1. Which condition is necessary for an experiment to yield useful data?
   a. Similar results should be obtained when the experiment is repeated
   b. Only the expected results should be considered each time the experiment is performed.
   c. The hypothesis must be correct.
   d. The experimental period must be short.

2. An investigation was conducted using three groups of laboratory rats, $X$, $Y$, and $Z$, to determine the relative effects of glucose and adrenaline on the rate of heartbeat. The experimental conditions for each group of rats were kept the same except for the type of solution injected, as shown in the data table below.

<table>
<thead>
<tr>
<th>Group</th>
<th>Solution Injected</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X$</td>
<td>1 mL adrenaline in distilled water</td>
</tr>
<tr>
<td>$Y$</td>
<td>1 mL glucose in distilled water</td>
</tr>
<tr>
<td>$Z$</td>
<td>1 mL distilled water, only</td>
</tr>
</tbody>
</table>

   According to the data table, which group of rats functioned as the control?
   a. $X$, only
   b. $Y$, only
   c. $Z$, only
   d. both $X$ and $Y$

3. In one of his experiments with pea plants, Mendel noted that 75% of the offspring of a certain cross had green pea pods. This statement would be considered
   a. an observation
   b. an inference
   c. a hypothesis
   d. a conclusion

4. An investigation was set up to determine the effectiveness of a particular fertilizer on the growth of bean plants. In the investigation, each of the 10 bean plants in group $A$ was watered with 50 milliliters of a solution of distilled water and fertilizer, while each of the 10 bean plants in group $B$ was watered with 50 milliliters of distilled water only. Both groups of plants were watered every other day for 1 month and grown under identical environmental conditions. The control for this investigation was
   a. group $A$, only
   b. group $B$, only
   c. both group $A$ and group $B$
   d. neither group $A$ nor group $B$

5. A student notes that placing the light at different distances from the plant causes the rate of bubbling to vary. The student decides to design an experiment to investigate the effect of light intensity on the rate of bubble production. An appropriate control for this experiment would be
   a. a plant at a fixed distance from the light source
   b. a plant exposed to sunlight
   c. the addition of oxygen to the water
   d. the use of blue light on some of the plants

6. A new drug for the treatment of asthma is tested on 100 people. The people are evenly divided into two groups. One group is given the drug, and the other group is given a glucose pill. The group that is given the glucose pill serves as the
   a. experimental group
   b. limiting factor
   c. control
   d. indicator

7. As part of an investigation, 10 bean seedlings in one setup were grown in the dark, while 10 seedlings in another setup were grown in sunlight. All other growth conditions were kept the same in both setups. The seedlings grown in the dark were white with long, slender stems. The seedlings grown in the sunlight were green and healthy. Which hypothesis was most likely being tested in this investigation?
   a. Plants grown in the dark cannot perform the process of respiration.
   b. Sunlight is necessary for the normal growth of bean plants.
   c. Light is necessary for the germination of bean seeds.
   d. Light is necessary for proper mineral absorption by plants.
An experiment was performed to determine the effect of different mineral salts on plant growth. Forty pots containing genetically identical plants were divided into four equal groups and placed in a well-lighted greenhouse. Each pot contained an equal amount of nonmineral potting soil and one plant. Minerals were then added in equal amounts to each experimental group of pots as shown below.

<table>
<thead>
<tr>
<th>Control Group</th>
<th>Experimental Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Plant]</td>
<td>![Plant] ![Plant] ![Plant]</td>
</tr>
<tr>
<td></td>
<td>Water + Nitrogen salts</td>
</tr>
</tbody>
</table>

For the experiment to be valid, what should be added to the control group of pots?

a. water  
b. nitrogen salts  
c. potassium salts  
d. potassium and phosphorus salts

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

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Fish</th>
<th>Temperature (°C)</th>
<th>Average Rate of Movement of Gill Covers per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>20</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>23</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>25</td>
<td>57</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>27</td>
<td>25</td>
</tr>
</tbody>
</table>

Which labeled axes should be used to graph the relationship shown between the two variables?
It has been hypothesized that a chemical known as BW prevents colds. To test this hypothesis, 20,000 volunteers were divided into four groups. Each volunteer took a white pill every morning for one year. The contents of the pill taken by the members of each group are shown in the chart below.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Volunteers</th>
<th>Contents of Pill</th>
<th>% Developing Colds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5,000</td>
<td>5 grams of sugar</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>5,000</td>
<td>5 grams of sugar 1 gram of BW</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>5,000</td>
<td>5 grams of sugar 3 grams of BW</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>5,000</td>
<td>5 grams of sugar 9 grams of BW</td>
<td>15</td>
</tr>
</tbody>
</table>

10. [Refer to figure 1]
Which group served as the control in this investigation?
   a. Group 1
   b. Group 2
   c. Group 3
   d. Group 4
Research indicates that many plants prevent the growth of other plants in their habitat by releasing natural herbicides (chemicals that kill plants). These substances are known as allelochemicals and include substances such as quinine, caffeine, and digitalis. Experiments have confirmed that chemicals in the bark and roots of black walnut trees are toxic, and when released into the soil they limit the growth of crop plants such as tomatoes, potatoes, and apples. Allelochemicals can alter growth and enzyme action, injure the outer cover of a seed so the seed dies, or stimulate seed growth at inappropriate times of the year. Studies on allelochemical effects help explain the observation that almost nothing grows under a black walnut tree even though light and moisture levels are adequate for growth.

11.  Refer to figure 2

Base your answer to the question on the passage and on your knowledge of biology.

A set of axes is shown in the diagram.

When using this set of axes to show the effect of black walnut allelochemicals on the number of plants, which labels would be appropriate for axis $X$ and axis $Y$?

a. $X$ – Number of Plants
   $Y$ – Distance from Walnut Tree Trunk (meters)

b. $X$ – Distance from Walnut Tree Trunk (meters)
   $Y$ – Number of Plants

c. $X$ – Number of Plants
   $Y$ – Time (days)

d. $X$ – Time (days)
   $Y$ – Number of Plants

12. Which statement best describes a hypothesis?

   a. A hypothesis is the process of making careful observations.
   b. The conclusion drawn from the results of an experiment is part of a hypothesis.
   c. A hypothesis serves as a basis for determining what data to collect when designing an experiment.
   d. The facts collected from an experiment are written in the form of a hypothesis.
An investigation was carried out over a five-year period to measure the effect of color on the survival of trout in a stream. The stream contained many brightly colored stones and food was plentiful. At the start of the investigation (year 0), 100 bright-colored trout and 100 drab-colored trout were placed into a section of the stream that had been blocked with netting. Investigators monitored the trout populations for five years and recorded the water condition each time a count was done. The data collected are shown in the table below.

<table>
<thead>
<tr>
<th>Year</th>
<th>Bright-Colored Trout</th>
<th>Drab-Colored Trout</th>
<th>Condition of Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
<td>100</td>
<td>clear</td>
</tr>
<tr>
<td>1</td>
<td>64</td>
<td>36</td>
<td>clear</td>
</tr>
<tr>
<td>2</td>
<td>86</td>
<td>25</td>
<td>clear</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>77</td>
<td>cloudy</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>86</td>
<td>cloudy</td>
</tr>
<tr>
<td>5</td>
<td>90</td>
<td>9</td>
<td>clear</td>
</tr>
</tbody>
</table>

13. [Refer to figure 3]

Using the information in the data table, a student constructs a line graph. What are appropriate labels for the axes of the graph?

a. x-axis bright colored trout, y-axis drab colored trout
b. x-axis condition of water, y-axis trout
c. x-axis years, y-axis number of trout
d. x-axis bright colored trout, y-axis years

14. What is the first step in any science experiment?

a. Testing
b. Reporting results
c. Observing
d. Research

15. Conrad did an experiment on three groups of laboratory rats, X, Y, and Z. He wanted to find the effects of glucose (sugar) and adrenaline on the rate of heartbeat. Conrad kept the experimental conditions the same for each group of rats except for the type of solution injected, as shown in the data table below.

<table>
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<tr>
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<th>Solution Injected</th>
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<tbody>
<tr>
<td>X</td>
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<td>1 mL glucose in distilled water</td>
</tr>
<tr>
<td>Z</td>
<td>1 mL distilled water, only</td>
</tr>
</tbody>
</table>

According to the data table, which group of rats acted as the control?

a. X, only
b. Y, only
c. Z, only
d. both X and Y