

**B - Experiment and Data Analysis - December 19 SO Practice - 12-19-2020**

Welcome to Experiment and Data Analysis!

This test contains 2 parts:

Part I: Designing an Experiment (you will need to submit your diagram here (<https://forms.gle/QJkV4PzAgvibpWPP9>) within 15 minutes after you finish the test)

Part II: Data Analysis

You will have 50 minutes to complete both parts of the test. Good luck!

**Part I: Design an Experiment**

Your task is to design an experiment that includes independent and dependent variables, and which relates to parachutes and air resistance using the materials provided.

The experiment you designed can require more than 50 mins to be conducted, but only limit to the materials available in the following list:

- Trash bag (x1)
- Paper napkins (x5)
- Paper clips (x5)
- String (~1m long)
- Scissors (1 pair)
- Pennies (x10)
- Timer (x1)
- Linear measuring device (x1)



**Trashbag**



**paper clips**



**strings**



**timer**



**ruler**



**Napkins**



**scissors**



**pennies**

1. (2.00 pts) Statement of the Problem

**Expected Answer:** 1pt defines the specific relationship 1pt clearly testable with the materials provided

2. (6.00 pts) Hypothesis

**Expected Answer:** 2pt includes the independent and dependent variables 2pt clear trend/ stand 2pt A brief rationale

3. (6.00 pts) Variables

a. Independent Variable (IV)

**Expected Answer:** 2 pt IV defined 4pt IV level defined (1 pt off if no OD, 1pt off if less than 3 levels.)

4. (4.00 pts) b. Dependent Variable (DV)

**Expected Answer:** 3pt DV clearly defined and inline with Hypothesis 1pt OD

5. (4.00 pts) c. Controlled Variables (CV)

**Expected Answer:** 2pt first CV correct 2pt second CV correct

6. (2.00 pts) d. Constant

**Expected Answer:**

7. (4.00 pts) Materials

**Expected Answer:** 2pt all materials listed 2pt no extra materials

8. (10.00 pts) Procedure

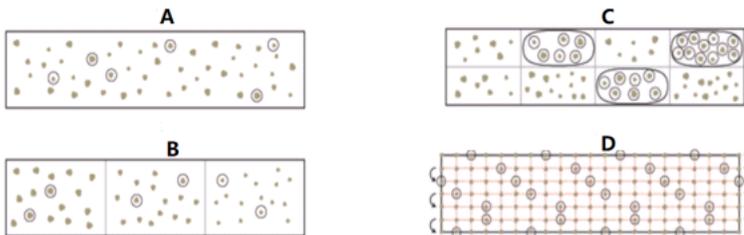
Expected Answer: 2pt procedure in list form 2pt logical sequence 2pt repeated trial 4pt enough info for others to repeat 2pt multiple diagrams 2pt labeled

9. (4.00 pts) Setup Diagrams (select True if you will submit a diagram)

True  False

### Part II: Data Analysis

Answer questions 10-13 using the following diagrams, which represents sampling methods used in some research.



10. (2.00 pts) Which diagram best represents Cluster Sampling?

- A) A
- B) B
- C) C
- D) D

11. (2.00 pts) Which diagram best represents Simple Random Sampling?

- A) A
- B) B
- C) C
- D) D

12. (2.00 pts) Which diagram best represents Stratified Random Sampling?

- A) A
- B) B
- C) C
- D) D

13. (2.00 pts) Which diagram best represents Systematic Sampling?

- A) A
- B) B
- C) C
- D) D

14. (2.00 pts)

Use the following information to answer questions 14-17.

A school principal randomly selected 3 classrooms in the entire school, and surveyed each students in those classrooms on their regular sleep hours. He received 63 responses from all the students, and then he plotted their average scores against the nightly sleep time.

In his study, what type of sample did the principal use?

- A) Random Sample
- B) Systematic Sample
- C) Clustered Sample
- D) Stratified Sample

15. (2.00 pts) Which of the following would be the most useful visual representation of the data?

- A) Bar chart
- B) Dot plot
- C) Pie chart
- D) Scatter plot

16. (2.00 pts) If he found the average grade is NEGATIVELY correlated to the nightly sleep hours, that means:

- A) The more the students sleep per night, the better their scores.
- B) The more the students sleep per night, the worse their scores.
- C) The scores are about the same for all the students.

17. (2.00 pts) Can he conclude there is causation?

- True
- False

18. (2.00 pts) Fill in the blanks: \_\_\_\_\_ does not mean \_\_\_\_\_.

- A) causation, correlation
- B) increase, causation
- C) relationship, causation
- D) correlation, causation

19. (2.00 pts) Causation is the most likely relationship between which of the following situations?

- A) Happiness and income earned
- B) Hours worked and income earned
- C) Temperature and weight loss
- D) Coffee and depression

20. (2.00 pts)

Alex is measuring an object with an accepted mass of 200.00 grams and masses it on his own balance. He records the mass of the object as 196.5 g. What is the percent error of his measurement?

- A) 1.75%
- B) 1.78%
- C) 3.5%
- D) 98.25%

21. (2.00 pts)

Use the following information to answer questions 21-25.

Two lab groups (A and B) are measuring the density of aluminum. They each use an aluminum cube and measure the mass using a balance, and then use a graduated cylinder with water to measure the volume.

Here is data for Lab Group A:

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7
2.65 g/cm <sup>3</sup>	2.75 g/cm <sup>3</sup>	2.80 g/cm <sup>3</sup>	2.77 g/cm <sup>3</sup>	2.60 g/cm <sup>3</sup>	2.65 g/cm <sup>3</sup>	2.68 g/cm <sup>3</sup>

The average of their data is \_\_\_\_\_ g/cm<sup>3</sup> (round to nearest hundredth).

2.70

22. (6.00 pts) The maximum of their data is \_\_\_\_\_ g/cm<sup>3</sup>, the minimum is \_\_\_\_\_ g/cm<sup>3</sup>, and the range is \_\_\_\_\_ g/cm<sup>3</sup>.

2.80

2.60

0.20

23. (4.00 pts) Lab Group B also conducted 7 trials and reported their data as  $2.75 \pm 0.07$  g/cm<sup>3</sup>

This means that the mean of their measurements is \_\_\_\_\_ g/cm<sup>3</sup> and the range is \_\_\_\_\_ g/cm<sup>3</sup>.

2.75

0.14

24. (2.00 pts) Given that the density of aluminum is known to be around 2.7 g/cm<sup>3</sup>, which of the following statements is true?

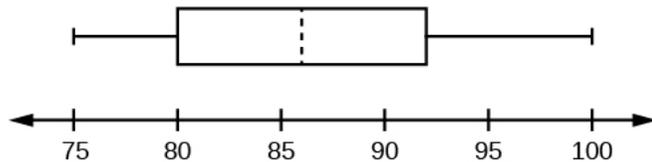
- A) Group A is more accurate and precise
- B) Group B is more accurate and precise
- C) Group A is more accurate, but group B is more precise
- D) Group B is more accurate, but group A is more precise

25. (2.00 pts) If one of the groups had a systematic error, which of the following could have been the cause?

(Mark ALL correct answers)

- A) There is a typo in their recorded data.
- B) The scale was not calibrated and reported overestimates mass.
- C) The scale on the graduated cylinder is not correctly printed and underestimates the volume.
- D) There is a hole that traps air inside in the sample the group used.
- E) Each group member take turns to read the scale and volume for each trial.

26. (2.00 pts) Use the following box plot to answer questions. The box plot represented the scores of a Science Olympiad test.



The median for this data is:

- A) 75
- B) 80
- C) 86
- D) 92
- E) 100

27. (2.00 pts) The first quartile for this data is:

- A) 75
- B) 80
- C) 86
- D) 92
- E) 100

28. (2.00 pts) The range for this data is:

25

29. (2.00 pts) The interquartile range for this data is:

30. (2.00 pts) The law of large numbers shows a relationship between the theoretical probability and the \_\_\_\_\_.

- A) exponential probability
- B) sample size
- C) experimental probability
- D) rational probability

31. (2.00 pts) Which type of graph would be the most useful to show changes in a quantity over time?

- A) Pictograph
- B) Line Graph
- C) Circle graph
- D) Bar Graph

32. (2.00 pts) Which of the following chart types are appropriate for quantitative data?

(Mark ALL correct answers)

- A) Bar Graph
- B) Dot Plot
- C) Histogram
- D) Pie Chart
- E) Stem Plot

33. (2.00 pts) Which of the following types of data are categorical?

(Mark ALL correct answers)

- A) Heights of students in your class
- B) Colors of the vehicles in the school parking lot
- C) Age group (under 12 years old, 12-17 years old, 18-24 years old, 25-34 years old, 35-44 years old and etc.)
- D) Number of pets in each household in a neighborhood
- E) Scores on a final exam
- F) Brand of soaps

34. (2.00 pts)

A student wonders if adding salt to fresh water will change the temperature at which the water boils. In her kitchen, she puts 1L of fresh water into 2 pans (one pan is large, the other is small), then adds 50 grams of salt to the water in the small pan. She places both pans on the stove, uses a thermometer to obtain their starting temperatures and then turns both heating elements to the same high temperature. She continues to monitor the water temperatures in both pans of water until they both boil. Identify the following parts of the experimental design process.

In her experiment, the independent variable is

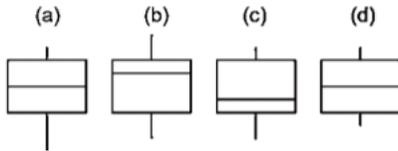
- A) volume of water
- B) Salt level
- C) water temperature when boiling

- D) small pan

35. (2.00 pts) The dependent variable is

- A) volume of water  
 B) salt level  
 C) water temperature when boiling  
 D) small pot

36. (2.00 pts) Which of the following box plots suggests a symmetric data distribution?



- A) (a)  
 B) (b)  
 C) (c)  
 D) (d)

37. (2.00 pts) Use the following information to answer questions 38-40

David tracks the gas price of a gas stations in Town A and Town B. The data, in dollars per gallon, are given below.

Town A	3.96	3.76	4.00	3.91	3.69	3.72
Town B	3.97	3.81	3.52	4.08	3.88	3.68

Which town has lower mean gas price?

- A) Town A  
 B) Town B  
 C) They are the same

38. (4.00 pts) The sample standard deviation for Town A is \_\_\_\_\_, and for Town B is \_\_\_\_\_. (round to nearest hundredth)

0.13

0.20

39. (2.00 pts) Which of the following statement is true?

- A) Town A has more consistent prices than Town B.  
 B) Town B has more consistent prices than Town A.  
 C) They are equally consistent.

40. (2.00 pts) What is the formula for finding the upper fence for outliers?

- A)  $Q1 - 1.5(IQR)$
- B)  $Q3 - 1.5(IQR)$
- C)  $Q3 + 1.5(IQR)$
- D)  $Q1 + 1.5(IQR)$

This is the end of the test. Don't forget to submit your diagram here (<https://forms.gle/QJkV4PzAgvibpWPP9>) within 15 minutes after you submit the test.

Thanks for participating!