

AP Chemistry Summer Assignment (Participation Credit)

Mental Math

There are NO CALCULATORS permitted on the multiple choice section of the AP Exam, so it is critical that you are able to do some math in your head (or with pencil/paper only). At this link <https://tinyurl.com/mhc8njq> you will find a packet of review & practice of the mental math skills most relevant to the AP Exam, as well as some sample AP Chem multiple choice questions utilizing these mental math skills. I printed out the part you need to hand in (last 7 pages of the packet) but not the first 13 pages of the review. You need to do the review before you try to answer the questions.

Significant Figures - Textbook section 1.5

Need a tutorial? <http://chemistry.bd.psu.edu/jircitano/sigfigs.html>
(Khan Academy video list): <https://goo.gl/uuOU2w>

- Round each of the following off to the specified number of sig fig's:
 - Round 78.241 g to 4 sf: _____ 3 sf: _____ 2 sf: _____ 1 sf: _____
 - Round 0.2983 g to 4 sf: _____ 3 sf: _____ 2 sf: _____ 1 sf: _____
 - Round 50,001 g to 4 sf: _____ 3 sf: _____ 2 sf: _____ 1 sf: _____
- Solve, and round answers to the proper number of sig figs. SHOW YOUR WORK & include units in your answer.
 - A 5627 g brick measures 5.60 cm x 4.51 cm x 24.71 cm. What is its density?
 - 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?
 - A 45.67g stone with a density of 6.81 g/cm³ is placed in a graduated cylinder, what is its volume?
 - 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) - Textbook section 1.6

Need a tutorial? <http://www.chem.tamu.edu/class/fyp/mathrev/mr-da.html>

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

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 ³	1 mL = 1 cm ³
- There are 355 ml of soda in a can. How many gallons is this?
- How many feet per second is a wave going if it travels a distance of 1.00 mile in 7.35 min?
- A speed of 60.0 miles/ hour is how many ft/sec?
- 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 - Textbook section 2.3

Need a tutorial? <http://www.kentchemistry.com/links/AtomicStructure/protneuele.htm>

8. 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? <http://www.kentchemistry.com/links/AtomicStructure/atomicmasscalc.htm>

- Textbook section 2.4

9. 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: - Textbook section 2.8

Identify the type of substance, then either name it or write the correct formula

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

10.

Name	Type of Compound? (ionic, covalent, or acid)	Formula
		Hydrobromic acid
		Dinitrogen pentoxide
BaI_2		
SO_2		
		Nickel II chloride
H_2CO_3		
		Phosphorous acid
		Potassium dichromate
$\text{Hg}(\text{OH})_2$		
HF		
HNO_2		
NiI_3		
		Zinc arsenide

		Xenon tetrafluoride
		Iron III nitrate
$\text{Cu}_2\text{Cr}_2\text{O}$		
PCl_3		
		Ammonium sulfide
K_2O		

Solubility Rules: - Textbook section 4.2

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.

silver nitrate and potassium chloride _____

magnesium nitrate and sodium carbonate _____

strontium bromide and potassium sulfate _____

cobalt (III) bromide and potassium sulfide _____

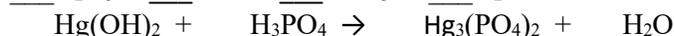
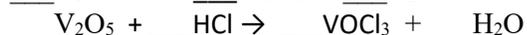
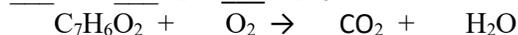
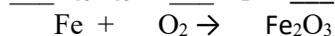
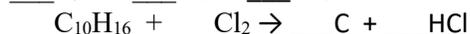
ammonium hydroxide and copper (II) acetate _____

lithium chlorate and chromium (III) fluoride _____

Chemical Equations: - Textbook section 3.1-3.2

Need a tutorial? <https://www.sophia.org/tutorials/balancing-chemical-equations--2>

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



Need a tutorial? (identify reaction types): <https://chemfiesta.wordpress.com/2015/09/08/the-six-types-of-reaction/>
(predicting products): <https://chemfiesta.org/2015/03/20/predicting-reaction-products/>

14. 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 ₈ H ₁₈) 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 ₂ H ₅ OH) is burned in the air		

Stoichiometry and Limiting Reactant - Textbook sections 3.3-3.4, 3.9-3.10

Need a tutorial? (list of tutorials & activities): <http://chemcollective.org/stoichiometry>
<https://chemfiesta.org/2015/09/18/reactions-and-stoichiometry/> (scroll down for list of stoichiometry resources)

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

$$\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$$

16. $2\text{NaClO}_3 \rightarrow 2\text{NaCl} + 3\text{O}_2$

a. What mass of sodium chloride is formed along with 45.0g of oxygen gas?

b. If only 49.1g of sodium chloride form, what is the percent yield?

17. $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$

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

Need a tutorial? <http://www.kentchemistry.com/aplinks/chapters/3Stoich.htm>

21. Bismuth subsalicylate, a medication used to treat upset stomachs, has the formula $C_7H_5BiO_4$.
- Calculate its percent composition.

 - If each tablet of the medication contains 262 milligrams of $C_7H_5BiO_4$ calculate the mass of Bi in 2 tablets.
22. 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

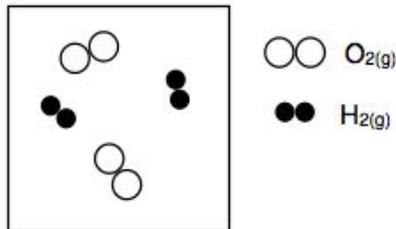
 - Naphthalene, used in mothballs, is composed of 93.7% carbon and 6.3% hydrogen. If naphthalene has a molar mass of 128 g/mol, what is its molecular formula?
23. Many homes in rural America are heated by propane gas, a compound that contains only carbon and hydrogen. Complete combustion of a sample of 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.)

Sample AP Multiple Choice Questions [no calculator!]

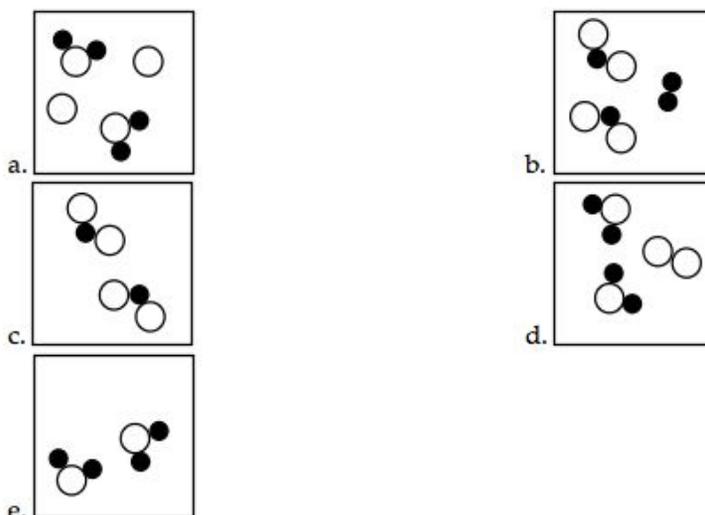
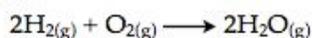
32. In which of the following groups are the three species isoelectronic; i.e., have the same number of electrons?
 (A) S^{2-}, K^+, Ca^{2+} (B) Sc, Ti, V^{2+} (C) O^{2-}, S^{2-}, Cl^- (D) $Mg^{2+}, Ca^{2+}, Sr^{2+}$ (E) Cs, Ba^{2+}, La^{3+}

33. What number of moles of O_2 are needed to produce 14.2 grams of P_4O_{10} from P? (Molecular weight $P_4O_{10} = 284$)
 (A) 0.0500 mole (B) 0.0625 mole (C) 0.125 mole (D) 0.250 mole (E) 0.500 mole

34.



The picture above is a representation of $H_2(g)$ and $O_2(g)$ 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?

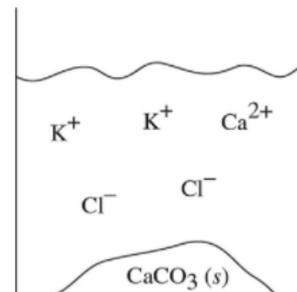


35. Barium reacts with a polyatomic ion to form a compound with the general formula $Ba_3(X)_2$. What would be the most likely formula for the compound formed between sodium and the polyatomic ion X?
 A) NaX B) Na_3X C) Na_2X D) Na_3X_2 E) Na_2X_2

36. Which one of the following molecular formulas is also an empirical formula?
 A) C_2H_6SO B) $C_6H_6O_2$ C) H_2O_2 D) $H_2P_4O_6$ E) C_6H_6

37. 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.

38. 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.
- (a) From these data, determine the empirical formula of the gas.
- (b) What fraction of the fluorine of the original compound is in the solid and what fraction in the gas after the reaction?
- (c) What is the formula of the solid product?
39. 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.
40. Answer the following questions about acetylsalicylic acid, the active ingredient in aspirin.
- (a) The amount of acetylsalicylic acid in a single aspirin tablet is 325 mg, yet the tablet has a mass of 2.00 g. Calculate the mass percent of acetylsalicylic acid in the tablet.
- (b) The elements contained in acetylsalicylic acid are hydrogen, carbon, and oxygen. The combustion of 3.000 g of the pure compound yields 1.200 g of water and 3.72 L of dry carbon dioxide, measured at STP. Determine the mass, in g, of each element in the 3.000 g sample of the compound.