

**STEIN IN-TERM EXAM -- BIOLOGY 3058 -- APRIL 22, 2010 -- 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 Glucagon Receptors.
  - 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. nicotinic Acetylcholine Receptors (nAChRs) in the plasma membranes of respiratory skeletal muscle cells.
  - B. Insulin Receptors in the plasma membranes of skeletal muscle cells.
  - C. GLUT4 Transporters in the sarcoplasmic reticulum membranes of skeletal muscle 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 a controlled variable in a negative feedback system?
  - A. Blood plasma levels of insulin.
  - B. Levels of hydrogen ions in the interstitial spaces of the brainstem.
  - C. Blood plasma levels of calcium.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.

4. Consider four culture dishes; each dish has one healthy neuron 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 -80 millivolts. At 1:55 AM, a large amount of TTX is added to the physiological saline in all four 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 and APV are added to the physiological saline of Dish W;  
glutamate is added to the physiological saline of Dish X;  
glutamate and glycine are added to the physiological saline of Dish Y;  
glutamate, glycine, and strychnine are added to the physiological saline of Dish Z.
- At 2:01AM, the total sodium conductance in Neuron X is greater than the total sodium conductance in Neuron Y.
  - At 2:01 AM, the amount of intracellular calcium in Neuron Y will be less than the amount of intracellular calcium in Neuron Z.
  - At 2:01AM, the total calcium conductance in Neuron W is less than the total calcium conductance in Neuron X.
  - A and B.
  - A and C.
  - B and C.
  - A, B, and C.
  - 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 glutamate in its synaptic vesicles. Neuron B has GABA in its synaptic vesicles. The only ligand-gated receptors in the plasma membrane of Neuron A are Glycine Receptors. The only ligand-gated receptors in Neuron B are AMPA Receptors. The only ligand-gated receptors in the plasma membrane of Neuron C are GABA<sub>A</sub> 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, glycine 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?
- At 2:01 AM, GABA is added to the bath.
  - At 2:01 AM, CNQX is added to the bath.
  - At 2:01 AM, strychnine is added to the bath.
  - A and B.
  - A and C.
  - B and C.
  - A, B, and C.
  - None of the above.

6. 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 tetravalent anion named TETRAVA with a valence of -4. The threshold for an action potential in Neuron B is -55 millivolts and the resting potential for Neuron B is -70 millivolts. The TETRAVA 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 TETRAVA conductance of Neuron B. Neuron A synapses onto Neuron B. Neuron A's neurotransmitter is LGD.
- A. The extracellular concentration of TETRAVA is 100,000 times greater than the intracellular concentration of TETRAVA. In response to an action potential in Neuron A, there will be an increase in the membrane voltage of Neuron B.
  - B. The extracellular concentration of TETRAVA is 10,000 times greater than the intracellular concentration of TETRAVA. In response to an action potential in Neuron A, there will be an increase in the amount of intracellular TETRAVA in Neuron B.
  - C. The extracellular concentration of TETRAVA is 1,000 times greater than the intracellular concentration of TETRAVA. In response to an action potential in Neuron A, there will be an excitatory 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.
7. Which of the following statements are true for fluid exchange between the blood plasma in a capillary in the leg and the interstitial spaces surrounding that capillary?
- A. Blood pressure tends to push fluid from the blood plasma into interstitial spaces surrounding the capillary.
  - B. In a normal steady state in a capillary, the magnitude of osmotic pressure greatly exceeds the magnitude of blood pressure.
  - C. Osmotic pressure tends to bring fluid into the blood plasma from interstitial spaces surrounding the capillary.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.
8. Erythropoietin (EPO)
- A. acts by increasing the production of red blood cells by cells in the bone marrow.
  - B. is secreted by peritubular interstitial cells of the kidney cortex.
  - C. levels 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.

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 carbon dioxide from red blood cells into plasma.
  - B. Net flux of bicarbonate from red blood cells into plasma.
  - 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.
10. Which of the following processes help bring oxygen to the body cells that are in a leg?
- A. Net flux of oxygen from red blood cells into blood plasma in the body capillaries in the leg.
  - B. An increase in hydrogen ion concentration in red blood cells in the body capillaries in the leg.
  - C. Removal of oxygen from hemoglobin in response to low (that is, less than 80 mmHg) partial pressures (concentration) of oxygen in red blood cells 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.
11. 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 sarcoplasmic reticulum 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 a decrease 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.
12. 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 diaphragm skeletal muscle fibers.
  - B. Action potentials in motor neurons whose axon terminals synapse on diaphragm skeletal muscle fibers.
  - C. Action potentials in rib cage smooth muscle fibers.
  - 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 X is an agonist at V2 receptors that remains bound to V2 receptors for one week.
  - B. Drug Y that blocks exocytosis of AQP2 for one week.
  - C. Drug Z that results in continuous very low levels of intracellular cyclic AMP (cAMP) 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. A healthy person is on a diet that consists of very small amounts of water.
- A. This person will have high water permeability across the luminal membranes of the medullary collecting duct epithelial cells.
  - B. This person will have very low blood plasma levels of vasopressin.
  - C. This person will produce a large volume of a dilute urine with low amounts of dissolved solutes.
  - 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 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 intracellular space to the luminal space in the lumen of the proximal tubule.
  - 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 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.
16. 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 luminal spaces via sodium-potassium-ATPase pumps located in the luminal 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.

17. Which of the following is true?
- A. V2 Receptors are located in luminal membranes of medullary collecting duct epithelial cells.
  - B. Binding of vasopressin to the V2 Receptor leads to a movement of the V2 Receptor from an intracellular vesicle to the basolateral membrane of the medullary collecting duct epithelial cell.
  - C. AQP2 Receptors are located in basolateral membranes of medullary collecting duct epithelial cells.
  - 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 is a situation in which a closed-loop negative feedback system is converted to an open-loop system? A disease that destroys all the
- A. V2 Receptors in all the epithelial cells of the kidney.
  - B. AQP2 channels in all the epithelial cells of the kidney.
  - C. G-proteins in all the epithelial cells 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.
19. 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 is converted into its active form by the enzyme enterokinase; the enzyme enterokinase is associated with the luminal membranes of epithelial cells in the walls of the small intestine.
  - C. Pepsinogen is produced by cells in the small intestine and is converted into its active form by HCl in the lumen of the small intestine.
  - 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 assist in the digestion of fats?
- A. Production of bile salts in the liver and the secretion of those bile salts into the small intestine.
  - B. Emulsification of fats into droplets by lipase in the lumen of the small intestine.
  - C. Production of lipase in the pancreas and secretion of lipase into the lumen of the small intestine.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.
21. 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.
22. 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 lower 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 lower 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.

23. Insulin binding to insulin receptors in the plasma membrane of a
- A. liver cell will lead to an increase in the intracellular amounts of cAMP in the liver cell.
  - B. beta-islet cell of the pancreas will lead to an increase in the glucose permeability of the plasma membrane of the beta-islet cell.
  - C. skeletal muscle cell will lead to an increase in exocytosis of GLUT4 Transporters from vesicular membranes to the plasma membrane of the skeletal muscle 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 true?
- A. GHRH Receptors (Growth Hormone Releasing Hormone Receptors) are located in the plasma membranes of cells in the anterior pituitary.
  - B. GHRH (Growth Hormone Releasing Hormone) travels in specialized capillaries located between the hypothalamus and the anterior pituitary.
  - C. Binding of GH (Growth Hormone) to GH Receptors (Growth Hormone Receptors) located in the plasma membranes of cells in the anterior pituitary leads to the secretion of GHRH Receptors (Growth Hormone Releasing Hormone Receptors) from the anterior pituitary 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.
25. 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 or drink for 12 hours. There is no glucose in X's urine at 9 PM on April 1. At 5 PM on April 2, X takes a dose of Y. The action of drug Y occurs within 10 minutes and lasts for 12 hours. Person X has a normal dinner at 6 PM on April 2 and then does not eat or drink for 12 hours. Which of the following is true?
- A. If drug Y blocks all the transport of sodium and glucose via sodium-glucose co-transporters located in the luminal membranes of proximal tubule epithelial cells, then at 9 PM on April 2 there will be glucose in X's urine.
  - B. If drug Y blocks endocytosis of GLUT4 Transporters in all fat and muscle cells, then at 9 PM on April 2 there will be glucose in X's urine.
  - C. If drug Y causes the closing of all the ATP-sensitive potassium channels in the beta-islet cells of the pancreas, then at 9 PM on April 2 there will be glucose in X's urine.
  - D. A and B.
  - E. A and C.
  - F. B and C.
  - G. A, B, and C.
  - H. None of the above.