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## Question: 1

A student is working on a science project and is going through each step of the scientific method. After the student conducts his or her first experiment and records the results of the experimental test, what should the student do next?

- A. Communicate the results.
- B. Draw a conclusion.
- C. Repeat the experiment.
- D. Create a hypothesis.

**Answer: C**

Explanation:

Repeating the experiment validates data. Each separate experiment is called a repetition. It should be possible to replicate the results of experiments or tests. Similar data gathered from many experiments can also be used to quantify the validity of the hypothesis. Repeating the experiments allows the student to observe variation in the results. Variation in data can be caused by a variety of errors or may be evidence against the hypothesis. Answer D, create a hypothesis, comes before experiments. Answers A, communicate the results, and B, draw a conclusion, occur after testing.

## Question: 2

The student formed the following hypothesis:

Lengthening the string of the pendulum increases the time it takes the ball to make one complete period. What correction would you have the student make to the hypothesis?

- A. Turn it into an "if/then" statement.
- B. Change "increases" to "will increase."
- C. Switch the order of the sentence so that the phrase about the period comes first, and the phrase about the string's length is last.
- D. No corrections are needed.

**Answer: A**

Explanation:

A formalized hypothesis written in the form of an if/then statement can then be tested. A statement may make a prediction or imply a cause/effect relationship, but that does not necessarily make it a good hypothesis. In this example, having the student rewrite the statement in the form of an if/then statement could read: If the length of the string of the pendulum is varied, then the time it takes the ball to make one complete period changes. This hypothesis is testable, doesn't simply make a prediction, nor

does it make a conclusion. The validity of the hypothesis can then be supported or disproved by experimentation and observation.

### Question: 3

What would be an appropriate control variable for this experiment?

- A. The period
- B. The length of the string
- C. The mass of the ball
- D. The color of the ball

**Answer: C**

Explanation:

The mass of the ball is appropriately called a control variable for the experiment. A control or controlled variable is a factor that could be varied, but for testing purposes should remain the same throughout all experiments; otherwise, it could affect the results. In this case, if the mass of the ball was changed, it could also affect the length of the period. The length of the string is meant to be an independent variable, one that is changed during experiments to observe the results upon the dependent variable, which is the variable (or variables) that are affected. In this case, the period would be the dependent variable.

### Question: 4

Once a hypothesis has been verified and accepted, it becomes a

- A. fact
- B. law
- C. conclusion
- D. theory

**Answer: D**

Explanation:

Once a hypothesis has been verified and accepted, it becomes a theory. A theory is a generally accepted explanation that has been highly developed and tested. A theory can explain data and be expected to predict outcomes of tests. Answer A, fact, is considered to be an objective and verifiable observation; whereas, a scientific theory is a greater body of accepted knowledge, principles, or relationships that might explain a fact. Answer B, law, is an explanation of events for which the outcome is always the same. Answer C, conclusion, is more of an opinion and could be based on observation, evidence, fact, laws or even beliefs.

### Question: 5

A student has collected data on the width of tree trunks and average precipitation rates for different locations. The student wants to show the relationship between these two variables. What type of graph should the student use?

- A. A multi-line graph with the width measurements on the x-axis and precipitation rates on the y-axis.
- B. A scatter plot with the width measurements on the y-axis and precipitation rates on the x-axis.
- C. A bar graph with the width measurements on the y-axis and precipitation rates on the x-axis.
- D. A pie chart with the width of trees shown as a percentage at different precipitation rates.

**Answer: B**

Explanation:

Scatter plots are useful for illustrating two sets of numerical data on the two axes and their relationship. In this case, by plotting the width of the tree trunks along the x-axis and the corresponding average precipitation rates along the y-axis, any relationship between the two can be found. Scatter plots are also useful when there are many data points. Answer A, multi-line graph, is useful for showing sets of data that change over time. Answer C, bar graph, is a good choice for comparing individual data points. Answer D, pie chart, is useful for graphically illustrating the parts to a whole.

### Question: 6

A student is measuring morning and afternoon temperatures for a school project using a thermal infrared gun instrument. The instrument is calibrated incorrectly and produces a cold bias of a degree in all the temperature measurements. How should the student deal with this error?

- A. The student should recalibrate the instrument and redo the project.
- B. Since it is not a major error, the student can ignore it.
- C. This is a systematic error, and the student should take it into consideration when analyzing the results by increasing the temperatures of a degree.
- D. This is a random error, so the student should only mention it as a potential problem in interpreting the results.

**Answer: C**

Explanation:

This is indeed a systematic error and must be treated accordingly. Answer A is probably not realistic in that the student may not be qualified to recalibrate the instrument. Answer B is incorrect as the scientific process does not include ignoring errors and assuming they are minor. Answer D is also incorrect as it is not random and does not take into account that the collected data will be off by 0.7 degrees.

### Question: 7

Make the following metric conversion:

5 decimeters = \_

- A. 0.5
- B. 0.05
- C. 50
- D. 500

**Answer: B**

Explanation:

In the metric system, 5 decimeters is equal to 0.05 decameters. A meter is the standard measurement of length. Prefixes are defined in increments of 10 to increase or decrease quantity. The prefix "deci" is equivalent to  $10^{-1}$  or a tenth (0.1). A decimeter would be equal to 0.1 meters. The prefix "deca" is equivalent to  $10^1$  or 10. A decameter would be equal to 10 meters. A decimeter would be equal to 0.1 meters. The prefix "deca" is equivalent to 10 or 101. A decameter would be equal to 10 meters. To convert a smaller unit to a larger one, move the decimal place to the left. Since 10 decimeters make up 1 meter, for 5 decimeters, move the decimal 1 place to the left to find meters, which would be 0.5 meters. Because a decameter is larger than 1 meter (10 meters in 1 decameter), move the decimal another place to the left to change from meters to decameters, which would be 0.05 decameters. An alternate method is to set up conversion factors. This method involves canceling units and is very helpful to learn for other scientific problems.

### Question: 8

Which of the data sets could be plotted on a pie chart?

- A. The total population of the top five largest U.S. cities.
- B. The incubation period of a penguin colony as it relates to hours of daylight.
- C. The distribution of weight among players of a football team.
- D. The percent of vegetation cover and precipitation rates in different national parks.

**Answer: C**

Explanation:

In this case, a pie chart can illustrate the whole number of players as well as the number (or percentage) of players at given weights. It would be easy to interpret the data that, for example, 75% of the team weigh 250 pounds or more, 20% weigh between 200 and 250 pounds, and a mere 5% weighs less than 200 pounds. The other answers would be better served in bar or line charts to compare variables or amounts that do not vary greatly.

### Question: 9

Which of the following processes uses electrical charges to separate substances?

- A. Spectrophotometry
- B. Chromatography
- C. Centrifugation
- D. Electrophoresis

**Answer: D**

Explanation:

Electrophoresis, also known as gel electrophoresis, uses electrical charges to separate substances such as protein, DNA and RNA. Depending upon the electrical charge and size of the molecules, they will travel through a porous gel at different rates when a charge is applied. Answer A, Spectrophotometry, refers to the measurement of visible light, near-ultraviolet, and near-infrared wavelengths. Answer B, Chromatography, refers to a number of techniques that separate mixtures of chemicals based on the differences in the compound's affinity for a stationary phase, usually a porous solid, and a mobile phase, which can be either a liquid or a gas. Answer C, Centrifugation, separates mixtures by spinning to generate centripetal force, which causes heavier particles to separate from lighter particles.

### Question: 10

When using a light microscope, how is the total magnification determined?

- A. By multiplying the ocular lens power by the objective being used
- B. By looking at the objective you are using only
- C. By looking at the ocular lens power only
- D. By multiplying the objective you are using by two

**Answer: A**

Explanation:

When using a light microscope, total magnification is determined by multiplying the ocular lens power times the objective being used. The term "ocular lens" refers to the eyepiece, which has one magnification strength, typically 10x. The objective lens also has a magnification strength, often 4x, 10x, 40x, or 100x. Using a 10x eyepiece with the 4x objective lens will give a magnification strength of 40x. Using a 10x eyepiece with the 100x objective lens will give a magnification strength of 1,000x. The shorter lens is the lesser magnification; the longer lens is the greater magnification.

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