Base your answers to questions 1 through 4 on the statement below.

The immune system protects against foreign substances and even some cancers. Explain how the immune system functions.

1. Identify one disease that damages the immune system and state how it affects this system.

2. Identify one way the immune system fights pathogens.

3. Identify the substance in a vaccine that stimulates the immune system.

4. Describe the response of the immune system to the vaccine.

Base your answers to questions 5 through 7 on the information below and on your knowledge of biology.

Feedback mechanisms have evolved that maintain homeostasis. Describe how homeostasis is maintained through feedback.

5. Identify one feedback mechanism in the human body.

6. Identify, other than death, one specific result if homeostasis fails in the human body.

7. Describe how a plant regulates water loss through a feedback mechanism that involves guard cells.
Base your answers to questions 8 through 12 on the information below, and on your knowledge of biology.

A student has a sandwich for lunch. The bread contains starch molecules and various other molecules. After chewing and swallowing some of the sandwich, the starch moves along the digestive system and is digested. The sequence below represents what takes place next.

digested starch → bloodstream → cell → cell structure → ATP

Explain what occurs, beginning with the digestion of starch and ending with ATP production.

8. Identify the molecules that are used to digest the starch.

9. Identify the molecules produced when starch is digested.

10. Explain why starch must be digested before its building block molecules can enter the bloodstream.

11. Identify the structure in the cell that will produce ATP from the starch building blocks.

12. State why ATP is important to cells.

13. Diagram A below represents a microscopic view of the lower surface of a leaf. Diagram B represents a portion of the human body.

Diagagram A

Diagram B

a Choose one diagram and record its letter, A or B, in the space provided.

b Identify the structure labeled X in the diagram you chose.

c State one problem for the organism that would result from a malfunction of the structure you identified.
Base your answers to questions 14 and 15 on the data table below and on your knowledge of biology.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Measles Vaccine</th>
<th>Polio Vaccine</th>
</tr>
</thead>
<tbody>
<tr>
<td>child A</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>child B</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>child C</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

14. Identify the system that will directly respond to these vaccines, and state the specific expected response

System: __________________________

Response: ________________________

15. State the specific expected result of administering these vaccines to child B. Explain your response.

Base your answers to questions 16 through 18 on the information below.

A student was visiting a friend at her home. Her friend owned two cats. After playing with the cats for a while, the student began to sneeze. Her nose began to run and her eyes became red, watery, and itchy. It also became hard for her to breathe. A few minutes after leaving her friend's home, the symptoms disappeared.

Provide a biological explanation for the symptoms the girl developed at her friend's house. In your response, be sure to:

16. Identify the type of reaction the student was most likely experiencing.
17. State one reason why her symptoms are not likely due to an infections agent.

18. Identify the body system that was responsible for triggering the reaction she experienced.

19. Base your answer this question on the information below and on your knowledge of biology.

   Stem cells present in an embryo are responsible for the formation of various tissues and organs. Recent research suggests that it may be possible to replicate stem cells from sections of skin taken from adult mice, rather than having to use stem cells from the embryos of mice. In the future, human stem cells may be used to replace human tissue damaged by diseases such as Parkinson's disease and multiple sclerosis.

Discuss why the use of stem cells taken from a patient to replace damaged tissues and organs may decrease the potential risk to a patient. In your answer, be sure to:

- identify the major problem that may occur when tissues and organs donated by another individual are used
- explain why this problem may occur
- explain why this problem will not occur if tissues and organs produced by stem cells from the patient are used

20. Describe one example of diffusion in the human body. In your description be sure to:

   - identify the place where diffusion takes place
   - identify a substance that diffuses there
   - identify where that substance diffuses from and where it diffuses to, at that place

21. Although human muscle cells and nerve cells have the same genetic information, they perform different functions. Explain how this is possible.
Base your answers to questions 22 through 24 on the diagram of nerve cells below and on your knowledge of biology.

22. In the space below, sketch a chemical molecule that might be released from nerve cell A and be recognized and bind to area I of nerve cell B.
23. Describe what would happen if a drug molecule shaped like □ were introduced into this nerve pathway.

24. Identify one substance, other than the secretions from nerve cells, used in cell communication.

Base your answers to questions 25 through 27 on the passage below and on your knowledge of biology.

When humans perspire, water, urea, and salts containing sodium are removed from the blood. Drinking water during extended periods of physical exercise replenishes the water but not the sodium. This increase in water dilutes the blood and may result in the concentration of sodium dropping low enough to cause a condition known as hyponatremia. Symptoms of hyponatremia include headache, nausea, and lack of coordination. Left untreated, it can lead to coma and even death. The body has a variety of feedback mechanisms that assist in regulating water and sodium concentrations in the blood. The kidneys play a major role in these mechanisms, as they filter the blood and produce urine.

25. Many runners pour water on their bodies during a race. Explain how this action helps to maintain homeostasis.

26. How would running in a marathon on a warm day most likely affect urine production? Support your answer.

27. Many people today drink sport drinks containing large amounts of sodium. Describe one possible effect this might have on a person who is not very active.
28. The diagrams below represent some of the systems that make up the human body.

Select one of the pairs of systems and write its number below. For the pair selected, identify each system and state one function of that system. Explain how the two systems work together to help maintain homeostasis in an individual.

Base your answers to questions 29 and 30 on the diagram below which illustrates a role of hormones.

29. Letter B indicates:

(1) ribosomes  
(2) receptor molecules  
(3) tissues  
(4) inorganic substances

30. Explain why cell A is a nontarget cell for the hormone illustrated in the diagram.
Base your answers to questions 31 and 32 on the information in the newspaper article below.

**Patients to test tumor fighter**

Boston–Endostatin, the highly publicized experimental cancer drug that wiped out tumors in mice and raised the hopes of cancer patients, will be tested on patients this year.

"I think it's exciting, but ... you always have the risk that something will fail in testing," said Dr. Judah Folkman, the Harvard University researcher whose assistant, Michael O'Reilly, discovered endostatin.

Endostatin and a sister protein, angiostatin, destroy the tumors' ability to sprout new blood vessels. This makes cancer fall dormant in lab animals, but no one knows if that will happen in humans.

– The Associated Press

31. State one reason that mice are often used by scientists for testing experimental drugs that may be used by humans.

32. Explain why it is necessary to test these experimental drugs on human volunteers as well as on test animals.

Base your answers to questions 33 and 34 on the information below and on your knowledge of biology.

A student checked her pulse rate three times during one day. When she first woke up, her pulse rate was 54 beats per minute (bpm). As she walked to her first-period class, it was 71 bpm. Later, she recorded 98 bpm after playing in a basketball game.

33. State one reason for the change in her pulse rate throughout the day.
34. State one way a change in pulse rate helps to meet the needs of the body.

Base your answers to questions 35 through 37 on the information and data table below.

Reaction time is a measure of how quickly an individual responds to a stimulus. An activity was performed to determine the reaction time of a student. To do this, one student suspended the zero end of a meterstick between the thumb and index finger of another student. The meterstick was dropped, and both the distance the meterstick dropped and the time it took for the student being tested to catch the meterstick were recorded. This procedure was repeated four more times. The results are shown in the data table below.

![Data Table]

**Data Table**

<table>
<thead>
<tr>
<th>Trial</th>
<th>Distance (cm)</th>
<th>Time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90</td>
<td>0.43</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>0.39</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>0.32</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>0.30</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>0.29</td>
</tr>
</tbody>
</table>

**Trials**

35. Plot the data for distance on the graph. Surround each point with a small circle and connect the points.

36. If the meterstick was caught at the 70-centimeter mark, the amount of time needed to catch it would most likely have been between

(1) 0.1 and 0.15 sec
(2) 0.2 and 0.3 sec
(3) 0.3 and 0.32 sec
(4) 0.35 and 0.4 sec
37. Using one or more complete sentences, state the relationship between the number of trials and the reaction time.
1. AIDS/HIV
   – attacks the immune system so it cannot fight off diseases
   cancer/leukemia
   – destroys immune system cells, which weakens immune responses
2. – White blood cells engulf pathogens. – Antibodies fight invaders. – produces antibodies
3. – dead/weakened pathogen, – antigens, – a small piece of the virus/viral coat
4. – The vaccine stimulates the immune system to produce antibodies.
   – It causes the body to make antibodies.
5. – the change in heart rate in response to exercise, – the change in respiratory rate in response to exercise, – sweating or shivering in response to changes in body temperature, – the maintenance of body temperature on a hot day, – increase in white blood cells in response to an infection
6. – disease/gets sick, – disruption in the body's ability to carry out
7. – Guard cells close opening in the leaves, slowing/stopping water loss. – When guard cells close the stomata, less water evaporates out of the leaves. – Guard cells regulate the rate of transpiration when they change shape. – enzymes, – biological catalysts, – amylase molecules – glucose molecules, – simple sugars, – monosaccharides, – sugars
8. – Starch molecules are too large. – They are too big to get from the digestive tract into the blood.
9. – Mitochondria
10. – ATP is the molecule that supplies usable energy for all the activities of a cell. – ATP molecules provide energy for cells.
11. – an allergic reaction or allergy – an immune response to a usually harmless substance
12. – An infection would probably take longer to develop.
    – An infection by a pathogen would probably not end so suddenly.
13. Examples:
    Diagram A:
    Structure X is a guard cell. If the guard cells do not function properly, the plant can lose too much water or gas exchange could be affected.
    Diagram B:
    Structure X represents the pancreas. If the pancreas does not produce enough insulin, a person will develop diabetes.
14. System: — Immune system
    Response: — make antibodies — increase white blood cell production — produces cells that engulf the virus/pathogen
    — Child B should be immune to both measles and polio.
    — Child B will form antibodies against both diseases. — Child B will not get measles or polio.
15. — rejection of tissues or organs, — foreign proteins from
16. • Identify a place in the human body where diffusion takes place (e.g., small intestine or digestive system)
    • Identify a substance that diffuses there (e.g., simple sugar or amino acid or digested food)
    • Identify where that substance diffuses from and where it diffuses to, at that place (e.g., simple sugar diffuses from the inside of the small intestine into the blood.)
21. Examples:
   - Different genes are "turned on" or "turned off" in different cells.
   - Cells are specialized for specific functions.
   - Different parts of DNA are used in different types of cells.

22. — Nothing; the shape would not be accepted by receptors on B.

23. — Nothing; the shape would not be accepted by receptors on B.
    — It would not bind with the receptors in area I.

24. — hormones — antigens — receptor molecules

25. Examples: - reduces loss of sodium - cools the body - decreases amount of perspiration - slows down water loss - reduces the chances of hyponatremia

26. Examples: - Less urine would be produced because a large amount of water is being lost as sweat.
   - Less urine will be produced because the feedback mechanisms in the kidneys regulate water levels in the blood.
   - The runner would sweat more, decreasing H2O levels in the blood.
   - This decrease would slow urine production because there is less water in the blood to be filtered.
   - Urine would be more concentrated because it would contain less water.

27. Example: - It could raise their blood pressure - It could cause them to retain water - It could decrease water production

28. (essay)

29. 2

30. — The receptor molecules on Cell A are not the correct shape to combine with the hormone or are not the correct receptors for the hormone.

34. — Increased pulse rate increases the availability of food and oxygen to cells.

35. — The pulse rate is an indication of the activity level of the body. Additional food and oxygen is provided to body cells with an increase in pulse rate. — increases the removal of wastes from cells

36. 4

37. As the number of trials increased, the reaction time decreased.

38. — When the student was sleeping, her activity was minimal and her pulse rate was slow. When she was walking, she used more energy, resulting in an increased pulse rate.
   — Pulse rate varies with activity level.
   — Her body was maintaining homeostasis. — Her heart beats faster when she is more active.
28. *Examples:*
   
   Pair 1 – The muscular system enables an organism to move. The nervous system detects stimuli and sends messages. The muscles receive messages carried by nerves and contract, resulting in movement.

   Pair 2 – The respiratory system brings in oxygen and the digestive system breaks down food so that both substances are available to cells to make ATP.

   Pair 3 – The circulatory system carries wastes. The excretory system removes wastes from the blood and excretes them.