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 a sensor, or as part of a sensor, that functions only in a negative feedback system and not in a positive feedback system?
   A. CaSRs (Calcium-Sensing Receptors) located only in the nucleus of Parathyroid Gland cells.
   B. Parathryroid Hormone Receptors (PTHRs) located only in the plasma membranes of Parathyroid Gland cells.
   C. Force-gated (mechanically-gated) channels in the plasma membranes of mechanoreceptor (force-sensitive) neurons located in the walls of the uterus of a pregnant female.
   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 positive feedback system?
   A. Blood plasma levels of PTH (Parathryroid Hormone).
   B. Blood plasma levels of Oxytocin Receptors (OXRs).
   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 negative feedback system?
   A. 1,25-dihydroxyvitamin D Receptors located intracellularly in cells in the intestine.
   B. Oxytocin Receptors (OXRs) 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. Which of the following substances serve as ligands that bind to G-Protein Coupled Receptors (GPCRs)?
   A. Calcium.
   B. Parathyroid Hormone (PTH).
   C. Oxytocin.
   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 calcium will lead to
   A. an increase in the calcium ion excretion in the urine.
   B. an increase in the calcium ion absorption from the contents of the intestine into the blood plasma.
   C. an increase 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.

6. An increase in blood plasma levels of 1,25-dihydroxyvitamin D will lead to an increase in the
   A. net flux of calcium from the contents of the intestine into the blood plasma.
   B. amount of 1,25-dihydroxyvitamin D that binds only to the extracellular binding sites of spanning proteins in the plasma membranes of cells in the intestine.
   C. net flux of 1,25-dihydroxyvitamin D from the blood plasma into the intracellular spaces of cells of the intestine.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

7. In a properly functioning negative feedback system, the
   A. value of the controlled variable will always be very close to the threshold value when the system is in steady state.
   B. sensor measures the current value of the controlled variable.
   C. the current value of the actuating signal will always be very close to the value of the set point when the system is in steady state.
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

8. 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 when compared to its value at 1 AM.
    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 decrease in the amount of water in the left 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.

9. An impermeable membrane separates one liter of a 1M KCl solution in the left compartment from one liter of 1M NaCl solution in the right compartment. At 2 AM today the membrane became permeable to chloride ions only. At 4 AM today the membrane became permeable to sodium ions and maintained its chloride permeability.
    A. The amount of chloride ions in the left compartment at 5 AM is equal to the amount of chloride ions in the left compartment at 3 AM.
    B. The amount of sodium ions in the left compartment at 5 AM is equal to the amount of sodium ions in the right compartment at 5 AM.
    C. The amount of sodium ions in the right compartment at 5 AM is less than the amount of sodium ions in the right compartment at 3 AM.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

10. An impermeable membrane separates a one liter solution of 1M NaCl in the left compartment from a one liter solution of 2M KCl in the right compartment. At 2 AM the membrane became permeable to sodium ions. At 4 AM the membrane also became permeable to potassium ions while maintaining its permeability to sodium ions. The amount
    A. of sodium ions in the left compartment at 3 AM is equal to the amount of sodium ions in the left compartment at 1 AM.
    B. of potassium ions in the left compartment at 5 AM is equal to the amount of potassium ions in the right compartment at 5 AM.
    C. of sodium ions in the left compartment at 3 AM is equal to the amount of sodium ions in the left compartment at 5 AM.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

11. A normal healthy cell is bathed in a normal extracellular saline. The plasma membrane of the cell contains voltage-gated sodium channels, sodium-glucose co-transporters, and sodium-potassium ATPase pumps. Via which of these spanning proteins is the net flux of sodium ions from a region of high concentration of sodium to a region of low concentration of sodium? The movement of sodium ions via
    A. an open voltage-gated sodium channel.
    B. the sodium-glucose secondary active cotransporter.
    C. the sodium-potassium ATPase primary active transport pump.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

12. At 1:02 AM, all the GLUT4 transporters of cell X are in the plasma membrane of cell X. Between 1:03 AM and 1:04 AM, there is endocytosis of all these GLUT4 transporters. No exocytosis 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.

13. Which of the following is an active transport process?
    A. Net flux of sodium across the plasma membrane via voltage-gated sodium channels.
    B. Net flux of glucose across the plasma membrane via GLUT2 transporters.
    C. Net flux of glucose across the plasma membrane via sodium-glucose co-transporters.
    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 for a G-protein?
    A. After the ATP-ase of the alpha subunit of a G protein converts the ATP bound to the alpha subunit to ADP and inorganic phosphate (P_i), the alpha subunit of the G-protein recombines with the beta and gamma subunits 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 GDP 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.

15. When an antagonist binds to the receptor site of a ligand-gated ion channel,
    A. it activates a tyrosine kinase.
    B. the molecular complex formed by the antagonist and the channel immediately enter's the cell nucleus.
    C. the ion channel opens and becomes selectively permeable to specific ions.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

16. Which of the following is true for a toe motor neuron that excites a toe muscle that moves the big toe in the right foot?
    A. The cell body of the toe motor neuron is located in the left half of the spinal cord.
    B. Some of the axon of the toe motor neuron is located in a peripheral nerve in the right leg.
    C. All of the axon terminals of the toe motor neuron are located in the right half of 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.

17. 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 mv prior to the peak of that action potential. In the time period between t_1 and t_2 of that single action potential, sodium conductance of the voltage-gated sodium channels
    A. increases as membrane voltage increases.
    B. changes with a faster time course than potassium conductance of the voltage-gated potassium channels.
    C. does not change.
    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 true?
    A. Tetrodotoxin (TTX) can block the voltage-gated potassium channel.
    B. Tetraethylammonium (TEA) ion can block the voltage-gated sodium channel.
    C. Nicotine can bind to a binding site on the nicotinic acetylcholine receptor (nAChR).
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

19. 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. For this question, ignore any possible effects due to the sodium-potassium 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 a decrease 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.

20. In a neuron at rest, the membrane
    A. voltage will be less than zero.
    B. sodium conductance is greater than the membrane potassium conductance.
    C. voltage is less than the voltage of the threshold 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.

21. 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 changes the
    A. intracellular perfusion fluid so that its concentration of potassium ion is decreased. This will cause an increase in the Nernst equilibrium potential for potassium ion.
    B. intracellular perfusion fluid so that its concentration of potassium ion is increased. This will cause a decrease in the resting membrane voltage.
    C. extracellular saline so that its concentration of potassium ion is decreased. 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.

22. 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 action potential peak at 3:05 AM is greater than resting potential at 3:04 AM.
    B. The peak of the action potential at 3:05 AM is less than the peak of the action potential at 2:05 AM.
    C. Resting voltage at 3:04 AM is greater than resting voltage at 2:04 AM.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

23. At 1:00AM, Neuron A is at rest with membrane potential equal to -70 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. -70 millivolts, then at 1:05AM there will be no change in membrane voltage following the application of force to the cell body of neuron A.
    B. -60 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.
    C. -90 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.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

24. Which of the following is true for a toe corticospinal interneuron that produces action potentials during movements of the big toe of the left foot?
    A. A portion of its axon is located in a nerve in the left leg.
    B. Its dendrites are located in the right primary motor cortex of the brain.
    C. Its axon terminals are located in the left half of 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.

25. During an action potential,
    A. there is a positive feedback effect involving potassium ion.
    B. the membrane voltage decreases during the initial part of the action potential.
    C. sodium ions flow out of the nerve cell by diffusion.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.