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. Mechanically-gated channels located in the plasma membranes of the peripheral axon terminals of carotid artery baroreceptor neurons.
   B. Osmoreceptor neurons whose peripheral terminals are located in the walls of the carotid artery.
   C. Calcium-Sensing Receptors (CaSRs) located in the plasma membranes of Parathyroid Gland cells.
   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. Blood plasma levels of oxytocin.
   B. Blood plasma levels of glucagon.
   C. Blood plasma levels of Vasopressin Releasing Hormone (VRH).
   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, in a negative feedback system?
   A. GLUT2 molecules in the plasma membranes of liver cells.
   B. Binding sites for calcium ions on tropomyosin molecules in rib cage inspiratory muscles.
   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. Blood plasma levels of glucagon.
   B. Blood plasma levels of glucose.
   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.

5. A new drug named AGON-CaSR has been developed that is an agonist at calcium-binding sites of CaSRs (Calcium-Sensing Receptors) in plasma membranes of parathyroid gland cells. Healthy Person P receives regular doses of AGON-CaSR as part of a clinical trial. When AGON-CaSR levels in the extracellular spaces surrounding parathyroid gland cells increase in Healthy Person P, this leads to
   A. an increase in the levels of calcium in the blood plasma.
   B. an increase in the levels of parathyroid hormone (PTH) in the blood plasma.
   C. a decrease in the plasma levels of 1,25-dihydroxyvitamin D.
   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 substances serve as ligands that bind to intracellular receptors that are located in the nucleus?
   A. Growth Hormone (GH).
   B. 1,25 dihydroxyvitamin D.
   C. Insulin.
   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 true?
   A. GLUT2 molecules are responsible for the net flux of glucose from the luminal spaces of the kidney cortex into the intracellular spaces of proximal tubule epithelial cells.
   B. When blood plasma levels of glucagon are low and blood plasma levels of insulin are high, GLUT2 molecules are responsible for the net flux of glucose from the intracellular spaces of liver cells into the interstitial spaces surrounding liver cells.
   C. GLUT4 molecules are responsible for the net flux of glucose from the interstitial spaces surrounding beta-islet cells of the pancreas into the intracellular spaces of beta-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.

8. Which of the following is an effect of the following drugs?
   A. Drug A is an agonist of the Vasopressin2 Receptor (V2R). High levels of Drug A in the interstitial spaces surrounding cells of the kidney medullary collecting ducts will lead to high levels of exocytosis of AQP2 molecules in these cells.
   B. Drug B is an agonist of the Insulin Receptor. High levels of Drug B in the interstitial spaces surrounding fat cells will lead to high levels of exocytosis of GLUT4 transporters in these cells.
   C. Drug C is an agonist of the Glucagon Receptor. High levels of Drug C in the interstitial spaces surrounding liver cells will lead to high levels of exocytosis of GLUT4 transporters in these cells.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

9. 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 left compartment at 5 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.

10. Which of the following is true for a G-protein?
   A. After the GTP-ase of the alpha subunit of a G-protein converts the GTP bound to the alpha subunit to GDP and inorganic phosphate (P_i), the inorganic phosphate (P_i) is released from the alpha subunit. The alpha subunit of the G-protein with GDP bound to it then associates with the beta and gamma subunits of the G-protein.
   B. When an agonist binds to the binding site of a G-protein-coupled receptor (GPCR), this leads to GDP displacing a GTP bound to the alpha subunit of the G-protein.
   C. When ADP binds to an alpha subunit of the G-protein, this leads to the alpha subunit of the G-protein associating with 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. Which of the following substances bind to a site on the intracellular surface of a spanning protein in the plasma-membrane?
    A. Parathyroid Hormone (PTH).
    B. Vasopressin.
    C. ATP.
    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 a ligand that binds to a receptor site on a ligand-gated ion channel?
    A. Strychnine.
    B. Curare.
    C. Muscarine.
    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 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. ACh (acetylcholine) released from central axon terminals of IA muscle-spindle stretch receptor neurons whose peripheral axon terminals are in the right knee extensor muscle.
    B. glutamate bound to AMPA Receptors in the plasma membranes of right knee extensor motor neurons.
    C. potassium conductance in the sarcoplasmic reticulum membranes of right knee extensor muscles.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

14. 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 agonist 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.

15. 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 R is less than E, if the value of E is less than T, 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 a decrease in the amount of intracellular chloride ions in 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 no change in the chloride conductance 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.

16. 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 a chloride equilibrium potential of zero (0) 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, glycine is added to the bath.
    B. At 2:01 AM, strychnine is added to the bath.
    C. At 2:01 AM, CNQX 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.

17. Consider Neuron B in the frog central nervous system whose plasma membrane has a newly discovered ligand-gated ionotropic receptor, named the LIGD receptor. The channel in the same molecular complex as the LIGD receptor is termed the LIGD receptor channel. The Nernst equilibrium potential for sodium in Neuron B is +100 mV, and the Nernst equilibrium potential for potassium in Neuron B is -100 mV.
The threshold for an action potential in Neuron B is -65 mV and the resting potential for Neuron B is -75 mV. LIGD is an agonist for the ligand-gated ionotropic receptor. When LIGD binds to its binding site, there is an increase in conductance of the LIGD receptor channel. Neuron A synapses onto Neuron B. Neuron A's transmitter is LIGD.
    A. Consider the situation that when the LIGD receptor channel is open in Neuron B, it is permeable to both sodium and potassium. For this situation, when open, it is permeable to no other ions. For this situation, when open, 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.
    B. Consider the situation that when the LIGD receptor channel is open in Neuron B, it is permeable to both sodium and potassium. For this situation, when open, it is permeable to no other ions. For this situation, when open, its potassium conductance equals seven 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.
    C. Consider the situation that when the LIGD receptor channel is open in Neuron B, it is permeable to both sodium and potassium. For this situation, when open, it is permeable to no other ions. For this situation, when open, 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.
    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 are ligands that bind to the nicotinic Acetylcholine Receptor (nAChR)?
    A. Curare.
    B. Nicotine.
    C. Muscarine.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

19. 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 divalent cation named DIVCAT with a valence of +2. The threshold for an action potential in Neuron B is -55 millivolts and the resting potential for Neuron B is -70 millivolts. The DIVCAT 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 DIVCAT conductance of Neuron B. Neuron A synapses onto Neuron B. Neuron A's neurotransmitter is LGD.
    A. The intracellular concentration of DIVCAT is 1000 times greater than the extracellular concentration of DIVCAT. In response to an action potential in Neuron A, there will be: a decrease in the membrane voltage of Neuron B; a decrease in the amount of intracellular DIVCAT in Neuron B; and an inhibitory postsynaptic potential in Neuron B.
    B. The intracellular concentration of DIVCAT is 100 times greater than the extracellular concentration of DIVCAT. In response to an action potential in Neuron A, there will be: an increase in the membrane voltage of Neuron B; an increase in the amount of intracellular DIVCAT in Neuron B; and an inhibitory postsynaptic potential in Neuron B.
    C. The intracellular concentration of DIVCAT is 10 times greater than the extracellular concentration of DIVCAT. In response to an action potential in Neuron A, there will be: an increase in the membrane voltage of Neuron B; an increase in the amount of intracellular DIVCAT in Neuron B; and 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.

20. 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. an increase in membrane voltage will lead to no change in sodium conductance.
    B. the value of the Nernst equilibrium potential for sodium ions for the neuron is less than +10 millivolts.
    C. an increase in sodium conductance will lead to an increase in the amount of intracellular sodium.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

21. 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 occur in response to an action potential in the plasma membrane of the muscle fiber?
    A. An increase in the amount of calcium ions bound to actin.
    B. An increase in the amount of Ryanodine bound to Ryanodine Receptors in the membranes of the sarcoplasmic reticulum.
    C. An increase in the calcium conductance of the channel associated with the Ryanodine Receptor in the membranes of 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.

22. Which of the following is true in a skeletal muscle?
    A. During rigor mortis, myosin heads that are already attached to actin molecules remain attached to the actin molecules due to no GTP or very low levels of GTP in the cytosol of the muscle.
    B. The binding of calcium to troponin causes movement of tropomyosin so that the tropomyosin no longer blocks binding sites on actin for energized myosin heads.
    C. The head of a myosin molecule is activated (energized) during the hydrolysis of ATP (which is bound to the myosin head) to ADP and P_i.
    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 potassium ions from extracellular space to intracellular space.
    B. Detachment of myosin heads from their binding sites on tropomyosin 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. For a sarcomere of a skeletal muscle, define the following terms: A is the length of the A Band; H is the length of the H Zone; I is the total length of the I Bands in the sarcomere. When the length of the sarcomere increases during a lengthening of the entire muscle,
    A. The value of A remains constant.
    B. The value of A plus the value of I (= A + I) increases.
    C. The value of A minus the value of H (= A - H) decreases.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

25. 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 sympathetic neurons that release ACh (acetylcholine) near SA node cells of the heart.
    B. Action potentials in ventricular muscle cells of the heart.
    C. Action potentials in 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.

26. Which of the following is true for SA node 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. An increase 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 a decrease 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.

27. The AV node of a mammalian heart is destroyed.
    A. The firing rate of action potentials in SA node cells will equal the firing rate of action potentials in atrial muscle cells.
    B. Each contraction of the left ventricle will occur at the same time, or nearly at the same time, as each contraction of the right ventricle.
    C. The firing rate of action potentials in Purkinje fibers will equal the firing rate of action potentials in 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.

28. At 1:00 AM, healthy person X's blood pressure is equal to the blood pressure set point. At 1:01 AM, there is an increase in the firing rate of carotid artery baroreceptors,
    A. this will lead to a decrease in the amount of ACh (acetylcholine) released near the SA node of the heart.
    B. this will lead to a decrease in the heart rate.
    C. this will lead to a decrease in the diameter of the arterioles.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

29. Which of the following is true for active hyperemia, a local control mechanism within the circulatory system?
    A. There will be an increase in force developed by smooth muscles surrounding arterioles that lead into a local region in which there has been an increase in the rates of activity of body cells in that region.
    B. There will be more blood flow into a local region in response to an increase in the rates of activity of body cells in that region.
    C. There will be an increase in the potassium conductance of ATP-sensitive potassium channels in smooth muscle cells in response to a decrease in the levels of intracellular ATP in those cells.
    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 is true for channels in the plasma membrane of a SA node cell in the heart?
    A. The equilibrium potential of its voltage-gated calcium channels is greater than the value of the threshold voltage for the action potential.
    B. The equilibrium potential of its F channels is less than the value of the threshold voltage for the action potential.
    C. The equilibrium potential of its voltage-gated potassium channels is less than the value of the threshold voltage for 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.

31. Which of the following processes in capillaries in the 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. Breakdown of carbonic acid into carbon dioxide and water 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.

32. Which of the following is true?
    A. The partial pressure of oxygen in the blood plasma in the right ventricle is lower than the partial pressure of oxygen in the blood plasma in the left ventricle.
    B. The blood plasma levels of bicarbonate in the right ventricle are higher than the blood plasma levels of bicarbonate in the left ventricle.
    C. The percent Hemoglobin saturation (percent of oxygen-binding sites in Hemoglobin that have oxygen bound) in the red blood cells in the right ventricle is lower than the percent Hemoglobin saturation in the red blood cells in the left ventricle.
    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 will lead to an increase in the rate of ventilation?
    A. An increase in the partial pressure of oxygen in the blood plasma in the carotid artery in a person who is mountain climbing at high altitude.
    B. An increase in the binding of EPO (erythropoietin) to EPO Receptors located only in the plasma membranes of red blood cells.
    C. An increase in levels of hydrogen ions in 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.

34. 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. Alpha islet cells of the pancreas.
    C. Peritubular interstitial cells (PIC) 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.

35. Which of the following serves as an actuating signal, or as part of an actuating signal, in a negative feedback system?
    A. Insulin Receptors in the diaphragm muscle.
    B. Voltage-gated sodium channels in motor neurons that synapse on diaphragm muscle fibers.
    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.

36. 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 endocytosis of AQP2 and blocks exocytosis of AQP2 for one week.
    B. Drug Y that produces a condition in which the levels of intracellular cyclic AMP (cAMP) are very high for one week.
    C. Drug Z that is an agonist 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.

37. A new drug named ANTI-V2R has been developed that is a V2 receptor antagonist. When ANTI-V2R binds to a V2 receptor, there is no binding of vasopressin to that V2 receptor and there is no activation of G proteins. ANTI-V2R will help relieve some of the problems for which of the following patients?
    A. A patient with nephrogenic diabetes insipidus caused by a mutation in the AQP2-channel gene.
    B. A patient with neurogenic diabetes insipidus who produces no vasopressin.
    C. A patient whose blood plasma vasopressin 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.

38. Luminal plasma membranes of epithelial cells in which of the following regions of the nephron have water permeability in a human with blood plasma levels of vasopressin that are very high?
    A. Descending limb of the Loop of Henle.
    B. Proximal Tubule.
    C. Medullary Collecting Ducts.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

39. 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 higher 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 higher 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.

40. Which of the following function in the Gastrointestinal Tract by converting an inactive form of an enzyme to the active form of the enzyme?
    A. Enterokinase.
    B. Hydrochloric acid (HCl).
    C. Trypsinogen.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

41. Insulin
    A. levels in the cytosol of a skeletal muscle increase in response to an increase in GLUT4 Transporter levels in the plasma membrane of the skeletal muscle cell.
    B. binding to Insulin Receptors in the plasma membrane of a liver cell leads to an increase in the levels of cAMP in the cytosol of the liver cell.
    C. binding to Insulin Receptors in the plasma membrane of a liver cell leads to an increase in the exocytosis of GLUT4 Transporters from intracellular vesicles into 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.

42. During a fever in a human,
    A. 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.
    B. shivering occurs when the actual body temperature is higher than the set point for body temperature during the fever.
    C. the control system for body temperature functions as a closed-loop positive-feedback system.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

43. Glycogen
    A. levels in a liver cell increase in response to an increase in cAMP levels in the cytosol of the liver cell.
    B. binding to Glycogen Receptors in the plasma membrane of an alpha-islet cell of the pancreas leads to an increase in the levels of cAMP in the cytosol of the alpha-islet cell.
    C. binding to Glycogen Receptors in the plasma membranes of a liver cell leads to an increase in the exocytosis of GLUT2 Transporters from intracellular vesicles into 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.

44. 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 on April 2, X's blood plasma levels of glucose will be higher than X's blood plasma levels of glucose at 1 AM.
    B. At 3 AM 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 1 AM.
    C. At 3 AM on April 2, X's blood plasma levels of insulin will be higher than X's blood plasma levels of insulin 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.

45. Which of the following is true?
    A. Binding of GHRH (Growth Hormone Releasing Hormone) to GHRHR (Growth Hormone Releasing Hormone Receptors) located in the plasma membranes of cells in the anterior pituitary leads to the secretion of GH (Growth Hormone) from the anterior pituitary into the blood plasma.
    B. GnRH Receptors (Gonadotropin Releasing Hormone Receptors) are located only in the plasma membranes of axon terminals in the posterior pituitary.
    C. ORH (Oxytocin Releasing Hormone) travels in specialized capillaries located in the pituitary stalk between the hypothalamus and 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.

46. 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?
    A. Consider the situation that P takes Drug A 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. Two days after taking Drug A, the net flux of water from luminal spaces to intracellular spaces across the luminal membranes of these cells in P will be less than pre-drug levels of the net flux of water from luminal spaces to intracellular spaces across the luminal membranes of these cells in P.
    B. Consider the situation that P takes Drug B 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. Two days after taking Drug B, the firing rate of action potentials in P's ventricular muscle cells will be lower than pre-drug levels of the firing rate of action potentials in P's ventricular muscle cells.
    C. Consider the situation that P takes Drug C 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 due to insulin binding to insulin receptors in the liver. Two days after taking Drug C, the amount of glycogen in P's liver cells will be lower than pre-drug levels of the amount of glycogen in P's liver cells.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

47. Healthy young adult human female F has very high blood plasma levels of hCG (human Chorionic Gonadotropin). During the time that F's blood plasma hCG levels are very high,
    A. she is pregnant.
    B. she will secrete estrogen and progesterone from the corpus luteum.
    C. she will ovulate once a month.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

48. 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 progesterone levels and ovulation.
    B. Thick endometrial walls of the uterus and the end of menstruation.
    C. High blood plasma LH levels and the start of menstruation.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

49. A complex question is flashed on a screen in the left visual field of right-handed Person Z. Z is a healthy individual with an normal nervous system. Z has a patch over Z's right eye so that Z sees the question only in Z's left eye.
    A. The stimulus of flashing the question will excite neurons in Z's right primary visual cortex (V1).
    B. The stimulus of flashing the question will excite neurons in the left half of Z's left retina.
    C. Z will understand the meaning of the question and generate a correct oral answer only after some of the axons in the corpus collosum generate action potentials.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

50. Which of the following is true for primary motor cortex (M1) corticospinal interneuron A that produces action potentials during movements of the big toe of the left foot in right-handed Patient X who has a complete transection of the corpus callosum.
    A. In Patient X, the central sulcus of the right cerebral cortex is located in between the cell body of interneuron A and the right eye.
    B. The axon terminals of interneuron A are located on the left side of Patient X's spinal cord.
    C. Interneuron A will increase its action potential firing rate after Patient X reads the statement "Wiggle the big toe of your left foot" presented in Patient X's right visual field.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.