Developing Competency One and Understanding Demonstrations(Material World)

First you should keep in mind that:
a chemical change is a change that creates compounds and or elements that differ from the original ones.

Observations that are Signs of Chemical Changes

(1) Colour change. Colour depends on atomic and molecular structure. If bread turns brown when toasted, the proteins are not the same as those in untoasted bread.
(2) Production of a gas. When an egg rots, it stinks because one of the proteins in eggs breaks down into smaller compounds and hydrogen sulphide gas.
(3) Appearance of a precipitate. A precipitate is a solid that forms from mixing two or more solutions. It is a compound that was not found in either of the original solutions. A shell contains $CaCO_3$, which is a precipitate that can be made from lime in solution and CO_2 dissolved in water.
(4) Release or absorption of large amounts of energy. This is a sign that new bonds between atoms have been broken and formed.

<table>
<tr><th>DEMONSTRATION</th><th>QUESTIONS/ANSWERS</th></tr>
<tr><td>(1)Burning of magnesium.
 
OBSERVATIONS
A piece of silvery magnesium is placed in a flame. After several seconds, a white dazzling, light is released. A white powder sticks to the tongs that were holding the magnesium.</td><td>1. What evidence is there that a chemical change occurred?
• A large amount of energy was released (in the form of light).
• A colour change occurred(silver to white)

2. What additional experiment would prove that a chemical change occurred?
• The white powder can be ignited. It will not burn again if it is no longer magnesium.
• If the powder is weighed, strangely, it will weigh more than the original magnesium. This is because oxygen bonds to magnesium when it burns, and so the atoms and weights combine.</td></tr>
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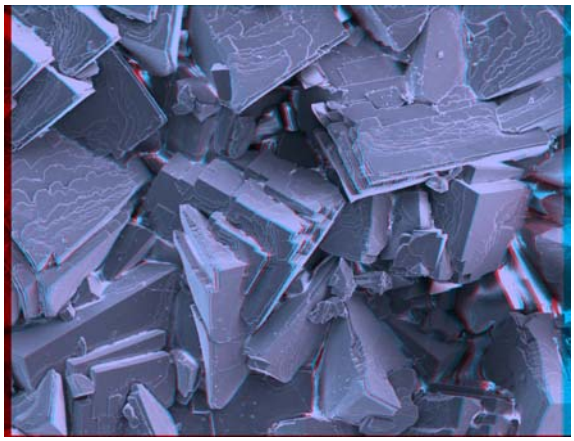
DEMONSTRATION	**QUESTIONS/ANSWERS**
(2)Calcium flakes are added to a flask of water. 	1. *What evidence is there that a chemical change occurred?* • A gas is released • A colour change occurred(silver to white) • Heat was released and warmed the beaker. 2. *Calcium, is an alkaline earth metal. Typically, these metals react with water to release hydrogen gas and produce a base, which is an acid-destroyer. How can we prove that?* • Place a flaming splint at the mouth of the flask. A characteristic popping sound will be heard. • Use an indicator (example, red litmus in the water. The calcium hydroxide produced by the calcium will change the litmus blue.
OBSERVATIONS Violent fizzing results. A white residue develops at the bottom of the beaker. The silvery flakes of calcium disappear. The beaker gets very hot.	

DEMONSTRATION

(3) A disk of potassium is added to water in a beaker. (must be dome in the fumehood!)

OBSERVATIONS

After a few seconds, we see orange and violet flames. Sparks result. An explosion is heard. There is a white residue on the glass door of the fume hood. We also notice a small silvery streak on the glass.

QUESTIONS/ANSWERS

1. *What evidence is there that at least <u>three</u> chemical changes occurred?*

   <u>First reaction</u>:

   - A gas is released
   - A colour change occurred(silver to white)

The above are the result of the reaction between potassium and water to create potassium hydroxide (a base) and hydrogen gas.

<u>Second and Third reactions</u>:

The heat released by the first reaction then ignites two different fuels, hydrogen and the oil that potassium was stored in.

2. *What evidence suggested that two different substances caught on fire?*

There were two different colours observed.

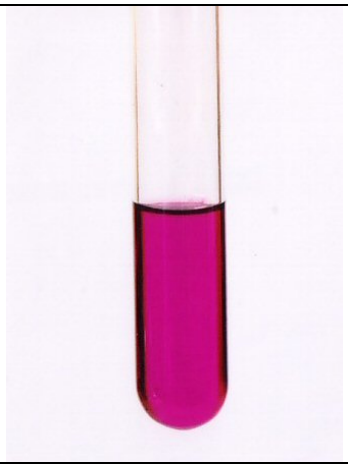
3. *How can we provide evidence for the formation of hydrogen gas and base from the first reaction?*

Use an indicator. Litmus works. But you can try bromothymol blue, which is green in the presence of water, but if placed in the beaker where potassium reacted, it will turn purple. Wet red litmus applied to the white residue on the screen will turn blue.

4. *How can one provide evidence for the hypothesis that the explosion sent some melted, unreacted potassium flying onto the glass?*

Add water to the silvery streak on the glass. It should fizz and create white coloured base.

DEMONSTRATION	QUESTIONS/ANSWERS
(4) The Sulphate(SO_4^{-2}) Test 25.0 ml of deionized (purified with filter) water were added to a plastic cup. A 2.0 ml sample of rainwater is then added to the water. Then while swirling, a reagent (from safewater.org) was poured in. With more swirling, a second reagent was added. After 1 minute, the solution turned cloudy.	1. *What evidence is there that a chemical change occurred?* • A precipitate formed. The cloudiness if allowed to settle will fall to the bottom of the cup. 2. *Why was deionized water used?* Deionized water was used as a "control", to make sure that there wasn't any sulphate already present before testing the actual sample. 3. *How does one make sure that there was not any sulphate in the deionized water?* The procedure should be carried out by adding a 2.0 ml sample of deionized water to the original 25.0 ml and then adding the two reagents as directed. 4. *How is the amount of cloudiness related to the amount of sulphate pollution in the water sample?* The more sulphate there was in the original rain sample, the more cloudy the final solution will be. The testing kit comes with a sample known to have 500 ppm (mg/kg) of SO_4^{-2}. If the test sample creates less cloudiness than the standard, then it has less than 500 ppm. Conversely, if it cloudier, then it has more than the acceptable 5-0 ppm limit.

DEMONSTRATION	QUESTIONS/ANSWERS
(5) Iodine's Split Personality A few crystals of iodine are placed into two different flasks. Upon close observation iodine crystals are not as silvery as they seem: they have a violet cast to them, and the colour becomes more apparent when the flask is warmed by one's hand. To the first flask we add alcohol, and the solution turns a pekoe-tea orange. We then add turpentine to the second flask, and we get a violet solution.	1. *Which reaction was a chemical change? How do we know?* The addition of alcohol causes a chemical change. This is apparent because of the colour change. 2. *Which reaction merely dissolves iodine?* The addition of turpentine ($C_{10}H_{16}$) is a physical change because the violet colour is retained.
 	

DEMONSTRATION

(6) Reaction Involving Sodium

A brown iodine tincture (containing alcohol, iodine and other ingredients) is placed in a beaker. 0.5 cm^3 of sodium is added to the tincture.

OBSERVATIONS

Gentle fizzing around the sodium is observed. Then the brown colour starts to fade. Eventually the solution is almost clear; it just has a yellowish tinge.

QUESTIONS/ANSWERS

1. *Was the reaction a chemical change? How do we know?*
Gas was formed. There was a colour change .

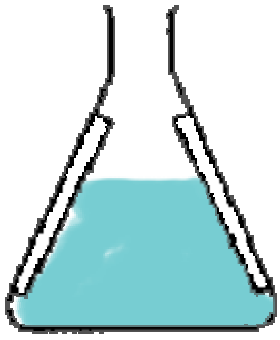
2. *What could have happened in each case? Propose hypotheses.*

a) The gas could have been formed from the reaction between alcohol and sodium or between water in the alcohol and sodium. Alcohol is never 100% pure.

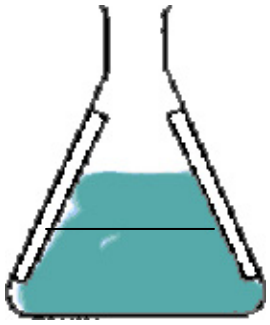
b) The sodium (a metal) could have reacted with iodine (a non metal) to produce NaI.

c) How could you test your hypothesis about why the brown colour disappeared?
We could look for sodium iodide by evaporating the liquid. We could check the properties of the leftover powder with those of NaI

(7)The Oxidation of Aluminum



$CuSO_{4(aq)}$



$CuCl_{2(aq)}$

A piece of aluminum foil is placed into two different solutions of Cu^{+2}, as shown above. Cu^{+2} is known to attack aluminum metal. The solution on the right seems to be a darker shade of blue. After a few seconds, the solution on the right($CuCl_2$) eats up the aluminum. Heat is released, and a brown substance collects at the bottom of the flask.
The $CuSO_4$ solution eventually reacts with the aluminum, but it takes a lot longer.

1. *Form 2 hypotheses to explain why the $CuCl_2$ solution reacts faster.*

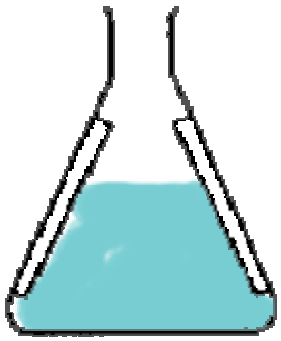
(1)The $CuCl_2$ solution had a higher concentration of Cu^{+2}.
(2) The Cl^- ion helps Cu^{+2} eat through the aluminum. The chloride acts as a catalyst.

2. *How could we check if the presence of chloride was the main factor?*

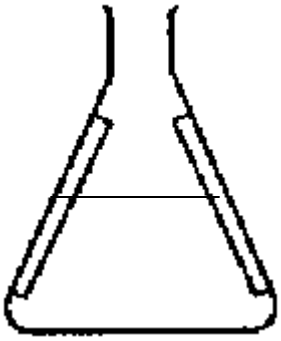
Repeat the experiment but using the same concentrations of $CuCl_2$ and $CuSO_4$

DEMONSTRATION

(8) To Precipitate or Not?



$CuSO_{4(aq)}$

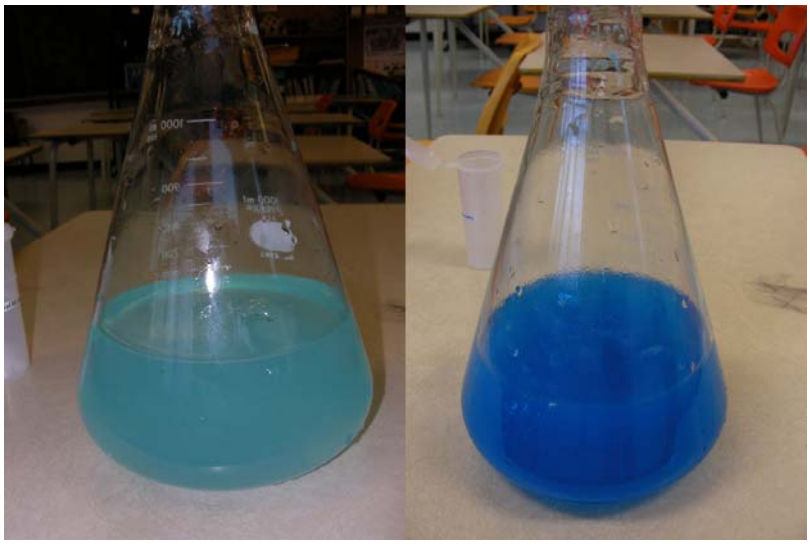


$NaOH_{(aq)}$

We have two solutions. The copper solution is light blue in colour. The sodium hydroxide solution is clear. The solutions are mixed.

OBSERVATIONS

Strangely, adding a clear solution actually creates a deeper blue mixture. Eventually the deep blue substance settles to the bottom, leaving an almost clear layer above it.



QUESTIONS/ANSWERS

1. *When we mix two ionic solutions: at least two possible things could happen:*

- *The ions could remain in solution.*
- *Or at least one pair of ions could form a new compound?*

In each possible scenario, what would you observe? Which scenario applies to our demo?

- If the ions had remained in solution, there would be a paint-effect: a clear solution + light blue would have resulted in an even lighter blue solution.
- If a new compound would have formed, it would have precipitated. This is what we observed. The dark blue colour was the result of a precipitate.

2. What precipitate could have formed?

Either $Cu(OH)_2$ or Na_2SO_4

3.How do we know which one was responsible for the colour?

Obtain Na_2SO_4, dissolve it in water, and it will produce a clear solution. So we could conclude that copper(II) hydroxide was responsible for the relatively deeper shade of blue.
