

## The Mendeleev Activity

Chemistry; Coleman

Use your knowledge of the periodic table to determine the identity of each of the nine unknown elements in this activity.

- The unknown elements are from the following groups in the periodic table. Each group listed below contains at least one unknown.  
1      2      11      13      14      17      18
- None of the known elements serve as one of the nine unknown elements.
- No radioactive elements are used during this experiment. The relevant radioactive elements include Fr, Ra, At, and Rn.
- You may not use your textbook or other reference materials. You have been provided with enough information to determine each of the unknown elements.

### Procedure:

1. Inspect the properties of the known elements.
2. **WITHOUT LOOKING AT A PERIODIC TABLE**, arrange the cards of the known elements in a crude representation of the periodic table.
3. Once the known elements are in place, inspect the properties of the unknowns to see where their properties would best "fit" the trends of the elements of each group.
4. In your data table, assign the proper element name and symbol to each of the unknowns.

### Some Hints:

- a. Remember that a group (a column on the periodic table) are elements that have some things in common. (like color, reactivity with water and conductivity)
  - a. There should also be some sort of trend in density, boiling point, atomic mass etc as you go down a family.
- b. Remember that the Mendeleev arranged the PT (roughly) by increasing atomic mass.
- c. Arrange the gas groups first (they are the easiest).

### Conclusion:

1. What is the identity of each of the unknown elements (name and symbol)?
  - a. Unknown #1: \_\_\_\_\_
  - b. Unknown #2: \_\_\_\_\_
  - c. Unknown #3: \_\_\_\_\_
  - d. Unknown #4: \_\_\_\_\_
  - e. Unknown #5: \_\_\_\_\_
  - f. Unknown #6: \_\_\_\_\_
  - g. Unknown #7: \_\_\_\_\_
  - h. Unknown #8: \_\_\_\_\_
  - i. Unknown #9: \_\_\_\_\_

2. In general, what happens to atomic mass as you:
  - a. Go down a family? \_\_\_\_\_
    - i. What accounts for this trend?
  - b. Go across a period? \_\_\_\_\_
    - i. What accounts for this trend?
3. Examine the melting points as you go down a family and across a period. Is there a trend? If there is a trend, what is it?
  - a. down a family: \_\_\_\_\_
  - b. across a period: \_\_\_\_\_
4. Examine the densities as you go down a family and across a period. Is there a trend? If there is a trend, what is it?
  - a. down a family: \_\_\_\_\_
  - b. across a period: \_\_\_\_\_
5. Examine the conductivity of the elements as you go across the periodic table. What is the general trend for conductivity as you go across the periodic table?
6. Examine physical state as you go across the periodic table. What is the general trend in physical state as you go across the periodic table?
7. Examine each family. What characteristics (list at least two) that the elements in each family share:
  - a. Family 1: \_\_\_\_\_
  - b. Family 2: \_\_\_\_\_
  - c. Family 11: \_\_\_\_\_
  - d. Family 13: \_\_\_\_\_
  - e. Family 14: \_\_\_\_\_
  - f. Family 17: \_\_\_\_\_
  - g. Family 18: \_\_\_\_\_
8. Helium is an element that would be directly above Neon on the periodic table. Based on the trends, predict the following for helium:
  - a. Approximate atomic mass: \_\_\_\_\_
  - b. Physical state: \_\_\_\_\_
  - c. Approximate density: \_\_\_\_\_
  - d. Approximate melting point: \_\_\_\_\_
  - e. Hardness: \_\_\_\_\_
  - f. Conductivity: \_\_\_\_\_
  - g. Solubility in water: \_\_\_\_\_
  - h. Colour: \_\_\_\_\_

**Periodic Table Layout (Template)** – once you have the cards arranged and approved, fill in the following table with Element Symbol, Name and Mass

1	2			14	17	18
		11	13			

<b>Li</b> atomic mass: 7	Physical State: solid Density: 0.534 g/cm <sup>3</sup> Hardness: soft, claylike Conductivity: good Solubility (H <sub>2</sub> O): reacts with water Melting Point: 180°C Color: silver	<b>Cl</b> atomic mass: 35	Physical State: gas Density: 0.00321 g/cm <sup>3</sup> Hardness: none Conductivity: very poor Solubility (H <sub>2</sub> O): slight Melting Point: -101°C Color: greenish yellow
<b>Ag</b> atomic mass: 108	Physical State: solid Density: 10.50 g/cm <sup>3</sup> Hardness: somewhat soft Conductivity: excellent Solubility (H <sub>2</sub> O): none Melting Point: 961°C Color: silver	<b>Unknown #7</b>	Physical State: solid Density: 5.32 g/cm <sup>3</sup> Hardness: fairly brittle Conductivity: fair to poor Solubility (H <sub>2</sub> O): none Melting Point: 937°C Color: gray
<b>Cu</b> atomic mass: 64	Physical State: solid Density: 8.96 g/cm <sup>3</sup> Hardness: somewhat soft Conductivity: excellent Solubility (H <sub>2</sub> O): none Melting Point: 1803°C Color: red-brown	<b>Na</b> atomic mass: 23	Physical State: solid Density: 0.971 g/cm <sup>3</sup> Hardness: soft, claylike Conductivity: good Solubility (H <sub>2</sub> O): reacts rapidly Melting Point: 98°C Color: silver
<b>C</b> atomic mass: 12	Physical State: solid Density: 2.10 g/cm <sup>3</sup> Hardness: soft, yet brittle Conductivity: good Solubility (H <sub>2</sub> O): negligible Melting Point: 3550°C Color: black	<b>Ca</b> atomic mass: 40	Physical State: solid Density: 1.57 g/cm <sup>3</sup> Hardness: medium Conductivity: good Solubility (H <sub>2</sub> O): reacts Melting Point: 845°C Color: silvery white
<b>Unknown #8</b>	Physical State: solid Density: 1.74 g/cm <sup>3</sup> Hardness: medium Conductivity: good Solubility (H <sub>2</sub> O): reacts slowly Melting Point: 651°C Color: silvery white	<b>Unknown #9</b>	Physical State: solid Density: 11.85 g/cm <sup>3</sup> Hardness: very soft Conductivity: medium Solubility (H <sub>2</sub> O): none Melting Point: 303°C Color: silvery white

<b>Be</b>	atomic mass: 9	<b>Sn</b>	atomic mass: 119
Physical State	solid	Physical State	solid
Density	1.85 g/cm <sup>3</sup>	Density	7.31 g/cm <sup>3</sup>
Hardness	brittle	Hardness	somewhat soft
Conductivity	excellent	Conductivity	good
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	none
Melting Point	1287°C	Melting Point	232°C
Color	gray	Color	silver
<b>Ne</b>	atomic mass 20	<b>Br</b>	atomic mass: 80
Physical State	gas	Physical State	gas
Density	0.00090 g/cm <sup>3</sup>	Density	3.12 g/cm <sup>3</sup>
Hardness	none	Hardness	none
Conductivity	very poor	Conductivity	very poor
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	negligible
Melting Point	-249°C	Melting Point	-7.2°C
Color	colorless	Color	reddish brown
<b>K</b>	atomic mass: 39	<b>Ba</b>	atomic mass: 137
Physical State	solid	Physical State	solid
Density	0.86 g/cm <sup>3</sup>	Density	3.6 g/cm <sup>3</sup>
Hardness	soft, claylike	Hardness	soft
Conductivity	good	Conductivity	good
Solubility (H <sub>2</sub> O)	reacts rapidly	Solubility (H <sub>2</sub> O)	reacts strongly
Melting Point	63°C	Melting Point	710°C
Color	silver	Color	silvery white
<b>Xe</b>	atomic mass: 131	<b>In</b>	atomic mass: 114
Physical State	gas	Physical State	solid
Density	0.00585 g/cm <sup>3</sup>	Density	7.31 g/cm <sup>3</sup>
Hardness	none	Hardness	very soft
Conductivity	very poor	Conductivity	medium
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	none
Melting Point	-119.9°C	Melting Point	157°C
Color	colorless	Color	silvery white
<b>I</b>	atomic mass: 127	<b>Pb</b>	atomic mass: 207
Physical State	solid	Physical State	solid
Density	4.93 g/cm <sup>3</sup>	Density	11.35 g/cm <sup>3</sup>
Hardness	soft	Hardness	somewhat soft
Conductivity	very poor	Conductivity	poor
Solubility (H <sub>2</sub> O)	negligible	Solubility (H <sub>2</sub> O)	none
Melting Point	113.5°C	Melting Point	327.5°C
Color	bluish-black	Color	gray

<b>Ar</b>	atomic mass: 40	<b>Ga</b>	atomic mass: 70
Physical State	gas	Physical State	solid
Density	0.00178 g/cm <sup>3</sup>	Density	5.904 g/cm <sup>3</sup>
Hardness	none	Hardness	soft
Conductivity	very poor	Conductivity	medium
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	none
Melting Point	-189.2°C	Melting Point	30°C
Color	colorless	Color	silvery
<b>Cs</b>	atomic mass: 133	<b>Unknown #1</b>	
Physical State	solid	Physical State	solid
Density	1.87 g/cm <sup>3</sup>	Density	2.33 g/cm <sup>3</sup>
Hardness	soft	Hardness	brittle
Conductivity	good	Conductivity	intermediate
Solubility (H <sub>2</sub> O)	reacts violently	Solubility (H <sub>2</sub> O)	none
Melting Point	29°C	Melting Point	1410°C
Color	silvery white	Color	gray
<b>Unknown #2</b>		<b>Unknown #3</b>	
Physical State	gas	Physical State	solid
Density	0.00170 g/cm <sup>3</sup>	Density	1.53 g/cm <sup>3</sup>
Hardness	none	Hardness	soft
Conductivity	very poor	Conductivity	good
Solubility (H <sub>2</sub> O)	slight	Solubility (H <sub>2</sub> O)	reacts violently
Melting Point	-219.6°C	Melting Point	39°C
Color	pale yellow	Color	silvery white
<b>Unknown #4</b>		<b>Unknown #5</b>	
Physical State	gas	Physical State	solid
Density	0.00374 g/cm <sup>3</sup>	Density	19.3 g/cm <sup>3</sup>
Hardness	none	Hardness	soft
Conductivity	very poor	Conductivity	excellent
Solubility (H <sub>2</sub> O)	none	Solubility (H <sub>2</sub> O)	none
Melting Point	-156.6°C	Melting Point	1064°C
Color	colorless	Color	gold
<b>Unknown #6</b>			
Physical State	solid		
Density	2.54 g/cm <sup>3</sup>		
Hardness	somewhat soft		
Conductivity	good		
Solubility (H <sub>2</sub> O)	reacts rapidly		
Melting Point	769°C		
Color	silvery white		