

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## AP Chemistry Summer Review Worksheet

### Significant Figures

Need a tutorial? <https://tinyurl.com/APsummer1> (Khan Academy video list): <https://goo.gl/uuOU2w>

1. Round each of the following off to the specified number of sig fig's:
- a. Round 78.241 g to 4 sf: \_\_\_\_\_ 3 sf: \_\_\_\_\_ 2 sf: \_\_\_\_\_ 1 sf: \_\_\_\_\_
- b. Round 0.2983 g to 4 sf: \_\_\_\_\_ 3 sf: \_\_\_\_\_ 2 sf: \_\_\_\_\_ 1 sf: \_\_\_\_\_
- c. Round 50,001 g to 4 sf: \_\_\_\_\_ 3 sf: \_\_\_\_\_ 2 sf: \_\_\_\_\_ 1 sf: \_\_\_\_\_
2. Solve, and round answers to the proper number of sig figs. SHOW YOUR WORK & include units.
- a. A 5627 g brick measures 5.60 cm x 4.51 cm x 24.71 cm. What is its density?
- b. Before a titration, the initial reading from a buret is 0.75 mL. Afterwards, the reading is 13.22 mL. What volume of liquid was used in the titration?
- c. A 45.67g stone with a density of 6.81 g/cm<sup>3</sup> is placed in a graduated cylinder, what is its volume?
- d. A series of masses are added together: 23.1g + 4.77g + 125.39g + 3.581g. What is the total mass?

### Dimensional Analysis: (AKA factor-labeling or unit conversions)

Need a tutorial? <https://tinyurl.com/APsummer2>

1 hr = 60 min	1 min = 60 sec	1 ton = 2000 lbs	7 days = 1 week
24 hrs = 1 day	1 kg = 2.2 lbs	1 gal = 3.79 L	264.2 gal = 1 cubic meter
1 mi = 5,280 ft	1 kg = 1000 g	1 lb = 16 oz	20 drops = 1 mL
365 days = 1 yr	52 weeks = 1 yr	2.54 cm = 1 in	1 L = 1000 mL
0.621 mi = 1.00 km	1 yd = 36 inches	1 cc is 1 cm <sup>3</sup>	1 mL = 1 cm <sup>3</sup>

3. The moon is 250,000 miles away. How many feet is it from earth?  
sum

4. There are 355 ml of soda in a can. How many gallons is this?
  
5. How many feet per second is a wave going if it travels a distance of 1.00 mile in 7.35 min?
  
6. A speed of 60.0 miles/ hour is how many ft/sec?
  
7. A liquid has a density of 0.729 g/mL. What is the volume of 1.45 tons of this liquid?

### Atomic Structure: The Basics

Need a tutorial? <https://tinyurl.com/APsummer3>

1. Complete the following table.

Nuclear Symbol	# of protons	# of neutrons	# of electrons	Atomic #	Mass #	Charge
		28	21	25		
			18	15	31	
$^{13}_6\text{C}$					13	
	17				36	1-
$^{56}_{26}\text{Fe}^{3+}$			23		56	

Need a tutorial? <https://tinyurl.com/APsummer4>

2. Calculate the average atomic mass for each of the following elements assuming that each consists of the isotopic mixtures given below:
  - a.  $^{10}\text{B} = 20.0\%$ ,  $^{11}\text{B} = 80.0\%$  B: \_\_\_\_\_
  
  - b.  $^{20}\text{Ne} = 90.9\%$ ,  $^{21}\text{Ne} = 0.3\%$ ,  $^{22}\text{Ne} = 8.8\%$  Ne: \_\_\_\_\_

**Nomenclature:** -Identify the type of substance, then either name it or write the correct formula

Need a tutorial? <https://tinyurl.com/APsummer5>

1.

Formula	Type of Compound? (ionic, covalent, or acid)	Name
		Hydrobromic acid
		Dinitrogen pentoxide
BaI <sub>2</sub>		
SO <sub>2</sub>		
		Nickel II chloride
H <sub>2</sub> CO <sub>3</sub>		
		Phosphorous acid
		Potassium dichromate
Hg(OH) <sub>2</sub>		
HF		
HNO <sub>2</sub>		
NiI <sub>3</sub>		
		Zinc arsenide
		Xenon tetrafluoride
		Iron III nitrate
Cu <sub>2</sub> Cr <sub>2</sub> O		
PCl <sub>3</sub>		
		Ammonium sulfide
K <sub>2</sub> O		

**Chemical Equations:**

Need a tutorial? <https://tinyurl.com/APsummer6>

13. Balance the following equations with the lowest whole number coefficients.

- $\underline{\quad} \text{S}_8 + \underline{\quad} \text{O}_2 \rightarrow \underline{\quad} \text{SO}_3$
- $\underline{\quad} \text{C}_{10}\text{H}_{16} + \underline{\quad} \text{Cl}_2 \rightarrow \underline{\quad} \text{C} + \underline{\quad} \text{HCl}$
- $\underline{\quad} \text{Fe} + \underline{\quad} \text{O}_2 \rightarrow \underline{\quad} \text{Fe}_2\text{O}_3$
- $\underline{\quad} \text{C}_2\text{H}_6\text{O}_2 + \underline{\quad} \text{O}_2 \rightarrow \underline{\quad} \text{CO}_2 + \underline{\quad} \text{H}_2\text{O}$
- $\underline{\quad} \text{KClO}_3 \rightarrow \underline{\quad} \text{KCl} + \underline{\quad} \text{O}_2$
- $\underline{\quad} \text{H}_3\text{AsO}_4 \rightarrow \underline{\quad} \text{As}_2\text{O}_5 + \underline{\quad} \text{H}_2\text{O}$
- $\underline{\quad} \text{V}_2\text{O}_5 + \underline{\quad} \text{HCl} \rightarrow \underline{\quad} \text{VOCl}_3 + \underline{\quad} \text{H}_2\text{O}$
- $\underline{\quad} \text{Hg}(\text{OH})_2 + \underline{\quad} \text{H}_3\text{PO}_4 \rightarrow \underline{\quad} \text{Hg}_3(\text{PO}_4)_2 + \underline{\quad} \text{H}_2\text{O}$

Need a tutorial? (identify reaction types): <https://tinyurl.com/APsummer7>  
 (predicting products): <https://tinyurl.com/APsummer8>

13. For each of the following reactions:

- Identify the type of reaction (decomposition, synthesis, single replacement, double replacement, acid-base neutralization, or combustion).
- Predict products and write a balanced equation

<u>Reactants</u>	<u>Type of Reaction</u>	<u>Complete Balanced Equation</u>
Ammonium chloride is added to silver nitrate		
Magnesium is added to a solution of copper II nitrate		
Calcium carbonate decomposes		
Octane (C <sub>8</sub> H <sub>18</sub> ) is burned in air		
Calcium hydroxide is added to sulfuric acid		
Strontium is added to hydrochloric acid		
Aluminum metal reacts with oxygen gas		
A solution of tin IV sulfate is added to a solution of ammonium hydroxide		
Lithium chloride is added to zinc phosphate		
Ethanol (C <sub>2</sub> H <sub>5</sub> OH) is burned in the air		

## Solubility Rules: -

Need a tutorial? <http://www.kentchemistry.com/links/Kinetics/PredictingDR.htm>

12. Predict whether each of these double replacement reactions will give a precipitate or not based on the solubility of the products. If yes, identify the precipitate.

Soluble Ionic Compounds		Important Exceptions
Compounds containing	$\text{NO}_3^-$	None
	$\text{CH}_3\text{COO}^-$	None
	$\text{Cl}^-$	Compounds of $\text{Ag}^+$ , $\text{Hg}_2^{2+}$ , and $\text{Pb}^{2+}$
	$\text{Br}^-$	Compounds of $\text{Ag}^+$ , $\text{Hg}_2^{2+}$ , and $\text{Pb}^{2+}$
	$\text{I}^-$	Compounds of $\text{Ag}^+$ , $\text{Hg}_2^{2+}$ , and $\text{Pb}^{2+}$
	$\text{SO}_4^{2-}$	Compounds of $\text{Sr}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Hg}_2^{2+}$ , and $\text{Pb}^{2+}$
Insoluble Ionic Compounds		Important Exceptions
Compounds containing	$\text{S}^{2-}$	Compounds of $\text{NH}_4^+$ , the alkali metal cations, and $\text{Ca}^{2+}$ , $\text{Sr}^{2+}$ , and $\text{Ba}^{2+}$
	$\text{CO}_3^{2-}$	Compounds of $\text{NH}_4^+$ and the alkali metal cations
	$\text{PO}_4^{3-}$	Compounds of $\text{NH}_4^+$ and the alkali metal cations
	$\text{OH}^-$	Compounds of the alkali metal cations, and $\text{NH}_4^+$ , $\text{Ca}^{2+}$ , $\text{Sr}^{2+}$ , and $\text{Ba}^{2+}$

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- silver nitrate and potassium chloride \_\_\_\_\_
- magnesium nitrate and sodium carbonate \_\_\_\_\_
- strontium bromide and potassium sulfate \_\_\_\_\_
- cobalt (III) bromide and potassium sulfide \_\_\_\_\_
- ammonium hydroxide and copper (II) acetate \_\_\_\_\_
- lithium chlorate and chromium (III) fluoride \_\_\_\_\_

## Stoichiometry and Limiting Reactant

Need a tutorial? (list of tutorials & activities): <https://tinyurl.com/APsummer9>  
<https://tinyurl.com/APsummer10> (scroll down for list of stoichiometry resources)

13. Given the equation below, what mass of water would be needed to react with 10.0g of sodium oxide?



14.  $2\text{NaClO}_3 \rightarrow 2\text{NaCl} + 3\text{O}_2$
- What mass of sodium chloride is formed along with 45.0g of oxygen gas?
    - If only 49.1g of sodium chloride form, what is the percent yield?

15.  $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$   
What mass of water will be produced when 100.0g of ammonia is reacted with excess oxygen?

18. If the reaction above is done with 25.0g of each reactant, which would be the limiting reactant?

19. What volume of hydrogen gas (measured at STP) would result from reacting 75.0g of sodium hydroxide with 50.0g of aluminum?  $6\text{NaOH} + 2\text{Al} \rightarrow 2\text{Na}_3\text{AlO}_3 + 3\text{H}_2$

20.  $\text{Na}_2\text{S} + 2\text{AgNO}_3 \rightarrow \text{Ag}_2\text{S} + 2\text{NaNO}_3$   
If the above reaction is carried out with 50.0g of sodium sulfide and 35.0g of silver nitrate, which is the limiting reactant?

What mass of the excess reactant remains?

What mass of silver sulfide would precipitate?

**Percent Composition, Empirical and Molecular Formulas - Textbook sections 3.5-3.6**

**Need a tutorial? <https://tinyurl.com/APsummer12>**

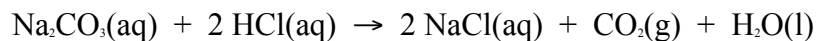
18. Bismuth subsalicylate, a medication used to treat upset stomachs, has the formula  $C_7H_5BiO_4$ .
- a. Calculate the percent by mass of C and also of Bi. [too easy to be an AP Chem prob]
- b. If each tablet of the medication contains 262 milligrams of  $C_7H_5BiO_4$ , calculate the mass of Bi in 2 tablets. [More like an AP Chem prob]
19. Determine the empirical and molecular formulas of each of the following substances:
- Benzene contains only carbon and hydrogen and is 7.74% hydrogen by mass. The molar mass of benzene is 78.1 g/mol.
  - Ibuprofen, a headache remedy, contains 75.69 percent C, 8.80 percent H, and 15.51 percent O by mass; molar mass about 206 g
  - Naphthalene, used in mothballs, is composed of 93.7% carbon and 6.3% hydrogen. If naphthalene has a molar mass of 128 g/mol, what is its molecular formula?

20. Many homes in rural America are heated by propane gas, a compound that contains only carbon and hydrogen. Complete combustion of a sample of propane produced 2.641 g of carbon dioxide and 1.442 g of water as the only products. Find the empirical formula of propane. (Hint: Figure out how many moles of C and H were produced. They all came from the fuel.)
21. Menthol, the substance we can smell in mentholated cough drops, is composed of C, H, and O. A 0.1005 g sample of menthol is combusted, producing 0.2829 g of  $\text{CO}_2$  and 0.1159 g of  $\text{H}_2\text{O}$ . Menthol has a molar mass of 156.27 g/mol. What is the molecular formula of menthol?



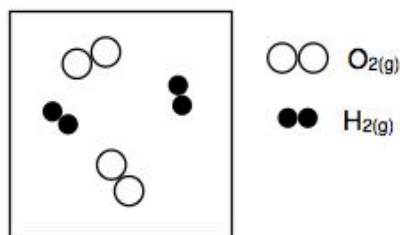


24. What volume of 0.955M HCl, in milliliters, is needed to completely react with 12.8 mL of 1.27M Na<sub>2</sub>CO<sub>3</sub>?

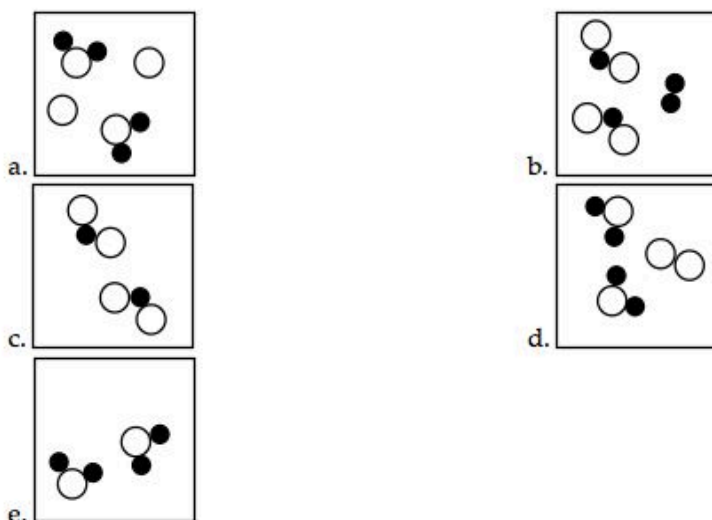
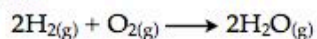


**Sample AP Multiple Choice Questions [no calculator!]**

32. In which of the following groups are the three species isoelectronic; i.e., have the same number of electrons?
- (A) S<sup>2-</sup>, K<sup>+</sup>, Ca<sup>2+</sup>      (B) Sc, Ti, V<sup>2+</sup>      (C) O<sup>2-</sup>, S<sup>2-</sup>, Cl<sup>-</sup>      (D) Mg<sup>2+</sup>, Ca<sup>2+</sup>, Sr<sup>2+</sup>  
(E) Cs, Ba<sup>2+</sup>, La<sup>3+</sup>
33. What number of moles of O<sub>2</sub> are needed to produce 14.2 grams of P<sub>4</sub>O<sub>10</sub> from P?  
(Molecular weight P<sub>4</sub>O<sub>10</sub> = 284)
- (A) 0.0500 mole      (B) 0.0625 mole      (C) 0.125 mole      (D) 0.250 mole      (E) 0.500 mole



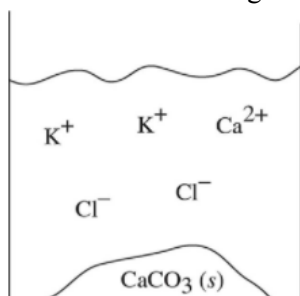
The picture above is a representation of  $\text{H}_2(\text{g})$  and  $\text{O}_2(\text{g})$  in a sealed container. Which of the following pictures would be the best representation of the products if the reaction below were to run to completion?



36. Barium reacts with a polyatomic ion to form a compound with the general formula  $\text{Ba}_3(\text{X})_2$ . What would be the most likely formula for the compound formed between sodium and the polyatomic ion X?
- A)  $\text{NaX}$       B)  $\text{Na}_3\text{X}$       C)  $\text{Na}_2\text{X}$       D)  $\text{Na}_3\text{X}_2$       E)  $\text{Na}_2\text{X}_2$

37. Which one of the following molecular formulas is also an empirical formula?
- A)  $\text{C}_2\text{H}_6\text{SO}$       B)  $\text{C}_6\text{H}_6\text{O}_2$       C)  $\text{H}_2\text{O}_2$       D)  $\text{H}_2\text{P}_4\text{O}_6$       E)  $\text{C}_6\text{H}_6$
38. Solutions of potassium carbonate and calcium chloride are mixed together, and the particulate representation shows what is present after the reaction has gone to completion.

Which of the two original solutions is the limiting reagent and why?



- The potassium carbonate, because of the polyatomic anion
- The potassium carbonate, because there is no carbonate left after the reaction
- The calcium chloride, because there is an excess of calcium ions post-reaction
- The calcium chloride, because the component ions are smaller than those in potassium carbonate

**Sample AP Free Response Questions (FRQ)**

*Note: Portions of each FRQ that we would not yet know how to do have been omitted.*

25. Water is added to 4.267 grams of uranium hexafluoride. The only products are 3.730 grams of a solid containing only uranium, oxygen and fluorine and 0.970 gram of a gas. The gas is 95.0% fluorine, and the remainder is hydrogen. From these data, determine the empirical formula of the gas.
26. Solid mercury(II) oxide decomposes as it is heated in an open test tube in a fume hood.
- a. Write a balanced equation for this reaction.
- b. After the reaction is complete, is the mass of the material in the test tube greater than, equal to, or less than the mass prior to heating? Justify your answer.