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. Calcium ions are agonists at the binding site of CaSRs (Calcium-Sensing Receptors).
   B. CaSRs (Calcium-Sensing Receptors) serve as sensors in a negative feedback control system that regulates the blood plasma levels of Calcium.
   C. CaSRs (Calcium-Sensing Receptors) are GPCRs (G-Protein Coupled Receptors) that are spanning proteins located only in the plasma membranes of cells in the kidney.
   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 system with negative feedback?
   A. Blood plasma levels of oxytocin.
   B. Blood plasma levels of CaSRs (Calcium-Sensing Receptors).
   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. PTHRs (Parathryroid Hormone Receptors) located in the plasma membranes of bone cells.
   B. Vitamin D Receptors (VDRs) located in the plasma membranes of cells in the intestine.
   C. Oxytocin Receptors (OXTRs) located in the plasma membranes of cells 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.

4. When the value of the controlled variable in a properly functioning negative feedback system is equal to or nearly equal to the value of the set point for a reasonable amount of time, then
    A. the effector will increase the value of the controlled variable so that it is nearly equal to the value of the plateau.
    B. the absolute value of the controlled variable will be always be zero or near zero during that time.
    C. 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.

5. At 2:00 AM, the blood plasma levels of calcium are equal to the set point value of the blood plasma levels of calcium. At 2:05AM, there is an increase in the blood plasma levels of calcium. This will lead to
    A. an increase in the blood plasma levels of 1,25-dihydroxyvitamin D.
    B. an increase in the calcium ion excretion in the urine.
    C. an increase in the calcium ion absorption from the contents of the intestine 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.

6. Which of the following substances serve as antagonists that bind to G-Protein Coupled Receptors (GPCRs)?
    A. PTH (Parathryroid Hormone).
    B. Insulin.
    C. Oxytocin.
    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. Bone cells are the only cells in the body that produce and secrete Parathyroid Hormone (PTH).
    B. Parathyroid Hormone Receptors (PTHRs) serve as an effector, or as part of an effector, in a negative feedback system.
    C. Levels of Parathyroid Hormone (PTH) in the blood plasma serve as an actuating signal in a negative feedback system.
    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 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. an increase in the amounts of calcium excreted 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.

9. A normal healthy cell is bathed in a normal extracellular saline. The plasma membrane of the cell contains voltage-gated sodium channels, the sodium-glucose cotransporter 2 (SGLT2), 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-potassium ATPase primary active transport pump.
   C. the sodium-glucose cotransporter 2 (SGLT2).
   D. A and B.
   E. A and C.
   F. B and C.
   G. A, B, and C.
   H. None of the above.

10. At 1 AM, an impermeable membrane separates a 1 liter solution of 1M NaCl and 1M KCl in the left compartment from a 1 liter solution containing both 1M NaCl and 2M KCl in the right compartment. At 2 AM, the membrane became permeable to potassium ions. At 4 AM, the membrane once again became impermeable to potassium ions. At 6 AM, the membrane became permeable to sodium ions and, in addition, maintained potassium ion impermeability. At 8 AM, the membrane once again became impermeable to sodium ions. At 10 AM the membrane once again became permeable to potassium ions and, in addition, maintained sodium ion impermeability. The membrane maintained impermeability to chloride ions during the entire period.
   A. The amount of sodium ions in the right compartment at 7 AM will be greater than the amount of sodium ions in the right compartment at 5 AM.
   B. The amount of potassium ions in the right compartment at 11 AM will be less than the amount of potassium ions in the right compartment at 9 AM.
   C. The amount of sodium ions in the left compartment at 11 AM will be less than the amount of sodium 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.

11. Which of the following is true for Vasopressin2 Receptors (V2Rs) in kidney collecting duct epithelial cells?
    A. When there is an increase in the amount of agonists that are bound to V2Rs in the plasma membrane of these cells, this leads to an increase in the amount of cAMP that is bound to alpha subunits of G-proteins associated with the V2Rs.
    B. When there is an increase in the amount of agonists that are bound to V2Rs in the plasma membrane of these cells, this leads to an increase in the amount of AQP2 that is stored in vesicular membranes in the cells.
    C. When there is an increase in the amount of agonists that are bound to V2Rs in the plasma membrane of these cells, this leads to an increase in the amount of GDP that is bound to alpha subunits of 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.

12. At 1:02 AM, all the GLUT4 transporters of cell X are in vesicular membranes in intracellular spaces of cell X. Between 1:03 AM and 1:04 AM, there is exocytosis of all these GLUT4 transporters. 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, GLUT4 transporters are released into extracellular space.
    B. The glucose permeability of the plasma membrane of cell X at 1:05 AM will be greater than the glucose permeability of the plasma membrane of cell X at 1:02 AM.
    C. Between 1:03 AM and 1:04 AM, portions of the plasma membrane of cell X are removed.
    D. A and B.
    E. A and C.
    F. B and C.
    G. A, B, and C.
    H. None of the above.

13. 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 an increase in the concentration of glucose in water in the left 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.

14. For movement of substances across the plasma membrane via AE1 (Anion Exchanger 1),
    A. the net flux of bicarbonate across the plasma membrane is in the opposite direction as the net flux of chloride across the plasma membrane.
    B. the net flux of bicarbonate across the plasma membrane is from a region with a high concentration of bicarbonate to a region with a low concentration of bicarbonate.
    C. ATP is directly required for the net flux of substances across AE1.
    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 an agonist that binds to a receptor site that is part of a ligand-gated ionotropic ion channel?
    A. Acetylcholine (ACh).
    B. Insulin.
    C. Erythropoietin (EPO).
    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 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 associates with beta and gamma subunits of a 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 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.

17. When an agonist binds to the receptor site of the
    A. V2R (vasopressin2 receptor), this will result in activation of an alpha subunit of a G-protein associated with the V2R.
    B. nAChR (nicotinic acetylcholine receptor), the channel associated with the nAChR opens and only calcium ions flow across the plasma membrane via the open channel.
    C. insulin receptor, there is activation of a tyrosine kinase in the intracellular portion of the insulin receptor.
    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 -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 mechanically-gated ion channel X spanning proteins that are located in the plasma membrane of the cell body of neuron A. Channel X is the only mechanically-gated ion channel in neuron A. At 1:00 AM, there are no external forces on the cell body of neuron A and all the mechanically-gated ion channel X's channels are closed. At 1:05 AM, force is applied to the cell body of neuron A and all the ion channels of mechanically-gated channel X are open.
If the equilibrium potential for mechanically-gated channel X is
    A. -60 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.
    B. -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.
    C. -80 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 an increase in the Nernst equilibrium potential for potassium ion.
    B. In the 2 AM intracellular perfusion saline, the concentration of potassium ion is increased; 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 decreased; in the 2 AM intracellular perfusion saline, the concentration of potassium ion is not changed. This will cause an 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.

20. 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. sodium conductance of the voltage-gated sodium channels increases as membrane voltage increases.
    B. the amount of intracellular sodium decreases.
    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.

21. The value of the Nernst equilibrium potential for sodium at 20^{o}C will be
    A. -58 millivolts if extracellular sodium concentration is ten times that of intracellular sodium ion concentration.
    B. zero volts if extracellular sodium ion concentration is equal to intracellular sodium ion concentration.
    C. less than zero volts if extracellular sodium ion concentration is less than intracellular sodium ion concentration.
    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. Some of the axon of the toe motor neuron is located in a peripheral nerve in the right leg.
    B. Axon terminals of the toe motor neuron are located near right toe muscles.
    C. The cell body of the toe motor neuron is 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.

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

24. 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 resting potential at 3:04 AM.
    B. The voltage of the resting potential at 3:04 AM is greater than the voltage of the resting potential at 2:04 AM.
    C. The voltage of the peak of the action potential at 3:05 AM is less than the voltage of the peak of the action potential at 2:05 AM.
    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 ATPase pump. At 2:01 AM, the resting membrane voltage of the neuron is -70 millivolts. At 2:02 AM,
    A. the value of the Nernst equilibrium potential for sodium ions for the neuron is greater than +30 millivolts.
    B. an increase in membrane voltage will lead to no change in sodium conductance.
    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.