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 is true?
   A. CaSRs (Calcium-Sensing Receptors) are GPCRs (G-Protein Coupled Receptors) that are spanning proteins located only in the membranes of the nucleus of Parathyroid Gland cells.
   B. Calcium ions are antagonists of the binding site of CaSRs.
   C. CaSRs serve as sensors in a negative feedback control system that regulates the 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.

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 Parathryroid Hormone Receptors (PTHRs).
   B. Blood plasma levels of Oxytocin.
   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.

3. Which of the following serves as an effector, or part of an effector, that functions in a positive feedback system?
   A. 1,25-dihydroxyvitamin D Receptors located intracellularly in cells in the intestine.
   B. Oxytocin Receptors (OXYRs) located in the plasma membranes of cells in the walls of the uterus of a pregnant female.
   C. CaSRs (Calcium-Sensing Receptors) in the plasma membranes of cells in the Parathryroid Gland.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

4. When a properly functioning negative feedback system with a comparator as part of its controller is in steady state,
    A. the absolute value of the error signal will always be zero or near zero for a reasonable amount of time.
    B. the value of the current level of the actuating signal will always be zero or near zero for a reasonable amount of time.
    C. the value of the controlled variable will always be zero or near zero for a reasonable amount of time.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

5. Which of the following will change a closed loop negative feedback system to an open loop system?
    A. Removing all sensors.
    B. Removing all actuating signals.
    C. Cutting all connections between sensors and controllers.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

6. A decrease in blood plasma levels of calcium will lead to
    A. a decrease in the calcium ion excretion in the urine.
    B. a decrease in the calcium ion absorption from the contents of the intestine into the blood plasma.
    C. a decrease in the blood 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.

7. Patient X has blood plasma levels of Parathyroid Hormone (PTH) that are always very high due to a tumor consisting of Parathyroid Gland cells that secrete high levels of PTH into the blood plasma. Which of the following drugs will help relieve some of the problems for Patient X?
    A. Drug A that is an antagonist of the Parathyroid Hormone Receptor (PTHR).
    B. Drug B that is an antagonist of the calcium-binding site of the Calcium-Sensing Receptor (CaSR).
    C. Drug C is a lipid-soluble molecule that is an antagonist of the 1,25-dihydroxyvitamin D Receptor.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

8. A new drug named ANTAG-CaSR has been developed that is an antagonist at calcium-binding sites of CaSRs (Calcium-Sensing Receptors) in the plasma membranes of Parathyroid gland cells. Healthy Person P receives regular doses of ANTAG-CaSR as part of a clinical trial. When ANTAG-CaSR levels in the extracellular spaces surrounding parathyroid gland cells increase in Healthy Person P, this leads to
   A. a decrease in the levels of calcium in the blood plasma.
   B. a decrease in the levels of Parathyroid Hormone (PTH) in the blood plasma.
   C. a decrease in the amount of PTH binding to PTH Receptors in bone.
   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 an effect of the following drugs?
   A. Drug A is an agonist of the Vasopressin2 Receptor (V2R). High levels of Drug A in the extracellular spaces surrounding cells of the kidney collecting ducts will lead to high levels of endocytosis of GLUT2 molecules in these cells.
   B. Drug B is an agonist of the Insulin Receptor. High levels of Drug B in the extracellular spaces surrounding fat cells will lead to high levels of endocytosis of GLUT4 molecules in these cells.
   C. Drug C is an antagonist of the Insulin Receptor. High levels of Drug C in the extracellular spaces surrounding skeletal muscle cells will lead to high levels of exocytosis of GLUT4 molecules 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.

11. Diffusion of which of the following substances across the plasma membrane occurs via a spanning membrane protein channel?
    A. Water.
    B. Steroid hormones.
    C. Glucose.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

12. An impermeable membrane separates one liter of a 0.01 M glucose solution in water in the left compartment from one liter of a 0.1 M glucose solution in water in the right compartment. At 2 AM the membrane became permeable to water only.
    A. At 3 AM, there will be an increase in the amount of glucose in the left compartment.
    B. At 3 AM, there will be a decrease in the concentration of glucose in water in the right compartment when compared to its value at 1 AM.
    C. At 3 AM, there will be an increase in the amount of water in the right compartment when compared to its value 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.

13. Which of the following is true for the secondary active cotransport of sodium and glucose?
    A. The net flux of sodium ions is from a region of high sodium ion concentration to a region of low sodium ion concentration.
    B. The net flux of glucose is from a region of low glucose concentration to a region of high glucose concentration.
    C. The spanning protein responsible for the secondary active cotransport is an ATPase, that is, it directly breaks down ATP.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

14. Which of the following is true?
    A. During one type of exocytosis, there is release of molecules from the inside of a vesicle into extracellular space.
    B. During exocytosis, a small portion of the plasma membrane of the cell is removed.
    C. During exocytosis, the vesicle membrane fuses with the plasma membrane of the cell.
    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 Vasopressin2 Receptors (V2Rs) in collecting duct epithelial cells?
    A. When agonists bind to V2Rs in the plasma membrane of the cells, this leads to an increase in the extracellular amount of cAMP.
    B. When antagonists bind to V2Rs in the plasma membrane of the cells, this leads to an increase in the amount of AQP2 in the luminal plasma membranes of the cells.
    C. When agonists bind to V2Rs in the plasma membrane of the cells, this leads to an increase in the amount of GTP that is bound to alpha subunits of the G-proteins associated with the V2Rs.
    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 are agonists that bind to the nicotinic Acetylcholine Receptor (nAChR)?
    A. Acetylcholine.
    B. Curare.
    C. Nicotine.
    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 a G-protein?
    A. When an agonist binds to the binding site of a G-protein-coupled receptor (GPCR), this leads to GTP displacing a GDP bound to the beta subunit of the G-protein.
    B. When GTP 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.
    C. 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 alpha subunit of the G-protein dissociates 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.

18. At 1:00AM, Neuron A is at rest with membrane potential equal to -60 millivolts; it is producing no action potentials. The threshold for an action potential in neuron A is -55 millivolts. There is a large amount of force-gated channel X spanning proteins that are located in the plasma membrane of the cell body of neuron A. Channel X is the only force-gated channel in neuron A. At 1:00 AM, there are no external forces on the cell body of neuron A and all the force-gated channel X's channels are closed. At 1:05 AM, force is applied to the cell body of neuron A and all the force-gated channel X's channels are open. If the equilibrium potential for force-gated channel X is
    A. -58 millivolts, then at 1:05AM there will be an increase in membrane voltage and an action potential following the application of force to the cell body of neuron A.
    B. -70 millivolts, then at 1:05AM there will be a decrease in membrane voltage following the application of force to the cell body of neuron A.
    C. -60 millivolts, then at 1:05AM there will be an increase in membrane voltage following the application of force to the cell body 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.

19. At 1 AM, a researcher places a healthy squid giant axon in a bath of normal squid physiological extracellular saline and internally perfuses the axon 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, the researcher replaces both the intracellular and the extracellular salines.
    A. In the 2 AM intracellular perfusion saline, the concentration of potassium ion is decreased; in the 2 AM extracellular saline, the concentration of potassium ion is not changed. This will cause a decrease in the Nernst equilibrium potential for potassium ion.
    B. In the 2 AM intracellular perfusion saline, the concentration of potassium ion is decreased; in the 2 AM extracellular saline, the concentration of potassium ion is not changed. This will cause an increase in the resting membrane voltage.
    C. In the 2 AM extracellular saline, the concentration of potassium ion is increased; in the 2 AM intracellular perfusion saline, the concentration of potassium ion is not changed. This will cause an increase 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.

20. 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.
    A. The axon terminals of interneuron A are located on the left side of the spinal cord.
    B. The cell body of interneuron A is located in the right side of the spinal cord.
    C. The axon of interneuron A is located in a peripheral nerve in the left leg.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

21. At 2 AM a healthy nerve cell is resting in a bath of normal physiological saline. At 2:05 AM the cell is depolarized just over threshold so that an action potential occurs. At 3 AM the nerve cell is placed in a new saline solution that contains a sodium ion concentration that is one half the concentration of normal physiological saline. Potassium ion concentration is not changed. At 3:05 AM the cell is depolarized just over threshold so that an action potential is produced. For this question, ignore any possible effects due to the sodium-potassium pump.
    A. The voltage of the peak of the action potential at 3:05 AM is greater than the voltage of the peak of the action potential at 2:05 AM.
    B. Resting voltage at 3:04 AM is greater than resting voltage at 2:04 AM.
    C. The voltage of the action potential peak at 3:05 AM is greater than resting potential at 3:04 AM.
    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 for a toe motor neuron that excites a toe muscle that moves the big toe in the right foot?
    A. All of the toe motor neuron's dendrites are located in the right foot near the toe muscles.
    B. The cell body of the toe motor neuron is located in the right side of the spinal cord.
    C. All of the axon terminals of the toe motor neuron are located in the spinal cord.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

23. Consider an axon of a neuron. At time=t_1, its voltage is at threshold for an action potential; at time=t_2, its voltage is at 0 millivolts prior to the peak of that action potential. In the time period between t_1 and t_2 of that single action potential,
    A. the amount of intracellular sodium increases.
    B. sodium conductance of the voltage-gated sodium channels increases as membrane voltage increases.
    C. sodium conductance of the voltage-gated sodium channels changes with a slower time course than potassium conductance of the voltage-gated potassium channels.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

24. In the axon of a healthy normal neuron at rest, the membrane
    A. voltage will be less than zero.
    B. voltage is greater than the voltage of the threshold for the action potential.
    C. sodium conductance is less than the membrane potassium conductance.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

25. 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 less than +10 millivolts.
    B. an increase in sodium conductance will lead to an increase in the amount of intracellular sodium.
    C. an increase in membrane voltage will lead to an increase in sodium conductance.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.