

Unknown Liquids

Task Information

Grade: 8th Grade

Content:

Density

- Block D (The Earth's Changing Surface). Section I.C.1.a.7. page 7

Format:

Manipulative

Purpose:

The student will use available information to design a procedure for determining and comparing the masses and densities of two (2) unknown substances.

Skills:

Primary: Interpreting data

Secondary: Applying math

Time: 10 -15 minutes

Materials:

Teacher:

- yellow and blue food coloring
- water
- rubbing alcohol
- salt
- sealant - hot glue or paraffin

Per Student or Station:

- 2 screw top bottles (28 ml) with solutions X and Z
- triple beam or double pan balance
- eye goggles
- calculator

Preparation:

- The yellow solution (Z) is a saturated salt solution with yellow food coloring.
 - start with one liter (1000 ml) of warm water. Add as much salt that will dissolve with constant stirring. Let cool. Filter out any undissolved salt. Add a few drops of yellow food coloring.
- The blue solution (X) is isopropyl rubbing alcohol and blue food coloring.
- Bottle - screw cap vials - flint glass, 28 ml
- Seal the caps on the bottles with glue or liquid paraffin to avoid evaporation and to facilitate reuse.
- Determine the mass of the bottles before student use.
- Pretest the mass difference between X and Z to determine if adequate for proper grading.

Safety:

- **Safety goggles must be worn.**
- Check MSDS (Materials Safety Data Sheet) for further precautions.
- Proper lab safety precautions are required
- Students should be instructed not to open the vials.
- Caution with breakage of glass bottles.

Extensions/Modifications: None

Unknown Liquids

Task: At this station, you will be determining which of two solutions is liquid X and which is liquid Z.

Materials

- bottle containing a blue liquid
- bottle containing a yellow liquid
- triple beam or double pan balance
- calculator
- eye goggles

Directions

The labels on the two bottles have fallen off. The labels had read "Liquid X" and "Liquid Z." Your job is to determine which bottle contains liquid X and which contains liquid Z. The real challenge is that you must do this **without opening the bottles**. All of the information you need to reach your conclusion is listed in the box below:

- The bottles and lids are identical in mass, volume, and shape when empty.
- Both bottles contain the same volume of solution.
- The density of liquid Z is greater than the density of liquid X.

1. In the space below, list the steps you will follow to determine which bottle contains liquid X and which contains liquid Z.

2. Put on eye goggles. Be careful not to drop either bottle.
CARRY OUT YOUR PLAN.

Please Continue on the Next Page

3. Record the results of your experiment in the space below.
* Show all work. *

4. Using the data collected in your experiment, which liquid is liquid X and which is liquid Z?

Blue Liquid _____ Yellow Liquid _____

5. Based on the results of your experiment, write a statement explaining the relationship between mass, volume, and density. Writing the formula is not sufficient.

Unknown Liquids - Scoring Rubric

Maximum score - 8 points

Question 1. Procedure for Identifying Liquids 3 points total

Point Criteria:

- Allow 3 points for a valid, logical procedure that includes the finding and comparing the masses of the two liquids. (The mass, volume, and density of the bottle is irrelevant to the student's responses for this activity.)
- Acceptable responses include:
 - **Mass Method**
 - Find the mass of the yellow liquid (1 point)
 - Find the mass of the blue liquid (1 point)
 - Compare to find which would have the greater density (1 point)
 - or
 - Mass the yellow and the blue (2 points)
 - The heavier will be more dense (1 point)
 - **Density Method**
 - Find the mass of both liquids (1 point)
 - Assign a volume to both liquids (1 point)
 - Compare densities (1 point)

Question 3. Results of Experiment 2 points total

Point Criteria:

- Allow 1 point for correct blue liquid data based upon the student's plan.
- Allow 1 point for correct yellow liquid data based upon the student's plan.
 - **Mass Method**
 - Qualitative mass comparison using a double pan balance is acceptable.
 - Quantitative mass must be within +/- 1.0 grams
 - **Density Method**
 - Density must be within +/- 0.5 g/mL

Question 4. Identification of Liquids 1 point total

Point Criteria:

- Allow 1 point for correctly identifying both liquids
 - Blue liquid = X
 - Yellow liquid = Z
- (Accept any student response based on his/her data)

Question 5. Density/Mass Relationship 2 points total

Point Criteria:

- Allow 2 points for a generalized statement about the density/mass relationship.
 - If two substances (solutions) have equal volumes, the one with the greater mass will have the greater density.
 - The mass of the yellow was greater than the blue. Since the volumes were the same, the yellow is more dense.
- Allow 1 point if the student does **not** address a constant volume.
 - The liquid with the greater mass has a greater density.

Highest possible score - 8 points

Student ID _____ Scoring Form - Unknown Liquids

Male or Female (circle one)

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

Question	Circle Point Breakdown	Points Earned
1. Procedure/Plan	0 1 2 3	_____
3. Results of Experiment		
Measurement Yellow	0 1	_____
Measurement Blue	0 1	_____
4. Identifying Liquids	0 1	_____
5. Density/Mass Relationship	0 1 2	_____

Total Score _____

Total possible Score - 8 points

Student ID _____ Scoring Form - Unknown Liquids

Male or Female (circle one)

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

Question	Circle Point Breakdown	Points Earned
1. Procedure/Plan	0 1 2 3	_____
3. Results of Experiment		
Measurement Yellow	0 1	_____
Measurement Blue	0 1	_____
4. Identifying Liquids	0 1	_____
5. Density/Mass Relationship	0 1 2	_____

Total Score _____

Total possible Score - 8 points

Student ID HM 81 -19 Scoring Form - Unknown Liquids

Male or Female (circle one)

#1

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

Question	Circle Point Breakdown	Points Earned
1. Procedure/Plan	0 (1) 2 3	<u>1</u>
3. Results of Experiment		
Measurement Yellow	0 (1)	<u>2</u>
Measurement Blue	0 (1)	
4. Identifying Liquids	0 (1)	<u>1</u>
5. Density/Mass Relationship	(0) 1 2	<u>0</u>

Total Score 4
Total possible Score - 8 points

Unknown Liquids

Task: At this station, you will be determining which of two solutions is liquid X and which is liquid Z.

MATERIALS:

bottle containing a blue liquid
bottle containing a yellow liquid
triple beam or double pan balance
calculator

DIRECTIONS:

The labels on the two bottles have fallen off. The labels read "Liquid X" and "Liquid Z." Your job is to determine which bottle contains liquid X and which contains liquid Z. The real challenge is that you must do this **without opening the bottles**. All of the information you need to reach your conclusion is listed below:

- The bottles and lids are identical in mass, volume, and shape.
- Both bottles contain the same amount of solution.
- The density of liquid Z is greater than the density of liquid X.

1. In the space below, list the steps you will follow to determine which bottle contains liquid X and which contains liquid Z.

will find the mass of both bottles
containing the liquid then since the
volume is the same the one
with the less mass will have
the most density

2. CARRY OUT YOUR PLAN.

3. Record the results of your experiment in the space below.

* Show all work. *

$$\rho = \frac{60.5 \text{ g}}{V} = D$$

$$Y = \frac{50.18 \text{ g}}{V} = D$$

$$\frac{M}{Dx}$$

both compressed

4. Using the data collected in your experiment, which liquid is liquid X and which is liquid Z?

Blue Liquid

X

Yellow Liquid

Z

5. Based on the results of your experiment, explain the relationship between mass and density.

something with the same volume
has a larger density if the mass
is less.

Student ID HM-81-17 Scoring Form - Unknown Liquids
Male or Female (circle one)

#2

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

Question	Circle Point Breakdown	Points Earned
1. Procedure/Plan	0 1 2 (3)	<u>3</u>
3. Results of Experiment Measurement Yellow	0 (1)	<u>2</u>
Measurement Blue	0 (1)	
4. Identifying Liquids	0 (1)	<u>1</u>
5. Density/Mass Relationship	0 1 (2)	<u>0</u>

Total Score 6
Total possible Score - 8 points

Unknown Liquids

Task: At this station, you will be determining which of two solutions is liquid X and which is liquid Z.

MATERIALS:

bottle containing a blue liquid
bottle containing a yellow liquid
triple beam or double pan balance
calculator

DIRECTIONS:

The labels on the two bottles have fallen off. The labels read "Liquid X" and "Liquid Z." Your job is to determine which bottle contains liquid X and which contains liquid Z. The real challenge is that you must do this **without opening the bottles**. All of the information you need to reach your conclusion is listed below:

- The bottles and lids are identical in mass, volume, and shape.
- Both bottles contain the same amount of solution.
- The density of liquid Z is greater than the density of liquid X.

1. In the space below, list the steps you will follow to determine which bottle contains liquid X and which contains liquid Z.

1. Find mass of yellow liquid
2. Find mass of blue/green liquid
3. Conclude which has the higher density
4. Conclude which is liquid Z and
which is liquid X.

2. CARRY OUT YOUR PLAN.

3. Record the results of your experiment in the space below. * Show all work. *

yellow liq = 51.6 g
(inc bottle etc)

blue liq = 60.8 g
(inc bottle etc)

Since volume is always the same,

∴ the blue liquid is more dense

$$\begin{array}{ccc} \text{yellow} & & \text{blue} \\ \downarrow & & \downarrow \\ \frac{51.6}{x} & < & \frac{60.8}{x} \end{array}$$

↓
this statement is
always true when
 $x \neq 0$ or x is not
negative

4. Using the data collected in your experiment, which liquid is liquid X and which is liquid Z?

Blue Liquid Liquid Z Yellow Liquid Liquid X

5. Based on the results of your experiment, explain the relationship between mass and density.

It will always happen that when
volume increases, mass increases, but
no matter what volume you have, if it
is pure (the make-up is the same throughout
the object) the density will always remain
the same

Student ID HM81-1 Scoring Form - Unknown Liquids
Male or Female (circle one)

#3

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

Question	Circle Point Breakdown	Points Earned
1. Procedure/Plan	0 1 2 <u>3</u>	<u>3</u>
3. Results of Experiment		
Measurement Yellow	0 <u>1</u>	<u>2</u>
Measurement Blue	0 <u>1</u>	
4. Identifying Liquids	0 <u>1</u>	<u>1</u>
5. Density/Mass Relationship	0 1 <u>2</u>	<u>2</u>

Total Score 8
Total possible Score - 8 points

Unknown Liquids

Task: At this station, you will be determining which of two solutions is liquid X and which is liquid Z.

MATERIALS:

bottle containing a blue liquid
bottle containing a yellow liquid
triple beam or double pan balance
calculator

DIRECTIONS:

The labels on the two bottles have fallen off. The labels read "Liquid X" and "Liquid Z." Your job is to determine which bottle contains liquid X and which contains liquid Z. The real challenge is that you must do this **without opening the bottles**. All of the information you need to reach your conclusion is listed below:

- The bottles and lids are identical in mass, volume, and shape.
- Both bottles contain the same amount of solution.
- The density of liquid Z is greater than the density of liquid X.

1. In the space below, list the steps you will follow to determine which bottle contains liquid X and which contains liquid Z.

Since both containers are of equal volume & mass,
and the volume of liquid is the same in each
bottle, whichever bottle has the most mass will
have greater density, thus being Liquid Z.
I will measure the mass of each bottle using
a triple beam balance.

2. CARRY OUT YOUR PLAN.

3. Record the results of your experiment in the space below. * Show all work. *

Blue's mass = 58.4 g

Yellow's mass = 44.1 g

$$58.4 \text{ g} > 44.1 \text{ g}$$

∴ Blue's mass > yellow's mass

Since ~~density~~ density (Z) > density (X) and

Volume (Z) = Volume (X) — in our experiment

then mass (Z) > mass (X)

∴ Blue = liquid Z and Yellow liquid = X

4. Using the data collected in your experiment, which liquid is liquid X and which is liquid Z?

Blue Liquid

 Z

Yellow Liquid

 X

5. Based on the results of your experiment, explain the relationship between mass and density.

~~If the volume of two substances is the same then:~~

A) If the volume of two substances is the same then:

- 1 If the mass of the first is higher then the density of the first is higher
- 2 If the mass of the second is higher then the density of the second is higher
- 3 If the mass of the two are equal then their densities are equal

B) If the volume of the first substance is ~~less~~ greater then:

- 1 If the mass of the first substance is greater, then you cannot tell which has greater density
- 2 If the
- 3

C)
1
2
3