Some tips: Breathe deeply... Relax... Read the questions carefully and answer the question asked, not some different question (i.e. Don’t go into data dump mode.). If the question asks for a diagram, draw a diagram. Do the easy questions first, and budget your time. Good Luck!
(60 Points Total)

1. Think about the advantages and disadvantages that the cooperativity of hemoglobin subunits bring to oxygen transport by the blood. Say that you are working on a mutant form of hemoglobin with the oxygen binding curve below. What is/are the advantage(s) to having this type of binding curve? What would be the disadvantage(s)? What does the curve say about cooperativity between the subunits? (9 pts.)

![Diagram of oxygen binding curve for normal and mutant hemoglobin]

2. You are Alan Hodgkin working on the squid axon in the early 1950's. You set up an experiment whereby you start an action potential from both ends of the isolated axon at the same time. What would happen to the action potentials when they meet in the middle? Why? (6 pts.)
3. Amplification of a signal, whether it be a hormone or a sensory signal, is important to cells. First, outline in some detail using diagrams the amplification of a hormone signal AND a sensory signal. Indicate on each diagram where amplification of the signal is taking place. Second, compare and contrast any similarities and differences that you see in the two cascades of events. (16 pts.)
4. Maintaining an appropriate blood pressure is important to the proper function of the body. Say, for example, that your great uncle Fred has really high blood pressure. What might the high blood pressure do to his: a) kidney function and the glomerular filtration rate; and b) the amount of fluids getting into the lymphatic system? Use diagrams as needed. (8 pts.)

5. What are the advantages of having a three or four-chambered heart and the associated circulatory system versus the two-chambered heart and the simpler circulatory system found in fishes? Use diagrams to illustrate your answer. (6 pts.)
6. You’re running in a marathon, and you’re sweating buckets, losing a lot of Na⁺, K⁺, Ca²⁺, and Cl⁻. You’re drinking a lot of water with sugars in it, so ATP production isn’t a problem, but you’re having problems moving your legs. Why might this be? **First, diagram** the sequence of events from the action potential being conducted down the motor neuron to the skeletal muscle, then the events that happen at the synapse, followed by the contraction of the muscle. **Second**, explain where and why this sequence of events would be disrupted by you sweating buckets. (15 pts.)