Exam 1

100 points

1. The term “internal environment”, as coined by Clause Bernard, is best defined as (3 points)
   a. the intracellular fluid.
   b. the extracellular fluid.
   c. the air between our clothes and skin.
   d. the inside of a building.

2. If a system is being regulated, and the rate of influx into the system increases, then the rate of efflux must (3 points)
   a. decrease.
   b. increase.
   c. remain the same.
   d. become negative.

3. Choose one of the following systems and provide the negative feedback loop(s) that would be at work, including three effectors. (Your explanation can be written or make use of a diagram, but diagrams should be clearly labelled with names and activities.) (10 points)

   Choices: a human who is too warm, a human who is too cold, or a human with low blood Ca²⁺.
4. Imagine we have two solutions, A and B, separated by a membrane. Each of the following questions presents a different, independent scenario for the setup. For each, indicate what would happen (in terms of solute and water movement) and briefly indicate why. None of the solutes is charged.

a. Solution A is 1M sucrose and solution B is 1M urea. The membrane is permeable to urea but not to sucrose or water. (3 points)

b. Solution A is 1M sucrose and solution B is 1M urea. A tiny amount of sucrase is added to A, which cleaves each sucrose into a glucose and fructose (we’ll ignore the presence of the sucrase as a solute). The membrane is permeable to urea, glucose and fructose, but not to water. (3 points)

c. Same scenario as in question b, except the membrane is permeable to water but none of the solutes. (3 points)

d. Speculate on what might happen if the scenarios was the same as in question b, but the membrane was permeable to water, glucose, and urea, but not fructose. (3 points)
e. In the scenario in question a, what would change if the setup was the same but the membrane was twice as thick? (2 points)

6. Describe an example of a secondary active transport system. (As before, you can use a diagram, but be sure the components and actions are explained.) (5 points)

7. Messages from the central nervous system promoting “rest and digest” functions are sent to organs and tissues mainly via the (3 points)
   a. enteric nervous system.
   b. parasympathetic nervous system.
   c. somatic nervous system.
   d. sympathetic nervous system.

8. The region of a neuron that normally exhibit action potentials is the (3 points)
   a. axon.
   b. dendrites.
   c. soma.
   d. All of the above normally exhibit action potentials.

9. In myelinated axons, action potentials (APs) propagate through a process known as ___________________________ conduction, in which the APs occur only at regions known as ___________________________. As a result of the myelin, propagation is much ___________________________ than it is in unmyelinated axons. (3 points)
10. Describe (you can use a diagram, yada, yada, yada) the voltage changes that occur in a cell membrane during an action potential. Also indicate which ion channels are open and closed at which times, and briefly explain how this relates to the voltage changes. (You do not need to discuss the details of the gate function in the channels.) (10 points)

11. How might the pattern of an action potential change if a cell had voltage-gated potassium channels with fast gates instead of slow gates? (3 points)

12. At a chemical neural synapse, the arrival of the AP at the axon terminal triggers the opening of voltage-gated channels that allow ________________ influx. This influx triggers release of __________________________ from the cytoskeleton; these structures then undergo __________________________ and release __________________________ into the __________________________, where it diffuses to the postsynaptic neuron. (5 points)
13. Give three differences in the effects of activating an ionotropic versus a metabotropic postsynaptic receptor. (3 points)

14. For each of the following, indicate whether the effect on the postsynaptic potential would be excitatory or inhibitory by circling the correct answer. (3 points)
   a. Closing of Na⁺ channels: Excitatory / Inhibitory
   b. Closing of K⁺ channels: Excitatory / Inhibitory
   c. Opening of Ca²⁺ channels: Excitatory / Inhibitory

15. Neuron A and neuron B are presynaptic neurons that affect postsynaptic neuron 1. If A alone releases neurotransmitter (NT), the postsynaptic potential increases. If A and B release NT at the same time, the postsynaptic potential increases, but by less than with A alone. (4 points)
   a. Neuron B must have effects that are: Excitatory / Inhibitory
   b. The second case is an example of: Spatial summation / Temporal summation

16. What benefit is gained from the use of lateral inhibition in the sensory system? (You don’t need to describe the detailed workings of the arrangement, just the outcome.) (3 points)

17. Both Ruffini’s corpuscles and Pacinian corpuscles are present in the subdermal layers of the skin. They represent an example of (3 points)
   a. interoceptors.
   b. nociceptors.
   c. range fractionation.
   d. a phasic and a tonic receptor.

18. In a few sentences, describe how salt triggers the release of neurotransmitter from taste receptors. (4 points)
19. In the structures responsible for linear acceleration, small mineral granules called __________________ influence the deflection of stereocilia of hair cells. Rotational movements are detected by hairs cells surrounded by a gel structure called a __________________; in this case, the movement of fluid in the __________________ causes deflection of the stereocilia. Both types of structures are located in the __________________. (4 points)

20. Explain how the cochlea transduces sound waves entering at the oval window into signals that can be passed to the central nervous system. (10 points)

21. The condition known as “night blindness” occurs when insufficient vitamin A is present in the diet. Given that the molecule retinal is a form of vitamin A, what specific problem(s) would result from a lack of this vitamin? (4 points)