

Advanced Placement Chemistry - Summer Review Packet

Welcome to AP Chemistry!

Advanced Placement Chemistry is a fast-paced college level course that covers two semesters of material covered in General Chemistry I and II. It is expected that all students have a good foundational knowledge of chemistry and strong applied mathematical skills. Students will not be permitted to use a calculator for most of the quizzes and exams given through the year, so it is important to have the ability to perform quick calculations involving operations, exponents, and applying logarithms in problem solving. This course culminates in the AP Chemistry exam in May which all students are expected to take.

Things to Memorize

Task 1: Memorize the names of the elements and their corresponding symbols

- You need to know elements 1-56, plus Pt, Au, Hg, Pb, Rn, Fr, Ra, U, Pu
- Many of these elements you will already know
- Making flashcards is helpful!
- It's important to know these elements because the periodic table you are provided has only the symbols and not the names of the elements.

Task 2: Memorize the following solubility guidelines

1. All common compounds of Group I (alkali metals) and ammonium ions are soluble.
2. All nitrates, acetates, and chlorates are soluble.
3. All binary compounds of the halogens (other than F) with metals are soluble, except those of Ag, Hg(I), and Pb. (Pb halides are soluble in hot water.)
4. All sulfates are soluble, except those of barium, strontium, calcium, lead, silver, and mercury (I). The latter three are slightly soluble.
5. Except for rule 1, carbonates, hydroxides, oxides, silicates, and phosphates are insoluble.
6. Sulfides are insoluble except for calcium, barium, strontium, magnesium, sodium, potassium, and ammonium.

Task 3: Memorize the following table of charges and polyatomic ions

<u>Monatomic Cations</u>	<u>Monatomic Anions</u>	<u>Polyatomic Cations</u>	<u>Polyatomic Anions</u>
<u>Group 1 (including H)</u> H ⁺¹ , hydrogen Li ⁺¹ , lithium Na ⁺¹ , sodium K ⁺¹ , potassium Cs ⁺¹ , cesium <u>Group 2</u> Be ⁺² , beryllium Mg ⁺² , magnesium Ca ⁺² , calcium Sr ⁺² , strontium Ba ⁺² , barium <u>Group 13</u> Al ⁺³ , aluminum <u>Transition and Heavier Metals</u> Cr ⁺² , chromium (II) Cr ⁺³ , chromium (III) Mn ⁺² , manganese (II) Mn ⁺⁴ , manganese (IV) Mn ⁺⁷ , manganese (VII) Cu ⁺¹ , copper (I) Cu ⁺² , copper (II) Fe ⁺² , iron (II) Fe ⁺³ , iron (III) Pb ⁺² , lead (II) Pb ⁺⁴ , lead (IV) Hg ⁺² , mercury (II) Ni ⁺² , nickel (II) Ni ⁺³ , nickel (III) Sn ⁺² , tin (II) Sn ⁺⁴ , tin (IV) Ag ⁺¹ , silver Zn ⁺² , zinc	<u>Group 17 and H</u> H ⁻¹ , hydride F ⁻¹ , fluoride Cl ⁻¹ , chloride Br ⁻¹ , bromide I ⁻¹ , iodide <u>Group 16</u> O ⁻² , oxide S ⁻² , sulfide <u>Group 15</u> N ⁻³ , nitride P ⁻³ , phosphide	Ammonium, NH ₄ ⁺¹ Mercury (I), Hg ₂ ⁺²	Acetate, C ₂ H ₃ O ₂ ⁻¹ Bicarbonate (hydrogen carbonate), HCO ₃ ⁻¹ Carbonate, CO ₃ ⁻² Perchlorate, ClO ₄ ⁻¹ Chlorate, ClO ₃ ⁻¹ Chlorite, ClO ₂ ⁻¹ Hypochlorite, ClO ⁻¹ Permanganate, MnO ₄ ⁻¹ Cyanide, CN ⁻¹ Hydroxide, OH ⁻¹ Peroxide, O ₂ ⁻² Nitrate, NO ₃ ⁻¹ Nitrite, NO ₂ ⁻¹ Chromate, CrO ₄ ⁻² Dichromate, Cr ₂ O ₇ ⁻² Sulfate, SO ₄ ⁻² Sulfite, SO ₃ ⁻² Phosphate, PO ₄ ⁻³ Phosphite, PO ₃ ⁻³

***Note: Transition metals are named with Roman numerals to indicate their oxidation state (charge) if they have multiple oxidation states. Silver and zinc are the only transition metals on this list that have a single oxidation state and therefore are not named with roman numerals. As long as you know which transition metals need Roman numerals, individual charges of these metals do not need to be memorized.

The Assignment

The assignment below is representative of basic skills covered in first-year chemistry. It is important to read Chapters 1-5 of the required text **Chemistry: A Molecular Approach** by Nivaldo J. Tro. **THERE WILL BE A TEST ON ALL OF THE FOLLOWING MATERIAL ON THE FIRST FULL DAY OF SCHOOL.**

Learning Target 1 – I can count the number of significant figures in a measurement.

1) Count the number of significant figures in the following measurements:

- a) 2.71 g _____ b) 0.00047 kg _____ c) 7.0×10^5 m _____ d) 1,030 L _____
e) 150 pencils _____ f) 37500 g _____ g) 0.1010 cm _____

Learning Target 2 – I can convert numbers to scientific notation while applying significant figures.

2) Express each of the following in proper scientific notation (Pay attention to sig figs and units)

- a) 0.000125 m _____ b) 155.0 mL _____
c) 123,030,000 kg _____ d) 481.9×10^{-9} cm _____

Learning Target 3 - I can add, subtract, multiply, and divide with the correct number of significant figures. NO CALCULATOR PERMITTED

3) Calculate the correct answer with proper units and sig figs for each of the following:

- a) $12 \text{ g} + 0.677 \text{ g} + 86.33 \text{ g} =$ _____
b) $(355.78 \text{ g}) / (0.056 \text{ g}) =$ _____
c) $97.34 \text{ mL} - 34.1 \text{ mL} =$ _____
d) $14.68 \times 5 =$ _____

4) Perform the following calculations with scientific notation and report your answer with the correct number of significant figures.

- a) $0.14 \times (6.02 \times 10^{23}) =$ _____
b) $\frac{(9.875 \times 10^4) - (9.795 \times 10^4)}{9.875 \times 10^4} \times 100 \% =$ _____ (assume 100 is exact)
c) $\frac{(3.8 \times 10^{-12} + 4.0 \times 10^{-13})}{(4 \times 10^{12} + 6.3 \times 10^{13})} =$ _____

Learning Target 4 – *I can use conversions to solve dimensional analysis problems.*

- 5) Solve the following problems using conversions and dimensional analysis.
- A large railroad car is filled with 1745 gallons of milk. The car springs a leak in the bottom, and milk starts dripping out at a rate of 204.84 mL/sec. If the train is traveling at a speed of 65.4 miles per hour, calculate how many miles it will travel before all the milk has drained out of the car.
(1 gal = 3.78 L, 1 mile = 5280 ft, 1 in = 2.54 cm)
 - The world record for the hundred meter dash is 9.77 seconds. What is the corresponding average speed in units of m/sec, km/hr, ft/sec, and miles/hr?

Learning Target 5 – *I can explain density and use the density equation to find an unknown.*

NO CALCULATOR

- A rectangular block has dimensions of 2.9 cm x 3.5 cm x 10.0 cm. The mass of the block is 615.0 grams. What are the volume and the density of the block?
- The density of pure silver is 10.5 g/mL at 20°C. If 5.25 grams of pure silver pellets are added to a graduated cylinder containing 11.2 mL of water, to what volume will the water in the cylinder rise?

Learning Target 6 – *I can define and explain terms that identify physical/chemical characteristics of matter.*

- 8) Define the following terms:
- Solid –
 - Liquid –

- c) Gas –
 - d) Pure substance –
 - e) Homogeneous mixture –
 - f) Heterogeneous mixture –
 - g) Chemical change –
 - h) Physical change –
- 9) Identify the following as a physical property, physical change, chemical property, or chemical change:
- a) Ethanol has a density of 0.697 g/mL.
 - b) The solution turns blue upon mixing water and food coloring.
 - c) Wood burns in an oven.
 - d) Methyl alcohol is highly flammable.
 - e) Ice melts in a beaker.
 - f) Methyl ethanoate smells like apples.
 - g) A car crashes into a wall.
 - h) Sugar dissolves in water.

Learning Target 7 – I can identify the number of protons, neutrons, and electrons in atoms and isotopes.

- 10) What number of protons and neutrons are contained in the nucleus of each of the following atoms?
Assuming each atom is uncharged, what number of electrons are present?

- a) ${}_{92}^{235}\text{U}$
- b) ${}_{6}^{13}\text{C}$
- c) ${}_{26}^{57}\text{Fe}$
- d) ${}_{82}^{208}\text{Pb}$

- 11) Complete the following table:

Name	Mass #	Atomic #	# of Protons	# of Neutrons	# of Electrons	Symbol
Gallium	70					
						${}_{15}^{31}\text{P}^{-3}$
Strontium-80						
						${}_{25}^{55}\text{Mn}^{+2}$

Learning Target 8 – I can define and use the Law of Definite Proportions and the Law of Multiple Proportions.

12) Explain:

- a) Law of Definite Proportions:
- b) Law of Multiple Proportions:

13) Solve the following problem:

Tin – Oxygen compound	Tin % by mass	Oxygen % by mass
Stannous oxide	88.10%	11.90%
Stannic oxide	78.70%	21.30%

Tin – Oxygen compound	Tin mass	Oxygen mass
Stannous oxide	100.0 grams	
Stannic oxide	100.0 grams	

- a) Use the Law of Definite Proportions to determine the mass of oxygen needed to combine with the given masses of tin for stannous oxide and stannic oxide.

- b) Does the Law of Multiple Proportions hold true in this case? Explain why or why not.

Learning Target 9 – I can name and write formulas for ionic compounds.

14) Name or give the formula for the following compounds:

<u>Name</u>	<u>Formula</u>
Sodium fluoride	_____
_____	K ₂ O
Calcium phosphate	_____
_____	FeCl ₃
Iron (II) chloride	_____
_____	Hg ₂ O

Sodium sulfate	_____
_____	CaCO ₃
Lithium phosphate	_____
_____	SO ₂
Calcium hydroxide	_____
_____	H ₂ SO ₄
Cupric chloride	_____

Learning Target 10 – *I can write and balance equations.*

Write and balance the following equations:

- Iron metal reacts with oxygen to form rust, iron (III) oxide.
- Calcium metal reacts with water to produce aqueous calcium hydroxide and hydrogen gas.
- Aqueous barium hydroxide reacts with aqueous sulfuric acid to produce solid barium sulfate and water.

Learning Target 11 – *I can do conversions associated with moles.*

NO CALCULATOR

15) Solve the following problems:

- Calculate the mass of 500. Atoms of iron (Fe).
- How many formula units are present in 87.2 grams of lead (IV) carbonate?
- Aspartame is an artificial sweetener that is 160 times sweeter than sucrose (table sugar) when dissolved in water. It is marketed as Nutra-Sweet. The molecular formula of aspartame is C₁₄H₁₈N₂O₅.
 - Calculate the molar mass of aspartame.
 - Calculate the mass, in grams, of 1.56 mol of aspartame.

- iii. How many molecules are in 5.0 mg of aspartame?
- iv. How many atoms of nitrogen are in 1.2 g aspartame?
- v. What is the mass of one molecule of aspartame?

Learning Target 12 – *I can calculate percent by mass for an element in a compound.*
NO CALCULATOR

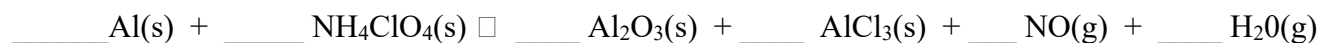
16) Calculate the percent by mass for each element in aspartame from the previous problem.

Learning Target 13 – *I can calculate the average atomic mass of an isotope using percent abundance.*
NO CALCULATOR

17) An element consists of 1.40% of an isotope with a mass of 203.973 amu, 24.10% of an isotope with mass 205.9745 amu, 22.10% of an isotope with mass 206.9759 amu, and 52.40% of an isotope with mass 207.9766 amu. Calculate the average atomic mass and identify the element.

Learning Target 14 – *I can solve stoichiometry problems, include those that use limiting and excess.*
NO CALCULATOR

18) The reusable booster rockets of the U.S. space shuttle employs a mixture of aluminum and ammonium perchlorate for fuel. A possible reaction for this is:



a) Balance the following reaction:

- b) If 4.0 g of aluminum reacted with 15.0 g of ammonium perchlorate, what would be the limiting reactant? How much excess of the other reactant would you have?
- c) Using the above information, how much aluminum chloride would be produced in grams?
- d) If you actually collected 4.18 g of aluminum chloride what would be your percent yield?

19) You add aluminum to a solution of copper (II) chloride and it reacts exothermically. Write and balance the equation below.

- a) If you react 1.25 g of Al, how much copper (II) chloride do you need to add for the Al to fully react?
- b) How much of each product would you collect?

20) When 125.0 g of ethylene (C_2H_4) burns in 60.0 grams of oxygen to give carbon dioxide and water, how many grams of CO_2 are formed? (Hint: balance the equation and determine limiting reactant first)

Learning Target 15 – I can determine the empirical and molecular formula by calculation.

- 21) Phenol is a compound that contains 76.57% carbon, 6.43% hydrogen, and 17.0% oxygen.
- a) Calculate the empirical formula.

b) If its molecular weight is 188 g/mol, what would be its molecular formula?

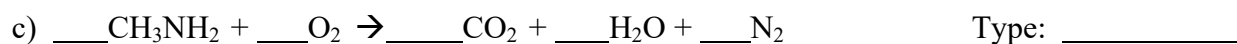
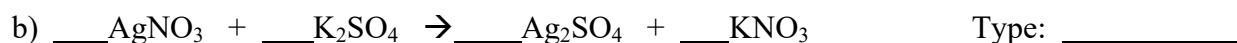
Learning Target 16 - *I can calculate the empirical formula of an unknown hydrocarbon through a combustion reaction and calculation.*

22) One killer of a problem – a GOLD STAR if you can get this one:

Menthol, the substance we can smell in mentholated cough drops, is composed of carbon, hydrogen, and oxygen. A 0.1005 gram sample of menthol is combusted producing 0.2829 g of CO₂ and 0.1159 g of H₂O. What is the empirical formula for menthol? Show work.

Practice Problems

23. Balance the following and equations and tell what type of reaction it is (synthesis, decomposition, single replacement, double replacement, or combustion)



24. What are diatomic molecules? List the 7.

Average Atomic Mass

25. Magnesium consists of 3 naturally occurring isotopes with the masses 23.98504, 24.98584, and 25.98259 amu. The relative abundances of these three isotopes are 78.70%, 10.13 %, and 11.17% respectively. Calculate the average atomic mass.

Percent Composition

26. Calculate the percent composition of $C_{12}H_{22}O_{11}$ (sugar). (Give Percent of each element.) Show all work.

Moles

27. Calculate the number of moles of the following:(SHOW WORK)

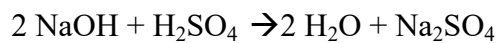
a) 42.8 g of KNO_3

b) 155.7 L of CO_2 at STP

c) 9.25×10^{26} molecules of $CaCl_2$

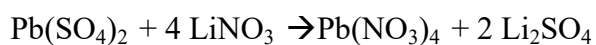
Stoichiometry

28. Using the following equation:



How many grams of sodium sulfate will be formed if you start with 200 grams of sodium hydroxide and you have an excess of sulfuric acid?

29. Using the following equation:



How many grams of lithium nitrate will be needed to make 250 grams of lithium sulfate, assuming that you have an adequate amount of lead (IV) sulfate to do the reaction?

30. Using the following equation: $\text{Fe}_2\text{O}_3 + 3 \text{H}_2 \rightarrow 2 \text{Fe} + 3 \text{H}_2\text{O}$

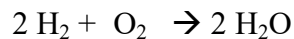
Calculate how many grams of iron can be made from 16.5 grams of Fe_2O_3 .

Limiting Reactant & Percent Yield

31. Determine the grams of sodium chloride produced when 10.0 g of sodium react with 10.0 g of chlorine gas according to the equation: $2 \text{Na} + \text{Cl}_2 \rightarrow 2 \text{NaCl}$

32. Determine the mass of lithium hydroxide produced when 50.0g of lithium are reacted with 45.0g of water according to the equation: $2 \text{Li} + 2 \text{H}_2\text{O} \rightarrow 2 \text{LiOH} + \text{H}_2$

33. Determine the percent yield of water produced when 68.3 g of hydrogen reacts with 85.4g of oxygen and 86.4g of water are collected.



34. Provide names for the following ionic compounds:

- a. AlF_3 _____
- b. $\text{Fe}(\text{OH})_2$ _____
- c. $\text{Cu}(\text{NO}_3)_2$ _____
- d. $\text{Ba}(\text{ClO}_4)_2$ _____
- e. Li_3PO_4 _____
- f. Hg_2S _____
- g. $\text{Cr}_2(\text{CO}_3)_3$ _____
- h. $(\text{NH}_4)_2\text{SO}_4$ _____

35. Write the chemical formulas for the following compounds:

- a. Copper(I) oxide
- b. Potassium peroxide
- c. Iron(III) carbonate
- d. Zinc nitrate
- e. Sodium hypobromite
- f. Aluminum hydroxide

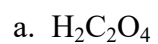
36. Give the name or chemical formula for each of the following molecular substances:

- a. SF_6 _____
- b. XeO_3 _____
- c. Dinitrogen tetroxide _____
- d. Hydrogen cyanide _____
- e. IF_5 _____
- f. Dihydrogen monoxide _____
- g. Tetraphosphorous hexasulfide _____

37. Give the name or chemical formula for the following compounds:

- a. Ammonium oxalate _____
- b. Manganese(III) dichromate _____
- c. $\text{Ti}(\text{OH})_4$ _____
- d. $\text{Ni}(\text{ClO}_2)_3$ _____
- e. Dinitrogen pentoxide _____
- f. Aluminum oxide _____
- g. Fe_2S_3 _____

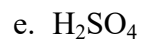
38. Name the following acids













39. Write formulas for the following acids.

a. hydrochloric acid

b. sulfuric acid

c. nitric acid

d. phosphoric acid

e. carbonic acid

f. acetic acid
