

Mendeleev for a Day

Text reference: Chapter 5

Introduction

As more and more elements were discovered during the 1800s, chemists began to categorize them according to similarities in chemical and physical properties. A Russian chemist, Dmitri Mendeleev (1834–1907), was more successful than most. He arranged the elements in vertical columns in order of increasing atomic mass. The columns were then arranged so that elements with similar chemical properties were placed side by side.

Mendeleev left numerous spaces in his table because there were no known elements with the appropriate properties to fill the spaces. (See Figure 13-1.) He then predicted the properties of these unknown elements based on the properties of the elements next to them on the periodic table. When these "missing elements" were discovered, they were found to have properties very similar to those predicted by Mendeleev.

Like Mendeleev, in this investigation you will group unknown compounds according to their chemical behaviors. You will see if a precipitate (solid substance) forms when two solutions are mixed together. You then will observe which precipitates are dissolved by another solution. Finally you will record any color changes that occur when two solutions are mixed together. After analyzing your data, you will place each unknown solution into a group with other solutions of similar characteristics.

		Ti = 50	Zr = 90	? = 180.
		V = 51	Nb = 94	Ta = 182.
		Cr = 52	Mo = 96	W = 186.
		Mn = 55	Rh = 104,4	Pt = 197,4
		Fe = 56	Ru = 104,4	Ir = 198.
	Ni = 59	Co = 59	Pd = 106,6	Os = 199.
		Cu = 63,4	Ag = 108	Hg = 200.
H = 1		Zn = 65,2	Cd = 112	
Be = 9,4	Mg = 24	? = 68	Ur = 116	Au = 197?
B = 11	Al = 27,4	? = 70	Sn = 118	
C = 12	Si = 28	As = 75	Sb = 122	Bi = 210?
N = 14	P = 31	Se = 79,4	Te = 128?	
O = 16	S = 32	Br = 80	I = 127	
F = 19	Cl = 35,5	Rb = 85,4	Cs = 133	Tl = 204
Li = 7	Na = 23	K = 39	Sr = 87,6	Ba = 137
	Ca = 40	? = 45	Ce = 92	Pb = 207.
	?Er = 56	La = 94		
	?Yt = 60	Di = 95		
	?In = 75,6	Th = 118?		

Figure 13-1 Mendeleev's Periodic Table (1869)

Name _____

Pre-Lab Discussion

Read the entire laboratory investigation and the relevant pages of your textbook. Then answer the questions that follow.

1. How does Mendeleev's periodic table differ from the modern periodic table? _____

2. Why did Mendeleev leave blank spaces on his periodic table? Did later discoveries justify his predictions? _____

3. Why is it necessary to mix any solution that does not show an immediate change? _____

4. Why is it necessary to rinse each test tube thoroughly between trials? _____
5. Which solutions need to be disposed of in a special container? _____

Problem

How can you group compounds according to their chemical behavior?

Materials

chemical splash goggles
laboratory apron
3 test tubes
marking pen
test-tube rack

graduated cylinder, 10-mL
unknown solutions 1-9
4 micropipets containing test
solutions A, B, C, and D
stirring rod

Safety



Wear your goggles and lab apron at all times during the investigation. Since you are dealing with unknown solutions, consider them all to be corrosive and toxic, and avoid direct contact. If you spill a solution on yourself, report the spill immediately to your teacher and wash the affected area with large amounts of cold running water. Note the caution alert symbols here and with certain steps of the Procedure. Refer to page xi for the specific precautions associated with each symbol.

Name _____

Procedure



1. Put on your goggles and lab apron.
2. Label three test tubes A, B, and C with the marking pen. Using the graduated cylinder, obtain 3 mL of solution 1. Place 1 mL into each of the three test tubes. **CAUTION:** *Some of the solutions that you will use in this investigation are corrosive. Avoid direct contact with all of them.*
3. To test tube A, add 12 drops of test solution A.
4. To test tube B, add 12 drops of test solution B.
5. To test tube C, add 12 drops of test solution C.
6. Any test tube that does not show an immediate change should be stirred for at least 10 seconds. Rinse the stirring rod after each use. Record all results in the Data Table.
7. To any test tube that contains a precipitate, add 20 drops of test solution D and stir for at least 15 seconds. Rinse the stirring rod after each use. Record all results.
8. Pour the waste materials in test tube A into a labeled container provided by your teacher. Rinse out the test tubes and graduated cylinder thoroughly for use in the next set of tests.
9. Repeat Steps 2 through 8 for each of the other solutions. When you are done testing solutions 4 and 9, pour the waste material into the labeled containers provided by your teacher.
10. Clean up your work area and wash your hands before leaving the laboratory.

Observations

DATA TABLE Reactions of Unknown Solutions

Unknown	A-ppt?	B-ppt?	C-Color	D-Dissolved?
1				
2				
3				
4				
5				
6				
7				
8				
9				

Name _____

Critical Thinking: Analysis and Conclusions

1. Why do you think that this investigation is titled "Mendeleev for a Day"? (*Drawing conclusions*) _____

2. Based on your observations, group the unknown solutions into families according to similarities in chemical behavior. Justify your answer with data from this investigation. (*Interpreting data*) _____

3. Why didn't all members of the same family show identical reactions? Give an example of a reaction that was similar but not identical. (*Developing hypotheses*) _____

Critical Thinking: Applications

1. Suppose you could do experiments with your unknowns in which you reacted each of them with oxygen to form an oxide, as Mendeleev did. How would this information help you determine the location of the compounds in the periodic table? (*Making predictions*) _____

2. No members of Group 8A (18) of the modern periodic table can be found on the version of Mendeleev's table shown in Figure 13-1. Suggest an explanation for their absence. (*Making inferences*) _____

Going Further

1. Research the contributions that scientists other than Mendeleev have made to the development of the modern periodic table. Prepare a short oral report to present to the class.