left and right compartments. At 3 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.
- A. The amount of extracellular oxygen in the right compartment at 4 AM will be less than the total amount of oxygen in the right compartment at 2 AM.
  - B. The total amount of oxygen in the left compartment at 4 AM will be equal to the total amount of oxygen in the left compartment at 2 AM.
  - C. The total amount of oxygen (extracellular, intracellular bound, and intracellular unbound oxygen) in the right compartment at 4 AM will be greater than the total amount of oxygen in the left compartment at 4 AM.
  - 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 processes help bring oxygen to the body cells that are in a leg?
- A. Net flux of oxygen from blood plasma into red blood cells in the body capillaries in the leg.
  - B. A decrease in hydrogen ion concentration in red blood cells in the body capillaries in the leg.
  - C. Removal of oxygen from hemoglobin only in response to a very high partial pressure (concentration) of oxygen.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.

13. 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 no change in
- A. the water permeability of the basolateral membranes of the collecting duct epithelial cells.
  - B. the amount of water that is reabsorbed into the blood plasma from the lumen of the collecting duct.
  - C. the net flux of water from the luminal spaces of the collecting duct to the interstitial spaces of the kidney medulla.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.
14. 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 X that blocks endocytosis of AQP2 for one week.
  - B. Drug Y that results in continuous very high levels of intracellular cyclic AMP (cAMP) for one week.
  - C. Drug Z is an antagonist at V2 receptors that 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.
15. Healthy Person H takes a new drug named ANTICAMPCOLLDUCT that blocks the production of cyclic AMP (cAMP) in collecting duct epithelial cells in response to vasopressin binding to V2 receptors. A single dose of the new drug works within one hour and lasts for one week. Which of the following is true for H one day after taking the new drug?
- A. Water permeability of the luminal membranes of the collecting duct epithelial cells will be higher than pre-drug levels.
  - B. The total amount of AQP2 channels stored in intracellular vesicles will be lower than pre-drug levels.
  - C. H will produce a smaller volume of urine compared with the volume of urine produced prior to taking the drug.
  - 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 luminal membrane is responsible for the net flux of glucose from the luminal space in the lumen of the proximal tubule to intracellular space.
  - B. The sodium-potassium pump in the basolateral membrane is responsible for the net flux of sodium from intracellular space to interstitial space.
  - C. The GLUT2 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. Which of the following is true for the kidney?
- A. Aquaporin1 (AQP1) channels are located in both luminal and basolateral membranes of epithelial cells in the descending limb of the Loop of Henle.
  - B. Sodium-potassium-2chloride (Na-K-2Cl) co-transporter molecules are located in basolateral membranes of epithelial cells in the ascending limb of the Loop of Henle.
  - C. Sodium-potassium pump 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. A healthy person is on a diet that consists of very small amounts of water.
- A. This person will produce a large volume of a dilute urine with low amounts of dissolved solutes.
  - B. This person will have very low water permeability across the luminal membranes of the collecting duct epithelial cells.
  - C. This person will have very high 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.
19. Which of the following is true for the G.I. (Gastro-Intestinal) system?
- A. Skeletal muscles directly control the movement of substances at the entrance of the G.I. system.
  - B. Smooth 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.

20. Which of the following is an inactive form of an enzyme that is converted into an active form within the gastro-intestinal tract?
- A. Vasopressin.
  - B. Pepsinogen.
  - C. Enterokinase.
  - 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 substances are released from cells whose cell bodies are in the hypothalamus?
- A. Oxytocin.
  - B. Vasopressin.
  - C. GH (Growth Hormone).
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.
22. 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 lower 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 lower 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.

23. 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 higher 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.
24. Which of the following is true for GHRH Receptors (Growth Hormone Releasing Hormone Receptors)?
- A. GHRH Receptors are only located in the plasma membranes of cells in the hypothalamus.
  - B. GHRH Receptors travel in the specialized capillaries located between the hypothalamus and the anterior pituitary.
  - C. Binding of GHRH to GHRH Receptors located in the plasma membranes of cells in the anterior pituitary leads to the secretion of GH (Growth Hormone) from the anterior pituitary.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.
25. Glycogen
- A. production in the liver increases in response to an increase in blood plasma levels of glucagon.
  - B. is secreted by alpha-islet cells of the pancreas.
  - C. binding to Glycogen Receptors in the plasma membranes of liver cells leads to an increase in the exocytosis of GLUT2 Transporters located in the plasma membrane of liver cells.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.