

The Elements and Electronic Structure

Introduction:

Placed around the room are various samples of elements (all labeled with their symbol). You are encouraged to feel, smell and look at all chemicals except for the few chemicals in the “DANGER CORNER.” **Handle those in the DANGER CORNER with CARE!!**

Procedure:

On this sheet there are a series of questions. Each question refers to one or more elements that you need to find in the lab somewhere. Find the element(s) and answer all parts of the question on the sheet that refer to it (them). Answering the questions may require you to observe, do a small experiment, or refer to the text or other resource. You may do them in any order you wish (avoid crowds!!!), but do keep a record of your answers. Plan a strategy. Please work with your a partner in the lab, but **each of you will be expected to submit your own individual chart of your answers**. Make sure you get to all the elements and answer those questions that must be done in the lab before the period ends. Watch out for elements intended to mislead—there are several elements on display that are NOT correct. Also, note that #15 involves three elements and questions comparing them. They are on display together.

Prelab:

Read Chapter 6.1, pp 154-158, in *your textbook*, Chemistry, Matter and Change. Make sure you pay attention to these regions on the periodic table: **metals (all), alkali metals, alkaline earth metals, transition metals, inner transition metals, metalloids, nonmetals, halogens, and noble gases**. Before coming to class, identify as many of the elements as possible (you should be able to identify #1, 3, 4, 5, 6, 7, 9, 10, 13, 14, 15, 17 from the clues provided) from the clues given. For example, if you were asked to identify an element whose electron configuration ended in $4p^2$, you would identify it as Ge. You may need to piece together several clues or go back and review previous material (e.g. mass number from Chapter 4). In all cases there is only one correct answer.

Write-Up:

Answer all of the following questions by neatly completing the chart on the data table. **Only answers written in the table will be graded**. For transition metals (elements in the d block), place a dash (–) or “N/A” in the “Valence Electrons” field. If a question involves calculation, you must show all steps of the calculation in the answer (Watch your units and significant figures!). You will hand in ONLY the answer sheet. Additional copies of the answer sheet are available on the website.

Questions:

(Some questions refer you to a textbook. It is NOT your textbook. The textbook is the Merrill Chemistry text. There are many copies of this textbook in the classroom.)

- 1) Identify the element whose neutral atoms have an electron configuration ending with $5p^5$.
 - a) What is the color of the solid crystals?
 - b) What family is this element in?
 - c) As a demo, your teacher will put one tiny flake into a test tube and gently heat over a Bunsen burner. What is the color of the vapor forming?
- 2) One element on display today is bright yellow in color. Find and identify it.
 - a) What is the charge of its most stable ion?
 - b) Is the ion larger or smaller than the neutral atom? (Use radii handout.)
- 3) One element on display today has a *last electron* configuration of $6p^2$. Identify it then find it.
 - a) Is the sample on display today in the form of pellets, chunks, powder, sheet or foil?
 - b) What family does this element belong to?

- 4) One element on display has an atomic mass of 40.08 amu. Identify it then locate it.
 - i) Put one piece of this metal into a test tube partially filled with water ($\frac{1}{4}$ full is plenty).
 - ii) Allow the metal to react for a minute or so—keep your finger over test tube opening to collect the gas produced in the reaction. (*Wait until the test tube starts to get warm or the reaction is occurring well*).
 - iii) Light a wooden splint. When the pressure has built up, remove your finger from the test tube opening and quickly hold the lit splint over the opening. Listen and watch for a reaction.
 - iv) **CLEANUP:** Pour water waste into beaker labeled “Waste.” Rinse out test tube with some water. Put test tube back in test tube rack. Put used splints into “used splints” beaker.
 - a) What happens when the lit splint is brought near the test tube opening?
 - b) What gas is being given off by this reaction of the metal element with water? (Hint: it was also produced by the demo of the electrolysis of water.)

- 5) One particular isotope of this element has a *mass number* of 64 and has 36 *neutrons*. Identify the element then find it.
 - a) Is the sample on display today in the form of pellets, chunks, powder or foil?
 - b) What is this element’s density? (Look in Appendix A of *Merrill*)

- 6) Find the transition metal that has only 7 electrons in its d orbitals. Identify it then find it.
 - a) List 2 beneficial uses of this element. (Refer to the pictorial periodic table beneath the flag.)

- 7) Mystery element Z is a metalloid with outermost electrons in the 5th energy level and 3 unpaired electrons. Identify mystery element Z then find it.
 - a) Does mystery element Z “look” metallic?
 - b) Element Z is displayed with silicon. Does the mystery element conduct electricity better or worse than silicon? Use the meter provided to measure RESISTANCE to current. If the metal has low resistance (near 0), it conducts electricity well. If it shows high resistance, it is a poor conductor. ALSO, sometimes the meter reading might jump around. Don’t worry--just get a good enough reading to answer the question.)
 - c) Silicon is also a metalloid. Thus, it should have properties of both metals and nonmetals. List one property of silicon that is metal-like and one that is nonmetal-like.

- 8) Mystery gas X is a noble gas with an atomic radius just over 1.0 \AA (\AA is the unit “angstrom,” where $1 \text{ \AA} = 10^{-10} \text{ m}$.) Use atomic radii handout to identify the element, then find it.
 - a) Report its color in its normal state (no electricity flowing through it.).
 - b) Report its color when an electric current is run through it.
(*BE CAREFUL! Just turn the machine on and off. Don’t touch the tube.*)

DANGER CORNER!!! #9-#13: Go to the designated area. The little bottles are fragile and the chemicals are dangerous if allowed into the air. For the small bottles stored in the foam, remove one bottle at a time carefully from the foam, observe and place back in the foam. DO NOT OPEN any jars or touch any bottle covered with tape!

- 9) Identify and find the element found in Group I, period 3.
 - a) How many electrons must this element lose to achieve “noble gas” stability?
 - b) What is the charge on its most stable ion? (What remains when the electron[s] is [are] lost?)
 - c) Is the ion larger or smaller than the neutral atom? (Use the radii handout.)
 - d) Why is this element stored in oil? (See p.138 in *Merrill*.)

- 10) Find and identify the **nonmetal** that has 3 unpaired electrons in the third energy level.
- What is its color?
 - Which *allotrope* (form) of this element is the most dangerous? (see *Merrill* p. 282-283.)
 - Why is this allotrope of the element so dangerous? (use *Merrill* again)
- 11) One of these elements is a dark red-orange liquid. Find and identify it.
- Look up this element in a dictionary. Its name was derived from a Greek word. What is this Greek word and what does it mean?
 - How many unpaired electrons does a neutral atom of this element have?
 - What is the name of this element's chemical family?
- 12) Find and identify the metalloid that is often the chemical of "choice" for poisoning people in mystery novels.
- What is its color here?
 - What other colors can it have? (Look up in dictionary)
 - This element is used in the making of semiconductors because it has "extra" electrons that can flow freely when mixed with another element. What element is it often mixed with to make a semiconductor? (see p. 408 in *Merrill*.)
- 13) Which element has an isotope that has 120 neutrons and a mass number of 200?
- What state (solid, liquid or gas) is this element now in?
 - Is this element a metal, metalloid, or nonmetal?
 - Is this sample heavier or lighter than the sample of element in question #12.
 - What is this element's density, with units? (see appendix A of *Merrill*)
 - What would be the mass of 25 ml of this element? (You must show calculation in chart.)

The rest are NOT in the danger corner.

- 14) What element has an electron configuration of $[\text{Ar}] 4s^2 3d^5$? Find it.
- Describe its appearance.
 - What type of metal is this (alkali, alkaline earth or transition)?
- 15) Find elements with atomic numbers of 13, 30 and 50. Identify all three (put all three in chart).
- Which is the shiniest element?
 - Which is the most bendable? (Be *gentle*. Do not rip the metals!!!)
 - Which has the largest molar mass?
 - Which is the densest? (See appendix A of *Merrill*.)
 - Which ends with a d^{10} electron?
- 16) Use the atomic radii handout to determine the element in the Group 14 (IVA) that has the smallest atomic radius, then find it.
- Record its atomic radius (be sure to include units!)
 - Is this element a metal or a nonmetal?
 - What is the percent abundance of this element in the earth's crust? (See appendix A in *Merrill*)
- 17) Find the open flask labeled as "Mystery Gas Y," which is the main gas in the open flask.
- What is the common name for the mixture in the flask?
 - What is the percentage of Mystery Gas Y in the flask? (See p. 458 in *Merrill text*)
 - What other substances are in the flask? (See p. 458. List all 7 other substances.)
 - What is the chemical formula for Mystery Gas Y? (See *Merrill text* p.282)
 - Give the names or chemical formulas for three common compounds that contain atoms of Mystery Gas Y. (See *Merrill text* p.282)

**The Elements and Electronic Structure
Lab [20 pts]**

NAME _____

Lab Partner(s) _____

Period _____ Date _____

#	Element name	Sym- bol	Atomic #	Electron Config (Noble gas notation)	# of valence e ⁻	Answers to <i>all</i> questions
1						a) b) c)
2						a) b)
3						a) b)
4						a) b)
5						a) b)
6						a)
7						a) b) c)
8						a) b)
9						a) b) c) d)
10						a) b) c)

#	Element name	Sym- bol	Atomic #	Electron Config (Noble gas notation)	# of valence e ⁻	Answers to <i>all</i> questions
11						a) b) c)
12						a) b) c)
13						a) b) c) d) e)
14						a) b)
15						a) b) c) d) e)
16						a) b) c)
17						a) b) c) d) e)