DOCUMENT RESUME

ED 184 823 SE 030 372

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TITLE User Information for Science Process Measure-Form A.
PUB DATE [76]
NOTE 17p.: For related documents, see SE 030 370-373. Contains occasional light and broken type.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Elementary Secondary Education: Evaluation: *Interpretive Skills: *Measures (Individuals): Performance Tests: *Process Education: Science Education: Science Teachers: *Science Tests

ABSTRACT

Presented is a Science Process Measure for teachers of science. The instrument consists of 18 items, a response sheet, and an answer key. No data regarding the instrument are provided. (CS)

User Information for Science Process Measure-Form A

Before you administer the Science Process Measure, place on your desk or on a large table the following items for the teachers to use as needed:

- equal-arm balance
- 30-cm ruler
- container of water
- paper clips, metal nuts, or gram masses
- several graduated cylinders

Task 15: Place on your desk a container, labeled "Task 15." The teachers are to estimate its diameter, height, and volume. An unmarked cylindrical object such as a tin can is satisfactory. The object should be at least one decimeter high.

Task 18: Each teacher should have an object whose length or diameter can be easily measured with a 30 cm ruler. The object should be hollow so that it can be filled with water and the volume of water measured to determine the volume of the object. Paper cups, tin cans, plastic vials, and drinking glasses are satisfactory.

SCIENCE PROCESS MEASURE -- FORM A*

Please complete each of the tasks to the best of your ability in the time allowed (45 minutes). Perform the tasks for which you feel most competent first; then return to those tasks you skipped.

Place all answers on the response sheet. When you have completed the tasks or when the time is up, return this booklet with your response sheet.

Please do not write in this booklet. Be sure your code or name is written on the cover of the response sheet.

The instructor will give you a set of objects for Tasks 15 & 18. Other materials will be found at the front desk.

1. On the response sheet are several statements. Indicate with an "X" in the appropriate box which statements are inferences and which are hypotheses.

2. Here is a table of data collected during an experiment to see how much moisture evaporated during successive hourly intervals.

Hour	Volume in Milliliters Evaporated During Each Hour
1	17
2	13
3	15
4	12
5	16
6	15

Construct a point graph of these data on your response sheet. Label the axes carefully.

3. Task 2 presented data collected during an experiment which required measuring the evaporation of water. Name the manipulated vaiable and the responding variable for this experiment.

4. On the response sheet, check the patterns that are symmetrical with respect to a line. If none is symmetrical with respect to a line, check "No pattern is symmetrical." Suppose you could cut out the figures. Describe how you would distinguish which patterns are symmetrical and which are not symmetrical.

5. Below is a table of data about eight children in a class. Construct a multistage classification that could be used to identify each of the eight children.

Name	Sex		Eyes		Mass	
	Boy	Girl	Blue	Brown	>30 kg	<30kg
Adam	✓		✓			✓
Betty		✓	✓			✓
Carl	✓			✓	✓	
Doris		✓		✓	✓	
Evan	✓		✓		✓	
Floyd	✓			✓		✓
Grace		✓		✓		✓
Helen		✓	✓		✓	

6. A class of children was shown five identical dishes labeled A, B, C, D, and E, in each of which a piece of steel wool had been placed. The table shows what was put in some of the dishes, and the results they observed.

Container	Contents	Observation
A	dry steel wool	no rust
B	steel wool moistened with water	some rust
C	steel wool covered by water	no rust
D	steel wool moistened with vinegar	much rust
E	steel wool covered with vinegar	no rust

Two inferences were made by the class:

A. Liquids cause steel wool to rust.

B. Air causes stell wool to rust.

List two observations that support each inference.

7. State a rule for determining the time rate of change of a property or position of an object.

8. A marble is 6 cm around (circumference). It takes 2.5 seconds for the marble to roll in a straight path from the starting line to the center of a circle, a distance of 150cm. What is the average speed of the marble in:

   A. Centimeters per second?

   B. Number of revolutions per second?

9. On the response sheet is a graph. Place an "X" over a point that represents an observation. Draw an arrow to identify any point on the curve that represents a prediction.

10. On the basis of the information in the graph shown for Task 9, write your predicitons of the length of the rubber band when the objects of the following masses are suspended from it:

    A. 175 grams

    B. 300 grams

11. An object was dropped from a height of 20 meters and it took 2 seconds for the object to strike the ground. From a height of 80 meters, it took 4 seconds for the object to fall. Based upon this information, three children predicted how long it would take the object to fall from a height of 50 meters:

    Louise predicted 3 seconds

    Barbara predicted 3.5 seconds

    Jill predicted less than 3 seconds, but more than 2 seconds.

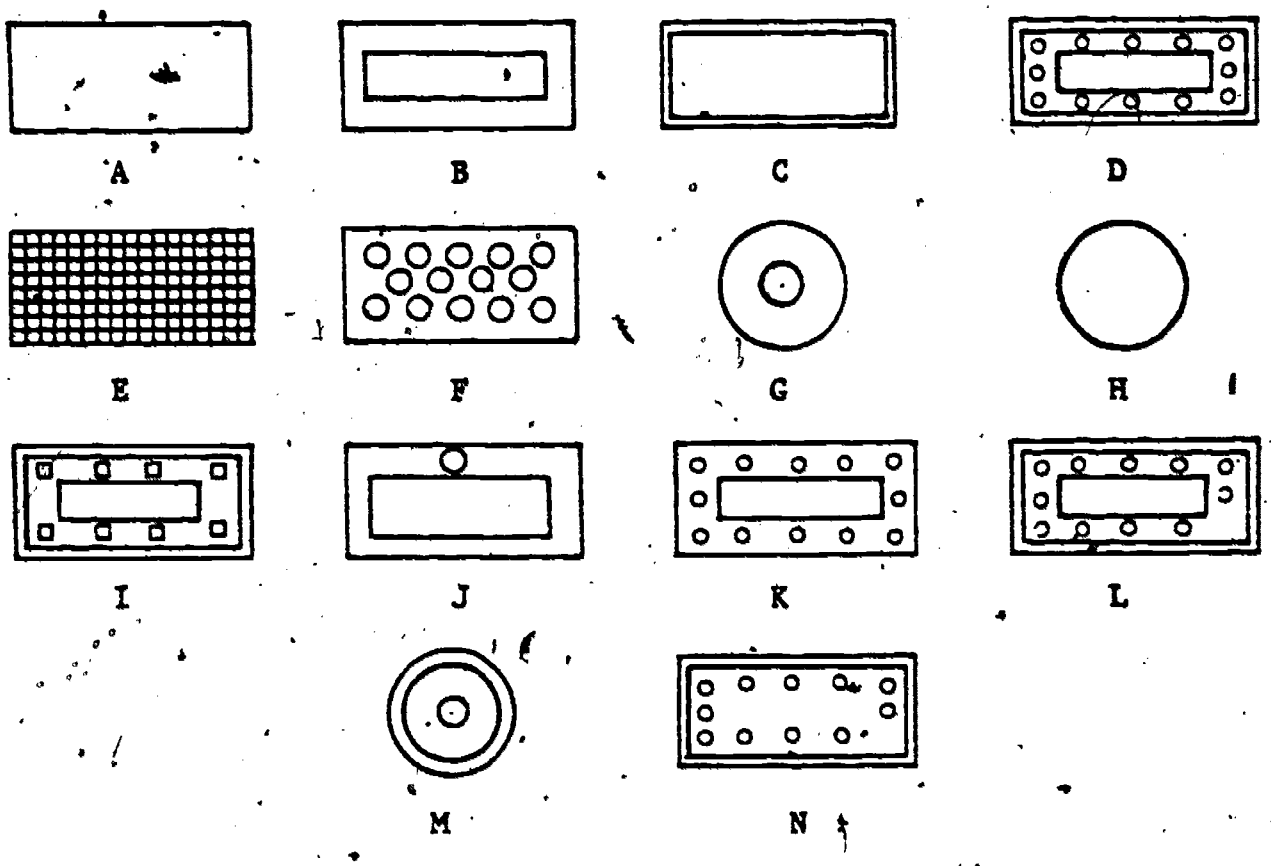
    Order these three predictions from most to least reliable and describe the basis for your decision.

12. The following table gives some data about the time it takes for various mixtures to freeze after being placed in a freezer.

Mixture placed in freezer	Time to freeze
(100 ml water	40 minutes)
A 100 ml water and 20 grams of salt	70 minutes
B 100 ml water and 20 grams of sugar	70 minutes
C 100 ml water and 30 grams of alcohol	100 minutes
D. 100 ml water and 30 grams of sand	40 minutes

Indicate whether the data in each row of the table support or do not support the following statement: Liquids freeze more slowly when they contain dissolved materials.

13. Examine carefully the pictures of the items shown in the following figure. Write a description of item D so that another person could pick it out from the other items.



14. A child was describing an object he had played with. Indicate whether each of the child's statements is an observation or an inference.

The child's statements were:

A. It was warmer than my fingers.

B. It loves me.

C. It moves by itself.

D. It is related to a wolf.

E. It was very hungry.

F. It is reddish brown.

15. At the front desk is an object labeled "Task 15". Without using any measuring instruments, you are to record the following estimations for this object on the response sheet:

A. Diameter of the object in centimeters.

B. Height of the object in decimeters.

C. Volume of water that the object could hold when filled full, in milliliters (cubic centimeters).

16. You have observed that bread left in the open dries out and rarely develops mold, but that bread that you cover or seal in plastic does develop mold if you leave it for several days. From your observations you infer that the amount of mold that develops on bread depends on the amount of moisture the bread retains.

    Describe how you would test your inference.

    List the variables in your test.

17. Some students measured the time it took for solid cylinders to roll down an inclined plane. They used aluminum cylinders that had the same lengths but different diameters. They tried cylinders that had diameters of 6 mm, 8 mm, and 10 mm and 12 mm and found that each took the same amount of time (3 seconds) to roll the same distance down the plane. From their observations the children made this hypothesis: "The amount of time it takes for a cylinder to roll down an inclined plane does not depend on its diameter."

    The children decided to test their hypothesis with other cylinders. The diameter of the cylinders and the time it took for each to roll the same distance down the plane are shown in the Table below.

Diameter of Cylinder	Time to Roll Down Plane
16 mm	3 sec
14 mm	3 sec
4 mm	3.4 sec
2 mm	5 sec

    On the response sheet state a revision of the hypothesis based on the new observations.

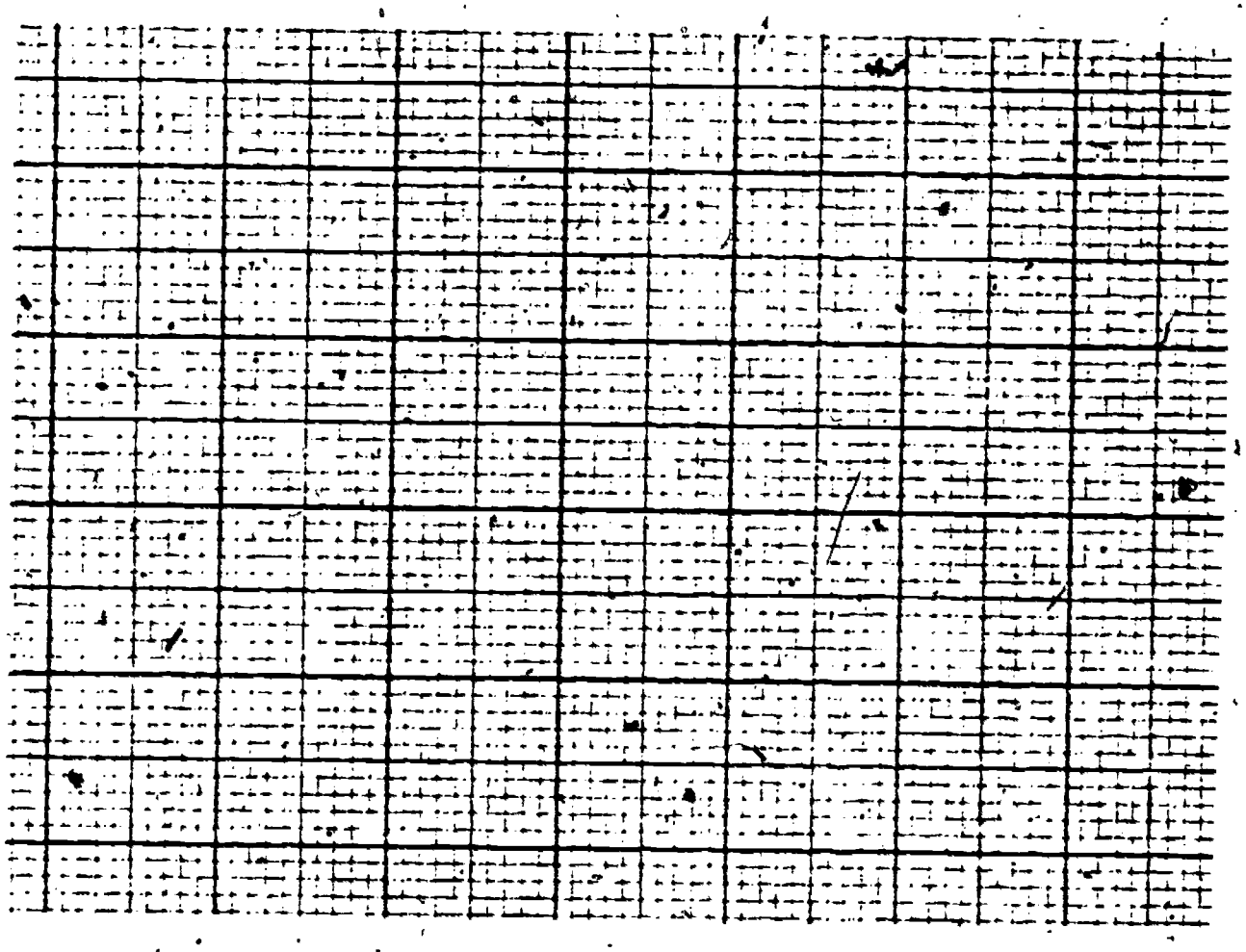
18. The instructor will name an object for use in this task. You are to measure the length or diameter and the volume of the object. You may use any of the materials at the front desk to help you make these measurements. Record the measurements on the response sheet.

FORM A RESPONSE SHEETS

1.

Inference	Hypothesis	
☐	☐	All plants and animals lose some mass during the first few days of life.
☐	☐	A pendulum that is longer than a meter swings more slowly than a pendulum that is shorter than a meter.
☐	☐	The white material is sugar.
☐	☐	A piece of chalk breaks easily because it is a poor conductor of heat.

2.

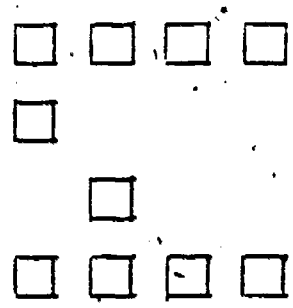


3. The manipulated variable is _____.

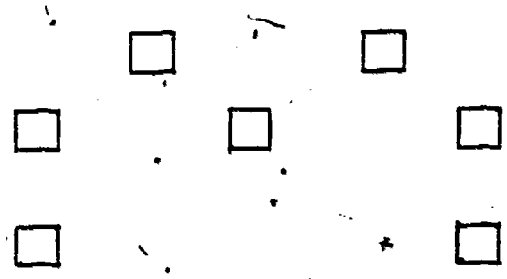
The responding variable is _____.

4.

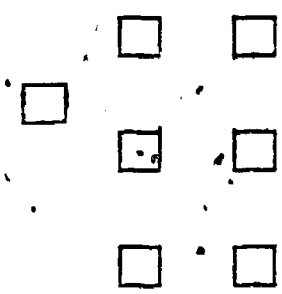
_____Pattern 1



_____Pattern 2



_____Pattern 3



_____No pattern is symmetrical.

If the figures were cut out, I would_____

_____

_____

_____

_____

5.

6. Observations that support Inference A: _____

_____

_____

_____

Observations that support Inference B: _____

_____

_____

_____

7. The rule for determining the time rate of change of a property or position of an object is: _____

_____

_____

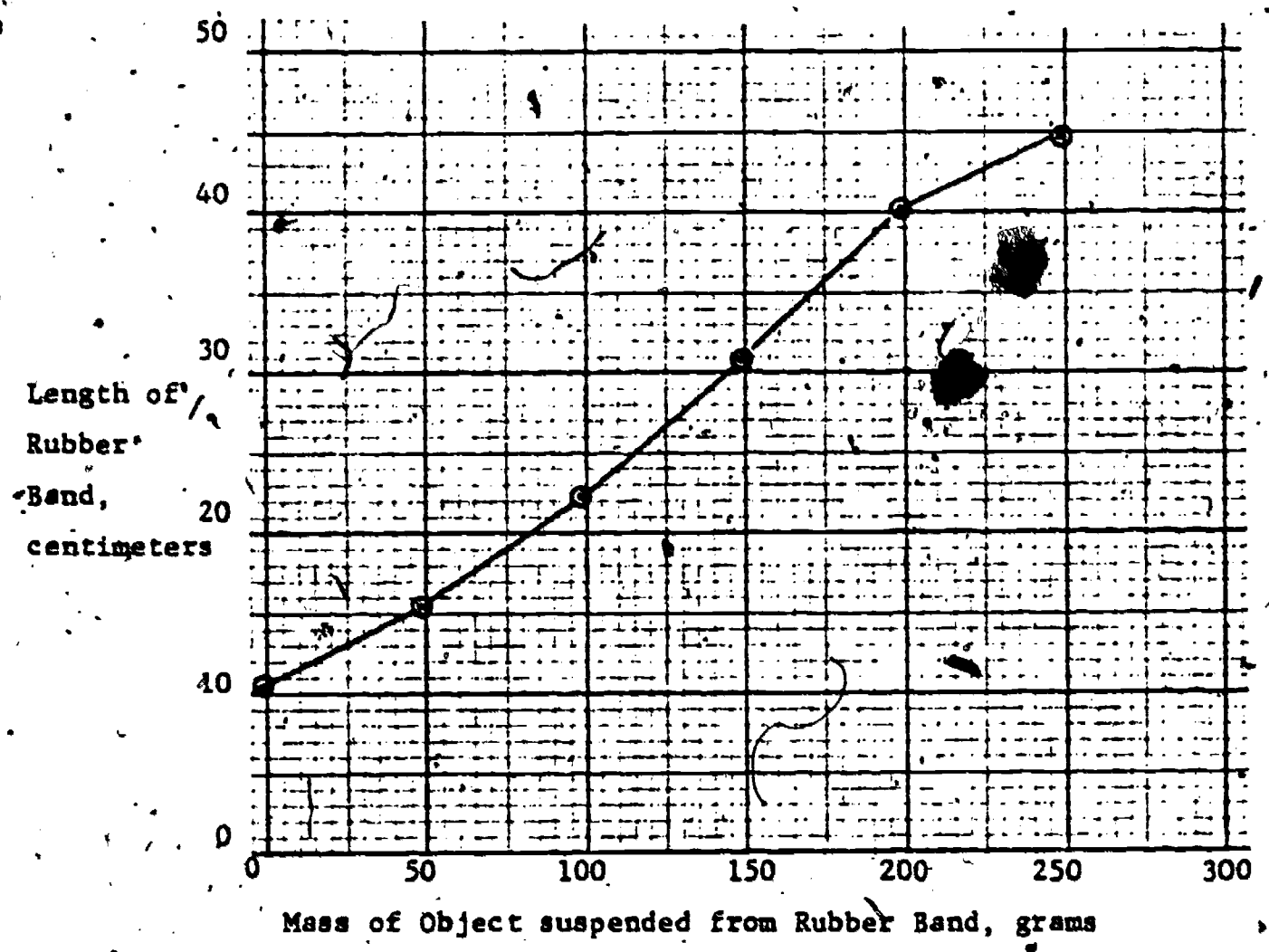
_____

_____

8. A. _____

B. _____

9.



10. A. _____

B. _____

11. _____ _____ _____

Most reliable Least reliable

Basis for the above ordered sequence: _____

_____

_____

12.

Support the Statement	Do Not Support the Statement	
☐	☐	Data for Mixture A
☐	☐	Data for Mixture B
☐	☐	Data for Mixture C
☐	☐	Data for Mixture D

13. Description of Item D: _____

_____

_____

_____

_____

_____

_____

14. A. Observation Inference Neither

B. Observation Inference Neither

C. Observation Inference Neither

D. Observation Inference Neither

E. Observation Inference Neither

F. Observation Inference Neither

15. Diameter in centimeters _____

or

Height in decimeters _____

Volume of water in milliliters (cubic centimeters) _____

16. Test of the inference: _____

_____

_____

_____

_____

_____

_____

_____

Manipulated variable is _____

_____

Responding variable is _____

_____

Variables held constant are _____

_____

17. Revised hypothesis: _____

_____

_____

_____

_____

18. The measurements are:

Length _____

Volume _____

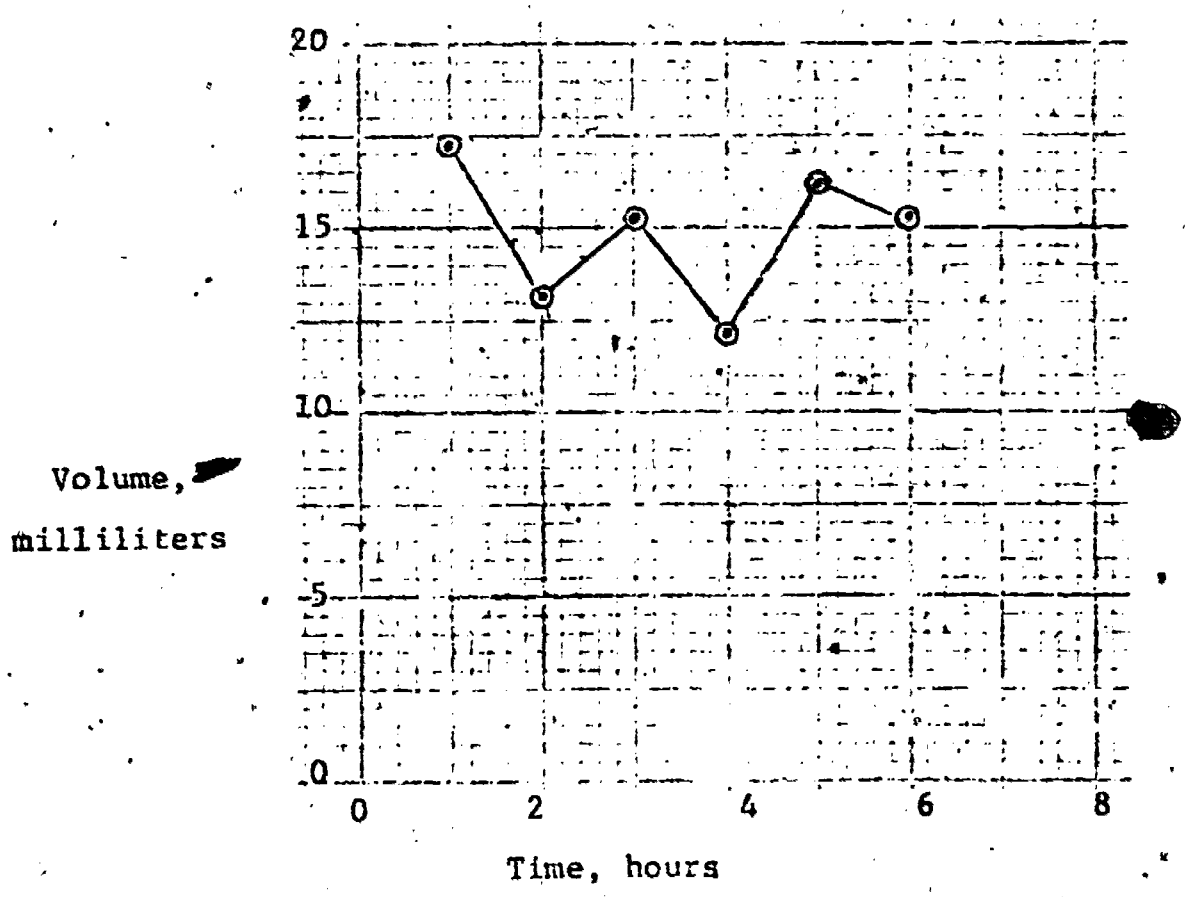
SCIENCE PROCESS MEASURE -- FORM A
KEY TO RESPONSE SHEET

1. All should be correctly identified.

Inference	Hypothesis	
☐	☒	All plants and animals lose some mass during the first few weeks.
☐	☒	A pendulum that is longer than a meter swings more slowly than a pendulum, shorter than a meter.
☒	☐	The white material is sugar.
☒	☐	This piece of chalk breaks easily because it is a poor conductor of heat.

2. All of these criteria must be met for an acceptable response:

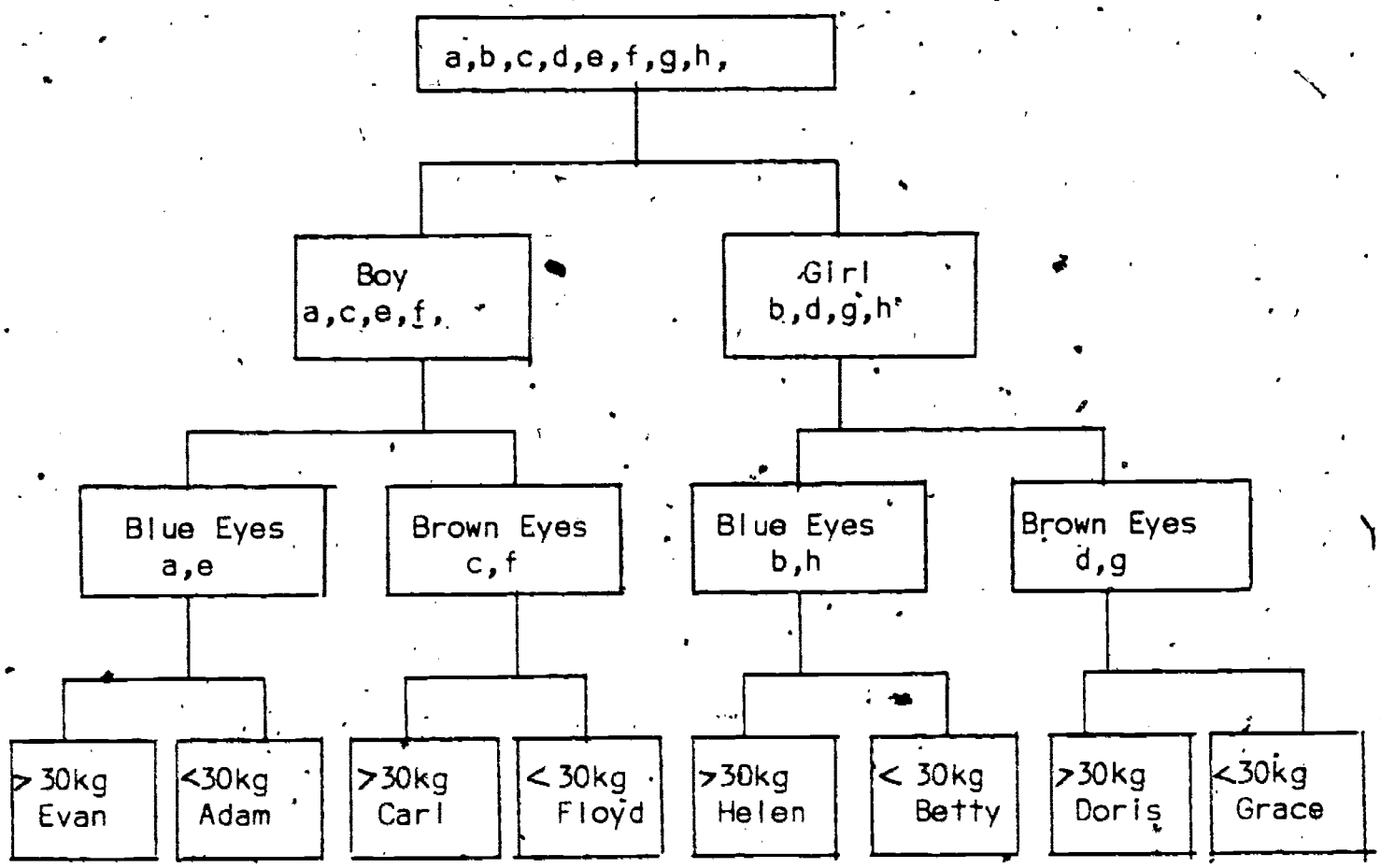
   1. Labeling of both axes.
   2. (0, 0) at the intersection of the axes.
   3. Equal intervals for each unit along an axis.
   4. Approximately correct location of five of the six points.
   5. Time plotted on the horizontal axis; volume plotted on the vertical axis.



3. The manipulated variable is Time, the responding variable is Volume evaporated per hour.

4. For an acceptable response, the description should include a statement about folding the cut out figures to see whether they have matching halves. Pattern 2 is the only one that is symmetrical with respect to a line.

5. For an acceptable response, the description should permit the identification of all eight children. For example,



6. Two observations that support Inference A:

Steel wool moistened with water rusts. B
Steel wool moistened with vinegar rusts. D

Two observations that support Inference B:

Steel wool covered with water does not rust. C
Steel wool covered with vinegar does not rust. E

7. The time rate of change of a property or position of an object is given by the amount of change divided by the time it took for the change to occur.

8. A. 60 cm/second
   B. 10 revolutions/second

   Both speeds must be correct for an acceptable response. Both numerals and units must be specified.

9. Both of the following are required for an acceptable response:

   1. An "X" over one of the circles.

   2. An arrow pointing at any point between the circles.

10. Both of the following are required for an acceptable response:

    A. Approximately 35 centimeters.

    B. Any number between 40 and 60 centimeters.

11. An acceptable response consists of a statement of the reasons for the sequence that is consistent with the sequence shown.

12.

Support the Statement	Do Not Support the Statement	
☒	☐	Data for Mixture A
☒	☐	Data for Mixture B
☒	☐	Data for Mixture C
☒	☐	Data for Mixture D

13. The description should permit correct identification of Item D for an acceptable response.

14. A. Observation

    B. Inference

    C. Observation

    D. Inference

    E. Inference

    F. Observation

    All must be correctly identified.

15. All three estimations should be within the range of actual measurement ± 25%. For example, if the actual volume is 600 milliliters, any estimation from 450 to 750 milliliters should be acceptable.

16. An acceptable response consists of correctly naming the manipulated and responding variables and at least two variables held constant, for example:

    Manipulated variable is - wetness of bread.

    Responding variable is - moldiness of bread.

    Variables held constant might be: kind of bread
    temperature
    brightness of light
    size of piece of bread

17. Any hypothesis about the rate of rolling is acceptable if it refers to the relationship of rolling time to diameter and is based on the new observations.

18. Two-measurements should be named. Both the numeral and unit should be specified for each measurement for an acceptable response.