

Pre-AP Chemistry Summer Assignment

Dear future Pre-AP Chemistry student,

Welcome to the World of Chemistry. I look forward to having you in my PAP Chemistry class this school year. In order to make this year run smoother, you will need to have a working knowledge of chemical symbols and charges, as well as, key introductory concepts.

Some students feel that memorizing the ions is somewhat of a challenging task. To assist with this endeavor, read the introduction regarding the symbols and charges, use the patterns on the periodic table presented in this packet, create flash cards with the chemical symbol, name, and ionic charge, and log into the sites below.

Anion Concentration: <http://www.sciencegeek.net/Concentration/Anions/anions.html>

Monatomic Concentration: <http://www.sciencegeek.net/Concentration/Monatomics/monatomic.html>

Please bring all pages of the summer assignment to class on the first day to receive a grade for the practice problems you have completed throughout the packet.

We will spend a brief period reviewing the content within the packet during the first week of school; however, **expect a quiz over the memorized ions on day TWO of class.**

I am looking forward to a great year. If you have any questions during the summer months, please e-mail me at mccurlej@cisdmil.com

Sincerely,

Julie McCurley
Carroll High School
Chemistry



An explanation of the charges is on page 4.
Please read for understanding prior to
memorizing.

ION MEMORIZATION LIST

Directions: Memorize this list of ions. It is important that you memorize the ions exactly AS THEY ARE TYPED. This includes capital or lowercase letters, subscripts, +/- charge, and magnitude of charge (superscript numbers). The spelling of the ion name must also be exactly correct. Even a one letter difference means the difference between sulfate (SO_4^{2-}) and sulfite (SO_3^{2-}). **Look for patterns to make memorization easier.**

You must understand these terms:

MONATOMIC ION = single atom with a charge.

POLYATOMIC ION = group of atoms with a charge.

MONATOMIC IONS (see periodic table)

Positive

1+	2+	3+	4+
H ⁺ Hydrogen	Be ²⁺ Beryllium	B ³⁺ Boron	C ⁴⁺ Carbon
Li ⁺ Lithium	Mg ²⁺ Magnesium		Si ⁴⁺ Silicon
Na ⁺ Sodium	Ca ²⁺ Calcium		
K ⁺ Potassium	Sr ²⁺ Strontium		
Rb ⁺ Rubidium	Ba ²⁺ Barium		
Cs ⁺ Cesium	Ra ²⁺ Radium		
Fr ⁺ Francium			

Negative

(notice all monatomic negative ions end with -ide)

1-	2-	3-	4-
F ⁻ Fluoride	O ²⁻ Oxide	N ³⁻ Nitride	C ⁴⁻ Carbide
Cl ⁻ Chloride	S ²⁻ Sulfide	P ³⁻ Phosphide	Si ⁴⁻ Silicide
Br ⁻ Bromide	Se ²⁻ Selenide	As ³⁻ Arsenide	
I ⁻ Iodide	Te ²⁻ Telluride		
At ⁻ Astatide			
(H ⁻ Hydride)			

MULTIPLE CHARGED MONATOMIC IONS

(notice Roman numerals)

Cu ⁺ Copper (I)	Fe ²⁺ Iron(II)	Pb ²⁺ Lead(II)
Cu ²⁺ Copper (II)	Fe ³⁺ Iron(III)	Pb ⁴⁺ Lead(IV)
Sn ²⁺ Tin (II)	Hg ₂ ²⁺ Mercury (I)	
Sn ⁴⁺ Tin (IV)	Hg ²⁺ Mercury (II)	

CONSTANT CHARGE TRANSITION METAL IONS

(notice absence of Roman Numerals)

Ag ⁺ Silver
Al ³⁺ Aluminum
Cd ²⁺ Cadmium
Zn ²⁺ Zinc

POLYATOMIC IONS

Positive

(NH ₄) ⁺	Ammonium
(H ₃ O) ⁺	Hydronium

Negative

1-	2-	3-
(C ₂ H ₃ O ₂) ⁻ Acetate	(CO ₃) ²⁻ Carbonate	(PO ₄) ³⁻ Phosphate
(CH ₃ COO) ⁻ Acetate*	(Cr ₂ O ₇) ²⁻ Dichromate	
(OH) ⁻ Hydroxide	(C ₂ O ₄) ²⁻ Oxalate	
(NO ₃) ⁻ Nitrate	(O ₂) ²⁻ Peroxide	
(MnO ₄) ⁻ Permanganate	(SO ₄) ²⁻ Sulfate	
(ClO) ⁻ Hypochlorite	(SO ₃) ²⁻ Sulfite	
(ClO ₂) ⁻ Chlorite		
(ClO ₃) ⁻ Chlorate		
(ClO ₄) ⁻ Perchlorate		
(HCO ₃) ⁻ Hydrogen carbonate (bicarbonate)		
(CN) ⁻ Cyanide		

*Acetate may be written either way. We will use the first one most of the time.

Notice this column has all **+1** charges.

Notice this column has all **+2** charges.



Look for patterns

PERIODIC TABLE OF THE ELEMENTS

1 H 1.0079											2 He 4.0026						
3 Li 6.941	4 Be 9.012											5 B 10.811	6 C 12.011	7 N 14.007	8 O 16.00	9 F 19.00	10 Ne 20.179
11 Na 22.99	12 Mg 24.30											13 Al 26.98	14 Si 28.09	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.938	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.91	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 *La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.2	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.02	89 †Ac 227.03	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 § (269)	111 § (272)	112 § (277)	§Not yet named					

*Lanthanide Series

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
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†Actinide Series

90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)
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Transitional Metals have variable charges; therefore, patterns are less discernible.

Ions and Symbols

An **ion** is an atom or molecule in which the total number of electrons is not equal to the total number of protons, giving it a net positive or negative electrical charge. An **anion**, is an ion with more electrons than protons, giving it a net negative charge (since electrons are negatively charged and protons are positively charged). Conversely, a **cation**, is an ion with more protons than electrons, giving it a positive charge.

An ion consisting of a single atom is a **monatomic ion**. If it consists of two or more atoms, it is a **polyatomic ion**. When writing the chemical formula or symbol for an ion, its charge is written as a superscript "+" or "-" following a number. This indicates the difference between the number of protons and the number of electrons. The number is omitted if it is equal to 1. For example, the sodium cation is written as Na^+ , the "+" indicates that it has one less electron than it has protons. The sulfate anion is written as SO_4^{2-} , the "2-" indicating that it has *two* more electrons than it has protons.

If the above paragraph seems confusing, think about it this way. Lithium, sodium, potassium, etc... have a +1 because that is how many electrons they need to lose to have 8 valence electrons (stable)? In 8th grade you studied how important it was for atoms to bond and form an octet (8) valence shell of 8 electrons. Therefore, sodium will lose (+) one electron to form a valence shell of 8. Chlorine is a -1 because it needs to gain one electron to obtain 8 electrons in the outer valence shell. Yes, this can also be confusing because lose is a "+" and gain is a "-". Sorry, can't make everything easy right☺

In chemistry, **valence electrons** are the outermost electrons of an atom, which are important in determining how the atom reacts chemically with other atoms. The number of valence electrons of an element is determined by its periodic table group (vertical column) in which the element is categorized. With the exception of groups 3–12 (transition metals), the number within the unit's place identifies how many valence electrons are contained within the elements listed under that particular column. Therefore, if you know how many valence electrons an element's atom contains, you can determine how many it needs to gain or lose to reach that magic number "8" valence electrons.

Data Analysis (Review)

I. Units of Measurement

A. Metric Prefixes

Please review the metric prefixes below. All of these have been presented in your mathematics courses; however, we will incorporate them in our use with Chemistry. You must know the information presented in COLUMNS 1, 2 AND 4!!

<i>1</i> <i>Prefix</i>	<i>2</i> <i>Symbol</i>	<i>3</i> <i>Meaning</i>	<i>4</i> <i>Scientific Notation</i>	<i>5</i> <i>Example</i>
giga	G	1 000 000 000 times larger than base unit	1×10^9	gigameter Gm
mega	M	1 000 000 times larger	1×10^6	megagram Mg
kilo	k	1000 times larger	1×10^3	kilometer km
base unit	(g, m, s, L)	1 base unit		
deci	d	10 times smaller (1/10 of base)	1×10^{-1}	deciliter dL
centi	C	100 times smaller (1/100)	1×10^{-2}	centimeter cm
milli	m	1000 times smaller (1/1000)	1×10^{-3}	milligram mg
micro	μ	1 million times smaller (1/1,000,000)	1×10^{-6}	microgram μ g
nano	n	1 billion times smaller (1/1,000,000,000)	1×10^{-9}	nanometer nm
pico	p	1 trillion times smaller (1/1,000,000,000,000)	1×10^{-12}	picometer pm

B. International System of Units

Please review the base units for the international system. Base unit is a defined as a system of measurement that is based on an object or event in the physical world. All other physical units can be derived from these base units: these are known as SI derived units. Below are the seven base units we will use in chemistry.

<i>Quantity Measured</i>	<i>Unit</i>	<i>SI Symbol</i>
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	Kelvin/ Celsius	K ($^{\circ}$ C)
Amount of substance	mole	mol
Electric current	ampere	A
Luminous Intensity	candela	cd

Mass

- the amount of matter in a substance
- kilogram (kg) is official base unit [too large for chemistry so we use gram (g)]
- measured on a balance

Length

- distance covered by a straight line connecting two points
- meter (m) is base unit
- measured with a ruler or similar device

Time

- the interval between two occurrences
- measured in seconds (s)
- measured with clock or watch

Temperature

- the measure of the average kinetic energy of the particles of a sample
- metric temperature scale (Celsius, °C):
 - ❖ 0° C = freezing point of water at 1 atmosphere of pressure
 - ❖ 100°C = boiling point of water at 1 atmosphere of pressure
 - ❖ room temperature = about 25°C
 - ❖ body temperature = about 37°C
 - ❖ absolute temperature scale (Kelvin, K)
 - 0 K = absence of all molecular motion (absolute zero)
 - 273 K = freezing point of water
 - 373 K = boiling point of water
 - 298 K = room temperature
 - Related to Celsius by: °C + 273 = K
- Fahrenheit (°F)
 - ❖ 32°F = freezing point of water
 - ❖ 212°F = boiling point of water
 - ❖ Related to Celsius by: $T_F = T_C \times 1.8 + 32^\circ\text{F}$

Practice

1) Normal body temperature is 98.6°F. Convert this to the Celsius and Kelvin scales.

2) Liquid nitrogen, which is often used as a coolant for low-temperature experiments, has a boiling point of 77 K. What is this temperature on the Fahrenheit scale?

II. DENSITY

Density is a derived unit. A unit that is defined as a combination of base units
Density = mass per unit volume

$$D = m/V$$

A. Mass (m)

- is measured in grams (g)
- is measured on a balance
- may be calculated using the procedures below

Procedures:

1. mass the empty container first
2. add desired material
3. mass the full container
4. subtract to find mass of material

*Example: Sally was asked to find the mass of 250 mL of water. She measured the mass of the 500 mL beaker. It weighed 800 g. She poured 250 mL of water into the beaker and placed the beaker plus the water on the balance. The new mass was 1500 g. Sally subtracted 800 g from 1500 mL to obtain the mass of the water which was **700 g**.*

B. Volume (V)

- measure of the amount of space matter occupies
- measured in cm^3 or mL
 $(1 \text{ cm}^3 = 1 \text{ mL}) \rightarrow$ MEMORIZE THIS conversion
- if you are determining the volume of a liquid in a graduated cylinder make sure you read from the bottom of the meniscus
- if you are obtaining the volume of a regular solid, measure with a ruler:
length x width x height = V
- if you are obtaining the volume of an irregular solid, measure by water displacement

Procedures:

1. fill graduated cylinder to specific volume (record)
2. add irregular shaped object
3. record the new volume
4. subtract: final volume - initial volume = object volume

C. Units of density

$$D = \frac{m}{V} = \frac{g}{\text{mL}} \quad \text{or} \quad \frac{g}{\text{cm}^3}$$

D. Density problems

- 1) Find the density of a liquid if the mass is 4.98 g and the volume is 2.36 mL.
- 2) Find the density of the wooden box if its mass is 3.2g, the length is 2.0 cm, the width is 2.0 cm, and the height is 2.0 cm.
- 3) Carla was given a piece of metal to determine its density. The initial mass of the object was 7.8 g. She dropped the metal into a graduated cylinder that had 10.0mL of water in it. When she dropped the metal into the water, the final volume read 17.4 mL. What is the density of the unknown metal?
- 4) What is the volume of the metal block if the density is equal to 2.1 g/mL and the mass is 3.5 g?

III. Accuracy and Precision

Accurate means "capable of providing a correct reading or measurement." In physical science it means 'correct'. A measurement is accurate if it correctly reflects the size of the thing being measured.

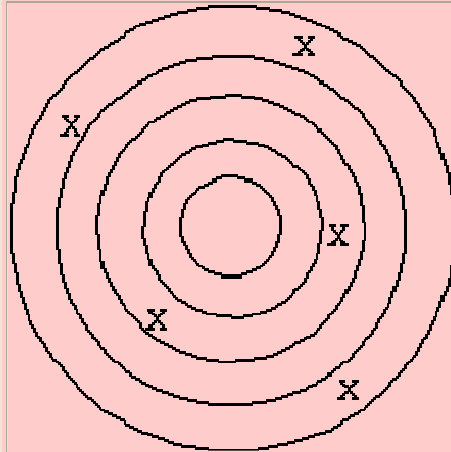
Precise means "exact, as in performance, execution, or amount. "In physical science it means "repeatable, reliable, getting the same measurement each time."

We can never make a perfect measurement. The best we can do is to come as close as possible within the limitations of the measuring instruments.

Let's use a model to demonstrate the difference.

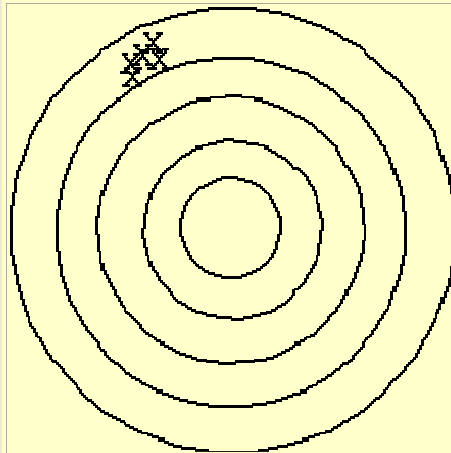
Suppose you are aiming at a target, trying to hit the bull's eye (the center of the target) with each of five darts. Here are some representative patterns of darts in the target.

Neither Precise Nor Accurate



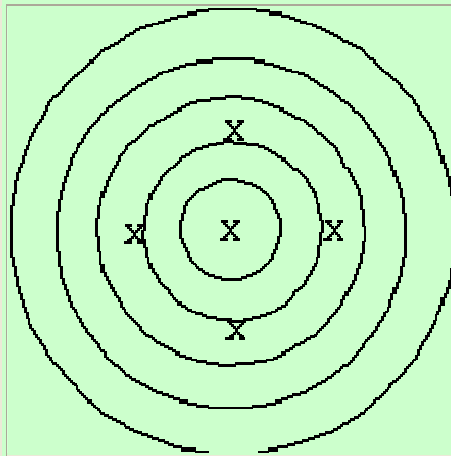
This is a randomlike pattern, neither precise nor accurate. The darts are not clustered together and are not near the bull's eye.

Precise, Not Accurate

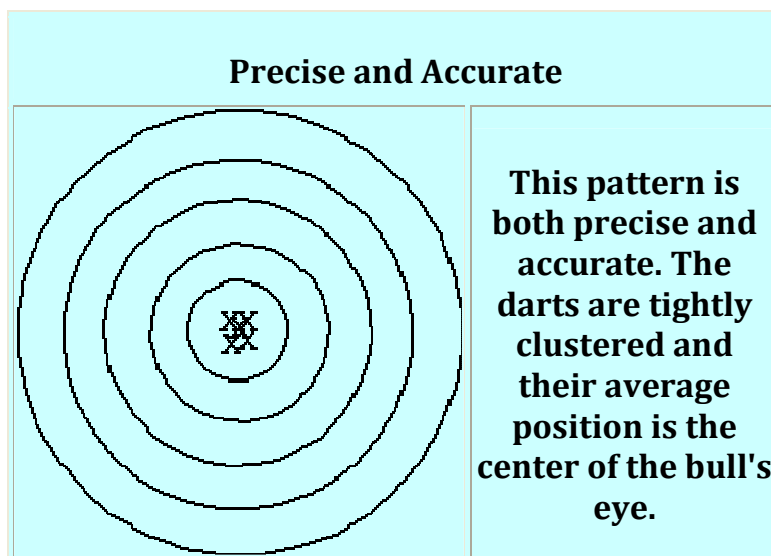


This is a precise pattern, but not accurate. The darts are clustered together but did not hit the intended mark.

Accurate, Not Precise



This is an accurate pattern, but not precise. The darts are not clustered, but their 'average' position is the center of the bull's eye.



VI. Significant Figures

The **minimum** number of digits required to report a value without loss of accuracy is the number of significant figures. It is important to use significant figures when recording a measurement so that it does not appear to be more accurate than the equipment is capable of determining. The most significant digit is the left-most non-zero digit, i.e. 7 in the number 0.007345. The least significant digit is the right-most digit if the number includes the decimal, i.e. in the number 23.540, 0 is the least significant digit. The least significant digit is the right-most non-zero digit if the number has no decimal, i.e. in 123000, 3 is the least significant digit.

RULES

- All non-zero digits are significant*
 EX: 456 (3 significant figures)
 932.76 (5 sigfigs.)
- Leading zeros are **NEVER** significant*
 EX: 0.0000234 (3 sigfigs.)
 0.002 (1 sigfig.)
- Middle zeros are **ALWAYS** significant*
 EX: 1002 (4 sigfigs.)
 9.0043 (5 sigfigs.)
- Trailing zeros are significant **ONLY IF THERE IS A DECIMAL POINT IN THE NUMBER***
 EX: 223.0 (4 sigfigs.)
 200 (1 sigfig.)
 9.87000 (6 sigfigs.)
- Counting numbers and defined constants have an infinite number of significant figures.
 EX: 6 molecules
 60 s = 1 min

Rounding Off

Calculations with measurements must maintain proper degree of certainty.

2. Significant figure rules in mathematic calculations:

- a. In multiplication and division, the answer may not contain any more **SIGNIFICANT DIGITS** than the number in the calculation with the fewest significant digits.

ex: $\frac{1.5 \text{ grams}}{4 \text{ mL}} = 0.375 \text{ g/mL}$

ROUND THIS TO: 0.4 g/mL

- b. In addition and subtraction, the answer may not contain any more **DECIMAL PLACES** than the number in the calculation with the fewest decimal places.

ex.
$$\begin{array}{r} 98 \\ + 213.67 \\ \hline 311.67 \end{array}$$
 ROUND THIS TO: 312

Significant Figures – Review and Practice Part I

Print out the worksheet from this website and read it as an extra review of the importance of significant figures and added explanation of the rules above. Answer the questions at the end of the worksheet as extra practice to be turned in on the first day of class.

<http://www.chalkbored.com/lessons/chemistry-11/significant-digits-worksheet.pdf>

Significant Figures – Basic Practice Part II

How many significant figures are in each of the following numbers?

- 1) 5.40 s _____
- 2) 210 mL _____
- 3) 801.5 g _____
- 4) 1,000 m _____
- 5) 101.0100 cm _____
- 6) 1.2×10^3 kg _____
- 7) 0.00120 mg _____
- 8) 0.0102 L _____
- 9) 9.010×10^{-6} mm _____
- 10) 2,370.0 g _____
- 11) Why are significant figures important when taking data in the laboratory?
- 12) Why are significant figures NOT important when solving problems in your math class?
- 13) Using two different instruments, I measured the length of my foot to be 27 centimeters and 27.00 centimeters. Explain the difference between these two measurements.

Significant Figure Calculations – Practice Part III

Solve the following mathematical problems such that the answers have the correct number of significant figures:

- 1) 334.540 grams + 198.9916 grams = _____
- 2) 34 grams / 10.1 mL = _____
- 3) 2.61×10^6 joules / 0.0034 seconds = _____
- 4) 0.0610 m – 0.18 m = _____
- 5) 349.0 cm + 1.10 cm + 100. cm = _____
- 6) 252 meters / 910 seconds = _____
- 7) 248.01010 kilograms + 84.097 kilograms = _____
- 8) 44 m/s x 20 s = _____