

SI Chemistry - Full Discipline Demo

Observations of Chemical Changes

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Categorize each change as physical or chemical.

⌘ Apple slices turning brown in the air	⌘ Baking muffin batter to make muffins
⌘ Burning paper	⌘ Chopping tomatoes
⌘ Combining dry ingredients (flour, salt, sugar, baking powder) when making muffins	
⌘ Cooking tomatoes to make tomato sauce	⌘ Peeling apples
⌘ Shredding paper	
Physical Change	Chemical Change
1	2

Correct answers:

1 Chopping tomatoes

Combining dry ingredients (flour, salt, sugar, baking powder) when making muffins

Shredding paper Peeling apples

2 Apple slices turning brown in the air

Baking muffin batter to make muffins Burning paper

Cooking tomatoes to make tomato sauce

Identify the products and the reactants in the reactions.

Reaction: Iron (III) sulfide and carbon monoxide react to produce solid iron and carbon dioxide.

	Reactant	Product
⚡ Carbon dioxide	1	2
⚡ Carbon monoxide		
⚡ Iron (III) sulfide		
⚡ Iron (s)		

Correct answers:

1 Carbon monoxide Iron (III) sulfide 2 Carbon dioxide Iron (s)

Identify the products and the reactants in the reactions.

Reaction: Water and carbon dioxide are formed when ethane (C₂H₆) is burned in the presence of oxygen.

	Reactant	Product
⚡ Carbon dioxide	1	2
⚡ Ethane		
⚡ Oxygen		
⚡ Water		

Correct answers:

1 Ethane Oxygen 2 Carbon dioxide Water

Identify whether each statement is an observation or a conclusion.

☒ Combustion occurred.	☒ No chemical reaction occurred.
☒ The color changed from blue to green.	☒ The reactants and products are clear.
☒ The solution is cloudy and there are small flakes.	

Observation	Conclusion
1	2

Correct answers:

- 1 The color changed from blue to green.
The reactants and products are clear.
The solution is cloudy and there are small flakes.

- 2 Combustion occurred. No chemical reaction occurred.

Exploration

A chemical change may also be referred to as a ____.

- ☐ physical change
- ☒ chemical reaction ✓
- ☐ chemical compound
- ☐ state of matter

Is silver tarnishing a chemical change or a physical change?

- ☒ Chemical change ✓
- ☐ Physical change

A chemical equation is the written representation of a chemical reaction, showing the relationship between the molecules of the reactants (the starting chemicals) and the products (the new chemicals produced through the reaction).

☒ True



☐ False

An observation is ____.

☒ a description of what happened



☐ an explanation of why something happened

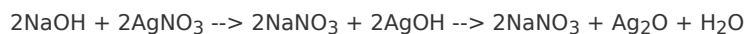
☐ a conclusion

Exercise 1

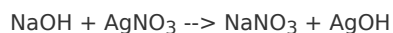
Suppose a household product label says it contains sodium hydrogen carbonate (sodium bicarbonate). Using your results from Data Table 1 as a guide, how would you test this material for the presence of sodium bicarbonate?

Using the results from Data Table 1 as a guide, to test for the presence of sodium bicarbonate, I would mix the household product with HCl (Hydrochloric Acid) and see if bubbles form. However, before I do this, I would read the other ingredients in the household product to make sure that mixing the product with HCl would not cause a harmful side reaction with the other ingredients in the household product.

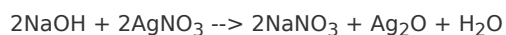
Write the chemical equation for the reaction in well A6.



or



or



One of the reactions you observed resulted in these products: $\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2(\text{g})$? What well did this reaction occur in? Describe how the observations for this reaction support your answer.

This product occurred in Well A1. The reaction in Well A1 was the only reaction to produce bubbles, indicative of $\text{CO}_2(\text{g})$ formation.

You found a sample of a solution that has a faint odor resembling vinegar (an acid). To verify that it is vinegar, you add a few drops of phenolphthalein. The sample turns pink. From this result, can you assume this sample is indeed vinegar or contains some vinegar? Explain your answer using your results from Data Table 1.

If the sample turns pink then the solution sample is a base. As demonstrated in Well A4 and Well A5, phenolphthalein is pink in basic solutions and colorless in acidic and neutral solutions. As vinegar is an acid, with a pH around 2.4, it would not cause phenolphthalein to turn pink, thus the sample is not vinegar.

While performing a starch test on several different cookie brands, four tests result in the typical black color of starch presence, but the fifth gives a yellow-brown color. How might you interpret this result?

The cookies of the four brands that turned the typical black color contain starch in the cookies. However, the fifth cookie does not contain starch.

You have read that a new brand of hair tonic is supposed to contain lead (an ingredient in Grecian Formula®). Devise a simple test to confirm the presence or absence of lead in that hair tonic. Use your observations in Data Table 1 to describe a positive result for this test.

Using the observations from Data Table 1, to determine if a hair tonic contains lead, I would add a few drops of KI (Potassium Iodide) and look for the formation of a yellow colored solution with cloudy precipitate. However, before I do this, I would read the other ingredients in the hair tonic to make sure that mixing the product with KI would not cause a harmful side reaction with the other ingredients in the hair tonic.

Is cutting a cake into 8 pieces a chemical or a physical change? Explain your answer.

Cutting a cake into 8 pieces is a physical change. The shape of the cake changes, but not the chemical make-up of the cake. Nothing new is formed.

When a soda is poured into a glass and the soda bubbles, is it the result of a chemical change? Explain your answer.

Students may answer the bubbles are a result of chemical changes, physical changes, or both, but should adequately explain the answers they provide. A physical change occurs with the bubbles if they were already present in the soda. A chemical change occurs if the bubbles are a result of carbonic acid breaking down as pressure is reduced from the system.

In well B1, what was the reactant in the second step? Did this reactant cause a chemical change? Use your observations to support your answer.

In well B1, the reactant in the second step was energy (sunlight). The reactant did cause a chemical change as the chemical on the paper towel changed in color to a brown-red color.

Think about how phenolphthalein acts as an acid/base indicator. Do your observations in well A5 support this or contrast what you would expect to happen? Explain your answer.

Phenolphthalein is an acid/base indicator that is colorless in solutions with a pH ranging greater than 0 and less than 8.2 and bright pink in solutions with a pH ranging greater than 8.2 and less than 12.0. As hydrochloric acid has a pH that is less than 8.2, typically around a pH of 1.0-2.0, thus the observations in Well A5, where the solution was colorless, support how phenolphthalein acts as an acid/base indicator.

Data Table 1: Chemical Change Observations
(SAMPLE ANSWER BELOW)

Well	Chemical #1 (4 drops)	Chemical #1 Appearance	Chemical #2 (4 drops)	Chemical #2 Appearance	Observations	Chemical Change (Yes/No)
A1	NaHCO ₃ Sodium Bicarbonate	Clear solution	HCl Hydrochloric Acid	Clear solution	Bubbles are formed	Yes
A2	IKI indicator	Brown solution	Starch	Clear solution	The color is black/blue	Yes
A3	KI Potassium Iodide	Colorless solution	Pb(NO ₃) ₂ Lead(II) Nitrate	Clear solution	The color becomes yellow and a cloudy precipitate forms	Yes
A4	NaOH Sodium Hydroxide	Colorless solution	C ₂₀ H ₁₄ O ₄ Phenolphthalein	Clear solution	The color observed is bright pink	Yes
A5	HCl Hydrochloric Acid	Colorless solution	C ₂₀ H ₁₄ O ₄ Phenolphthalein	Clear solution	Colorless Solution	No
A6	NaOH Sodium Hydroxide	Colorless solution	AgNO ₃ Silver Nitrate	Clear solution	A brown colored solution with brown, cloudy/milky precipitate is formed	Yes
B1	AgNO ₃ Silver Nitrate	Colorless solution	NH ₄ OH Aqueous Ammonia	Clear solution	Observation 1: Forms white precipitate + Absorb in paper towel and expose to sunlight Observation 2: Colorless, then brown/red	Yes
B2	NH ₄ OH Aqueous Ammonia	Colorless solution	CuSO ₄ Copper(II) Sulfate	Blue Solution	Dark blue precipitate	Yes

Exercise 2

Describe the similarities and/or differences between heating and burning the magnesium metal. Did either heating or burning produce a chemical change? Explain your answer using the observations collected in Data Table 2.

Both heating and burning caused changes to the magnesium metal. When the magnesium was heated, the color turned from silver to black, and when burned, the magnesium produced a very bright light. While both heating and burning caused a chemical change (color and formation of light), the two methods produced distinctly different products.

Describe the similarities and/or differences between heating and burning the mossy zinc metal. Did either heating or burning produce a chemical change? Explain your answer using the observations collected in Data Table 2.

Unlike for the magnesium metal, both heating and burning of the mossy zinc resulted in the same product, melted zinc. When heated in the test tube, the solid zinc melted, causing a change in the state of matter. Likewise, when burned, the solid zinc melted, causing a change in the state of matter. Neither heating, nor burning, caused a chemical change; rather both caused a physical change.

Describe the similarities and/or differences between heating and burning the CuCO_3 . Did either heating or burning produce a chemical change? Explain your answer using the observations collected in Data Table 2.

Both heating and burning caused changes to the copper carbonate. When heated, the copper carbonate turned black in color, while burning the copper carbonate caused the flame of the burner to turn green in color. Both heating and burning produced a chemical change as copper carbonate decomposed to form a gas such as CO_2 , O_2 , and CuO .

How would you describe the differences between heating and burning? Use your experiences in the experiment to describe these differences.

Heating and burning are two separate processes. Heating is actually energy that is absorbed from an outside source, while burning is the process of combustion which produces heat.

Which of the three chemicals that were heated produced a physical change? Support your answer with observations made and recorded in Data Table 2.

Of the three chemicals that were heated, only zinc produced a physical change. The zinc melted, causing a change in state of matter.

Data Table 2: Heating and Combustion
(SAMPLE ANSWER BELOW)

Chemical	Initial Observations	Heating Observations	Burning Observations
Mg	Shiny silver, solid, rice- sized pieces of metal	The magnesium turns into a blackcolored metal.	The magnesium creates an awesome display of very bright light
Zn	Is slightly silver and covered in a small white chalky film. Solid piece of metal.	Zinc melted, remained silver in color	Zinc melted, remained silver in color.
CuCO ₃	Fine green colored powder	The chemical turned black in color.	The copper carbonate caused the flame to turn green in color

Competency Review

A ____ is a change in the form of a substance.

- ☐ chemical change
- ☒ physical change



Identify an example of a chemical change.

- ☐ Boiling water
- ☒ Cooking an egg ✓
- ☐ Condensing vapor
- ☐ Cutting a steak

A chemical reaction is a process where the atoms of substances interact with one another to form new substances.

- ☒ True ✓
- ☐ False

In a chemical reaction the reactants are on the ____ of the written chemical equation.

- ☐ same side as the products
- ☐ right side
- ☒ left side ✓

Physical observations can be used to determine if a chemical change has occurred.

- ☒ True ✓
- ☐ False

A(n) ____ is the explanation of why something happened, and a(n) ____ is a description of what happened.

- ☐ observation; conclusion
- ☒ conclusion; observation ✓

A white precipitate formed from the mixing of two liquids is an indication of a chemical change.

- ☐ True ✓
- ☐ False

A metal is added to a liquid and bubbles form. What might be concluded?

- ☐ A chemical reaction occurred. ✓
- ☐ A physical change occurred.
- ☐ Both a chemical and physical change occurred.

Heating chemicals is defined by the process of combustion.

- ☐ True
- ☐ False ✓

_____ magnesium generates a very bright light.

- ☐ Burning ✓
- ☐ Heating
- ☐ Both burning and heating

Extension Questions

Mark decided to investigate some household materials using the phenolphthalein solution. He placed 10 drops of each liquid or a small amount of solid (just enough to cover the tip of the spatula) in 2 mL of distilled water. Then he added 2 drops of the phenolphthalein solution and identified each substance as either an acid or a base, as shown in the table:

Tube #	Substance	Color before Phenolphthalein	Color after Phenolphthalein	Conclusion
1	Baking soda	Colorless	Pink	Base
2	White vinegar	Colorless	Colorless	Acid
3	Salt	Colorless	Colorless	Acid
4	Apple juice	Pale yellow	Pale yellow	Acid
5	Shampoo	Pale yellow	Pale yellow	Base

Tube #	Substance	Color before Phenolphthalein	Color after Phenolphthalein	Conclusion
6	Window cleaner	Pale blue	Pale purple	Base
7	Milk	Slightly cloudy white	Slightly cloudy white	Acid

a. Can you draw any general conclusions about household materials based on his results?

b. Can you find any problems with Mark's logic? Explain.

(SAMPLE ANSWER BELOW)

a. The solutions that showed a color change upon the addition of phenolphthalein are bases. However, the lack of a change in color is NOT sufficient evidence to identify the other items as acids. This would only work if all substances were either acids or bases, which is not the case.

b. Mark needs another indicator that shows a color when it is in an acid solution to support his conclusions.