

Chapter 1: Matter, Mass, and Moles

Answers to Summary Questions 2

Sample Experiment

Experiment 1: Low Sodium 3

Text reading time 2 hours

Experiment time 2-3 hours

Materials :

any four white household powders such as:

sugar

salt

baking powder

flour

white corn meal

corn starch

Answers to Summary Questions:

1. protons, neutrons, and electrons. Protons have a positive (+) charge and electrons have a negative (-) charge.
2. 150
3. 74 amu
4. a. chlorine Cl
b. carbon C
c. lithium Li
d. nitrogen N
e. mercury Hg
5. atomic number 9, fluorine; atomic number 17, chlorine; atomic number 35, bromine
6. atomic number 10, neon; atomic number 36, krypton; atomic number 2, helium; atomic number 18, argon.
7. atomic number 3, lithium; atomic number 11, sodium; atomic number 19, potassium; atomic number 37 rubidium.
8. one mole
9. one mole weighs 10.81 grams, so 3 moles would be: $3 \times 10.81 = 32.43$ grams.
10. To find how much one mole of ammonia weighs, first look on the periodic chart and find the atomic weight for each atom in the ammonia molecule.

one mole of nitrogen weighs 14.01 grams

one mole of hydrogen weighs 1.00 grams

Next, write down how many of each atom ammonia has.

ammonia has one (1) nitrogen atom and three (3) hydrogen atoms:

Now, plug these numbers into an equations where the number of each atom is multiplied by their atomic weight.

One (1) nitrogen atom times 14.01 grams, plus (+) three (3) hydrogen atoms times 1.001 equals (=) 17.01 grams.

$[(1 \text{ N}) \times (14.01\text{grams})] + [(3 \text{ H}) \times (1.00\text{grams})] = 14.01\text{grams} + 3\text{grams} = 17.01\text{grams}$

one mole of ammonia weighs 17.01 grams.

Instructions for Experiment 1

In this chapter your student learned about matter, mass, and moles. The experiment outlined below will help your student further explore these concepts.

The students will need to learn dimensional analysis to perform this experiment. A full discussion of dimensional analysis is given in Appendix D. Have the students read Appendix D before doing the experiment.

The students are given a hypothetical request by their family doctor to limit their sodium intake. The limit is expressed in moles. They will discover that all of the food products list the sodium amount in milligrams (mg). Help the students think through how to solve this dilemma.

A “hint” is provided to help the students get started.

If your student gets stuck or frustrated, help them think through the experiment by asking questions. Here are some suggested questions to ask.

1. What can you call your experiment? What are you trying to find out with this experiment?
2. What is an “objective?” Specifically what is your objective with this experiment? What did the doctor request?
3. What is a “hypothesis?” What foods do you think you may or may not be able to eat?
4. How would you write the steps for the experiment? What do you think you should do first?
5. How could you organize the information from the food labels? Can you put the information in a table or a graph? Which information do you think you should look for? What is the “daily recommended allowance?” What is the serving size for each item?
6. How many food items do you think you should check?
7. What if all of the food items have too much sodium? Should you look for other food items? Do you think you could eat less of each?
8. What is a “conclusion?” Did you prove or disprove your hypothesis? How can you tell?

EXPERIMENT 1: LOW SODIUM

You go to the family doctor and he decided to put you on a special diet. He tells you that you have been eating too much sodium. He tells you not to eat more than 0.01 moles of sodium. This sounds pretty easy, until you go home and find out that all of the food items list the amount of sodium in mg (milligrams). How do you follow your doctors orders? Which foods can you eat?

HINTS:

First determine the atomic weight of sodium. It is on the periodic chart and the quantity is given as moles per gram (moles/gram). Record this quantity here 22.99 grams/mole

Remember that the atomic weight tells you how many grams of an element are in one mole. But you need to find out how many grams are in 0.01 moles. To find out how many grams of sodium are in 0.01 moles, first convert grams of sodium in one mole to milligrams of sodium (1000 milligram = 1 grams) in one mole and then multiply by 0.01 moles. This will give you milligrams of sodium in 0.01 moles.

Do your calculation here:

There are 22.99 grams of sodium in one mole.

22.99 grams (in one mole) x 1000 milligrams/grams = 22990 milligrams (in one mole)

$$(22.99 \text{ grams}) (1000 \frac{\text{milligrams}}{\text{gram}}) = 22990 \text{ milligrams}$$

22990 milligrams/mole x 0.01 moles = 229.9 milligrams

$$\frac{(22990 \text{ mg})}{\text{mole}} (0.01 \text{ moles}) = 229.9 \text{ mg (milligrams)}$$

milligrams (mg) of sodium in 0.01 moles = 229.9 mg sodium

Now set up your experiment.

Experiment 1: What can I eat? Date: _____

Objective: To determine which foods contain less than 0.01 moles of sodium

Hypothesis: I will be able to eat cereal, but not peanut butter.

I. List the Materials you need:

MATERIALS

1. Calculation from page 1 of this experiment.
2. Several food item package containers.
3. pen

II. Write out the steps of your experiment in as much detail as possible.

EXPERIMENT

1. First I will record how much sodium is in 0.01 moles.

2. Next, I will make a list of several items and record the amount of sodium in each.

3. I will then compare the amount of sodium in each food item with the limit.

4. I will determine the food items below the limit and list these as permissible foods.

5. _____

III. Record your results.

RESULTS

Food Item	Serving size	Sodium (in milligrams)
<i>Raisin Bran cereal</i>	<i>1 cup</i>	<i>350 mg</i>
<i>Nature Valley Granola Bars</i>	<i>2 bars</i>	<i>160 mg</i>
<i>Jiff Peanut Butter</i>	<i>2 Tbsp</i>	<i>150 mg</i>
<i>Chicken of the Sea tuna</i>	<i>2 oz.</i>	<i>250 mg</i>
<i>Baked Beans</i>	<i>1/2 cup</i>	<i>550 mg</i>

Foods that are below 229 mg sodium:

Granola bars - 2 bars, 160 mg sodium

Peanut butter - 2 Tbsp, 150 mg sodium

IV. Discuss your results and write your conclusions.

CONCLUSIONS

If I follow the serving size suggestions for each food item, I will only be allowed to eat the peanut butter and granola bars.

My hypothesis was incorrect, I am not able to eat the cereal at the suggested serving size.

I can reduce the serving size for the food items with high sodium and still be within the 0.01 mole limit.

I can eat less than 1/4 cup of baked beans, or 1 oz. of tuna, or 1/2 cup of bran cereal.