1. What is the difference between a paracrine agent and a hormone?

2. Name two hormones that would be expected to activate intracellular receptors.

3. Complete the following table for the hypothalamic-pituitary system by filling in the blanks with the appropriate promoter (not inhibitory) hormones. You may use h. as an abbreviation for the word “hormone.”

<table>
<thead>
<tr>
<th>Hypothalamus</th>
<th>Anterior Pituitary</th>
<th>Target Organs or Tissue and Their Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Adrenal cortex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cortisol release</td>
</tr>
<tr>
<td>General body tissues</td>
<td></td>
<td>Development, milk production</td>
</tr>
<tr>
<td>Liver</td>
<td></td>
<td>Growth and repair</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IGF-1 release</td>
</tr>
</tbody>
</table>

4. What are two major types of physiological responses seen to an increase in cortisol levels?
5. Diagram or describe the full thyroid hormone pathway that would result from an increase in body temperature above normal. Be sure to include all feedback loops.

Now consider a drug that blocks the hormone receptors present in the thyroid gland. What would be the expected effect on the blood levels of each of the hormones in the thyroid pathway?

6. Describe the process that results in the growth in length of bones such as the femur and humerus.
7. Describe the process by which an action potential arriving at the terminal of a motor neuron triggers contraction of a muscle fiber. You should end your discussion at the point when ions diffuse into the myofibrils.

8. List the different steps in the cross-bridge cycle as it occurs at the molecular level. (Your “ingredients” should be myosin, actin and ATP.) You do not need to diagram the events.

9. How is a tetanic contraction normally achieved? How does force production during such a contraction compare to that seen in a twitch contraction?
10. Answer the following questions using the recording of a twitch contraction shown below. The action potential in the muscle occurs at $t = 0$.

![Graph of twitch contraction]

How long is the latent period?

What is the maximum amount of force the muscle produces under these contraction conditions?

If this muscle had to lift a weight of 3.0 N, what would be the delay between the action potential and time the muscle began lifting the weight?

11. Describe the pattern of recruitment of motor units that occur when a muscle begins to lift a relatively heavy weight.
12. Describe the events during ventricular systole, being sure to make cause-and-effect relationships clear.

What might happen (and when during the heartbeat cycle) to an individual with a semilunar valve that did not seal completely when closed?

13. During a normal heartbeat cycle, the action potentials occur first at the pacemaker cells in the __________________________, then pass to the cardiac muscle of the __________________________. From there, the __________________________ introduces a delay of about 0.1 second before the action potentials pass down the ventricular septum via the __________________________, then into the __________________________, before finally reaching the cardiac muscle of the ventricle.
14. Briefly describe three ways in which vasoconstriction of arterioles can be controlled.

15. Exposure to cold tends to induce vasoconstriction in cutaneous blood vessels (as you no doubt recall from earlier in the semester). What would be the expected effect of this vasoconstriction on mean arterial pressure if no other changes occurred? And then what regulatory changes might normally be expected to occur in response to the cutaneous vasoconstriction? Be certain to briefly explain the reason for your answers.

16. What is lymph? Where (briefly) does it come from, and where does it go?
17. A sample of water has nitrogen gas dissolved in it to the point that the concentration of $N_2$ is 40 ml per liter of water, with a partial pressure of 1000 torr. If the water is exposed to normal air with a concentration of $N_2$ of 780 ml per liter and a partial pressure of 590 torr, which way will the $N_2$ diffuse, and why?

18. Describe the mechanical events that occur during an inhalation at resting ventilation levels, being sure to make cause-and-effect relationships clear.

19. If a “typical” male’s tidal volume is 550 ml, and he is taking 10 breaths per minute, what is his minute ventilation? How about his (approximate) alveolar ventilation rate?
20. Before entering the lungs, inhaled air passes through a single cartilage-ringed tube called the ___________________, which then splits into the ____________________, the tubes that enter each lung. After a number of additional divisions, the tubes become ____________________, which lack cartilage rings, before ending at the main location of gas exchange, the ____________________.

21. Use the oxygen saturation curve below to answer the following questions.

![Oxygen Saturation Curve](image)

What is the percent saturation of hemoglobin at a \( P_{O_2} \) of 50 torr?

Assuming the lungs are at normal \( P_{O_2} \) levels, how much oxygen (in units of percent saturation) would be delivered to tissues with a \( P_{O_2} \) of 25 torr?

Draw the change in the curve that might be expected at blood pH drops. Based on your new curve, how much oxygen would be delivered to tissues with a \( P_{O_2} \) of 25 torr?

Considering the original curve again, how much oxygen would be delivered if the \( P_{O_2} \) in the lungs was reduced to 70 torr because the person was at high altitude? (Tissues still at \( P_{O_2} = 25 \) torr.)

Same question again, but provide the amount of oxygen in units of ml of \( O_2 \) off-loaded per liter of blood.
22. What are the three major forms in which CO$_2$ is transported in the blood, and about what percentage is transported in each way?

23. What is the typical P$_{CO2}$ in systemic arterial blood? What about venous blood? How is a rise in arterial P$_{CO2}$ above this normal level detected, and what would the response be?