1) Which statement correctly describes the location of structures A and B in the diagram below?

1) Structure A is dorsal to structure B.
2) Structure B is anterior to structure A.
3) Structure B is posterior to structure A.
4) Structure A is ventral to structure B.

2) Blue indophenol becomes colorless in the presence of vitamin C. Because of this change, blue indophenol could be classified as

1) an enzyme
2) an indicator
3) an acid
4) a stain

3) Which experimental procedure would best determine the effectiveness of a vaccine for preventing a certain disease in pigeons?

1) Inoculate 50 pigeons with the vaccine and 50 pigeons with a harmless solution and then expose all 100 pigeons to the disease.
2) Expose 100 pigeons to the disease and then inoculate 50 of these pigeons with the vaccine.
3) Inoculate 10 pigeons with the vaccine and 90 pigeons with a harmless solution and then expose all 100 pigeons to the disease.
4) Expose 100 pigeons to the disease and then inoculate all 10 pigeons with the vaccine.

4) To investigate the effect of a substance on plant growth, two bean plants of the same species were grown under identical conditions with the substance added to the soil of one of the plants. At the end of 2 weeks, the plant grown with the substance was 12.5 centimeters tall and the plant grown without the substance was 12.2 centimeters tall. The researcher concluded that the presence of the substance causes plants to grow taller.

Using one or more complete sentences, state one reason that this conclusion may not be valid.

5) After a thin slice of potato was stained with iodine, numerous blue-black granules were observed in the potato cells when viewed with a compound microscope.

Using one or more complete sentences, explain why these normally colorless granules turned blue-black.

6) Data from measurements of transpiration and water uptake in an ash tree are plotted in the graph below.

Which conclusion can correctly be drawn from the information in the graph?

1) The rate of transpiration is not related to the amount of water uptake.
2) Transpiration reaches a maximum rate faster than water uptake.
3) As transpiration increases, the amount of water uptake decreases.
4) Transpiration and water uptake are similar processes.

7) When compared to the image of a specimen observed with a compound light microscope under low power, the image of the specimen observed under high power will appear

1) larger and lighter
2) larger and darker
3) smaller and darker
4) smaller and lighter
8) The diagram below represents a compound light microscope. 

The observation of a specimen under both high and low power could be interfered with by a spot on the surface of which structure?

1) 1  2) 3  3) 4  4) 2

Questions 9 through 13 refer to the following:

POLIO VACCINES
Polio is a disease that results in the destruction of nerve cells. The first vaccine against polio was developed by Jonas Salk and was made from polio viruses that were killed using the chemical formalin. In 1953, Salk tested the vaccine on himself, his wife, and his three sons. The vaccine was found to be safe and seemed to work. In 1954, more than 1.8 million school children were part of a trial to test the vaccine, and in April 1955, the vaccine was declared to be safe and effective.

Albert Sabin also developed a vaccine against polio. The vaccine developed by Sabin was made from weakened polio viruses. While the Salk vaccine had to be injected, the Sabin vaccine was administered orally on a cube of sugar.

Both vaccines were found to be effective in protecting people against polio because these vaccines stimulate immune responses involving antibody production. However, the Sabin vaccine is effective over a longer period of time and is easier to administer. Together, these vaccines have nearly eliminated polio in many parts of the world.

9) Using one or more complete sentences, explain why the polio virus often causes paralysis of muscles.

10) Using one or more complete sentences, explain how the Salk and Sabin vaccines provide protection against polio.

11) Using one or more complete sentences, state one reason the Sabin vaccine is used more frequently than the Salk vaccine.

12) Which statement about the Salk vaccine is correct?
   1) Antibodies are administered orally.
   2) Dead viruses are injected.
   3) Antibodies are injected.
   4) Sugar cubes are administered orally.

13) Using one or more complete sentences, state how the Salk vaccine was produced.

14) Vitamin A was used in the experiment above. Which conclusion can best be made concerning the effect of vitamin E on the production of mutated cells in hamsters exposed to this mutagenic chemical?
   1) There will be no measurable effect of vitamin E on the percentage of mutated cells produced.
   2) No valid conclusion can be made concerning the effect vitamin E on the percentage of mutated cells produced.
   3) Vitamin E will decrease the percentage of mutated cells produced.
   4) Vitamin E will increase the percentage of mutated cells produced.

15) The diagram below represents a cell in the field of view of a compound light microscope.

In which direction should the slide be moved on the microscope stage to center the cell in the field of view?

1) toward A  3) toward D
2) toward C  4) toward B
16) In the diagram below, the view of the insect specimen can *best* be described as

1) a ventral view, with the posterior end to the right of the page
2) a dorsal view, with the anterior end to the left of the page
3) an internal view showing the dorsal side of the head region
4) an external view showing the ventral side of the abdomen

Questions 17 and 18 refer to the following:

17) Using one or more complete sentences, identify part A and describe its function.

18) Using one or more complete sentences, identify part B and describe its function.

19) To measure glucose use in a human, a blood sample was taken from a vein, and the amount of glucose in the sample was determined. A glucose solution was then ingested by the person being tested. Blood samples were taken periodically for 5 hours and tested to determine the amount of glucose present.

Using one or more complete sentences, give a possible explanation for a drop in the glucose level between 0.5 and 1 hour after the glucose was ingested.

20) Which condition is necessary for an experiment to yield us data?
1) The experimental period must be short.
2) Similar results should be obtained when the experimer repeated.
3) Only the expected results should be considered each tir experiment is performed.
4) The hypothesis must be correct.

21) When viewed with a compound light microscope, which le would *best* illustrate that the microscope inverts and revers image?

1) F
2) D
3) W
4) A

22) Which statement correctly describes the relative locations fins in the drawing below?

1) The anal fin is anterior to the pelvic fin.
2) The anal fin is dorsal to the caudal fin.
3) The pelvic fin is posterior to the caudal fin.
4) The pelvic fin is anterior to the anal fin.

Questions 23 through 25 refer to the following:

**VIRUSES**

Most viruses are little more than strands of genetic materia surrounded by a protein coat. Given the opportunity to enter a l cell, a virus springs into action and is reproduced.

Researchers have long known that viruses reproduce by us some of the cell's enzymes and protein-making structures. How the precise details of the process remain unclear. Microbiologists have recently enabled viruses to reproduce outside a living cell, test-tube medium containing crushed human cells, salts, ATP, amino acids, and nucleotides.

In the test tube, the viral genetic material was replicated and viral proteins were synthesized. These new proteins were then organized into coats around the newly formed genetic material. Complete viruses were formed, demonstrating that a virus can be active outside the cell if given the right environment.

23) Using one or more complete sentences, explain the function the new viral proteins.

24) Using one or more complete sentences, state a valid concl that can be drawn from this research about viruses.
25) Using one or more complete sentences, describe a possible reason that the microbiologists added ATP to the test-tube medium.

26) A student placed a slide on the stage of a compound microscope and adjusted the stage clips, as shown in the diagram below.

Draw the position of the letter as it would be viewed when observed under low power.

27) A student is observing a temporary wet mount of onion epidermis under the low-power objective of a compound light microscope. Which would be the most appropriate procedure for the student to follow in order to view the wet mount under the high-power objective?
   1) Increase the amount of light passing through the specimen.
   2) Remove the coverslip.
   3) Add a drop of water to the specimen.
   4) Add another layer of onion epidermis to the slide.

28) The illustration below shows onion root-tip tissue viewed under the high-power objective of a compound light microscope.

Using one or more complete sentences, describe one adjustment that could be made to the microscope to make the field of view brighter.

29) Using one or more complete sentences, describe one safety precaution that a technician should use while analyzing the sample of intestinal fluid.

30) Which piece of equipment should be used to accurately measure the 10-milliliter sample for analysis?
   1) metric ruler
   2) large test tube
   3) graduated cylinder
   4) triple-beam balance

31) Which part of a compound light microscope should a student adjust to allow more light to pass through a specimen?
   1) ocular
   2) stage
   3) diaphragm
   4) fine adjustment

32) Which laboratory equipment is correctly paired with a unit it measures?
   1) glass beaker — millimeters
   2) graduated cylinder — milliliters
   3) Celsius thermometer — degrees Fahrenheit
   4) metric ruler — centigrams

Questions 33 through 35 refer to the following:

Nutrient broth was inoculated with bacteria and incubated at 37°C. Samples were taken at 2-hour intervals and bacterial counts were made. The data collected are recorded in the table below.

<table>
<thead>
<tr>
<th>TIME</th>
<th>NUMBER OF BACTERIA (millions per cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 a.m.</td>
<td>0.5</td>
</tr>
<tr>
<td>9 a.m.</td>
<td>1.0</td>
</tr>
<tr>
<td>11 a.m.</td>
<td>3.0</td>
</tr>
<tr>
<td>1 p.m.</td>
<td>8.0</td>
</tr>
<tr>
<td>3 p.m.</td>
<td>9.5</td>
</tr>
<tr>
<td>5 p.m.</td>
<td>9.0</td>
</tr>
<tr>
<td>7 p.m.</td>
<td>6.0</td>
</tr>
<tr>
<td>9 p.m.</td>
<td>2.0</td>
</tr>
</tbody>
</table>

33) According to the data table, the greatest increase in bacterial population growth took place during which time interval?
   1) 5 p.m.-7 p.m.
   2) 11 a.m.-1 p.m.
   3) 7 a.m.-9 a.m.
   4) 7 p.m.-9 p.m.

34) According to the data table, at what time was the bacterial population the greatest?
   1) 9 a.m.
   2) 5 p.m.
   3) 3 p.m.
   4) 11 a.m.
35) The most probable reason for the decrease in population shown in the data table is that
   1) the bacteria ceased to mate after 10 hours
   2) mutations occurred in the bacteria, increasing their resistance to antibiotics
   3) the temperature in the incubator was too high
   4) toxic wastes from the bacteria accumulated in the nutrient broth

Questions 36 and 37 refer to the following:

A student prepared a wet mount of the letter "e" from a newspaper. He then placed the slide on the stage of a compound light microscope and adjusted the stage clips as shown below.

36) Which drawing most closely resembles the image of the letter "e" that would be seen by the student when using the low-power objective?
   1) ![Image 1]
   2) ![Image 2]
   3) ![Image 3]
   4) ![Image 4]

37) After the student switched to high power, he indicated on his laboratory drawing that the total magnification of the "e" was 440x. What is the magnifying power of the objective lens if the ocular (eyepiece) has a magnifying power of 10x?
   1) 340x
   2) 44x
   3) 4,400x
   4) 430x

38) A student performed an experiment involving two strains of microorganisms, strain A and strain B, cultured at various temperatures for 24 hours. The results of this experiment are shown in the data table below.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Strain A</th>
<th>Strain B</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>28</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>31</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>34</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

Based on the results of the experiment, the student inferred that strain A was more resistant to higher temperatures than strain B was. What, if anything, must the student do for this inference to be considered valid?
   1) repeat this experiment several times using different variables
   2) develop a new hypothesis and test it
   3) repeat this experiment several times and obtain similar results
   4) nothing, because this inference is a valid scientific fact

39) In a controlled experiment, 20 marigold plants of the same age were grown singly in 20 different pots containing soil of the same composition and moisture level. The pots were divided into two groups of 10. One group was exposed to 8 hours of sunlight each day for 15 days, and the other group was exposed to 8 hours of light from a 75-watt bulb for the same time period. In this investigation, the source of light represents the experimental
   1) problem
   2) variable
   3) hypothesis
   4) control

40) Which instrument is used to separate mitochondria from other cell organelles?
   1) scalpel
   2) medicine dropper
   3) ultracentrifuge
   4) graduated cylinder

Questions 41 through 43 refer to the following:

An investigation of the effect of temperature on the amount of protein digestion by a specific enzyme was conducted over a 24-hour period. The observations were recorded in the data table below.

<table>
<thead>
<tr>
<th>Test Tube</th>
<th>Temperature (°C)</th>
<th>Amount of Protein Digested (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>2.5</td>
</tr>
<tr>
<td>4</td>
<td>37</td>
<td>6.0</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
<td>0.5</td>
</tr>
</tbody>
</table>
41) Using one or more complete sentences, state a possible reason for the difference in the amount of protein digested at 45°C compared to the amount of protein digested at 37°C.

42) Using the information in the data table, construct a line graph following the directions below.
(a) Mark an appropriate scale on each of the labeled axes.
(b) Plot the data from the data table. Surround each point with a small circle and connect the points.

43) Using one or more complete sentences, state one conclusion that relates increasing temperature to protein digestion.

44) Bromthymol blue turns yellow in the presence of carbon dioxide. This characteristic makes it possible for bromthymol blue to function as
1) a measure of volume  3) an indicator
2) a catalyst  4) an energy source

45) Two sets of the laboratory equipment shown in the diagram below were set up. One was exposed to light for 24 hours, the second was kept in the dark for the same time period.

Gas collected in the test tube of the setup that was exposed to light. No gas collected in the test tube of the setup that was kept in the dark. The experiment was repeated 10 times with the same result. At the end of the experiment, a statement was made that all plants produce gas in the presence of light. This statement is known as a
1) control  3) generalization
2) limitation  4) hypothesis

46) Using one or more complete sentences, explain how petri dish serves as a control for the experiment.

47) Using one or more complete sentences, state a hypothesis that this experiment could have been testing using petri dish B as the control.
48) In an investigation to determine the effects of environmental pH on the germination of dandelion seeds, 25 dandelion seeds were added to each of five petri dishes. Each dish contained a solution that differed from the others only in its pH, as shown below. All other environmental conditions were the same. The dishes were covered and observed for 10 days.

<table>
<thead>
<tr>
<th>Petri Dish</th>
<th>pH of Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Using one or more complete sentences, state the variable in this investigation.

49) The diameter of the field of view shown below is 1.25 millimeters.

The approximate diameter of each cheek cell is
1) 150 μm  
2) 50 μm  
3) 350 μm  
4) 250 μm

50) A student heated a sugar solution in a test tube. Which procedure followed by the student was unsafe?
1) using a burner with an open flame  
2) using a metal test-tube clamp  
3) wearing plastic goggles  
4) sealing the test tube with a cork

51) The white blood cell represented below measures 0.02 millimeter from point A to point B.

The length of the bacterium is approximately
1) 5 μm  
2) 2000 μm  
3) 500 μm  
4) 20 μm

52) Which laboratory equipment would most likely be used to measure the size of a living paramecium?
1) ultracentrifuge  
2) dissecting microscope  
3) compound light microscope  
4) graduated cylinder

53) A student is heating a test tube containing an indicator solution and glucose. The student is wearing safety goggles and a laboratory apron. Using one or more complete sentences, another safety procedure this student should be following.

54) Four discs, each soaked in a different antibiotic, were placed on the surface of a culture plate that had been inoculated with E. coli bacteria. The diagram below shows the culture plate after it had been incubated for 48 hours. Which antibiotic was most effective in inhibiting the growth of E. coli?

1) streptomycin  
2) erythromycin  
3) penicillin  
4) chloramphenicol
55) The diagram below represents a technique used in the preparation of a specimen for observation with a compound light microscope.

Which technique is illustrated in the diagram?
1) sterilizing the specimen
2) placing the specimen under the coverslip
3) testing the specimen for starch
4) staining the specimen

56) Which safety precaution is recommended when a liquid is being heated in a test tube?
1) Stopper the test tube with a rubber stopper.
2) When holding the test tube, keep fingers closest to the open end of the tube.
3) Direct the flame of the burner into the open end of the test tube.
4) Wear goggles and a laboratory apron.

Questions 57 through 60 refer to the following:

A study was made to determine the water quality of a lake. Water samples were collected at different depths, and chemical tests were performed to determine the amount of dissolved oxygen in parts per million (ppm) in each water sample. The results are shown in the data table below.

<table>
<thead>
<tr>
<th>Depth of Water (m)</th>
<th>Dissolved Oxygen Content (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10.0</td>
</tr>
<tr>
<td>5</td>
<td>9.8</td>
</tr>
<tr>
<td>10</td>
<td>9.0</td>
</tr>
<tr>
<td>15</td>
<td>6.8</td>
</tr>
<tr>
<td>20</td>
<td>5.4</td>
</tr>
<tr>
<td>25</td>
<td>4.6</td>
</tr>
<tr>
<td>30</td>
<td>3.8</td>
</tr>
<tr>
<td>35</td>
<td>3.2</td>
</tr>
<tr>
<td>40</td>
<td>2.8</td>
</tr>
</tbody>
</table>

57) What process produces most of the dissolved oxygen found in the lake?

58) Using the information in the data table, construct a line graph.
(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.

59) Approximately how many parts of oxygen per million would be found at a depth of 13 meters? (Your answer should be rounded to the nearest tenth.)

60) The change in the amount of dissolved oxygen as the water gets deeper is most likely due to
1) a decrease in the amount of light
2) an increase in water temperature
3) a decrease in the respiration rate of fish
4) an increase in the number of autotrophs

61) To expose the brain of an earthworm during a dissection, a student should make an incision in the skin that is both
1) dorsal and anterior
2) ventral and posterior
3) ventral and anterior
4) dorsal and posterior
62) What is the lowest possible magnification that can be obtained using the microscope shown below?

1) 800x  
2) 200x  
3) 20x  
4) 40x

63) A nutrient medium was prepared by mixing powdered agar with boiling distilled water. Some of the prepared medium was then placed in a sterile petri dish, covered, and allowed to solidify. The cover was then removed and the agar was touched to a doorknob. The petri dish was covered again and incubated at 37 °C. After 48 hours, bacterial growth was observed. The investigator concluded that bacteria on doorknobs cause disease. One error in the investigation was that the investigator
1) covered the petri dish  
2) did not show that the bacteria caused disease  
3) did not incubate the materials at the proper temperature  
4) used distilled water

Questions 64 and 65 refer to the following:

The diagram below represents some internal structures of an earthworm.

64) Structure A has a diameter of 3 millimeters. What is the approximate diameter of the blood vessel indicated by arrow C?

1) 2.0 mm  
2) 1.5 mm  
3) 2.5 mm  
4) 0.5 mm

65) Which laboratory equipment should be used to observe the surface details of structure B?
1) graduated cylinder  
2) compound light microscope  
3) ultracentrifuge  
4) dissecting microscope

66) While attempting to study a specimen using the low-power objective of a compound light microscope, a student found the field of view was too dark. Using one or more complete sentences, describe a procedure that would increase the amount of light in the field of view.

67) Which piece of laboratory equipment should a student use to accurately measure 10 milliliters of bromthymol blue?

68) On a slide preparation of a thin slice of potato, starch grains be made more visible by adding
1) distilled water  
2) salt solution  
3) Benedict's solution  
4) Lugol's iodine

69) A student performed an experiment and observed that when strains of microorganisms, strain A and strain B, were grown at 25 °C, both survived. When the experiment was repeated using increasing temperatures, more colonies of strain A survived those of strain B, until at 35 °C, only strain A survived. Based on these results, the student inferred that strain A was more resistant to higher temperatures than strain B.

Which action must be taken before this inference can be considered valid?
1) The experiment must be repeated using different variables.  
2) A different strain of bacteria must be tested.  
3) A new hypothesis must be developed and tested.  
4) The experiment must be repeated and similar results obtained.

70) In an investigation, equal amounts of water were added to each of four test tubes. An aquatic plant was added to two of these tubes. The four test tubes were each fitted with a stopper containing a pipette to measure the amount of gas released. The test tubes were then paired so that one tube in each pair contained a plant. One pair was placed 1 meter from a light source, and the other pair was placed 2 meters from the same light source.

The investigator was most likely attempting to determine the effect on photosynthesis of different
1) mineral concentrations  
2) wavelengths of light  
3) amounts of carbon dioxide  
4) intensities of light
71) A student records his body temperature at 6:00 a.m. and 6:00 p.m. each day for 30 days. He notices a trend in his temperature data and offers a possible explanation. His explanation is known as
1) a limitation 3) raw data
2) an observation 4) the hypothesis

72) Using one or more complete sentences, state a scientific purpose of dissecting an organism.

73) In attempting to demonstrate the effectiveness of a new vaccine, a scientist performed the experimental procedures below:

I. One hundred genetically similar rats were divided into two groups of 50 rats each (group A and group B).
II. Each rat in group A was given an injection of the vaccine suspended in a glucose-and-water solution.
III. Each rat in group B was given an injection of a glucose-and-water solution containing no vaccine.
IV. After several weeks, all rats in both groups were exposed to the disease for which the vaccine was developed.

Using one or more complete sentences, state the variable being studied in this experiment.

74) Which equipment should a student use to observe the stained chromosomes in onion cells during mitosis?
1) ultracentrifuge 3) compound light microscope
2) microdissection instruments 4) graduated cylinder

Questions 75 and 76 refer to the following:

75) After part 3 is turned, which part must often be adjusted?
76) Which part must be adjusted to enable the viewer to continue observe a paramecium swimming at changing levels in a coverslip mount under high power?
1) 3 2) 7 3) 8 4) 2

77) Which safety procedure should a student follow during the dissection of a frog?
1) The student should direct the cutting motion away from the body.
2) The student should wear gloves and hold the specimen in her palm while cutting the specimen open.
3) The student should cut the specimen open while holding it under running water.
4) The student should apply additional preservative to the specimen.

78) The development of the cell theory was most directly related to
1) discovery of bacteria and viruses
2) development of the gene-chromosome theory
3) improvement of the microscope and microscopic techniques
4) use of a five-kingdom classification system

79) Using one or more complete sentences, describe one safety procedure a student should use when performing a test with Benedict's solution to determine the presence of simple sugar in a food sample.

80) The diagram below represents four pieces of string, A through E, placed below part of a centimeter ruler.

Which piece of string is 40 millimeters long?
1) A 2) D 3) C 4) E

81) Which substance should be used in an investigation designed to determine the degree of acidity at which an enzyme works best?
1) methylene blue 3) glucose solution
2) pH paper 4) Lugol's iodine

82) A student conducted an original, well-designed experiment, carefully following proper scientific procedure. In order for conclusions to become generally accepted, the experiment
1) support the original hypothesis
2) be conducted by a scientist
3) contain several experimental variables
4) be repeated to verify the reliability of the data
83) The diameter of a microscope field of view is illustrated below.

What is the approximate length of the cell in this field of view?

1) 2,000 m  
2) 1,000 m  
3) 700 m  
4) 1,500 m

84) Name an internal structure, visible in the diagram above, that is anterior to the kidneys of the frog.

85) A slide of onion epidermal cells is prepared for viewing with a compound light microscope. A student tries to focus the material under high power before focusing under low power. Using one or more complete sentences, explain why this procedure should not be used to focus the microscope.

86) In preparing a wet mount of onion cells for observation with a compound light microscope, a student placed a small piece of onion epidermis in a drop of water on a clean slide. Next he added a clean coverslip. He then placed the slide on the stage of the compound light microscope and focused under high power. Using one or more complete sentences, state an error in the student's procedure.

87) Choose one of the labeled parts from the diagram below of a compound light microscope.

Write the letter of the part you have chosen and, using one or more complete sentences, identify the part and state its function.

88) Which piece of equipment would most likely be used to separate materials by density?

1) centrifuge  
2) scalpel  
3) dissecting microscope  
4) compound light microscope

89) Which piece of equipment is used to obtain ribosomes for biochemical analysis?

1) microdissection instrument  
2) dissecting microscope  
3) ultracentrifuge  
4) electron microscope
90) The diagram below represents some tissue as seen through a compound light microscope.

Which procedure was most likely used to prepare this tissue for viewing with the microscope?
1) A vertical cut was made through the body of an earthworm, and a thin slice was mounted on a slide.
2) A thin cross section of a leaf was mounted on a slide.
3) A section of the exoskeleton of a grasshopper was removed and mounted on a slide.
4) A small slice of a root tip was mounted on a slide.

91) A specimen was viewed under the high-power objective of a compound light microscope. Its length was estimated to be 0.75 millimeter. What is the approximate length of the specimen in micrometers?
1) 0.75
2) 0.00075
3) 75
4) 750

92) A chemical solution was added to an unknown substance in a test tube. The test tube was then heated, and the solution turned brick red.

<table>
<thead>
<tr>
<th>Row</th>
<th>Chemical Solution Added</th>
<th>Unknown Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Lugol’s iodine</td>
<td>starch</td>
</tr>
<tr>
<td>B</td>
<td>Bromthymol blue</td>
<td>an acid</td>
</tr>
<tr>
<td>C</td>
<td>Benedict’s solution</td>
<td>sugar</td>
</tr>
<tr>
<td>D</td>
<td>Salt solution</td>
<td>a mineral</td>
</tr>
</tbody>
</table>

Which row in the chart above most likely identifies the unknown substance and the chemical solution that was added to the test tube?
1) C
2) B
3) A
4) D

93) A solution in a test tube is tested for the presence of glucose using an indicator and a heat source. Using one or more complete sentences, describe a control that should be used in this activity.

94) In an experiment, the setup that provides a basis of comparison is known as
1) a control
2) a variable
3) a constant
4) a hypothesis

95) A wet-mount slide preparation of a thread viewed in the low power field (100x) of a compound light microscope is shown in diagram A below. Diagram B shows the field of view as it appeared when the objective was switched to high power.

Which statement best explains why the thread is not visible in diagram B?
1) No stain was added to the slide preparation.
2) The thread is too large to be viewed with high power.
3) The diaphragm was not adjusted for more light.
4) The specimen was not centered in the low-power field.

96) A student prepared the list of steps shown below for performing a laboratory investigation. She omitted one important step completing the investigation.

**STEPS TO FOLLOW IN AN EXPERIMENT:**
1) Define a problem.
2) Develop a hypothesis.
3) Select suitable lab materials and perform a controlled experiment to test the hypothesis.
4) Collect, organize, and graph the experimental data.
5) ?
6) Repeat steps 3 through 5.

Using one or more complete sentences, state the procedure that is missing at step 5.

97) A student needs 20 milliliters of water for an experiment. How much additional water must the student add to the graduated cylinder shown below to reach 20 milliliters?
1) 6.0 mL
2) 7.0 mL
3) 13.0 mL
4) 6.5 mL
98) Which laboratory equipment would most likely be used for testing a substance for the presence of monosaccharides?
1) an ultracentrifuge, a graduated cylinder, and a metric ruler
2) a triple-beam balance, pH paper, and a compound light microscope
3) a dissecting microscope, a slide, and a dropping pipette
4) a beaker of water, an indicator, and a hotplate

99) The diagram below shows a student conducting a laboratory experiment.

Using one or more complete sentences, describe one safety procedure the student should be following that is not represented in the diagram.

100) The illustration below shows a sample of stained frog blood cells as viewed with the high-power objective of a compound light microscope.

The stain was most likely used to
1) increase the magnification of the cells
2) stop meiotic activity in the cells
3) test for the presence of simple sugars
4) make cell parts more visible

101) Using one or more complete sentences, state the function of structure X represented in the diagram below.

102) The diagram below represents cells seen in the low-power field of view of a compound light microscope.

The length of one of these cells is approximately
1) 2,000 µm
2) 500 µm
3) 200 µm
4) 400 µm

103) A student used a compound light microscope to obtain data on the concentration of stomates in leaves. The student observed a small area of the lower epidermis of a leaf and counted 10 stomates in the high-power field of view. The student then observed an area of equal size from the upper epidermis of the same leaf and found no stomates in the high-power field of view. After making these observations, the student should
1) make additional observations before drawing conclusions about stomate concentration
2) conclude that the lower epidermis of this leaf has a greater stomate concentration than the upper epidermis
3) assume that leaves never have stomates on their upper surface
4) conclude that the lower epidermis of all leaves has a greater stomate concentration than the upper epidermis
104) The diagram below represents two cells next to a metric measuring device under the low-power objective of a compound light microscope.

What is the approximate length of a nucleus of one of these cells?
1) 100 μm
2) 1000 μm
3) 1500 μm
4) 500 μm

105) Each division of the metric ruler shown in the diagram below equals 1 millimeter.

The diameter of the field of vision is approximately
1) 3,700 μm
2) 4,400 μm
3) 2,800 μm
4) 4,700 μm

106) What is the first step of a scientific investigation?
1) formulate a hypothesis
2) state the problem
3) perform the experiment
4) analyze the experimental data

107) A portion of the digestive tract of an earthworm is represented in the diagram below.

The position of organ C is best described as
1) anterior to D
2) dorsal to A
3) ventral to B
4) posterior to E

108) The diagram below shows a microscopic field containing portion of the cross section of a root tip.

How should a student adjust the microscope in order to view greater portion of the root tip?
1) switch to a higher power and adjust the focus
2) switch to a lower power and decrease the size of the opening of the diaphragm
3) stay at the same power but increase the size of the opening of the diaphragm
4) stay at the same power and adjust the focus

109) The warmer areas of the body of a Siamese cat have light fur, and the cooler areas, such as the ears and feet, are covered dark fur. A specific enzyme controls the production of the pigment that causes the fur to become dark. One inference could be drawn about the enzyme that controls dark pigment formation is that it is
1) denatured at cooler body temperatures
2) affected by an acidic pH
3) more active at warmer temperatures
4) more active at cooler temperatures

110) A student is designing a procedure to determine the effect of the absence of a specific amino acid in the nutrient culture medium of a certain species of bacteria. Using one or more complete sentences, describe the control that the student should use in the experiment.

111) A student observed several cell layers positioned on top of one another in the high-power field of view of a compound light microscope. To observe the details of only one of these cell layers, the student should
1) turn the ocular
2) move the slide from left to right
3) rotate the fine adjustment
4) adjust the diaphragm to a smaller opening

112) Zebra finches are small black-and-white birds that lay eggs about the size of a bean seed. Which unit of measurement best for accurately measuring the length of these eggs?
1) micrometers
2) millimeters
3) feet
4) meters
113) Which statement correctly identifies the function and relative location of two structures shown in the diagram below?

1) Excretory structure B is anterior to excretory structure D.
2) Digestive structure C is ventral to digestive structure A.
3) Digestive structure A is posterior to excretory structure B.
4) Circulatory structure D is dorsal to respiratory structure C.

114) In an investigation to determine which sugar concentration is most attractive to flies, containers of sugar solutions of various concentrations were placed on a window ledge. The number of flies that landed on each container during a one hour period was recorded. The information is represented in the data table and graph below.

Using one or more complete sentences, state one error in the graph.

115) When a test tube of water containing elodea (an aquatic plant) is placed near a bright light, the plant gives off gas bubbles. When the light is placed at different distances from the plant, the rate of bubbling is affected.

The experimental variable in this demonstration is the

1) distance of the plant from the light
2) type of aquatic plant in the test tube
3) concentration of gas in the water
4) amount of water in the test tube

116) Which substance is a suitable indicator for detecting the presence of starch in a plant cell?

1) Fehling's solution
2) bromthymol blue
3) pH paper
4) iodine solution

117) Using one or more complete sentences, state one safety procedure that a student should follow when dissecting a preserved frog.

118) A student used several different indicators to conduct tests on a sample of partially digested food. The results obtained are shown in the table below.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH paper</td>
<td>No change in color</td>
</tr>
<tr>
<td>Benedict's solution</td>
<td>Changed color upon heating</td>
</tr>
<tr>
<td>Lugol's iodine</td>
<td>Changed color</td>
</tr>
<tr>
<td>Bromthymol Blue</td>
<td>No change in color</td>
</tr>
</tbody>
</table>

Based on these test results, the food sample most likely contained partially digested

1) amino acids
2) carbohydrates
3) lipids
4) proteins

119) A study was conducted using two groups of 10 plants of the same species. During the study, the plants were placed in identical environmental conditions. The plants in one group were given a growth solution every 3 days. The heights of the plants in both groups were recorded at the beginning of the study and at the end of a 3-week period. The data showed that the plants given the growth solution grew faster than those not given the solution.

When other researchers conduct this study to test the accuracy of the results, they should

1) make sure the conditions are identical to those in the study
2) give growth solution to both groups
3) double the amount of growth solution given to the first group
4) give an increased amount of light to both groups of plants.
120) A frog dissection is represented in the diagram below.

Which statement best describes the relationship of structure A to structure B?
1) B is ventral to A.  
2) A is posterior to B.  
3) B is posterior to A.  
4) A is dorsal to B.

121) In the diagram below, letter A represents the starting volume of liquid in a graduated cylinder. Letter B represents the volume after 8 milliliters of this liquid was removed.

This information indicates that the scale on this graduated cylinder is in milliliter increments of
1) 2  
2) 8  
3) 4  
4) 1

122) Using one or more complete sentences, explain why a student should focus only with the fine adjustment when observing muscle tissue with the high-power objective of a compound light microscope.

123) To observe the internal structure of mitochondria in a cell biologist would use
1) a compound light microscope  
2) an electron microscope  
3) an ultracentrifuge  
4) a dissecting microscope

124) Using one or more complete sentences, state one observation a student could make to determine that a slide preparation unicellular organisms contained protists and not monera.

125) Which materials would most likely be used in an experim determine if yeast produces carbon dioxide during fermentation?
1) starch and iodine  
2) salt and Lugol's solution  
3) water and a staining solution  
4) glucose and an indicator

126) Using one or more complete sentences, explain why a test tube of material being heated over an open flame should not be stoppered.

127) Which pieces of equipment should be used to observe the behavior of a living specimen of the type of organism sh below?
1) forceps, culture dish, and electron microscope  
2) scissors, dissecting pan, and compound light microscope  
3) pipette, culture dish, and dissecting microscope  
4) scalpel, dissecting pan, and electron microscope

128) A student adds several drops of iodine solution to a sample of onion tissue. Which cell component would become more visible under low power of a compound light microscope result of this procedure?
1) Golgi complex  
2) deoxyribonucleic acid  
3) nucleus  
4) centriole
129) A scientific study showed that the depth at which algae were found in a lake varied from day to day. On clear days, the algae were found as much as 6 meters below the surface of the water but were only 1 meter below the surface on cloudy days. Which hypothesis best explains these observations?

1) Light intensity affects the growth of algae.
2) Nitrogen concentration affects the growth of algae.
3) Wind currents affect the growth of algae.
4) Precipitation affects the growth of algae.

130) Which procedure would be part of a laboratory investigation designed to determine if a specific nutrient is present in a food?

1) place a sample of the food in a test tube containing methylene blue
2) test a moist sample of the food with pH paper
3) add Lugol's iodine solution to a sample of the food
4) add bromthymol blue to a sample of the food

131) The graph below represents the results of an investigation of the growth of three identical bacterial cultures incubated at different temperatures.

Which inference can be made from this graph?

1) Bacteria cannot grow at a temperature of 5°C.
2) Life activities in bacteria slow down at high temperatures.
3) Temperature is unrelated to the reproductive rate of bacteria.
4) Refrigeration will most likely slow the growth of these bacteria.

132) In a laboratory investigation, a student weighed each of several genetically similar mice and then placed them in separate cages, where they received identical diets. Half of the mice were given additional amounts of selected amino acids. After 4 weeks, the mice were all weighed and compared. Using one or more complete sentences, state a hypothesis being tested in this investigation.

133) The graph below shows the results of an experiment.

At 16°C, what percentage of the brook trout reached maximum size?

1) 75% 3) 55%
2) 95% 4) 30%

134) In an investigation designed to determine the effect of the amount of water on plant growth, two groups of equal-sized bean plants of the same species were grown under identical conditions, except for the amount of water they were given. One group was watered with 200 milliliters of water once a day while the other group was watered with 400 milliliters of water once a day. After several days, the heights of the plants were measured. It was determined that the plants watered with 400 milliliters of water once a day showed more growth.

The variable in this investigation is the

1) type of bean plants used in the experiment
2) amount of water given the plants each day
3) type of soil the bean plants were growing in
4) group of bean plants watered with 200 mL of water

135) A new drug for the treatment of asthma is tested on 100 people. The people are evenly divided into two groups. One group given the drug, and the other group is given a glucose pill. The group that is given the glucose pill serves as the

1) control
2) limiting factor
3) indicator
4) experimental group
136) Which generalization can be made from the data in the table below?

<table>
<thead>
<tr>
<th>Sex</th>
<th>Height (in)</th>
<th>Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>62</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>61</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>64</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>66</td>
<td>146</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td>126</td>
</tr>
<tr>
<td>Female</td>
<td>64</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>62</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>59</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>61</td>
<td>110</td>
</tr>
</tbody>
</table>

1) As height increases, weight usually increases.
2) The height of an individual determines his or her weight.
3) As height increases, weight usually decreases.
4) No relationship exists between height and weight.

137) A student prepared a wet mount of human cheek cells. Using one or more complete sentences, state a procedure that would make the nucleus more visible.

138) Which substances would most likely be used to stain wet-mount slides of plant and animal cells?
1) amylase and bromthymol blue
2) hemoglobin and Benedict’s solution
3) Lugol’s iodine and methylene blue
4) glucose and Lugol’s iodine

139) A protist measures 500 micrometers in diameter. What is the diameter of this organism in millimeters?
1) 500
2) 5.0
3) 0.5
4) 50

140) Apple cider containing yeast was placed in a sterile container and kept at room temperature. When small bubbles of gas formed in the cider 2 days later, a student asked, “What is producing the gas bubbles?”

Which statement is a hypothesis that could be tested experimentally to answer this question?
1) Set up an apparatus to collect and test the gas.
2) A container of cider without yeast should serve as a comparison.
3) Cellular respiration is being carried out by the yeast.
4) The rate of gas produced must be determined.

141) Which invention most influenced the development of the theory?
1) light microscope
2) electron microscope
3) thermometer
4) ultracentrifuge

142) Cobalt chloride paper is an indicator for moisture. It is blue when dry and turns pink when moist. In an investigation strip of dry cobalt chloride paper was placed on the upper epidermis of a leaf on a geranium plant, and one strip was placed on the lower epidermis of the same leaf. The leaf was securely wrapped in clear cellophane wrap. A piece of dry cobalt chloride paper was attached to each side of a clean slide, and the slide was sealed in clear cellophane wrap. The geranium plant and the sealed slide were placed in sunlight for 10 hours.

To determine if light affects the results of this investigation the investigator should prepare another complete setup in the same way but change the procedure by
1) placing the setup under artificial white light instead of sunlight
2) submerging this setup in water for 12 hours
3) placing this setup in an area with no light
4) using a plant species with nongreen leaves

143) Figure A represents a cell as viewed by a student using the 10× ocular and the 10× objective of a compound light microscope. Figure B represents the same cell as seen with a different objective.

The magnification of the objective used to observe the cell shown in figure B is most likely
1) 4×
2) 60×
3) 40×
4) 100×

144) When stained with certain dyes, nucleoproteins appear black. These dyes would most likely be used to
1) stain all types of cell organelles
2) identify specific nucleoproteins within cells
3) indicate the presence of nucleoproteins within cells
4) determine the chemical composition of nucleoproteins

145) A sealed dialysis membrane containing iodine solution was placed in a beaker of starch solution. After 1 hour, the color of the starch solution would most likely be
1) pink
2) blue black
3) white
4) red orange
146) Using one or more complete sentences, state one safety procedure that should be followed when handling a blood sample.

147) The diagram below represents a graduated cylinder containing a liquid.

![Graduated Cylinder Diagram]

How many milliliters of fluid should be added to the graduated cylinder to raise the volume to 21 milliliters?
1) 5  
2) 8  
3) 4  
4) 10

148) The coarse adjustment of a compound light microscope should be used to
1) focus the image of a specimen under the low-power objective lens
2) focus the image of a specimen under the high-power objective lens
3) measure the diameter of the high-power field
4) increase the light intensity passing through the specimen

149) A compound light microscope has a 5x ocular (eyepiece) and a 10x low-power objective. Calculate the total magnification that is obtained using this low-power objective.

150) Onion epidermis is a suitable tissue to use for observing cellular structures with a compound light microscope because this tissue is thin enough to
1) be placed very close to the ocular
2) allow light to pass through it
3) fit on top of a coverslip
4) allow water to diffuse through the cell membrane

151) Which substance reacts with the starch grains in a potato cell and makes them more distinct in appearance?
1) distilled water
2) salt solution
3) Lugol's iodine
4) Benedict's solution

152) The size of the image of a cell being examined with a microscope is determined by the
1) objectives and ocular
2) diaphragm and coarse adjustment
3) light source and fine adjustment
4) stage and stage clips

153) The diagram below represents cells in a microscopic field view with a diameter of 1.5 millimeters.

![Cell Diagram]

What is the approximate length of a single cell?
1) 5,000 µm  
2) 500 µm  
3) 0.5 µm  
4) 50 µm

154) A graduated cylinder containing water is shown in diagram below. Pea seeds were dropped into the cylinder and the results are shown in diagram B.

![Graduated Cylinder Diagram with Seeds]

What is the volume of water displaced by the seeds?
1) 15 mL  
2) 14 mL  
3) 4 mL  
4) 5 mL
A student calculated the diameter of the highpower field of a microscope to be approximately 400 micrometers (μm). The diagram below represents the epidermal cells of a leaf observed in this high-power field.

What is the approximate length of cell A?

1) 0.10 mm  
2) 0.01 mm  
3) 1,000 mm  
4) 100 mm

Questions 156 through 158 refer to the following:

A student was given a sample of food and asked to determine the types of nutrients present in the sample. The student placed half of the sample in a test tube with Benedict's solution and heated it. The solution turned brick red. When an iodine solution was added to the remaining half of the sample, it turned blue black.

156) The iodine and Benedict's solutions used in this investigation serve as
1) hydrolytic enzymes  
2) nitrogenous bases  
3) indicators  
4) stains

157) The student can correctly conclude that the food sample contained
1) monosaccharides and polysaccharides  
2) monosaccharides and polypeptides  
3) polypeptides and fats  
4) polysaccharides and lipids

158) Using one or more complete sentences, describe one safety procedure that should be followed when conducting this investigation.

159) State a function of glucose in the human body.

A student is using a compound light microscope to observe a wet mount of unstained human cheek cells. Which cell organelle will most likely become more visible after she iodine solution to the slide?

1) mitochondrion  
2) cell wall  
3) ribosome  
4) nucleus

To compare the growth of plants grown under specific conditions of light with that of plants grown under natural conditions, four groups of bean plants were grown under the light conditions indicated below. All other factors were kept constant.

Group A—red light  
Group B—green light  
Group C—violet light  
Group D—white light

In this investigation, which group of plants served as the control?

1) D  
2) B  
3) A  
4) C

Forty bean seeds were planted in 40 different pots containing soil of the same composition and moisture level. All seeds were of the same age and plant species. The pots were divided into four groups of 10, and each group was kept at a different temperature: 5°C, 10°C, 15°C, and 20°C, respectively, for a period of 30 days. All other environmental conditions were kept constant.

Using one or more complete sentences, state a problem being investigated in this experimental setup.

A student placed a test tube half-filled with a solution in a water bath to be heated. The student left the test tube unstoppered and pointed the opening of the test tube away from other individuals in the laboratory.

Using one or more complete sentences, describe one additional safety procedure the student should have used while performing this activity.

The diagram below represents a Celsius thermometer.

The reading on the thermometer might indicate the temperature of a

1) very cool day  
2) healthy human  
3) human with a fever  
4) beaker of boiling water
165) The diagram below represents a portion of a metric ruler as seen with a compound microscope.

The diagram below represents a portion of a metric ruler as seen with a compound microscope. The diameter of the field of view illustrated is approximately

1) 2000 \( \mu m \)  
2) 1600 mm  
3) 0.0016 mm  
4) 1600 \( \mu m \)

166) The best estimate of the number of ovules found in the ovary of a gladiolus flower would be determined by averaging the data from

1) 10 students each counting the ovules in 10 different ovaries  
2) 1 student counting the ovules in the same ovary 100 times  
3) 10 students each counting the ovules in the same ovary 10 times  
4) 2 students each counting the ovules in the same ovary 50 times

167) Which equipment should a student use to remove the mouth parts from a grasshopper?

1) probe and dropping pipette  
2) dissecting pins and coverslips  
3) forceps and scissors  
4) scalpel and compound microscope

168) Which piece of laboratory equipment would be best to use observing a living cell with a diameter of 70 micrometers?

1) ultracentrifuge  
2) compound light microscope  
3) graduated cylinder  
4) dissecting microscope

169) Using one or more complete sentences, state a safety precaution that a student should use when heating a liquid in a test tube.
170) The diagram below represents an unstained bean seed.

Which instruments were most likely used to prepare the bean seed as shown?

1) A and B  
2) C and D  
3) B and C  
4) A and D

171) The diameter of a microscope field under low power (100x) is 2,000 micrometers. Which diagram best shows how a paramecium 500 micrometers long would appear under high power (400x)?

1)  
2)  
3)  
4)
Questions 172 through 174 refer to the following:

In an experiment using chicken eggs, 100 fertilized eggs were injected with a saline (salt) solution containing vitamin B during day 1 of incubation period. At the same time, a second group of 100 fertilized eggs was injected with plain saline solution. All the chicks that hatched on the 21st day were weighed and measured at hatching. The results are recorded in the data table below.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of Eggs Hatched on the 21st Day</th>
<th>Average Weight of Chicks at Hatching (g)</th>
<th>Average Leg Length at Hatching (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin B Injection</td>
<td>91</td>
<td>50</td>
<td>3.2</td>
</tr>
<tr>
<td>Saline Injection</td>
<td>65</td>
<td>35</td>
<td>1.5</td>
</tr>
</tbody>
</table>

172) Using one or more complete sentences, state a relationship between growth rate and the injection of chicken eggs with vitamin B.

173) The purpose of injecting the second group of eggs with plain saline solution is to
1) encourage the growth of larger eggs
2) increase the number of fertilized eggs
3) provide a control for the experiment
4) produce disease-resistant chicks

174) According to the data in the table, one effect of injecting vitamin B into chicken eggs is that it
1) changes the amount of yolk stored in the egg
2) increases the number of eggs hatching on the 21st day
3) produces larger eggs
4) increases the incubation period

175) Which type of diagram could best be used to display data showing the numerical relationship between the components of a substance and the entire substance?

1) 
2) 
3) 
4)
One similarity between all the microscopes shown is that they
1) have two objective lenses
2) lack a diaphragm and coarse adjustment
3) depend on electrons passing through the specimen
4) have three oculars

For what purpose would the equipment illustrated below most likely be used?

1) dissecting a vertebrate
2) observing mitosis on prepared slides
3) identifying and classifying protists
4) extracting cell organelles

Questions 178 and 179 refer to the following:

The illustrations below represent photographs showing two views of a microorganism observed with a compound light microscope.

178) If the organism indicated by the pointer is 100 micrometers long before fission, the length of each new individual immediately after fission would be closest to
1) 50 millimeters
2) 1.0 millimeter
3) 0.05 millimeter
4) 100 millimeters

179) Which adjustment must be made to the microscope to make the image in view 1 as clear as the image in view 2?
1) change from low power to high power
2) turn the fine adjustment
3) close the diaphragm opening
4) remove the eyepiece
Certain chemicals cause mutations in cells by breaking chromosomes into pieces. Cells containing such broken chromosome known as mutated cells. Certain nutrients, such as beta carotene (a form of vitamin A), have the ability to prevent chromosome breakage by such mutagenic chemicals.

The results of an investigation of the effect of beta carotene in preventing chromosome damage are represented in the data tab below. In this investigation, varying amounts of beta carotene per kilogram of body weight were added to the diets of hamsters. A mutagenic chemical was also added to the diets at a constant rate of dosage.

<table>
<thead>
<tr>
<th>Amount of Beta Carotene Added to Diet per kg of Hamster's Body Weight</th>
<th>Percentage of Mutated Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 mg</td>
<td>11.5</td>
</tr>
<tr>
<td>20 mg</td>
<td>11.0</td>
</tr>
<tr>
<td>30 mg</td>
<td>8.0</td>
</tr>
<tr>
<td>40 mg</td>
<td>7.0</td>
</tr>
<tr>
<td>50 mg</td>
<td>4.5</td>
</tr>
<tr>
<td>75 mg</td>
<td>3.5</td>
</tr>
<tr>
<td>100 mg</td>
<td>2.0</td>
</tr>
<tr>
<td>150 mg</td>
<td>1.5</td>
</tr>
</tbody>
</table>

The greatest effect of added beta carotene on the percentage of mutated cells occurred as the dose rate increased from
1) 50 to 75 mg  2) 20 to 30 mg  3) 0 to 10 mg  4) 100 to 150 mg

181) A scientist performed an experiment using the following steps:

Define and research the problem → X → Set up and conduct the experiment once → Make observations and record data → Formulate a conclusion → Repeat the experiment

Using one or more complete sentences, identify the step that belongs in box X.
182) To measure glucose use in a human, a blood sample was taken from a vein, and the amount of glucose in the sample was determined. Glucose solution was then ingested by the person being tested. Blood samples were taken periodically for 5 hours and tested to determine the amount of glucose present. Results from the tests were used to construct the data table below.

<table>
<thead>
<tr>
<th>TIME (hours)</th>
<th>GLUCOSE (mg/100 mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>0.5</td>
<td>170</td>
</tr>
<tr>
<td>1</td>
<td>120</td>
</tr>
<tr>
<td>2</td>
<td>90</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
</tr>
</tbody>
</table>

Based on the information given, how much glucose would most likely be present in 100 deciliters (dL) of the blood 1.5 hours after glucose was ingested?

1) 105 mg  
2) 120 mg  
3) 90 mg  
4) 170 mg

183) The apparatus below was designed with the understanding that animals take in oxygen and release carbon dioxide, and that ordinary air contains very little carbon dioxide.

The apparatus can be used to measure the

1) amount of heat produced by the animal  
2) effect of carbon dioxide on the animal  
3) amount of carbon dioxide absorbed by the animal  
4) rate of respiration of the animal
184) In addition to an indicator and proper safety equipment, which pieces of equipment shown below should be used to test for the presence of glucose in apple juice?

1) B, F, and I
2) A, B, and J
3) C, G, and H
4) A, D, and E

Questions 185 and 186 refer to the following:

Equal amounts of distilled water were added to graduated cylinders A and B. Two hundred mustard seeds were placed in cylinder B and then both cylinders were covered to prevent evaporation. After 24 hours, there was very little water in cylinder B.
185) What was the original volume of the 200 mustard seeds?
1) 7 mL  
2) 9 mL  
3) 5 mL  
4) 4 mL

186) Using one or more complete sentences, state a possible explanation for the apparent decrease in water volume in cylinder \(B\) after 24 hours.

187) Nutrient broth was inoculated with bacteria and incubated at 37°C. Samples were taken at 2-hour intervals and bacterial counts were made. The data collected are recorded in the data table below.

**DATA TABLE**

<table>
<thead>
<tr>
<th>TIME</th>
<th>NUMBER OF BACTERIA (millions per cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 a.m.</td>
<td>0.6</td>
</tr>
<tr>
<td>9 a.m.</td>
<td>1.0</td>
</tr>
<tr>
<td>11 a.m.</td>
<td>3.0</td>
</tr>
<tr>
<td>1 p.m.</td>
<td>8.0</td>
</tr>
<tr>
<td>3 p.m.</td>
<td>9.5</td>
</tr>
<tr>
<td>5 p.m.</td>
<td>9.0</td>
</tr>
<tr>
<td>7 p.m.</td>
<td>6.0</td>
</tr>
<tr>
<td>9 p.m.</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Using the data table, construct a line graph following the directions below.

(a) Mark an appropriate scale on each of the labeled axes.
(b) Plot the data on the graph. Surround each point with a small circle and connect the points.

Example:

188) The diagram below represents an apparatus used to show that an animal gives off carbon dioxide. Part 1 contains a substance that removes carbon dioxide from the air passing through it. Parts 2 and 4 both contain a liquid that changes in appearance when carbon dioxide passes through it. Part 3 of this apparatus consists of a container holding an animal.

Which type of container used for part 3 would cause the liquid in part 4 to change in appearance most quickly?
1) a container that is kept in bright light  
2) a container in which the air is kept moist  
3) a small container  
4) a large container
189) A student divided some insect larvae into four equal groups, each having the same amount of food. Each group was kept at a different temperature, and the average length of the larvae was determined after each shedding of the exoskeleton (molt). The data obtained are shown in the data table below.

**DATA TABLE**

<table>
<thead>
<tr>
<th>MOLTS</th>
<th>AVERAGE LENGTH OF LARVAE (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group 1 (15 °C)</td>
</tr>
<tr>
<td>1</td>
<td>10.0</td>
</tr>
<tr>
<td>2</td>
<td>11.0</td>
</tr>
<tr>
<td>3</td>
<td>11.5</td>
</tr>
<tr>
<td>4</td>
<td>11.8</td>
</tr>
</tbody>
</table>

According to the data, the most favorable temperature for total growth in these larvae is

1) 25 °C  
2) 30 °C  
3) 15 °C  
4) 20 °C

190) To measure glucose use in a human, a blood sample was taken from a vein, and the amount of glucose in the sample was determined glucose solution was then ingested by the person being tested. Blood samples were taken periodically for 5 hours and tested to determine the amount of glucose present. Results from the tests were used to construct the data table below.

**DATA TABLE**

<table>
<thead>
<tr>
<th>TIME (hours)</th>
<th>GLUCOSE (mg/100 dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>0.5</td>
<td>170</td>
</tr>
<tr>
<td>1</td>
<td>120</td>
</tr>
<tr>
<td>2</td>
<td>90</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
</tr>
</tbody>
</table>

Using the information in the data table, construct a line graph on the grid, following the directions below.

(a) Mark an appropriate scale on each of the labeled axes.
(b) Plot the data from the data table. Surround each point with a small circle and connect the points.

**Example:**

![Graph Example]
191) Using the information in the data table, construct a line graph following the directions below.

(a) Mark an appropriate scale on the axis labeled “Temperature (°C).”
(b) Plot the data for setup A on the grid. Surround each point with a small circle and connect the points.

Example:

(c) Plot the data for setup B on the grid. Surround each point with a small triangle and connect the points.

Example:

192) Four similar bean seedlings were used to study the effects of the growth hormone gibberellic acid on the rate of plant growth. The seedlings were placed in four different flasks, each containing a different hormone concentration in distilled water, as shown below. The change in stem height was recorded every day for 1 week.

Identify one variable in this investigation.
A student cut a piece of potato into 8 cubes, each measuring 5 millimeters along each edge, and placed 7 of them in a beaker containing a 25% salt solution. One cube was removed from the beaker every 10 minutes for a period of 70 minutes and the average length of two sides was determined. The results are shown in the data table below.

### DATA TABLE

<table>
<thead>
<tr>
<th>TIME (min)</th>
<th>AVERAGE LENGTH (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5.0</td>
</tr>
<tr>
<td>10</td>
<td>4.5</td>
</tr>
<tr>
<td>20</td>
<td>4.0</td>
</tr>
<tr>
<td>30</td>
<td>3.5</td>
</tr>
<tr>
<td>40</td>
<td>3.0</td>
</tr>
<tr>
<td>50</td>
<td>2.5</td>
</tr>
<tr>
<td>60</td>
<td>2.5</td>
</tr>
<tr>
<td>70</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Which line graph most accurately shows the relationship between time in the salt solution and size of the cube?
Questions 194 and 195 refer to the following:

A student conducted an investigation to determine the effectiveness of three different mouthwashes in destroying bacteria. He covered the surface of the nutrient agar in four petri dishes with bacteria found in the human mouth. One paper disk, 1 centimeter in diameter; that had soaked in a specific mouthwash was placed on the agar surface of plates B, C, and D. The disk placed on the surface of plate A had been soaked in distilled water. Sterile procedures were used throughout the experiment. Each petri dish was placed in an incubator at a temperature of 37 for a 24-hour period. The diagram below represents the sequence of events in this investigation. The shaded areas in the petri dishes represent regions of bacterial growth.

![Diagram of petri dishes showing bacterial growth and mouthwash disks](image)

194) The student can determine which mouthwash is most effective in destroying bacteria by observing the
   1) rate of mouthwash evaporation from each disk
   2) amount of bacterial growth around each dish
   3) color of the mouthwash on each disk
   4) size of bacterial cells in each plate

195) Which factor was *not* needed to promote growth of the bacteria in the petri dishes?
   1) warmth
   2) nutrients
   3) light
   4) moisture

Questions 196 through 198 refer to the following:

A study was made to determine the effect of different salt concentrations on the number of contractions per minute of contractile vacuoles of paramecia. Four beakers of water containing different salt concentrations and equal numbers of paramecia were prepared. All other environmental conditions were kept constant. The paramecia were then observed with a compound microscope, and the contractions of their vacuoles were counted and recorded in the table below.

<table>
<thead>
<tr>
<th>Beaker</th>
<th>Salt Concentration (mg/ml)</th>
<th>Contractions per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.000</td>
<td>5.5</td>
</tr>
<tr>
<td>B</td>
<td>0.001</td>
<td>4.0</td>
</tr>
<tr>
<td>C</td>
<td>0.010</td>
<td>2.5</td>
</tr>
<tr>
<td>D</td>
<td>0.100</td>
<td>1.5</td>
</tr>
</tbody>
</table>

196) According to the information in the data table, which statement is true?
   1) The paramecia in beaker A respond the least to the water concentration in the beaker.
   2) The paramecia in beaker D have nonfunctioning contractile vacuoles.
   3) Beaker C has a lower salt concentration than beaker D.
   4) Beaker B has a lower salt concentration than beaker A.
197) According to the data, as the salt concentration increases, the number of contractions per minute changes. What most likely accounts for this change?
   1) an increased percentage of water in the paramecium
   2) a decrease in the salt concentration outside the paramecium
   3) an increased diffusion of salt out of the paramecium
   4) a decrease in the water concentration outside the paramecium

198) Using the information in the data table, construct a line graph following the directions below.
   (a) Mark an appropriate scale on the axis labeled **Contractions per Minute**.
   (b) Plot the data from the data table. Surround each point with a small circle and connect the points.

![Example Graph](image)

199) The diagram below represents the letter “h” as seen in the low-power field of view of a compound light microscope.

![Diagram](image)

Which diagram best represents the field of view if the slide is *not* moved and the objective is switched to high power?

1) ![Diagram](image)  
2) ![Diagram](image)  
3) ![Diagram](image)  
4) ![Diagram](image)
200) A group of 100 female water fleas was placed in each of three culture jars of different sizes. The graph below shows the average number of offspring produced per female each day in each jar.

The information in the graph suggests that
1) the ability of a water flea to produce offspring is affected by population density
2) water fleas have fewer offspring when they are thinly populated
3) the reproduction rate of water fleas increases steadily after 20 days
4) water fleas produce more offspring when they are crowded together

201) A student recorded the length of the earthworm in the diagram below as 10.4 centimeters.

Using one or more complete sentences, state one reason that this measurement is not valid.
Questions 202 through 205 refer to the following:

"I MISSED THAT WHAT DID YOU SAY?"

According to the National Center for Health Statistics, one out of 10 Americans has a hearing loss. There are three types of hearing conductive, sensorineural, and mixed. In conductive hearing loss, problems in the outer or middle ear block the transmission of vibrations to the inner ear. Conductive hearing loss can be the result of any number of disorders. The most common disorders are ear infections, excess ear wax, fluid in the middle ear, and perforated eardrum. This type of hearing loss can usually be treated by medical or surgical procedures.

Sensorineural hearing loss, or “nerve deafness,” is most often due to the gradual aging process or long-term exposure to loud noise. However, it can also be caused by high fever, birth defects, and certain drugs.

Some people with impaired hearing have both conductive and sensorineural hearing loss, which is known as mixed hearing loss. Many people with this condition can be helped by either a hearing aid or surgery.

Depending on the symptoms, certain tests can be done to determine the cause and extent of the hearing loss. A standard hearing evaluation may include the following:

- **tympanometry**, which examines the middle ear, eardrum, and possible blockage of the ear canal
- **pure-tone and speech reception testing**, which determines the softest level or threshold at which tones and speech are heard
- **word discrimination testing**, which measures the ability to distinguish words at a comfortable volume

In a recent interview, a rock band saxophone player admitted that over a 6-year period, he developed a 40 percent hearing loss because he neglected to use ear protection during his concert performances. Likewise, the use of personal listening devices, such as headphones, may cause hearing loss. Your ability to hear is not renewable. It pays to protect your ears from loud noises.

202) Which test is used to determine the presence of excessive wax in the ear canal?

1) word discrimination
2) sensorineural assessment
3) pure-tone and speech reception
4) tympanometry

203) Using one or more complete sentences, explain how a personal listening device may be controlled to decrease damage to the hearing process.

204) Which graph best represents a common relationship between age and nerve deafness?

1) ![Graph 1](image1.png)
2) ![Graph 2](image2.png)
3) ![Graph 3](image3.png)
4) ![Graph 4](image4.png)

205) A prolonged body temperature of 105°F may result in

1) an inner-ear infection
2) a perforated eardrum
3) conductive hearing loss
4) sensorineural hearing loss
206) Using one or more complete sentences, state the role of the paper towel in the staining procedure shown in the diagram below.

[Diagram of staining process showing paper towel, water, epidermal cells, coverslip, and staining solution]

207) In a laboratory investigation, the height and weight of six males and six females, all 15 years old, were measured and recorded. The results are shown in the data table below.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Height (in)</th>
<th>Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>62</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>61</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>64</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>66</td>
<td>146</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td>126</td>
</tr>
<tr>
<td>Female</td>
<td>64</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>62</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>59</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>61</td>
<td>110</td>
</tr>
</tbody>
</table>

Using the information in the data table, construct a line graph on the grid above by following the directions below.

(a) Mark an appropriate scale on each labeled axis.
(b) Plot the data for the males on the graph. Surround each point with a small circle and connect the points.
(c) Plot the data for the females on the graph. Surround each point with a small triangle and connect the points.
(d) The investigation is repeated with another set of six males and six females, all 15 years old. Using one or more complete sentences, explain why the results will most likely be different from those of the original investigation.
208) The data below were obtained during an investigation involving freshwater sunfish.

<table>
<thead>
<tr>
<th>Water Temperature (°C)</th>
<th>Average Rate of Opening of Gill Covers (openings/minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>20</td>
<td>38</td>
</tr>
<tr>
<td>23</td>
<td>60</td>
</tr>
<tr>
<td>25</td>
<td>57</td>
</tr>
<tr>
<td>27</td>
<td>25</td>
</tr>
</tbody>
</table>

Which set of labeled axes should be used to present the data most clearly?

1) ![Graph 1](image1)
2) ![Graph 2](image2)
3) ![Graph 3](image3)
4) ![Graph 4](image4)

209) The diagram below represents a hydra as viewed with a compound light microscope.

If the hydra moves toward the right of the slide preparation, which diagram best represents what will be observed through the microscope?

1) ![Diagram 1](image5)
2) ![Diagram 2](image6)
3) ![Diagram 3](image7)
4) ![Diagram 4](image8)
Questions 210 and 211 refer to the following:

A group of biology students extracted the photosynthetic pigments from spinach leaves using the solvent acetone. A spectrophotometer used to measure the percent absorption of six different wavelengths of light by the extracted pigments. The wavelengths of light were measured in units known as nanometers (nm). One nanometer is equal to one-billionth of a meter. The following data were collected:

- yellow light (585 nm) — 25.8% absorption
- blue light (457 nm) — 49.8% absorption
- orange light (616 nm) — 32.1% absorption
- violet light (412 nm) — 49.8% absorption
- red light (674 nm) — 41.0% absorption
- green light (533 nm) — 17.8% absorption

210) (a) Complete all three columns in the data table so that the wavelength of light either increases or decreases from the top to the bottom of the data table.

<table>
<thead>
<tr>
<th>Color of Light</th>
<th>Wavelength of Light (nm)</th>
<th>Percent Absorption by Spinach Extract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) Mark an appropriate scale on the axis labeled "Percent Absorption" on the graph.

(c) Plot the data from the data table into the graph. Surround each point with a small circle and connect the points to finish the graph.

EXAMPLE:

211) Which statement is a valid conclusion that can be drawn from the data obtained in this investigation?

1) Green and yellow light are not absorbed by spinach plants.
2) The data would be the same for all pigments in spinach plants.
3) Photosynthetic pigments in spinach plants absorb blue and violet light more efficiently than red light.
4) All plants are efficient at absorbing violet and red light.
Questions 212 and 213 refer to the following:

The table below shows the average systolic and diastolic blood pressure measured in millimeters of mercury (Hg) for humans between the ages of 2 and 14 years.

<table>
<thead>
<tr>
<th>Age</th>
<th>Systolic</th>
<th>Diastolic</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>101</td>
<td>64</td>
</tr>
<tr>
<td>10</td>
<td>110</td>
<td>72</td>
</tr>
<tr>
<td>14</td>
<td>119</td>
<td>76</td>
</tr>
</tbody>
</table>

212) Using one or more complete sentences, state one conclusion that compares systolic blood pressure to diastolic blood pressure in humans between the ages of 2 and 14 years.

213) (a) Mark an appropriate scale on each labeled axis.

(b) Plot the data for systolic blood pressure on the graph. Surround each point with a small triangle and connect the points.  
**EXAMPLE:**

(c) Plot the data for diastolic blood pressure on the graph. Surround each point with a small circle and connect the points.  
**EXAMPLE:**
Questions 214 through 216 refer to the following:

Nondiabetic individuals have a blood glucose concentration before breakfast of 80 to 90 milligrams per 100 deciliters of blood. A glucose level before breakfast above 110 milligrams per 100 deciliters of blood indicates diabetes.

Two patients suspected of being diabetic are given a glucose tolerance test before breakfast. Each patient ingests a glucose solution and undergoes periodic measurements to determine blood glucose levels. The results are represented in the data table below.

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>Blood Glucose (mg/100 dL)</th>
<th>Blood Glucose Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patient A</td>
<td>Patient B</td>
</tr>
<tr>
<td>0.0</td>
<td>90</td>
<td>150</td>
</tr>
<tr>
<td>0.5</td>
<td>120</td>
<td>180</td>
</tr>
<tr>
<td>1.0</td>
<td>140</td>
<td>220</td>
</tr>
<tr>
<td>1.5</td>
<td>110</td>
<td>250</td>
</tr>
<tr>
<td>2.0</td>
<td>90</td>
<td>240</td>
</tr>
<tr>
<td>2.5</td>
<td>85</td>
<td>230</td>
</tr>
<tr>
<td>3.0</td>
<td>90</td>
<td>210</td>
</tr>
<tr>
<td>3.5</td>
<td>85</td>
<td>190</td>
</tr>
<tr>
<td>4.0</td>
<td>90</td>
<td>170</td>
</tr>
</tbody>
</table>

214) (a) Mark an appropriate scale for the data for patient A on each labeled axis.
(b) Plot the data for patient A on the grid. Surround each point with a small circle and connect the points.

EXAMPLE: 🔄 🔄

215) Which conclusion is valid based on the results of the glucose tolerance test?

1) Only patient B is diabetic.
2) Neither patient A nor patient B is diabetic.
3) Both patients A and B are diabetic.
4) Only patient A is diabetic.

216) With no further intake of glucose solution, the blood glucose level of patient A after five hours will most likely

1) rise rapidly
2) rise to 110 and then drop
3) remain between 85 and 90
4) drop to 0

217) The diagram below shows an earthworm that has been dissected.

Select one of the lettered structures from the diagram. Record the letter of this structure and, using one or more complete sentences, a digestive function of this structure.
Questions 218 and 219 refer to the following:

218) Which laboratory technique is illustrated in the diagram above?
   1) measuring the photosynthetic rate in a specimen
   2) determining the pH of a specimen
   3) testing a specimen for amino acids
   4) preparing a wet mount of a specimen

219) Using one or more complete sentences, state a reason why methylene blue was used in the laboratory technique illustrated in the diagram above.

Questions 220 through 223 refer to the following:

TAKE TWO AND CALL ME IN THE MORNING

Hippocrates observed that pain could be relieved by chewing the bark of a willow tree. We now know that this bark contains salicylic acid, which is similar to acetylsalicylic acid, the active ingredient in aspirin. Over 2,300 years after this observation by Hippocrates, scientists have learned how aspirin works.

When people get the flu or strain their backs, the body responds by making prostaglandins (PG), a group of hormonelike substances. Presence of certain prostaglandins may result in fever, headaches, and inflammation. Scientists have determined that aspirin interferes with prostaglandin H2 synthase (PGHS-2), an enzyme that the body uses to make pain-causing prostaglandins. In 1994, the structure of this enzyme was found to be a crystal with a tube running up the middle of it. Raw materials move through this tunnel to reach the core of the enzyme, where they are transformed into prostaglandin molecules. Research has shown that aspirin blocks this tunnel. Part of the aspirin molecule attaches to a particular place inside the tunnel, preventing the raw materials from passing through the tunnel. This blockage interferes with the production of prostaglandins, thus helping to prevent or reduce fever, headaches, and inflammation.

The body makes two forms of the enzyme. PGHS-1 is found throughout the body and has a variety of uses, including protecting the stomach. PGHS-2 usually comes into play when tissue is damaged or when infections occur. Its action results in pain and fever. Aspirin plugs up the tunnel of PGHS-1 completely and often causes stomach irritation in some people. Aspirin plugs up the tunnel partially in PGHS-2, thus helping to relieve pain and fever.

Perhaps further research could result in a drug targeting PGHS-2 but not PGHS-1, relieving the aches, pains, and fever, but not irritating the stomach as aspirin does now.

220) Why does aspirin irritate the stomach of some people who take it?
   1) It is obtained from willow bark, which cannot be digested in the stomach.
   2) It interferes with the activity of an enzyme that helps to protect the stomach.
   3) It is the only acid in the stomach and irritates the stomach lining.
   4) It stimulates prostaglandin production in the stomach.

221) Using one or more complete sentences, explain why chewing the bark of a willow tree could help relieve the symptoms of headache and fever.

222) How does aspirin relieve the symptoms of the flu?
   1) It is an acid that dissolves the prostaglandins that cause the symptoms.
   2) It dissolves the crystal of the enzyme, preventing it from producing prostaglandins.
   3) It forms a barrier around the outer surface of PGHS-2 molecules, separating them from the prostaglandins.
   4) It reduces the amount of raw material reaching the active site of the enzyme that produces prostaglandins.

223) Using one or more complete sentences, describe the molecular structure of prostaglandin H2 synthase.
224) An experiment is represented in the diagram below.

An inference that can be made from this experiment is that

1) fertilization must occur in order for frog eggs to develop into adult frogs
2) a nucleus is necessary for an egg to develop into an adult frog
3) adult frog A can develop only from an egg and a sperm
4) the nucleus of a body cell fails to function when transferred to other cell types

225) The charts below show the relationship of recommended weight to height in men and women age 25-29.

<table>
<thead>
<tr>
<th>Height Feet</th>
<th>Small Frame</th>
<th>Medium Frame</th>
<th>Large Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>138-145</td>
<td>142-154</td>
<td>149-168</td>
</tr>
<tr>
<td>5</td>
<td>140-148</td>
<td>145-157</td>
<td>152-172</td>
</tr>
<tr>
<td>5</td>
<td>142-151</td>
<td>148-160</td>
<td>155-176</td>
</tr>
<tr>
<td>5</td>
<td>144-154</td>
<td>151-163</td>
<td>158-180</td>
</tr>
<tr>
<td>5</td>
<td>146-157</td>
<td>154-166</td>
<td>161-184</td>
</tr>
<tr>
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<td>157-170</td>
<td>164-188</td>
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<td>152-164</td>
<td>160-174</td>
<td>168-192</td>
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<tr>
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<td>155-168</td>
<td>164-178</td>
<td>172-197</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Height Feet</th>
<th>Small Frame</th>
<th>Medium Frame</th>
<th>Large Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>117-130</td>
<td>127-141</td>
<td>137-155</td>
</tr>
<tr>
<td>5</td>
<td>120-133</td>
<td>130-144</td>
<td>140-159</td>
</tr>
<tr>
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<td>123-136</td>
<td>133-147</td>
<td>143-163</td>
</tr>
<tr>
<td>5</td>
<td>126-139</td>
<td>136-150</td>
<td>146-167</td>
</tr>
<tr>
<td>5</td>
<td>129-142</td>
<td>139-153</td>
<td>149-170</td>
</tr>
<tr>
<td>5</td>
<td>132-145</td>
<td>142-156</td>
<td>152-173</td>
</tr>
<tr>
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<td>135-148</td>
<td>145-159</td>
<td>155-176</td>
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<tr>
<td>6</td>
<td>138-151</td>
<td>148-162</td>
<td>158-179</td>
</tr>
</tbody>
</table>

The recommended weight for a 6'0"-tall man with a small frame is closest to that of a

1) 5'9" woman with a large frame
2) 6'0" woman with a medium frame
3) 5'10" man with a medium frame
4) 6'0" man with a medium frame
226) Which set of laboratory equipment could a student use to determine whether or not apple juice contains simple sugars?

<table>
<thead>
<tr>
<th>Set A</th>
<th>Set B</th>
<th>Set C</th>
<th>Set D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety goggles</td>
<td>Safety goggles</td>
<td>Safety goggles</td>
<td>Safety goggles</td>
</tr>
<tr>
<td>Bromthymol blue solution</td>
<td>Benedict's solution</td>
<td>Lugol's iodine solution</td>
<td>Lens paper</td>
</tr>
<tr>
<td>Test tubes</td>
<td>Test tubes</td>
<td>Scalpel</td>
<td>Hot water bath</td>
</tr>
<tr>
<td>Straw</td>
<td>Test tube holder</td>
<td>Forceps</td>
<td>Graduated cylinder</td>
</tr>
<tr>
<td>Water</td>
<td>Hot water bath</td>
<td>Graduated cylinder</td>
<td>Distilled water</td>
</tr>
</tbody>
</table>

1) A  2) B  3) C  4) D

227) The diagram below represents the measurements of two leaves.

The difference in length between leaves A and B is closest to

1) 0.65 m  2) 20 mm  3) 1.6 m  4) 20 cm

228) A field biologist was researching the possibility of interbreeding among various amphibians living in a particular habitat in New State. The mating timetable for these amphibians is shown below.

Which generalization could the field biologist correctly make?

1) All of the amphibians interbreed randomly throughout the mating season.
2) The frogs can interbreed with any of the other frogs but not with toads.
3) The peeper frog and green frog do not interbreed.
4) The wood frog and the tree frog interbreed.
229) Which graduated cylinder represented below contains a volume of liquid closest to 15 milliliters?

1)  

2)  

3)  

4)  

230) The verdun is a small desert bird that builds a nest with an entrance on only one side. In the early nesting season when temperature cold, the verdun usually moves this opening away from the normal wind direction, as shown in diagram I below. Diagrams I and II: bar graphs in which the length of a bar represents the number of nests with an opening facing in a particular direction.

According to diagram II, how does the verdun react to hotter climate conditions?

1) It uses the same nest orientation.
2) It moves to a cooler climate.
3) It moves its nest opening to get more wind.
4) It moves its nest opening north.

231) The diagram below represents a thermometer.

The temperature reading on this thermometer would most likely indicate the temperature

1) at which water freezes
2) of the human body on a very hot summer day
3) at which water boils
4) of a human with a very high fever
232) The diagram below represents three different circulatory systems.

When asked to describe the anatomical location of the heart chambers, a student describes the atria as anterior to the ventricles. Which statement is accurate?

1) The student is incorrect for A, B, and C.
2) The student is correct for A, B, and C.
3) The student is correct for B and C, but incorrect for A.
4) The student is incorrect for B and C, but correct for A.

233) The diagram below shows some cells in the meristematic region of a root tip.

Which statement about these cells is correct?

1) Most of the cells are undergoing meiosis.
2) About 80 percent of the cells are dividing.
3) About 20 percent of the cells are dividing.
4) Most of the cells will never undergo mitosis.
234) The illustrations below represent photographs of cells viewed through a compound light microscope.

To change from the view shown in photograph 1 to that shown in photograph 2, a student should manipulate the
1) stage clips  2) fine adjustment  3) eyepiece  4) nosepiece

235) The dotted line in the diagram below shows the path taken by an insect larva when it is placed in a round experiment chamber with light in the center. Blocks of wood are placed around the light, which cause regions of light and shade within the chamber as shown. Temperatures are given for light areas.

Which statement best describes the movement of the insect larva?
1) The larva does not move into light areas.
2) The larva does not move into shaded areas.
3) The larva is attracted to light but moves into shaded areas when it is too hot.
4) The larva is attracted to light and moves steadily toward the light source.
236) Which diagram illustrates how a cross section of an earthworm should be prepared?

1) ![Diagram 1]

2) ![Diagram 2]

3) ![Diagram 3]

4) ![Diagram 4]

237) Which diagram shows a correct measurement?

1) ![Volume Measurement Diagram]

2) ![Temperature Scale Diagram]

3) ![Metric Ruler Diagram]

4) ![Length Measurement Diagram]
238) Which microscope setup would allow a student to see the largest field?

1) 238)

2) 238)

3) 238)

4) 238)

239) What is the length of the garden snail in the diagram below, from the beginning of its foot at point A to the end of its foot at point B?

1) 26 cm
2) 260 cm
3) 2.6 mm
4) 26 mm
Certain chemicals cause mutations in cells by breaking chromosomes into pieces. Cells containing such broken chromosomes are known as mutated cells. Certain nutrients, such as beta carotene (a form of vitamin A), have the ability to prevent chromosome breakage by such mutagenic chemicals.

The results of an investigation of the effect of beta carotene in preventing chromosome damage are represented in the data table below. In this investigation, varying amounts of beta carotene per kilogram of body weight were added to the diets of hamsters. A mutagenic chemical was also added to the diets of the hamsters at a constant rate of dosage.

**DATA TABLE**

<table>
<thead>
<tr>
<th>Amount of Beta Carotene Added to Diet per kg of Hamster's Body Weight</th>
<th>Percentage of Mutated Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 mg</td>
<td>11.5</td>
</tr>
<tr>
<td>20 mg</td>
<td>11.0</td>
</tr>
<tr>
<td>30 mg</td>
<td>8.0</td>
</tr>
<tr>
<td>40 mg</td>
<td>7.0</td>
</tr>
<tr>
<td>50 mg</td>
<td>4.5</td>
</tr>
<tr>
<td>75 mg</td>
<td>3.5</td>
</tr>
<tr>
<td>100 mg</td>
<td>2.0</td>
</tr>
<tr>
<td>150 mg</td>
<td>1.5</td>
</tr>
</tbody>
</table>

(a) Mark an appropriate scale on each of the labeled axes.
(b) Plot the data from the data table. Surround each point with a small circle and connect the points.

Example:

![Graph Example]

The data table below contains information about the human death rate from various disorders for the years 1911 and 1957.

**DATA TABLE**

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Deaths per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1911 YEAR 1957</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>224.6 6.7</td>
</tr>
<tr>
<td>Communicable childhood diseases</td>
<td>58.9 0.1</td>
</tr>
<tr>
<td>Cancer</td>
<td>69.3 136.2</td>
</tr>
<tr>
<td>Heart Diseases</td>
<td>156.4 256.2</td>
</tr>
</tbody>
</table>

Which statement is a valid conclusion based on the data table?

1) Lung cancer caused more deaths in 1957 than in 1911.
2) Life expectancy was higher in 1957 than in 1911 due to the development of improved crops providing better nutrition.
3) The death rate due to communicable childhood disease was lower in 1957 than in 1911.
4) Better housing in 1957 reduced the death rate due to tuberculosis.