

Balancing equations and conserving atoms

Grade 8 science (Year 9 · Class 8) · Lab

Name: _____ Date: _____ Class: _____

Does the mass change when a reaction makes a gas? In this lab you react vinegar with baking soda in an open flask and in a sealed one, measure the mass before and after, and use atoms to explain why the readings differ.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS1-2, MS-PS1-5

Aim

To measure the mass before and after a reaction that makes a gas, in an open flask and in a sealed flask, and to explain the results using atoms.

Equipment

- 250 mL conical flask, a small test tube and a balloon
- Balance reading to 0.01 g
- Baking soda (sodium hydrogencarbonate), 3.0 g per trial
- Vinegar, 50 mL per trial, and a measuring cylinder
- Safety goggles

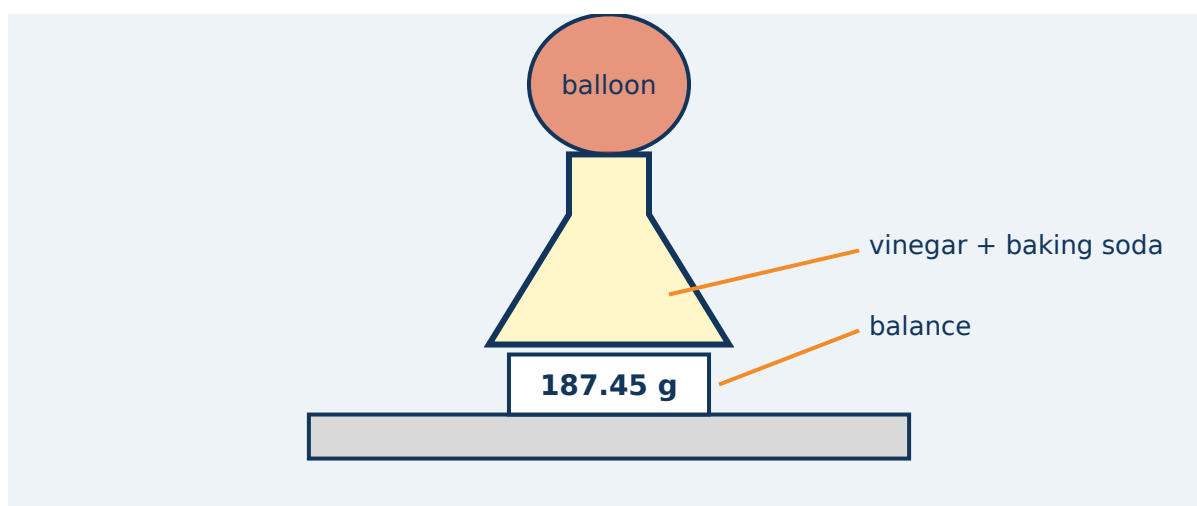
Safety

Safety

Wear safety goggles. Vinegar is a mild acid and can sting eyes and cuts, so wipe up spills. Do not seal the flask with a hard stopper because the gas could build up pressure; use a balloon, which can expand.

Method

1. Pour 50 mL of vinegar into the flask.
2. Put 3.0 g of baking soda into the test tube, and stand the test tube upright in the flask without spilling.
3. Place the flask on the balance and record the starting mass. (*Open version: leave the neck open. Sealed version: fit the balloon over the neck first.*)
4. Tip the flask so the baking soda falls into the vinegar and wait until the fizzing stops.
5. Record the final mass.
6. Repeat three times for each version and calculate the change in mass each time.



Set-up: vinegar and baking soda react in a flask on a balance; a balloon catches the gas in the sealed version.

Results

The reaction is $\text{NaHCO}_3 + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$. A class in Dar es Salaam recorded this sample data.

Version	Trial	Mass before (g)	Mass after (g)	Change (g)
Open	1	186.52	185.07	-1.45
Open	2	186.48	185.05	-1.43
Open	3	186.55	185.10	-1.45
Sealed	1	188.91	188.89	-0.02
Sealed	2	188.87	188.86	-0.01
Sealed	3	188.95	188.93	-0.02

Analysis questions

Question 1 Mean mass change

Calculate the mean change in mass for the open flask and for the sealed flask.

Question 2 Explaining the open flask

Explain why the open flask lost mass although no atoms were destroyed.

Question 3 Explaining the sealed flask

Explain why the sealed flask showed almost no change.

Question 4 Checking the equation

Show that $\text{NaHCO}_3 + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$ is balanced by counting the atoms of Na, C, H and O.

Question 5 Expected mass of gas

From the equation, 84 g of NaHCO_3 makes 44 g of CO_2 . Calculate the expected mass of CO_2 from 3.0 g.

Question 6 Percentage escaped

Use your answers to calculate the percentage of the expected CO_2 that was measured as lost from the open flask.

Question 7 Why not 100 %?

Suggest two reasons why the lost mass was less than the expected mass.

Question 8 Improving the lab

Suggest one way to make the open-flask measurement more reliable.