Reactivity of Li, Na, and K

Recommended for Chapter(s): 2 & 9

Demo #004

Materials NOT in box

1. Safety goggles.
2. Three 4 L beakers (on shelf next to demonstration box).
3. Wire mesh (on top of demonstration box).

Procedure

1. (Prep) Put ~500 mL of water in each of the 4 L beakers.
2. (Prep) Cut off a small piece of Na and K to use during the demo. The labels on the jars show the approximate size to cut the Na and K. Cut the Na and K in the Petri dish. The Petri dish will have oil in it from previous cuttings.
3. Put ~5 granules of Li in one of the 4 L beakers
4. Quickly place wire mesh over beaker. The wire mesh is used to insure that the reaction occurs inside the beaker.
5. Put a small piece of Na in another of the 4 L beakers.
6. Quickly place wire mesh over beaker.
7. Put a small piece of K in the last 4 L beaker.
8. Quickly place wire mesh over beaker.

Phenolphthalein is also included in the demonstration kit. You can add phenolphthalein to the water before adding the Li, Na, or K. This will allow students to visualize the formation of LiOH, NaOH, or KOH as the reaction takes place.

Safety

1. Wear Safety goggles.
2. The potassium is very reactive with water; you only need a very small piece.
3. After you do this demo check for small pieces of metal that are left stuck to the inside wall of the beaker. When you clean it with water, it reacts violently with Na and K. Therefore, before you clean the beaker with water, knock any little pieces off into water inside the beaker with the screen cover over the beaker to protect yourself.

Clean Up

1. Return the materials to the cart in the demonstration library room.

Stockroom Notes

1. The waste can be poured down the sink.
2. Wash the beakers. (SEE SAFTEY NOTE)
3. Wipe off tweezers and knife with a paper towel.
4. Close Petri dish and place flat in box (it is O.K. if it still has oil in it).
5. If needed, refill any materials that have been used up.
6. Return items to demonstration tub.
7. Return tub to the demonstration library.
    a. Return the goggles to the goggle box.
    b. Return the beakers to their boxes and put them on the shelf next to the demonstration box. DO NOT THROW AWAY THE BOXES THAT THE BEAKERS GO IN.
    c. The wire mesh sits on top of the demonstration box

Discussion

The reactivity of the alkali metals increases as you go down in the group. This is a result of the outer electrons being farther away from the nucleus, therefore, not as attracted to the positive change of the nucleus. The following reactions take place in solution.

$2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$

$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$

For the Na and the K flames are seen. These flames are cause by the burning hydrogen gas.

This demonstration can also be performed when talking about thermodynamics. To use this demonstration in the thermodynamics chapter, put the sodium in the water and allow the students to observe the reaction. Write the reaction on the board seen below:

$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$.

Have the students determine the signs of w, q, ΔE and ΔH. Work is negative when the system does work on the surroundings (system expands) and is positive when work is done on the system (system contracts). Since a gas is produced in the reaction and the system is at constant pressure the system will expand and work is negative. Heat is positive when heat leaves the system and negative when heat enters the system. During the reaction students should observe flames for both Na and K. Therefore, since the reaction produces heat, q is negative. $\Delta E = q + w$ since q is negative and w is negative ΔE must be negative. At constant pressure ΔH is equal to q, therefore; since q is negative ΔH is also negative.

Materials in box

1. 3 4 L beakers (stored next to box)
2. Li Fisher AC21144-0250
3. Na
4. K Fisher AC22386-0100
5. 0.5% Phenolphthalein in dropper bottle
6. Paper Towels
7. Knife
8. Petri Dish (DO NOT WASH)
9. Tweezers
10. Screen (stored on top of box)