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SKU: 9781266640216-TEST-BANK

Correct Answers are located at the end of each chapter.

TRUE/FALSE - Write 'T' if the statement is true and 'F' if the statement is false.

1) To consider variation while also lessening the impact of extreme data points, one should examine the standard deviation rather than the range of experimental data.
   - ◎ true
   - ◎ false

2) The scientific method can be effectively used for moral choices, ethical dilemmas, and intestable ideas.
   - ◎ true
   - ◎ false

3) In an experiment that examines the differences in tadpole size that occur as a result of different diets that are fed to tadpoles, it would be sufficient to test only one single pan of tadpoles that were fed one diet, and only one single pan of tadpoles fed a different diet.
   - ◎ true
   - ◎ false

CHECK ALL THE APPLY. Choose all options that best completes the statement or answers the question.

4) Why is an increased number of replications an advantage in an experiment?
   - A) Increased replications are not useful in an experiment.
   - B) Replications make allowances for naturally occurring variations.
   - C) Replications can serve as controls.
   - D) Replications remove experimental bias.

5) Which of these are true regarding theories and facts?
   - A) Theories become fact.
   - B) Theories are used to explain facts.
   - C) Theories incorporate facts.
   - D) Theories are unsubstantiated guesses about facts.

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6) What is true about science? Check all statements that apply.
   A) It is a single entity.
   B) It generally contains bias.
   C) It is an orderly process.
   D) It proceeds by posing and answering questions.
   E) Its results in scientific experiments that are repeatable.

7) What should be considered in formulating a hypothesis? Check all that apply.
   A) The possibility the hypothesis will not be supported by the experimental data
   B) The relationship between the variables in the experiment
   C) The possibility the hypothesis will be proved true
   D) The possibility the hypothesis will be supported by the experimental data

8) What does it mean if two treatments are said to be "significantly different"? Check all that apply.
   A) The difference was very likely not due to natural variation.
   B) The means of each sample plus or minus half the variance do not overlap.
   C) The means of each sample plus or minus half the standard deviation do not overlap.
   D) The ranges overlap.

9) What makes a theory different from a hypothesis? Check all that apply.
   A) A theory has a greater range of experimental support.
   B) A theory has stood the test of time.
   C) A theory can be a guess.
   D) A theory cannot be used to make predictions.

MULTIPLE CHOICE - Choose the one alternative that best completes the statement or answers the question.

10) In an experiment that tests the impact of temperature on cricket chirping frequency, what is the independent variable?
   A) Temperature
   B) Chirping frequency
   C) Cricket species
   D) This experiment does not have an independent variable.

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11) What is the dependent variable in an experiment that tests the impact of temperature on cricket chirping frequency?

A) Temperature
B) Chirping frequency
C) Cricket species
D) A dependent variable is not present in this experiment

12) Which of these is an example of a null hypothesis?

A) Medication X will not impact the size of a tumor.
B) Green frogs have a more distinct call than grey tree frogs.
C) The water level in Lake Michigan has increased in the past 12 months.
D) Changes in weather patterns seem to increase the incidence of migraines.

13) Consider the following general observation:
Groups of tadpoles of the same species raised in the lab may have significantly different average weights.
Which is a more precise, insightful observation that could be tested?

A) Wood frog tadpoles grow larger if fed a meat-based diet.
B) The average weight for groups of bullfrog tadpoles is higher if the density of tadpoles per gallon of water is less than 1.
C) Green frog tadpoles grow larger if kept in water above $18^{\circ}C$.
D) All of the choices are correct.

14) Imagine that you wish to compare a new diet of meat-based fish food for tadpoles that are raised in the laboratory to the traditional laboratory diet of boiled lettuce. You want to see if the new diet will be associated with an increase in the average weight of the tadpoles. In your experiment, you keep all other factors, such as tadpole density per pan, temperature, pH, and the amount of food the same. The only difference between your control and experimental groups is the type of food the tadpoles receive.
Which is a null hypothesis for this tadpole experiment?

A) Tadpoles will be larger if fed a meat-based diet.
B) Tadpoles will be larger if fed boiled lettuce.
C) Diet will have no effect on tadpole size.
D) Tadpole size will be more variable if fed a meat-based diet.

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15) In an experiment that compares the size of tadpoles that are fed a diet of meat-based fish food to the size of tadpoles that are fed the traditional laboratory diet of boiled lettuce, which is an alternate hypothesis?
    A) Tadpole size will be unaffected by diet.
    B) Tadpole size will differ if groups of tadpoles are fed different diets.
    C) Tadpole size will determine the diet the tadpoles are fed.

16) What is the independent variable in an experiment that examines the differences in tadpole size that occur as a result of different diets that are fed to tadpoles?
    A) Diet
    B) Tadpole size
    C) Species of tadpole
    D) Lab conditions

17) What is the dependent variable in an experiment that examines the differences in tadpole size that occur as a result of different diets that are fed to tadpoles?
    A) Diet
    B) Size of tadpoles
    C) Tadpole species
    D) Lab conditions

18) At the conclusion of an experiment that examines the effect of the type of diet the tadpoles receive on tadpole size, tadpoles are weighed in the process of data collection. How would a researcher determine if the type of diet significantly impacted tadpole size?
    A) The final conclusion should be based on the impressions and opinions of the researcher.
    B) The data should undergo statistical analysis.
    C) The average of the control group should be compared to the average of the experimental group, and the researcher could then form an opinion on importance of the difference between the two means.
    D) The researcher must meet with other scientists to discuss the results and form an opinion.

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19) What is not a question that can be answered using the scientific method?
A) Does the amount of daylight have an effect on tadpole growth?
B) Is the length of the larval period variable for tadpoles within a species?
C) Are wood frog tadpoles cuter than bullfrog tadpoles?
D) Is adult frog size related to size as a tadpole?

20) What does the range of a sample represent?
A) The difference between the treatment types.
B) The difference between the smallest and largest data.
C) The difference between the null and alternate hypotheses.
D) The geographic location in which the experiment was conducted.

21) What accounts for a single observation, and what accounts for a group of observations?
A) A hypothesis accounts for a single observation, and a null hypothesis accounts for a group of observations.
B) A null hypothesis accounts for a single observation, and a hypothesis accounts for a group of observations.
C) A hypothesis accounts for a single observation, and a theory accounts for a group of observations.
D) A theory accounts for a single observation, and a hypothesis accounts for a group of observations.

FILL IN THE BLANK. Write the word or phrase that best completes each statement or answers the question.

22) The hypothesis states there will be no difference between the control and experimental groups in an experiment is the__ hypothesis.

23) In a well-designed experiment, the number of treatment variable(s) that differ between the control and experimental group is __.

SECTION BREAK. Answer all the part questions.

24) Please watch the video and answer the following questions.
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24.1) Of what is standard deviation a direct measure? Check all that apply.

A) The variation in a data set
B) Natural variations that occur throughout biology
C) The average value of a data set
D) Variation within an individual measurement
E) The number of individuals in a sample

24.2) Obtain the mean of this data set of frog snout-to-ischium measurements, which are recorded in centimeters.

Frog number	**Frog length: snout-to-ischium**
1	2.00 cm
2	3.60 cm
3	1.90 cm
4	2.40 cm
5	2.00 cm

A) 2.38
B) 11.9
C) 2.00
D) 12.0
E) 2.10

24.3) Calculate the sum of squared deviations of this data set of frog snout-to-ischium measurements, which are recorded in centimeters.

Frog number	**Frog length: snout-to-ischium**
1	2.00 cm
2	3.60 cm
3	1.90 cm
4	2.40 cm
5	2.00 cm

A) 2.01
B) 2.48
C) 4.04
D) 5.00
E) 2.16

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24.4) Calculate the variance of this data set of frog snout-to-ischium measurements, which are recorded in centimeters.

Frog number	**Frog length: snout-to-ischium**
1	2.00 cm
2	3.60 cm
3	1.90 cm
4	2.40 cm
5	2.00 cm

A) 0.50
B) 1.01
C) 1.42
D) 0.40
E) 1.15

25) Please watch the video and answer the following questions.
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25.1) What advantage does a graph have over a data table?
A) A graph includes more data.
B) A graph allows for greater statistical analysis of data.
C) A graph readily reveals trends.
D) A graph allows data to be interpreted.

25.2) What are the necessary components of a graph? Check all that apply.
A) X-axis and Y-axis
B) Labels with units of measure
C) Values on each axis
D) Data curve
E) Title
F) Statistical analysis

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25.3) You are conducting an experiment in which you are measuring the effect of nutritional status on reaction time. What is your independent variable?

A) Reaction time
B) Nutritional status
C) Number of subjects in the study
D) The location of the study

25.4) Which variable should be placed on the x-axis?

A) Independent variable
B) Dependent variable
C) Responding variable
D) Controlled variable
E) Independent variable, which is also known as the controlled variable
F) Dependent, which is also known as the responding variable

25.5) A student has plotted the data from his experiment on a graph. Instead of connecting the data points, he draws a straight line that comes as close to each data point as is possible. What is the line called?

A) Standard fit
B) Best fit
C) Average fit
D) Interpretive fit

25.6) You are conducting an experiment in which you are measuring the effect of nutritional status on reaction time. What is your independent variable?

A) Reaction time
B) Nutritional status
C) Number of subjects in the study
D) The location of the study

26) {MISSING IMAGE}
Safety video
Please watch the video and answer the following questions.

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26.1) As you are working on your lab procedure with your lab partner, she hands you a beaker that contains a chemical. As you look at the beaker, you notice it is not labeled. When you ask your lab partner about this, she says she is sure it contains glucose, which is the chemical that is required for the next step in the procedure. What should you do?

A) You have to work as a team, so you should trust your lab partner and accept the chemical as glucose.
B) You should visually compare the chemical to a stock solution of glucose to be sure it is glucose.
C) You should visually compare the chemical to another group's glucose to be sure it is glucose.
D) You can assume that since the chemical was on your lab tray, it is ok to use the chemical.
E) You must inform your instructor and then dispose of the unlabeled chemical as instructed.

26.2) Check any items that would not be appropriate for the laboratory.

A) A long necklace
B) Dangling jewelry
C) Sandals
D) Blue jeans
E) Long, braided hair

26.3) Although food may not be consumed in the laboratory, the consumption items of necessity such as bottled water and cough drops is permitted.

◎ true
◎ false

26.4) What is expected of students before they enter the laboratory? Check all that apply.

A) Students will have thoroughly read the lab procedure.
B) Students will have memorized the lab procedure.
C) Students with long hair will have tied their hair back.
D) Students will wear appropriate lab attire.
E) Students will take special note of hazardous chemicals as indicated in the lab procedure.

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26.5) As you are working through your lab procedure, an empty test tube rolls off of your lab table and shatters on the floor. Your lab partners want to pick up the broken glass and throw it away in a nearby waste bin. What should you tell them?

A) Go ahead with this methodology, but use extreme caution when touching the broken glass.
B) Use a broom and dustpan instead of handling the glass directly, and then dispose of it in the nearest waste bin.
C) Notify the instructor first, then use a broom and dustpan to dispose of the broken glass in the nearest waste bin.
D) Notify the instructor first, then use a broom and dustpan to dispose of the broken glass in the disposal box that is designated specifically for broken glass.

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Answer Key

Test name: Exercise 01

1) TRUE
2) FALSE
3) FALSE
4) [B]
5) [B, C]
6) [C, D, E]
7) [A, B, D]
8) [A, C]
9) [A, B]
10) A
11) B
12) A
13) D
14) C
15) B
16) A
17) B
18) B
19) C
20) B
21) C
22) null
23) 1
24) Section Break
24.1) [A, B]
24.2) A
24.3) A
24.4) A
25) Section Break
25.1) C
25.2) [A, B, C, D, E]
25.3) B
25.4) E
25.5) B
25.6) B
26) Section Break
26.1) E

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26.2) [A, B, C]
26.3) FALSE
26.4) [A, C, D, E]
26.5) D

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