

# **Honors Chemistry with AP Chemistry link**

## **Expectations:**

In first-year chemistry, students will be introduced to chemical nomenclature and writing chemical formulas. It is our expectation that students be able to generate proper stock or IUPAC chemical names and formulas from any of the ions on Page 2. These ions should be memorized. In addition, students must be familiar with locations of the various groups of elements on the periodic table in order to appreciate the predictable variations in physical and chemical properties over the periodic table. Students also need to be able to identify the name of, proper use of, and measurement precision for glassware that will be used during labs. And, when performing calculations, students must learn how to appropriately set up, calculate, and then round their answers to the number of significant digits that reflect the precision of their measurements.

## **Students will:**

- 1) Print this entire document. Bring it to the first day of class.
- 2) Create flashcards of these common elements and ions on Page 2. Past students will attest to the learning power of writing all these ions and their names. The full list is split into four sections. We recommend that students focus on one section at a time to assist them in retaining the knowledge.
- 3) Study the background information on the periodic table. A few days after first learning the material, fill in the twelve questions provided without looking back at the notes. Use the notes to check your answers.
- 4) Color and label the periodic table. Bookmark and use <https://ptable.com> to assist you in finding the symbols and their atomic numbers.
- 5) Study the lab equipment and complete the worksheet that follows.
- 6) Read the notes on significant digits and rounding. Complete the worksheets attached.
- 7) Ideally, students should complete this material before 29 August. Classroom instruction on this material will begin 29 August and testing on this material will begin the week of \*August 29<sup>th</sup> with the first sections of Elements and Ions.

## **Parents/Guardians should:**

- 1) Encourage their student(s) to begin and complete this summer assignment packet in a time frame that allows for both the fulfillment of family obligations and content mastery. Due dates are much closer than students typically appreciate.
- 2) Remind their student(s) that chemistry will require a depth of preparation, practice, knowledge, and mastery that was not required for success in previous science courses.

## **Support:**

Questions can be e-mailed to [mshea1@wcpss.net](mailto:mshea1@wcpss.net). Please allow as much as a week for your reply.

\* Dates subject to change to reflect adjustments in the academic calendar and PLT decisions

## Assessment Date: 01 September 2022

<b>Fixed-charge metals</b> (01 Sept)	Calcium	Ca	Cesium cation	Cs <sup>1+</sup>	
Lithium	Li	Strontium	Sr	Beryllium cation	Be <sup>2+</sup>
Sodium	Na	Barium	Ba	Magnesium cation	Mg <sup>2+</sup>
Potassium	K	Aluminum	Al	Calcium cation	Ca <sup>2+</sup>
Rubidium	Rb	Lithium cation	Li <sup>1+</sup>	Strontium cation	Sr <sup>2+</sup>
Cesium	Cs	Sodium cation	Na <sup>1+</sup>	Barium cation	Ba <sup>2+</sup>
Beryllium	Be	Potassium cation	K <sup>1+</sup>	Aluminum cation	Al <sup>3+</sup>
Magnesium	Mg	Rubidium cation	Rb <sup>1+</sup>		
<b>Variable-charge metals</b> (01 Sept)					
Chromium	Cr	Nickel (II)	Ni <sup>2+</sup>		
Iron	Fe	Titanium (II)	Ti <sup>2+</sup>		
Cobalt	Co	Titanium (IV)	Ti <sup>4+</sup>	<b>Latin Names</b>	
Copper	Cu	Chromium (II)	Cr <sup>2+</sup>	chromous	
Tin	Sn	Chromium (III)	Cr <sup>3+</sup>	chromic	
Mercury	Hg	Iron (II)	Fe <sup>2+</sup>	ferrous	
Nickel	Ni	Iron (III)	Fe <sup>3+</sup>	ferric	
Lead	Pb	Copper (I)	Cu <sup>1+</sup>	cuprous	
Molybdenum	Mo	Copper (II)	Cu <sup>2+</sup>	cupric	
Titanium	Ti	Manganese (II)	Mn <sup>2+</sup>	manganous	
Silver	Ag	Manganese (III)	Mn <sup>3+</sup>	manganic	
Zinc	Zn	Tin (II)	Sn <sup>2+</sup>	stannous	
Manganese	Mn	Tin (IV)	Sn <sup>4+</sup>	stannic	
Silver cation	Ag <sup>1+</sup>	Mercury (I)	Hg <sub>2</sub> <sup>2+</sup>	mercurous	
Zinc cation	Zn <sup>2+</sup>	Mercury (II)	Hg <sup>2+</sup>	mercuric	
Cobalt (II)	Co <sup>2+</sup>	Lead (II)	Pb <sup>2+</sup>	plumbous	
		Lead (IV)	Pb <sup>4+</sup>	plumbic	

## Assessment Date: 02 September 2022

<b>Nonmetals</b> (02 Sept)	Oxygen	O <sub>2</sub>	Fluoride	F <sup>1-</sup>	
Helium	He	Ozone	O <sub>3</sub>	Chloride	Cl <sup>1-</sup>
Neon	Ne	Nitrogen	N <sub>2</sub>	Bromide	Br <sup>1-</sup>
Argon	Ar	Sulfur	S	Iodide	I <sup>1-</sup>
Krypton	Kr	Selenium	Se	Oxide	O <sup>2-</sup>
Xenon	Xe	Phosphorus	P	Sulfide	S <sup>2-</sup>
Hydrogen	H <sub>2</sub>	Arsenic	As	Selenide	Se <sup>2-</sup>
Fluorine	F <sub>2</sub>	Carbon	C	Nitride	N <sup>3-</sup>
Chlorine	Cl <sub>2</sub>	Silicon	Si	Phosphide	P <sup>3-</sup>
Bromine	Br <sub>2</sub>	Boron	B	Arsenide	As <sup>3-</sup>
Iodine	I <sub>2</sub>	Hydrogen cation	H <sup>1+</sup>		
		Hydride	H <sup>1-</sup>		
<b>Polyatomic ions</b> (02 Sept)					
Ammonium	NH <sub>4</sub> <sup>1+</sup>	Bromate	BrO <sub>3</sub> <sup>1-</sup>	Carbonate	CO <sub>3</sub> <sup>2-</sup>
Perchlorate	ClO <sub>4</sub> <sup>1-</sup>	Iodate	IO <sub>3</sub> <sup>1-</sup>	Bicarbonate	HCO <sub>3</sub> <sup>1-</sup>
Chlorate	ClO <sub>3</sub> <sup>1-</sup>	Nitrate	NO <sub>3</sub> <sup>1-</sup>	Sulfate	SO <sub>4</sub> <sup>2-</sup>
Chlorite	ClO <sub>2</sub> <sup>1-</sup>	Nitrite	NO <sub>2</sub> <sup>1-</sup>	Sulfite	SO <sub>3</sub> <sup>2-</sup>
Hypochlorite	ClO <sup>1-</sup>	Cyanide	CN <sup>1-</sup>	Bisulfate	HSO <sub>4</sub> <sup>1-</sup>
Phosphate	PO <sub>4</sub> <sup>3-</sup>	Hydroxide	OH <sup>1-</sup>	Chromate	CrO <sub>4</sub> <sup>2-</sup>
Phosphite	PO <sub>3</sub> <sup>3-</sup>	Peroxide	O <sub>2</sub> <sup>2-</sup>	Dichromate	Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup>
Acetate	C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> <sup>1-</sup>	Permanganate	MnO <sub>4</sub> <sup>1-</sup>	Oxalate	C <sub>2</sub> O <sub>4</sub> <sup>2-</sup>
		Thiocyanate	SCN <sup>1-</sup>		
		Thiosulfate	S <sub>2</sub> O <sub>3</sub> <sup>2-</sup>		

# THE PERIODIC TABLE

## Background Information

The Periodic Table is a list of all the ***known elements***. It is organized by ***increasing atomic number***. There are two main sections on the periodic table: ***metals and nonmetals***. The left side of the table contains elements with the greatest metallic properties (metals). As you move from the left to the right, the elements become less metallic with the far-right side of the table consisting of nonmetals. The elements in the middle of the table are called "***transition***" elements because they have a wide range of metallic properties. A small subset whose members touch the zigzag line are called ***metalloids*** because they have both metallic and nonmetallic properties.

The table is also arranged in horizontal rows called "***periods***" and in vertical columns called "***groups***" or "***families***." Each arrangement is significant. The elements in the first period or row all have one ***energy level***. The elements in period 2 all have two (2) energy levels. The elements in period 3 all have three (3) energy levels, and so on. The elements in each vertical column or group have similar chemical properties. Group 1 elements all have one (1) electron in their outer shells (***valence electrons***). Group 2 elements all have two (2) electrons in their outer shells. Not all of the groups, however, hold true for this pattern. The number of valence electrons for a group impact the properties of that group. There are a number of major groups with similar properties. They are as follows:

***Hydrogen:*** The properties of this element do not match the properties of any other group, so it stands alone. It is placed above group 1, but it is not part of that group. It is a very reactive, colorless, odorless gas at room temperature. **(1 valence electron)**

***Group 1: Alkali Metals*** – These metals are extremely reactive and are never found in nature in their pure elemental form. They are silver-colored and shiny. Their density is extremely low so that they are soft enough to be cut with a knife. **(1 valence electron, s-block)**

***Group 2: Alkaline-Earth Metals*** – Slightly less reactive than alkali metals. They are silver-colored and denser than alkali metals. **(2 valence electrons, s-block)**

***Groups 3 – 12: Transition Metals*** – These metals have a moderate range of reactivity and a wide range of properties. In general, they are shiny and good conductors of heat and electricity. They also have higher densities and melting points than Groups 1 & 2. **(varying range of valence electrons, d-block)**

***Lanthanides and Actinides:*** These are also transition metals that were taken out and placed at the bottom of the table so the table wouldn't be so wide. The elements in each of these two series share many properties. The lanthanides are shiny and reactive. The actinides are *all* radioactive and are therefore unstable. Elements 95 through 118 do not exist in nature but have been manufactured in the lab. **(f-block)**

***Group 13: Boron Group*** – Contains one metalloid and 5 metals. Reactive. Aluminum is in this group and is also the most abundant metal in the earth's crust. **(3 valence electrons, p-block)**

***Group 14: Carbon Group*** – Contains one nonmetal, two metalloids, and three metals. Varied reactivity. **(4 valence electrons, p-block)**

***Group 15: Nitrogen Group*** – Contains two nonmetals, two metalloids, and two metals. Varied reactivity. **(5 valence electrons, p-block)**

***Group 16: Oxygen Group*** – Contains three nonmetals, one metalloid, and two metals. Reactive group. **(6 valence electrons, p-block)**

***Groups 17: Halogens*** – All nonmetals. Very reactive. Poor conductors of heat and electricity. Tend to form salts with metals. (Ex. NaCl, sodium chloride, i.e., "table salt".) **(7 valence electrons, p-block)**

***Groups 18: Noble Gases*** – Unreactive (Inert) nonmetals. All are colorless, odorless gases at room temperature. All found in earth's atmosphere in small amounts. **(8 valence electrons, p-block)**

Bookmark and use <https://ptable.com> to assist you!

## Color Coding the Periodic Table

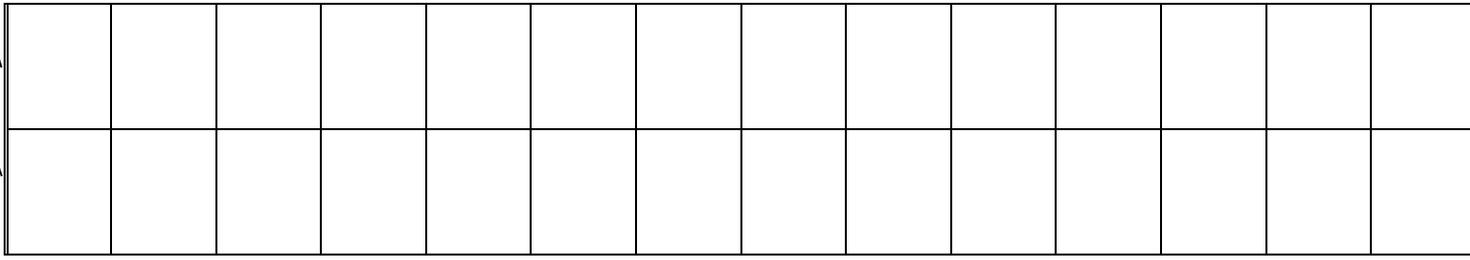
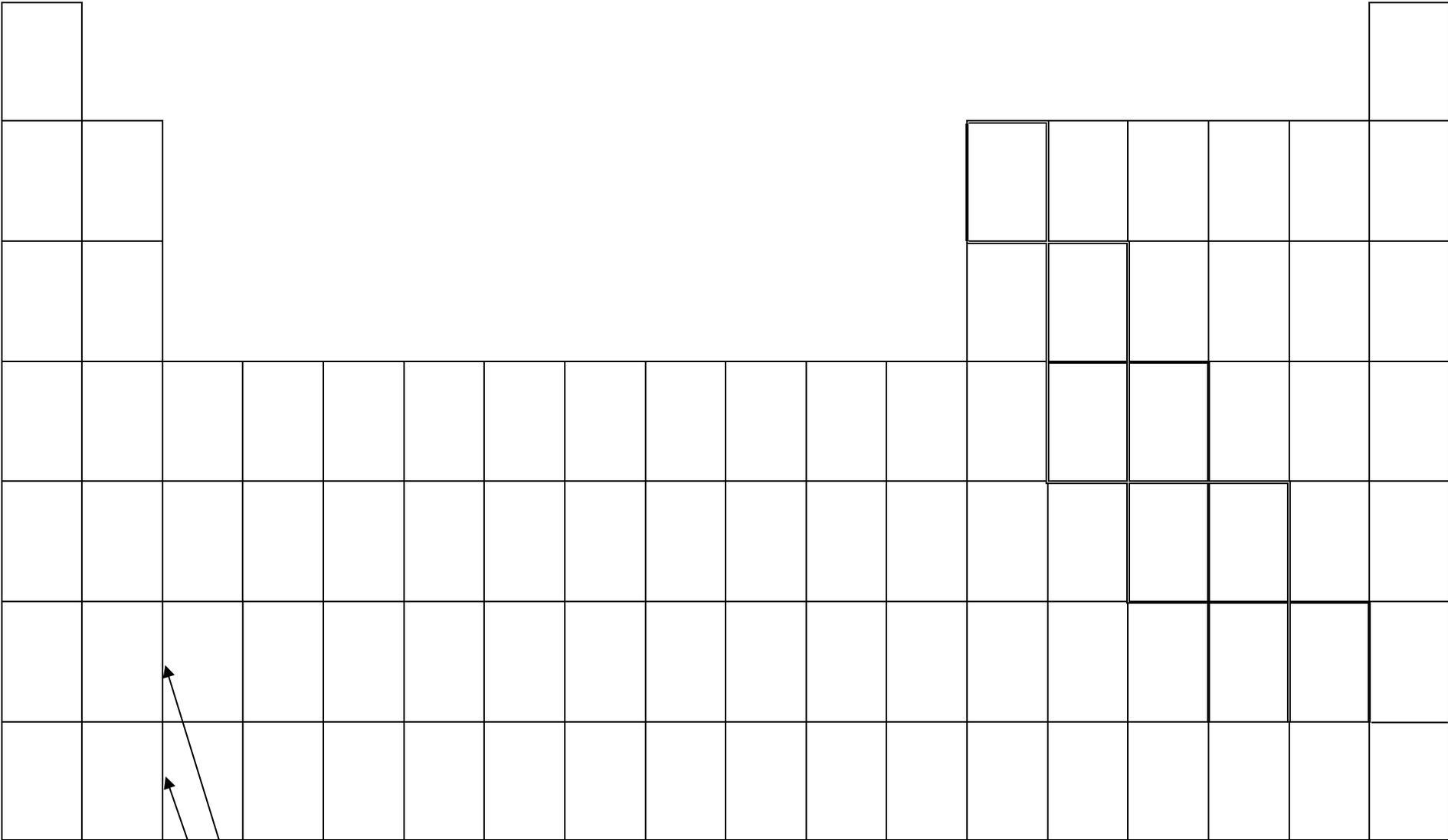
- I. Write the element ***SYMBOL and ATOMIC NUMBER only*** in the square for each element.
- II. Using colored pencils, ***COLOR and LABEL*** each group on the periodic table as follows:
  1. Color Hydrogen ***PINK***.
  2. Lightly color all metals ***YELLOW***.
    - a. Label and place black dots in the squares of all alkali metals.
    - b. Label and draw a horizontal line across the squares of all alkaline-earth metals.
    - c. Label and draw a diagonal line across the squares of all transition metals.
    - d. Label and color all the lanthanide series elements ***HALF YELLOW/RED***.
    - e. Label and color all the actinide series elements ***HALF YELLOW/GREEN***.
  3. Label and trace (outline) the metalloid staircase (zigzag), starting at Boron, with a ***BLACK MARKER***. This separates the metals from the nonmetals. Color each metalloid element ***PURPLE***.
  4. Lightly color all nonmetals ***ORANGE***.
    - a. Label and draw small black diamonds in the squares of all halogens.
    - b. Label and draw small checkerboard squares in the squares of all noble gases.
  5. Label each block of the periodic table with a bracket ( { ) and the appropriate lower-case letter.

***\*\*When you are finished, make a key that indicates which color identifies which group (Ex: Alkali Metals = Yellow w/black dots)\*\****

## Family Ties

Follow the instructions below to label the major groups and divisions of the periodic table.

1. The vertical columns on the periodic table are called \_\_\_\_\_.
2. The horizontal rows on the periodic table are called \_\_\_\_\_.
3. Most of the elements in the periodic table are classified as \_\_\_\_\_.
4. The elements that touch the zigzag (staircase) line are classified as \_\_\_\_\_.
5. The elements above the metalloids are classified as \_\_\_\_\_.
6. Elements in the first group have one valence electron and are extremely reactive. They are called \_\_\_\_\_.
7. Elements in the second group have two valence electrons and are also very reactive. They are called \_\_\_\_\_.
8. Elements in groups 3-12 have many useful properties and are called \_\_\_\_\_.
9. Elements in group 17 are known as "salt formers". They are called \_\_\_\_\_.
10. Elements in group 18 are very unreactive (inert). We call these the \_\_\_\_\_.
11. The elements at the bottom of the table were pulled out to keep the table from becoming too long. The first series at the bottom is called the \_\_\_\_\_.
12. The second series at the bottom of the table is called the \_\_\_\_\_.



A number of items that may be used in the laboratory are shown below. Study this page and decide for what activity or operation the items may be used. Use the names of the equipment shown to answer the questions on page 7.



# LAB EQUIPMENT

**Unscramble the letters in parentheses to name each piece of equipment that would be useful for each of the following tasks. Refer to page 6 as needed.**

- 1) Holding 100 mL of water (ebkare) \_\_\_\_\_
- 2) Measuring 27.0 mL of liquid (daudgtear ldnreiy) \_\_\_\_\_
- 3) Measuring exactly 43.00 mL of an acid (rtube) \_\_\_\_\_
- 4) Diluting a solution to exactly 100.0 mL (omveltciru skfla) \_\_\_\_\_
- 5) Massing out 120.0 g of sodium chloride (nlocteeric ebcnla) \_\_\_\_\_
- 6) Suspending glassware over the Bunsen burner (rwei zeagu) \_\_\_\_\_
- 7) Used to pour liquids into containers with small openings or to hold filter paper (unfenl) \_\_\_\_\_
- 8) Mixing small amounts of chemicals together (lewl letpa) \_\_\_\_\_
- 9) Heating contents in a test tube (estt ubet smalcp) \_\_\_\_\_
- 10) Holding many test tubes filled with chemicals (estt ubet karc) \_\_\_\_\_
- 11) Used to clean the inside of test tubes or graduated cylinders (iwer srbuh) \_\_\_\_\_
- 12) Keeping liquid contents in a beaker from splattering (tahcw sgasl) \_\_\_\_\_
- 13) A narrow-mouthed container used to transport, heat or store substances, often used when a stopper is required (ymerereel kslaf) \_\_\_\_\_
- 14) Heating contents in the lab (nuesnb bneurr) \_\_\_\_\_
- 15) Transport a hot beaker (gntos) \_\_\_\_\_
- 16) Protects the eyes from flying objects or chemical splashes (ggloges) \_\_\_\_\_
- 17) Used to grind chemicals to powder (tmraor nda stlepe) \_\_\_\_\_

# SIGNIFICANT DIGITS

What are significant digits?

**Significant digits** are a method of reporting numbers to the **precision** that we know them. For example, if you have about \$20, then you have reported your wealth to the tens place (one significant digit). If you recount it as \$21, then you have reported your wealth to the ones place (two sig digs). If you completely count it as \$21.37, then you have reported it now to four significant digits - each time increasing the *precision* of your data, although not the *accuracy*.

Which digits are significant?

- **All nonzero digits are significant.**
- **All sandwich zeroes are significant.** (as in 2.05 or 1064)
- **Leading zeroes are never significant.** (as in 0.0025)
- **Trailing zeroes are significant only when** a decimal is present. (as in 7.30 or 60.80 or 400.)
- Trailing zeroes are not significant when a decimal is absent. (as in 25000)

Value	Significant Digits	Rewrite the value in scientific or standard notation (Forgot how to do this?!? Helpful reminder video <a href="#">here</a> )
104		
25.300		
0.0065		
0.000406		
$1.250 \times 10^5$		
$2.78 \times 10^{-4}$		
$6.02070 \times 10^{-3}$		

Rules for rounding to significant digits

Identify the digit to be rounded and then inspect the number immediately to the RIGHT of that digit.

If the number to the RIGHT of the rounded digit is less than 5, then don't change the digit (round down).

If the number to the RIGHT of the rounded digit is greater than or equal to 5, then round the digit up.

Example: Round 3043.25 to three significant digits.

└───▶ The "4" is the digit to be rounded. Look immediately to the right at the "3". Since  $3 < 5$ , then "3043.25" rounds down to "3040".

Round 4.3352 to three significant digits.

└───▶ The "3" is the digit to be rounded. Look immediately to the right at the "5". Since  $5 = 5$ , then "4.3352" rounds up to "4.34".

Round each value to the number of significant digits shown in parentheses.

1.395	(3)	2450.762350	(6)
1.395	(2)	2450.762350	(4)
1.395	(1)	2450.762350	(2)

Computation with significant digits

When doing calculations, you will have to figure out how many significant digits each measured value has and then, at the end of your calculations, round your answer to the appropriate precision.

## Multiplying and Dividing with Significant Digits

When you multiply or divide measurements, it is the number of significant digits in each measurement that matters for the answer. Count the number of significant digits in each value. The answer is rounded so that it has the same number of significant digits as the value with the **FEWEST significant digits**.

Example:  $56.82 \text{ g} / 4.18 \text{ cm}^3 = 13.593301435 \text{ g/cm}^3$ , which rounds to **13.6 g/cm<sup>3</sup>**  
(56.82 has 4 sig digs, 4.18 has 3 sig digs, so the answer has 3 sig digs)

	Number of sig digs in each value		What your calculator says	Answer rounded to the correct number of sig digs
$1.57 \times 3.5$				
$2.000 \times 5.32$				
$2.0 \times 5.32$				
$123 / 61.5$				
$287 / 7$				
$489.5 / 0.46$				
$(3.64 \times 10^2) \times (6.945 \times 10^5)$				
$(7.26 \times 10^{-4}) \times (1.39 \times 10^{-2})$				
$(1.5 \times 10^{-2}) / (3.41 \times 10^2)$				

## Adding and Subtracting with Significant Digits

This rule causes more heartache than any other rule because it has to do with place value (precision), not the number of significant digits. The answer in addition or subtraction is rounded to the **LEAST PRECISE place value** of the numbers being combined. This process is easiest when the numbers are not in scientific notation.

Example:  $4.0807 \text{ g} + 10.43 \text{ g}$   
Lining up the decimals, you get:

$$\begin{array}{r} 4.0807 \text{ g} \quad (\text{four decimal places}) \\ + 10.43 \text{ g} \quad (\text{two decimal places}) \\ \hline 14.5107 \text{ g} \text{ rounds to } \mathbf{14.51 \text{ g}} \quad (\text{two decimal places}) \end{array}$$

You will note that the first value ends at the ten-thousandths place and the second value ends at the hundredths place. The answer is rounded to the hundredths place to match that *least precise* value.

	Number of decimal places in each value		What your calculator says	Answer rounded to the least precise place value
$14.01 + 12.4$				
$5.050 + 4.3$				
$64 + 0.45$				
$340.671 - 72.3$				
$56.790 - 2.44$				
$7100.0 - 0.65$				