

STEIN FINAL EXAM -- BIOLOGY 3058 -- MAY 1, 2009 -- PAGE 1 of 16

There are 50 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 50 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 a sensor, or as part of a sensor, that functions in a negative feedback system?
 - A. Central thermoreceptor neurons whose peripheral terminals are located in the skin.
 - B. Plasma-membrane Calcium Receptors located in the plasma membrane of Parathyroid Gland cells.
 - C. Carotid artery baroreceptor neurons whose peripheral terminals 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.

2. 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 parasympathetic neurons that release acetylcholine (ACh) as their neurotransmitter and synapse upon skeletal muscles surrounding the arterioles.
 - C. Action potentials in peripheral hydrogen-ion-sensitive chemoreceptor neurons that release glutamate as their neurotransmitter from their central terminals located in the brain stem.
 - 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 effector, or as part of an effector, that functions in a negative feedback system?
- A. Muscarinic Acetylcholine Receptors (mAChRs) in the SA node cells of the heart.
 - B. Nicotinic Acetylcholine Receptors (nAChRs) in skeletal muscle fibers located in the alveoli of the lung.
 - C. Glycogen Receptors in the plasma membranes 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.
4. Which of the following serves as a controlled variable in a negative feedback system?
- A. Levels of hydrogen ions in the interstitial spaces of the brainstem.
 - B. Blood plasma levels of calcium.
 - C. Blood plasma levels of glucagon.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
5. A decrease in blood plasma levels of parathyroid hormone
- A. occurs in response to an increase in the levels of calcium ions in blood plasma.
 - B. leads to an increase in the amount of calcium released from the bones into the plasma.
 - C. leads to an increase in calcium ion excretion in the urine.
 - 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 is true for exocytosis?
- A. During exocytosis in skeletal muscle cells, there will be release of calcium ions from intracellular vesicles in the sarcoplasmic reticulum in response to high levels of ryanodine binding to ryanodine receptors in the transverse tubules.
 - B. During exocytosis in toe motor neurons, there will be release of acetylcholine (ACh) from axonal terminals near toe skeletal muscles in response to an increase in the amount of intracellular calcium in the axonal terminals of these neurons.
 - C. During exocytosis in collecting duct epithelial cells, there is insertion of AQP4 channels from vesicular membranes into luminal membranes.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.

7. At 1 AM, an impermeable membrane separates a 1 liter solution of 1M NaCl in the left compartment from a 1 liter solution containing both 1M NaCl and 1M KCl in the right compartment. At 2 AM, the membrane became permeable to chloride ions. At 4 AM, the membrane once again became impermeable to chloride ions. At 6 AM, the membrane became permeable to sodium ions and, in addition, maintained chloride ion impermeability. At 8 AM, the membrane once again became impermeable to sodium ions. At 10 AM the membrane once again became permeable to chloride ions and, in addition, maintained sodium ion impermeability. The membrane maintained impermeability to potassium ions during the entire period.
- A. The amount of sodium ions in the left compartment at 7 AM will be greater than the amount of sodium ions in the right compartment at 7 AM.
 - B. The amount of chloride ions in the left compartment at 11 AM will be greater than the amount of chloride ions in the left compartment at 5 AM.
 - C. The amount of chloride ions in the left compartment at 11 AM will be less than the amount of chloride ions in the right compartment at 11 AM.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
8. At 1:02 AM, cell X has GLUT4 transporters included in the vesicular membranes of all its intracellular vesicles. Between 1:03 AM and 1:04 AM, there is exocytosis of all these vesicles of cell X. No endocytosis of vesicles in cell X occurs between 1:00 AM and 1:06 AM.
- A. Between 1:03 AM and 1:04 AM, portions of the plasma membrane of cell X are removed.
 - B. Between 1:03 AM and 1:04 AM, GLUT4 transporters are released into extracellular space.
 - C. The glucose permeability of the plasma membrane of cell X at 1:05 AM will be less than the glucose permeability of the plasma membrane of cell X at 1:02 AM.
 - 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 endocytosis?
- A. During endocytosis of GLUT4 transporters in fat cells, there is removal of GLUT4 transporters from plasma membranes.
 - B. During endocytosis of GLYCOGEN4 transporters in liver cells, there is removal of GLYCOGEN4 transporters from plasma membranes.
 - C. During endocytosis of AQP4 channels in epithelial cells in the kidney medullary collecting duct, there is removal of AQP4 channels from luminal membranes.
 - 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 a G-protein?
- A. When an agonist binds to the binding site of a G-protein-coupled receptor (GPCR), this leads to ATP displacing a ADP bound to the alpha subunit of the G-protein.
 - B. When an antagonist binds to the binding site of a G-protein-coupled receptor (GPCR), this leads to GTP displacing a GDP bound to the alpha subunit of the G-protein.
 - C. When GTP binds to an alpha subunit of the G-protein, this leads to the alpha subunit of the G-protein dissociating from the beta and gamma subunits of the G-protein.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
11. 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: nACh Receptors (nicotinic Acetylcholine Receptors), NMDA Receptors, and GABA_A 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:
ACh (acetylcholine) is added to the physiological saline of Dish W;
glutamate is added to the physiological saline of Dish X;
ACh and glutamate are added to the physiological saline of Dish Y;
ACh, glutamate, and GABA are added to the physiological saline of Dish Z.
- For each neuron, define MAXV as the maximum voltage that is reached by that neuron during the period from 2:00 AM to 2:02 AM.
- A. At 2:01AM, the total sodium conductance in Neuron Y is greater than the total sodium conductance in Neuron Z.
 - B. MAXV of Neuron W is greater than MAXV of Neuron X.
 - C. At 2:01 AM, the amount of intracellular calcium in Neuron X will be less than the amount of intracellular calcium 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.

12. 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 TRVA 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 TRVA 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 TRVA conductance of Neuron B. Neuron A synapses onto Neuron B. Neuron A's neurotransmitter is LGD.
- A. The extracellular concentration of TRVA is 10,000 times greater than the intracellular concentration of TRVA. 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 TRVA is 100 times greater than the intracellular concentration of TRVA. In response to an action potential in Neuron A, there will be an increase in the amount of intracellular TRVA in Neuron B.
 - C. The extracellular concentration of TRVA is 10,000 times greater than the intracellular concentration of TRVA. In response to an action potential in Neuron A, there will be 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.
13. 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_A 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 -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, 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.

14. 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 glycine and glutamate to the physiological saline will lead to an increase in the amount of intracellular chloride.
 - B. The addition of glycine to the physiological saline will lead to no change in the amount of intracellular chloride.
 - C. The addition of glycine and GABA to the physiological saline will lead to a decrease 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.
15. A complete motor neuron is removed from a frog and placed in normal physiological saline at 1 AM. The neuron is healthy. At 2 AM, the physiological saline bathing the neuron is removed and replaced with a modified physiological saline. The composition of the modified physiological saline is as follows: its potassium concentration is the same as normal physiological saline; its sodium concentration is the same as the intracellular sodium concentration of the motor neuron; its total concentration of solutes (osmolarity) is the same as normal physiological saline. The modified physiological saline also contains molecules that block the flux of ions via the sodium-potassium primary active transport pump. At 2:05 AM, the resting membrane voltage of the neuron is -70 millivolts. At 2:06 AM,
- A. the value of the Nernst equilibrium potential for sodium ions for the neuron is greater than +20 millivolts.
 - B. an increase in sodium conductance will lead to an increase in the amount of intracellular sodium.
 - C. an increase in sodium conductance will lead to no change in the membrane voltage.
 - 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 a neurotransmitter that binds to a receptor site that is part of a ligand-gated metabotropic receptor?
- A. GABA.
 - B. ACh.
 - C. muscarine.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.

17. 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 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 membrane voltage of 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 an increase in the amount of intracellular potassium 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 an increase in the chloride conductance of the plasma membrane of neuron A.
 - 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 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. open force-gated channels in the central axon terminals of IA muscle-spindle stretch receptor neurons whose peripheral terminals are in the right knee extensor muscle.
 - B. calcium conductance in the central axon terminals of IA muscle-spindle stretch receptor neurons whose peripheral terminals are in the right knee extensor muscle.
 - C. calcium conductance in the membranes of the sarcoplasmic reticulum in the muscle fibers of 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.
19. Person Z swallowed a large amount of substance X and, as a result, has convulsions (abnormal violent contractions of skeletal muscles). Swallowing which of the following substances could lead to convulsions?
- A. An antagonist of the glycine receptor.
 - B. An antagonist of the nicotinic ACh receptor.
 - C. A blocker of the voltage-gated sodium channel.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.

20. At 1 AM, a healthy squid giant axon is placed in a bath of normal squid physiological extracellular saline and is internally perfused with normal squid intracellular saline. Its resting potential at 1:55 AM is -70 millivolts. For this question, ignore any possible effects due to the sodium-potassium pump. At 2 AM, there is a change in the
- A. intracellular perfusion fluid so that its concentration of potassium ion is decreased. This will cause an increase in the resting membrane voltage.
 - B. extracellular saline so that its concentration of potassium ion is decreased. This will cause a increase in the Nernst equilibrium potential for potassium ion.
 - C. intracellular perfusion fluid so that its concentration of potassium ion is increased. This will cause a decrease in the Nernst equilibrium potential for potassium ion.
 - 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 in a skeletal muscle?
- A. Detachment of the myosin head from its actin binding site always occurs during rigor mortis.
 - B. The binding of ATP to myosin occurs only when the myosin head is not attached to the actin molecule.
 - C. The head of a myosin molecule is activated (energized) when P_i and ADP are converted to ATP.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
22. 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 will lead to an increase in the overlap between thin and thick filaments in the muscle fiber?
- A. An increase in the amount of binding of ACh to the muscarinic Acetylcholine Receptors (mAChRs) on the surface of the skeletal muscle.
 - B. An increase in the calcium conductance of the membranes of the sarcoplasmic reticulum.
 - C. an increase in the amount of calcium ions bound to actin.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
23. ATP is **directly** required in which of the following processes in muscle?
- A. Net flux of sodium ions from intracellular space to extracellular space.
 - B. Detachment of myosin heads from their binding sites on actin molecules.
 - C. Net flux of calcium ions from the cytosol into 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.

24. When the overlap between the thin and thick filaments of a skeletal muscle is increasing,
- A. the length of the H zone is increasing.
 - B. the length of the A band is decreasing.
 - C. the total length of the I bands in the sarcomere is decreasing.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
25. Consider a time when the membrane voltage of a SA node cell in the heart is at its minimum value (near -80 mv). At this time,
- A. all the voltage-gated calcium channels will be open.
 - B. the membrane voltage in the SA node cell will be less than the threshold voltage for the action potential in the SA node cell.
 - C. the conductance of the channels that carry the F-current (also called I_F) will be high when compared to the conductance of these channels at the peak of the action potential.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
26. Starting at 1 AM, you record the firing frequency of the axons of carotid artery baroreceptors as well as the blood pressure in the carotid artery. At 2 AM, you directly apply chemical Z to all the axons of the carotid artery baroreceptors at location L in a peripheral nerve at a place that is midway between the baroreceptor peripheral terminals and the baroreceptor central axonal terminals. You discover that chemical Z induces a previously unknown lowering of the excitability of the axon with the following property: for every two action potentials produced between baroreceptor peripheral terminals and location L, there is one action potential produced between location L and baroreceptor central axonal terminals. Thus, chemical Z causes a reduction of the rate of firing of carotid baroreceptors as action potentials pass location L; only one-half of the action potentials initiated in the peripheral terminals propagate all the way to the central axonal terminals.
- A. At 2:10 AM, blood pressure will be higher than at 1:50 AM.
 - B. At 2:10 AM, the parasympathetic output to the heart will be higher than at 1:50 AM.
 - C. At 2:10 AM, arteriolar diameters will be smaller than at 1:50 AM.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.

27. Which of the following is true for SA node cardiac muscle cells?
- A. An increase in the binding of norepinephrine to beta-adrenergic receptors in SA node cells will lead to an increase in intracellular levels of cAMP in these cells.
 - B. A decrease in intracellular levels of cAMP in SA node cells will lead to a decrease in the amount of time between two successive action potentials in SA node cells.
 - C. An increase in the binding of acetylcholine to muscarinic ACh receptors in 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.
28. Which of the following is true for the ATP-sensitive potassium channel?
- A. The channel is a spanning protein with a receptor site for ATP located on an extracellular region of the protein.
 - B. When blood plasma levels of glucose are very high, the potassium conductance of the ATP-sensitive potassium channels in the plasma membranes of beta-islet cells will be very high.
 - C. In smooth muscle cells surrounding an arteriole serving a region of the body that has just recently had very high levels of metabolism, the potassium conductance of the ATP-sensitive potassium channels in the plasma membranes of these smooth muscle cells will be very high.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
29. 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. Arteriole diameter will decrease.
 - C. Parasympathetic discharge to the heart will increase.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
30. Which of the following processes in capillaries in a leg 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.

31. Which of the following is true for ventilation?
- A. Interneurons responsible for generating the rhythm of ventilation are located only in the hypothalamus.
 - B. All the central chemoreceptors that sense the levels of hydrogen ions in the interstitial fluids of the brain are located in the hypothalamus.
 - C. Motor neurons that excite the diaphragm muscle utilize glutamate as their neurotransmitter.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
32. Which of the following processes occur in the lung?
- A. Net flux of oxygen from red blood cells into the plasma in capillaries of the lung.
 - B. Removal of oxygen from hemoglobin in response to high levels of hydrogen ions in red blood cells in the lung.
 - C. Binding of oxygen to hemoglobin in response to high partial pressures of oxygen in red blood cells in the lung.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
33. 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. Erythropoietin Receptors (EPORs) in bone marrow cells.
 - C. Dihydropyridine Receptors (DHPRs) in diaphragm muscles.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
34. Which of the following will lead to a decrease in the amount of oxygen delivered to the body cells in a leg?
- A. A decrease in hydrogen ion concentration in red blood cells in the body capillaries in a leg.
 - B. An increase in the rate of ventilation.
 - C. An increase in hydrogen ion concentration in the interstitial spaces of the brain stem.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.

35. Healthy Person P takes a drug that produces 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. 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 stimulates endocytosis of AQP2 for one week and blocks exocytosis of AQP2 for one week.
 - B. Drug Y that results in continuous very low 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.
36. 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 potassium from intracellular space to interstitial space.
 - C. The GLUT2 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 interstitial space.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
37. Which of the following is true?
- A. If a patient with neurogenic diabetes insipidus is not treated, the patient will produce small volumes of concentrated urine.
 - B. A patient with neurogenic diabetes insipidus will benefit from injections of vasopressin into the blood plasma.
 - C. A patient with no functional AQP2 channels in collecting duct epithelial cells will benefit from injections 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.

38. 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.
39. A new drug named ANTI-V2R has been developed that is a V2 receptor antagonist. ANTI-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 levels are always very high due to a tumor whose cells 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.
40. Which of the following is true?
- A. Trypsinogen is produced in the pancreas and 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 stomach.
 - B. Pepsinogen is produced by cells in the stomach and is converted into its active form by HCl in the lumen of the stomach.
 - C. 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.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.

41. A patient has complete destruction of all of the beta-islet cells of the pancreas. Prior to receiving treatment, this patient will have
- A. high blood plasma levels of glucose.
 - B. high levels of glucose in the urine.
 - C. high 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.
42. 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 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.
43. 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 endocytosis of GLUT4 Transporters from 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.

44. 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 Receptors (Growth Hormone Releasing Hormone Receptors) travel 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.
45. During a fever in a human,
- A. shivering can occur when the actual body temperature is higher than the set point for body temperature during the fever.
 - B. the control system for body temperature functions as a closed-loop positive-feedback system.
 - C. there is an increase in the value of the set point for body temperature when compared with the value of the set point for body temperature when that person was healthy prior to the fever.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
46. Which of the following pairs of events in a human female occur at, or nearly at, the same time during the menstrual cycle?
- A. High blood plasma LH levels and ovulation.
 - B. High blood plasma progesterone levels and thick endometrial walls of the uterus.
 - C. High blood plasma FSH levels and follicle development.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
47. In an adult male, which of the following is true?
- A. The plasma membranes of Leydig cells contain LH receptors.
 - B. The plasma membranes of Sertoli cells contain FSH receptors.
 - C. Testosterone receptors are located in intracellular spaces of Sertoli cells.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.

48. Right-handed adult patient X with a complete transection of the corpus callosum is presented with a simple written question in his right visual world. A barrier is positioned so that patient X can see his right hand only in his right visual world and his left hand only in his left visual world. Patient X will be
- A. able to respond correctly to the sentence with a verbal reply.
 - B. able to use his left hand to move scrabble tiles (pieces of wood with letters on them) so that he spells out the correct answer with his left hand.
 - C. able to use a pencil in his right hand to spell out the correct answer on a piece of paper.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
49. Which of the following is true for a motor cortex corticospinal interneuron A that produces action potentials during movements of the big toe of the right foot in right-handed Patient X who has a complete transection of the corpus callosum.
- A. In Patient X, the cell body of interneuron A is located in between the central sulcus of the left cerebral cortex and the left eye.
 - B. Interneuron A will increase its action potential firing rate after Patient X reads the statement "Wiggle the big toe of your right foot" presented in Patient X's right visual field and responds to the question.
 - C. The axon terminals of interneuron A are located on the left side of Patient X's spinal cord.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.
50. A question is flashed on a screen in the left visual world of right-handed person Z. Person Z is a healthy individual with an normal nervous system. Person Z has a patch over Z's right eye so that Z sees the question only in Z's left eye.
- A. Z will understand the meaning of the question and generate a correct oral answer even when all action potentials in all axons of Z's corpus callosum are completely blocked by Drug XCC. All other axons in Person Z are not affected by Drug XCC.
 - B. The stimulus will excite neurons in the right half of Z's left retina.
 - C. The stimulus will excite neurons in Z's right visual cortex.
 - D. A and B.
 - E. A and C.
 - F. B and C.
 - G. A, B, and C.
 - H. None of the above.