1. Which statement describes the best procedure to determine if a vaccine for a disease in a certain bird species is effective?
   (1) Vaccinate 100 birds and expose all 100 to the disease.
   (2) Vaccinate 100 birds and expose only 50 of them to the disease.
   (3) Vaccinate 50 birds, do not vaccinate 50 other birds, and expose all 100 to the disease.
   (4) Vaccinate 50 birds, do not vaccinate 50 other birds, and expose only the vaccinated birds to the disease.

2. Scientists have cloned sheep but have not yet cloned a human. The best explanation for this situation is that
   (1) the technology to clone humans has not been explored
   (2) human reproduction is very different from that of other mammals
   (3) there are many ethical problems involved in cloning humans
   (4) cloning humans would take too long

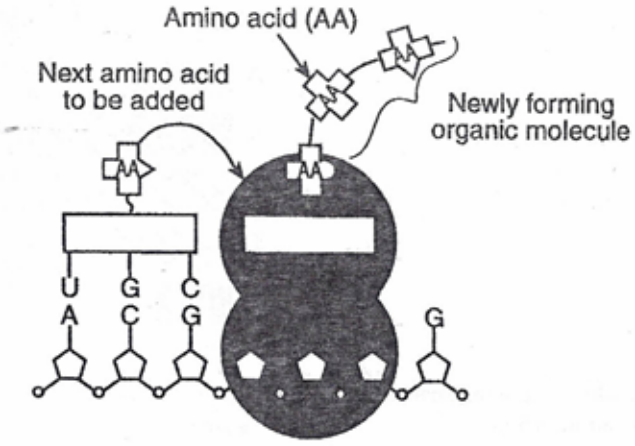
3. The main function of the human digestive system is to
   (1) rid the body of cellular waste materials
   (2) process organic molecules so they can enter cells
   (3) break down glucose in order to release energy
   (4) change amino acids into proteins and carbohydrates

4. The normal sodium level in human blood is 135 mEq/L. If a blood test taken immediately after a meal reveals a sodium level of 150 mEq/L, what will most likely result?
   (1) Antibody production will increase.
   (2) The person will move to an ecosystem with a lower sodium level.
   (3) The nutritional relationships between humans and other organisms will change.
   (4) An adjustment within the human body will be made to restore homeostasis.

5. When a person's teeth are being x rayed, other body parts of this person are covered with a protective lead blanket to prevent
   (1) loss of hair
   (2) increase in cell size
   (3) changes in DNA molecules
   (4) changes in glucose structure

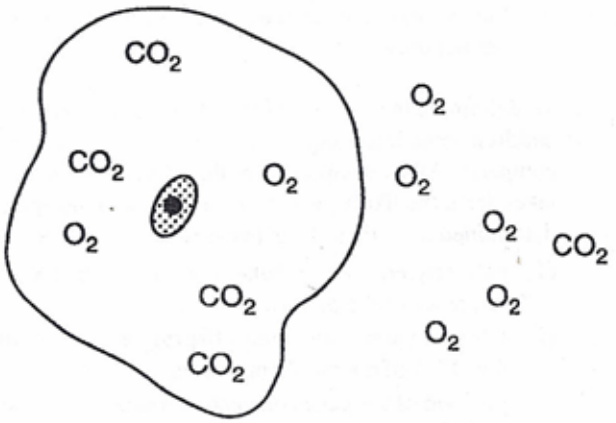
6. Which phrases best identify characteristics of asexual reproduction?
   (1) one parent, union of gametes, offspring similar to but not genetically identical to the parent
   (2) one parent, no union of gametes, offspring genetically identical to parents
   (3) two parents, union of gametes, offspring similar to but not genetically identical to parents
   (4) two parents, no union of gametes, offspring genetically identical to parents

7. The diagram below represents a process that occurs within a cell in the human pancreas.



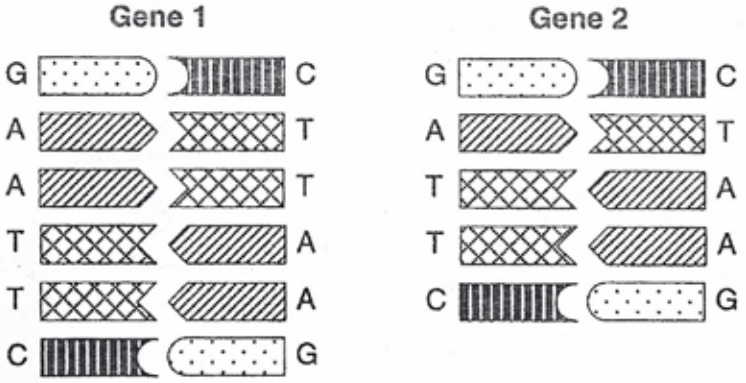
This process is known as
   (1) digestion by enzymes
   (2) protein synthesis
   (3) energy production
   (4) replication of DNA

8. The diagram below represents a cell in water. Formulas of molecules that can move freely across the cell membrane are shown. Some molecules are located inside the cell and others are in the water outside the cell.



Based on the distribution of these molecules, what would most likely happen after a period of time?
   (1) The concentration of O_2 will increase inside the cell.
   (2) The concentration of CO_2 will remain the same inside the cell.
   (3) The concentration of O_2 will remain the same outside the cell.
   (4) The concentration of CO_2 will decrease outside the cell.

9. The diagrams below represent portions of the genes that code for wing structure in two organisms of the same species. Gene 1 was taken from the cells of a female with normal wings, and gene 2 was taken from the cells of a female with abnormal wings.



The abnormal wing structure was most likely due to
(1) an insertion (2) a substitution (3) a deletion (4) normal replication

10. During the warm temperatures of summer, the arctic fox produces enzymes that cause its fur to become reddish brown. During the cold temperatures of winter, these enzymes do not function. As a result, the fox has a white coat that blends into the snowy background. This change in fur color shows that
    (1) the genes of a fox are made of unstable DNA
    (2) mutations can be caused by temperature extremes
    (3) random alteration of DNA can occur on certain chromosomes
    (4) the expression of certain genes is affected by temperature

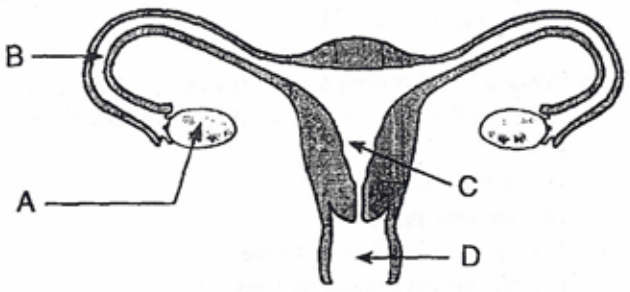
11. To determine the identity of their biological parents, adopted children sometimes request DNA tests. These tests involve comparing DNA samples from the child to DNA samples taken from the likely parents. Possible relationships may be determined from these tests because the
    (1) base sequence of the father determines the base sequence of the offspring
    (2) DNA of parents and their offspring is more similar than the DNA of nonfamily members
    (3) position of the genes on each chromosome is unique to each family
    (4) mutation rate is the same in closely related individuals

12. Although all the body cells in an animal contain the same hereditary information, they do not all look and function the same way. The cause of this difference is that during differentiation
    (1) embryonic cells use different portions of their genetic information
    (2) the number of genes increases as embryonic cells move to new locations
    (3) embryonic cells delete portions of chromosomes
    (4) genes in embryonic body cells mutate rapidly

13. The energy an organism requires to transport materials and eliminate wastes is obtained directly from
    (1) DNA (3) hormones
    (2) starch (4) ATP

14. New inheritable characteristics would be *least* likely to result from
    (1) mutations which occur in muscle cells and skin cells
    (2) mutations which occur in male gametes
    (3) mutations which occur in female gametes
    (4) the sorting and recombination of existing genes during meiosis and fertilization

15. The diagram below shows the human female reproductive system.



The fetus normally develops within structure
(1) *A* (3) *C*
(2) *B* (4) *D*

16. Most cells in the body of a fruit fly contain eight chromosomes. How many of these chromosomes were contributed by each parent of the fruit fly?
    (1) 8 (3) 16
    (2) 2 (4) 4

17. One way to produce large numbers of genetically identical offspring is by
    (1) cloning
    (2) fertilization
    (3) changing genes by agents such as radiation or chemicals
    (4) inserting a DNA segment into a different DNA molecule

18. Which disease damages the human immune system, leaving the body open to certain infectious agents?
    (1) flu
    (2) AIDS
    (3) chicken pox
    (4) pneumonia

19. Which characteristic of sexual reproduction has specifically favored the survival of animals that live on land?
    (1) fusion of gametes in the outside environment
    (2) male gametes that may be carried by the wind
    (3) fertilization within the body of the female
    (4) female gametes that develop within ovaries

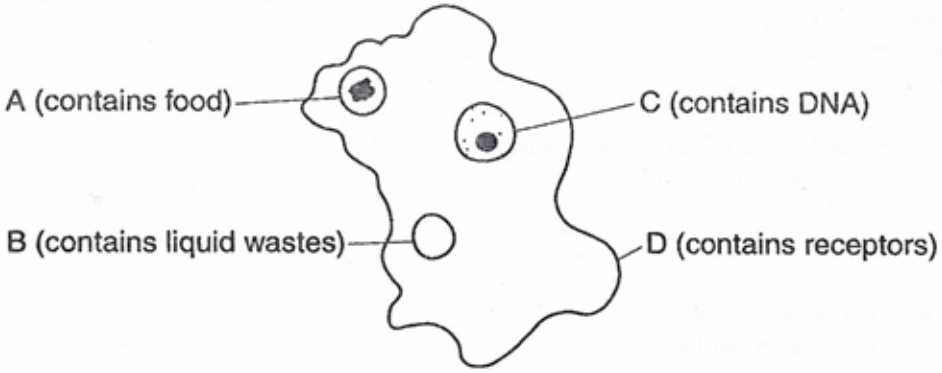
20. What usually results when an organism fails to maintain homeostasis?
    (1) Growth rates within organs become equal.
    (2) The organism becomes ill or may die.
    (3) A constant sugar supply for the cells is produced.
    (4) The water balance in the tissues of the organism stabilizes.

21. Which activity is *not* a response of human white blood cells to pathogens?
    (1) engulfing and destroying bacteria
    (2) producing antibodies
    (3) identifying invaders for destruction
    (4) removing carbon dioxide

22. In some individuals, the immune system attacks substances such as grass pollen that are usually harmless, resulting in
    (1) an allergic reaction
    (2) a form of cancer
    (3) an insulin imbalance
    (4) a mutation

23. A characteristic shared by all enzymes, hormones, and antibodies is that their function is determined by the
    (1) shape of their molecules
    (2) DNA they contain
    (3) inorganic molecules they contain
    (4) organelles present in their structure

24. Base your answer to the following question on the diagram below, which shows some of the specialized organelles in a single-celled organism.



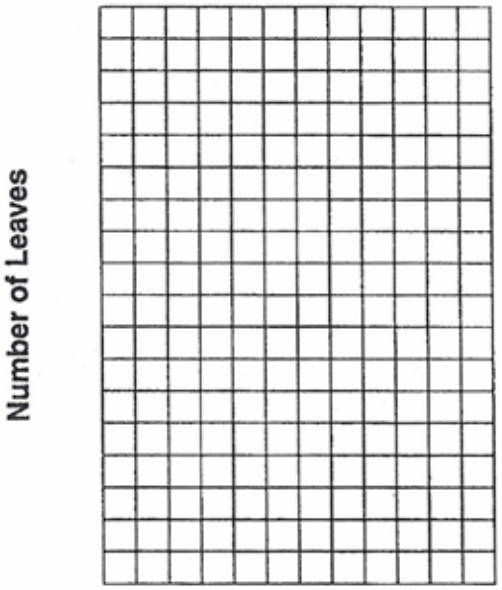
a Write the letter of *one* of the labeled organelles and state the name of that organelle.

b Explain how the function of the organelle you selected in part *a* assists in the maintenance of homeostasis.

c Identify a system in the human body that performs a function similar to that of the organelle you selected in part *a*.

Base your answers to questions **25** through **27** on the information and data table below. A student counted the total number of leaves in a group of duckweed plants (*Lemna gibba*) over a 5-day period. The data collected are shown in the table below.

Growth of Duckweed Leaves



Growth of Duckweed Leaves

Time in Days	Number of Leaves
0	15
1	20
2	25
3	40
4	60
5	80

Example: 

25. *a* Mark an appropriate scale on each labeled axis.

b Plot the data from the data table. Surround each point with a small circle and connect the points.

26. The time it takes for the number of leaves to increase from 15 to 30 is approximately
(1) 2.0 days (2) 2.3 days (3) 2.9 days (4) 3.2 days

27. State what would most likely happen to the production of oxygen by duckweed plants if the intensity and duration of exposure to light were increased.

28. Base your answer to the following question on the information and data table below.

Two species of fish were subjected to a series of treatments. The number of red blood cells flowing per minute through one capillary in the tail of each fish was counted and the average calculated. The data table below shows the treatments given to each species of fish and the results of the various treatments.

Data Table

Treatment	Species of Fish	Number of Fish Used	Average Number of Red Blood Cells
Adrenaline added (1:10,000 solution)	Trout	10	35
Adrenaline added (1:1,000 solution)	Trout	10	50
50% alcohol solution added	Trout	5	78
Temperature reduced (25°C to 4°C)	Trout	6	30
Lactic acid added (1:5,000 solution)	Sunfish	6	90
25% alcohol solution added	Sunfish	6	89
Adrenaline added (1:10,000 solution)	Sunfish	6	17
Temperature reduced (25°C to 4°C)	Sunfish	6	14
Temperature increased (15°C to 25°C)	Sunfish	6	22

State *two* errors in this investigation.

29. Meiosis occurs in the development of sex cells. Mitosis occurs in most other cells. Identify *two* additional differences between these processes.

30. Using *one* specific example, identify *one* action taken by a mother that could have a negative effect on the embryonic development of her baby.

31. In desert environments, organisms that cannot maintain a constant internal body temperature, such as snakes and lizards, rarely go out during the hot, sunny daylight hours. They stay in the shade, under rocks, or in burrows during the day. Explain how this behavior helps maintain homeostasis in these organisms.

32. Hemoglobin is a complex protein molecule found in red blood cells. Hemoglobin with the normal sequence of amino acids is able to carry oxygen to body cells effectively. In the disorder known as sickle-cell anemia, one amino acid is substituted for another in the hemoglobin. One characteristic of this disorder is poor distribution of oxygen to the body cells. Explain how the change in amino acid sequence of this protein could cause the results described.

33. The chart below shows information about the relationship between the age of the mother and the occurrence of Down syndrome in the child.

Age of Mother	Occurrence of Down Syndrome per 1000 Births
25	0.8
30	1.0
35	3.0
40	10.0
45	30.0
50	80.0

State *one* conclusion that can be drawn from the chart concerning the relationship between the age of the mother and the chance of her having a child with Down syndrome.

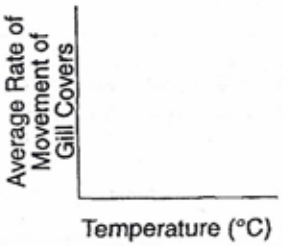
34. In an investigation, students determined the average rate of movement of gill covers of a species of freshwater fish at different temperatures. The results are shown in the data table below.

Data Table

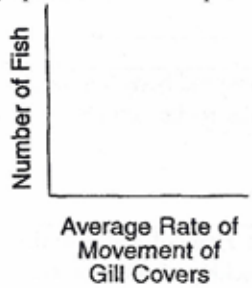
Group	Number of Fish	Temperature (°C)	Average Rate of Movement of Gill Covers per Minute
1	5	10	15
2	6	15	25
3	4	18	30
4	7	20	38
5	6	23	60
6	4	25	57
7	4	27	25

Which labeled axes should be used to graph the relationship between the two variables?

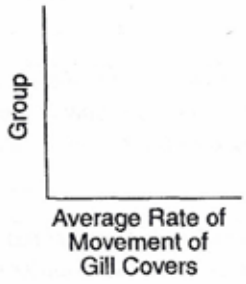
(1)



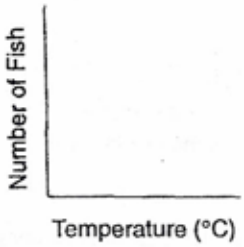
(2)



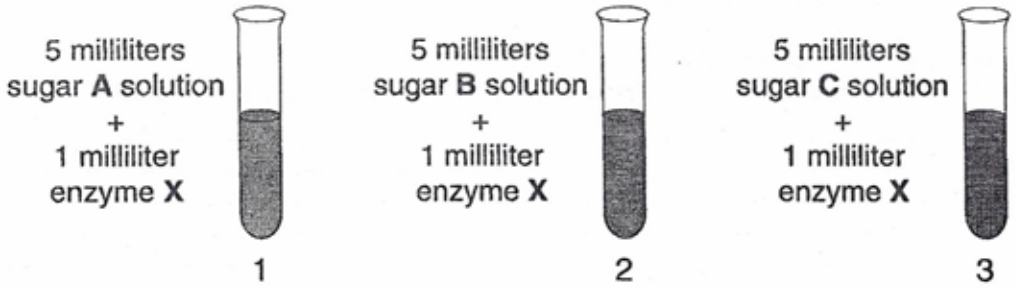
(3)



(4)



Base your answers to questions 35 through 37 on the information below. An investigation was performed to determine the effects of enzyme *X* on three different disaccharides (double sugars) at 37°C. Three test tubes were set up as shown in the diagram below. At the end of 5 minutes, the solution in each test tube was tested for the presence of disaccharides (double sugars) and monosaccharides (simple sugars). The results of these tests are shown in the table below.



	Test Tube 1	Test Tube 2	Test Tube 3
Monosaccharide	not present	not present	present
Disaccharide	present	present	not present

35. What can be concluded about the activity of enzyme *X* from the data table?

36. With only the materials list supplied below and common laboratory equipment, design an investigation that would show how a change in pH would affect the activity of enzyme *X*. Your design need only include detailed procedure and a data table.

Materials

Enzyme *X*, Sugar *C* solution, Indicators, Substances of various pH values: vinegar (acidic), water (neutral), baking soda (basic)

37. State *one* safety precaution that should be used during the investigation.

38. For many years, humans have used a variety of techniques that have influenced the genetic makeup of organisms. These techniques have led to the production of new varieties of organisms that possess characteristics that are useful to humans. Identify *one* technique presently being used to alter the genetic makeup of an organism, and explain how humans can benefit from this change. Your answer must include at least:

- the name of the technique used to alter the genetic makeup
- a brief description of what is involved in this technique
- *one* specific example of how this technique has been used
- a statement of how humans have benefited from the production of this new variety of organism

Base your answers to questions **39** and **40** 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

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

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