

AP Chemistry Review

This Review is due on the first day we arrive for the 2022-2023 school year. Please place a question mark or a star beside the questions you do not know how to do or you do not understand.

I. Learn the **solubility rules** for sodium, potassium, and ammonium compounds. Their compounds are always soluble.

II. **polyatomic ions**. MEMORIZE THEM. You will NOT be provided with these for ANY tests or quizzes. You can start by memorizing the polyatomic ions you used in Pre-AP chemistry. Feel free to download and print polyatomic ions from other sources also.

III. **Significant Figures**. How many significant figures do the following numbers have?

1. 1000 mL _____

2. .00300 s _____

3. 1.234 g _____

4. 1500 hours _____

5. 450.6 L _____

6. 50. cm _____

7. 20 students _____

IV. **Scientific Notation**. Place the following numbers in correct scientific notation.

8. 1 000 000 C/s _____

9. .000 500 ns _____

10. 18 000 m _____

11. .000 000 000 250 s _____

V. **Math with Scientific Notation.** Perform the following operations, answering in the correct number of significant figures and with the correct label. Usually if a number is less than .001 or greater than 10 000, it needs to be expressed in scientific notation, not standard notation.

12. $(2.341 \times 10^3 \text{ s}) \times (9.65 \times 10^6 \text{ s}) =$ _____

13. $1500 \text{ m} \div (2.50 \times 10^{-2} \text{ s}) =$ _____

14. $2.77 \text{ g} \div 18.64 \text{ mL} =$ _____

15. $(4.672 \times 10^{-3} \text{ mol}) \div (3.66 \times 10^{-6} \text{ L}) =$ _____

16. $(1.26 \times 10^{-3} \text{ cm}) - (6.88 \times 10^{-3} \text{ m}) =$ _____

17. $(9.88 \times 10^6 \text{ g}) + (5.44 \times 10^8 \text{ mg}) =$ _____

VI. **Metric Conversions.** Convert the following numbers to the desired unit. It is in your best interest if you use dimensional analysis to do these conversions. Remember: your answer needs to have the same number of sig figs as your original quantity.

18. $1500 \text{ Mg} =$ _____ g

19. $1500 \text{ km} =$ _____ mm

20. $1.66 \times 10^4 \text{ nm} =$ _____ km

21. $2500 \text{ }\mu\text{L} =$ _____ L

22. $3.45 \times 10^{-8} \text{ L} =$ _____ mL

V. **Dimensional Analysis.** Use dimensional analysis to work the following conversions.

23. How many minutes are there in the month of June?
24. How many years are there in 2.550 microseconds?
25. In the movie “Raiders of the Lost Ark” Indiana Jones and a guide play catch with the gold idol Jones removed from a booby-trapped pedestal. Assuming that the idol’s volume is 1.00 L and that it is solid gold, is playing catch with the idol plausible? (Gold’s density is 19.32 g/mL).

Density problems:

26. A 25.00-gram sample of a solid is placed in a graduated cylinder and then the cylinder is filled to the 50.00-mL mark with benzene. The mass of the benzene and solid together is 58.80 g. Assuming that the solid is insoluble in benzene and that the density of benzene is 0.880 g/cm³, calculate the density of the solid.
27. A material will float on the surface of a liquid if the material has a density less than that of the liquid. Given that the density of water is approximately 1.00 g/mL, will a block of material having a volume of 1.2 X

10^4 in^3 and weighing 350 lb float or sink when placed in a reservoir of water?

There are 2.54 cm in 1.00 inch

There are 453.6 g in 1.00 lb

28. A star is estimated to have a mass of $2.0 \times 10^{36} \text{ kg}$. Assuming it to be a sphere of average radius $7.0 \times 10^5 \text{ km}$, calculate the average density of the star in units of grams per cubic centimeter.

29. Know the placement of the following groups (columns, families) on the periodic table:

- a. alkali metals
- b. alkaline earth metals
- c. transition metals
- d. rare earth metals
- e. metals (in general)
- f. nonmetals (in general)
- g. metalloids (semimetals)
- h. the halogens
- i. the noble gases

30. Give the oxidation state for the ions formed by the following atoms:

- a. silver: _____
- b. neon: _____
- c. sodium: _____
- d. phosphorus: _____
- e. iodine: _____
- f. gallium: _____
- g. calcium: _____
- h. hydrogen: _____
- i. selenium: _____

31. Recall that ionic bonds are formed when one or more atoms or group of atoms (polyatomic ion) lose(s) electrons and one or more atoms or group of atoms gain(s) electrons. Ionic bonds are formed by the GIVE AND TAKE of negative electrons. Type I metals almost always have only one oxidation state (examples are sodium and magnesium). Also, recall that many of the transition and “other” metals have more than one oxidation state (these are sometimes called Type II metals). I have included the most common oxidation states of some of these metals. (Look on the back of the polyatomic ion list).

ALWAYS REDUCE your ion ratios to their lowest whole numbers. There are a couple of exceptions when ions like peroxide and oxalate are involved. Prefixes are NEVER used unless they are part of the polyatomic ion name, such as dichromate.

Name the following ionic compounds:

- a. NaCl _____
- b. PbO₂ _____
- c. Ni(NO₃)₂ _____
- d. K₂S _____
- e. (NH₄)₂CO₃ _____
- f. Li₃N _____
- g. TiF₂ _____
- h. Zn₃(PO₄)₂ _____
- i. FeSe _____
- j. Co₂(SiO₃)₃ _____
- k. Ca(CN)₂ _____

Give the correct chemical formula for the following ionic compounds:

- a. Cobalt (III) chloride _____
- b. sodium peroxide _____
- c. magnesium oxide _____
- d. cupric iodate _____
- e. rubidium selenide _____
- f. lithium phosphate _____

g. mercury (I) fluoride _____

h. zinc sulfate _____

i. ammonium nitrate _____

32. Molecular compounds are formed by the sharing of electrons among nonmetallic atoms – covalent bonding. Molecular compounds are what they are: they may or may not be reducible. For example, butane's chemical formula is: C_4H_{10} . If you reduce the ratio of carbon to hydrogen to 2:5, the molecule is no longer butane. Therefore, for binary molecular compounds, **ALWAYS USE PREFIXES TO INDICATE HOW MANY ATOMS OF EACH ELEMENT ARE PRESENT EXCEPT WHEN THERE IS ONE ATOM OF THE FIRST ELEMENT.**

33. Name the following **molecular** compounds using the systematic naming scheme mentioned above. If the compound has a common name and you know it, please also include this in your answer.

a. C_3H_8 _____

b. CH_4 _____

c. P_4O_{10} _____

d. NO_2 _____

e. SO_3 _____

f. NH_3 _____

34. When writing the chemical formula for molecular compounds, simply write them as the prefixes indicate. You do NOT have to figure up charges!! Write the correct chemical formulas for the following molecular compounds.

a. carbon dioxide _____

b. dicarbon hexahydride (ethane) _____

- c. dihydrogen monoxide _____
- d. hydrogen monochloride gas _____
- e. dinitrogen monoxide _____
- f. triphosphorus pentoxide _____

35. Acids. When a molecular gas containing hydrogen is bubbled through water, it becomes an acid. The way you name the compound changes.

Non-oxy acids (those not containing oxygen). Begin the acid's name with hydro and end in -ic. The root of the acid's name is taken from the anion that hydrogen is bonded to. For example: HCl (aq) is hydrochloric acid. HCN(aq) is hydrocyanic acid. H₂S(aq) is hydrosulfuric acid. The net charge is zero!!! Hydrogen is the cation in an acid and has a +1 charge.. If H₂S is followed by a (g), then it is not an acid and its name follows the molecular naming scheme and would be hydrogen disulfide gas (the common name is hydrogen sulfide gas).

Oxyacids are formed when the hydrogen ion hooks up with a polyatomic ion that contains oxygen. To name these correctly, you must determine the identity of the polyatomic ion. If the polyatomic ion's name ends in -ate, the acid's name ends in -ic. The acid does NOT begin with hydro-. Example: H₂SO₄(aq) is sulfuric acid. H₃PO₄(aq) is phosphoric acid. If the polyatomic ion bonded to the hydrogen ion has a name ending in -ite, the acid's name ends in -ous. Examples are: H₂SO₃(aq) is sulfurous acid and H₃PO₃(aq) is phosphorous acid. The net charge MUST BE ZERO !!!!!

Now, you give it a twirl:

Name the following acids correctly. All are (aq)

- a. H₃P _____
- b. H₂Se _____
- c. HBrO₃ _____

- d. HI _____
- e. H_2CO_3 _____
- f. $\text{HC}_2\text{H}_3\text{O}_2$ _____
- g. HClO_4 _____
- h. HClO_2 _____

Write the correct chemical formula for the following acids:

- a. chloric acid _____
- b. hydrofluoric acid _____
- c. phosphorous acid _____
- d. hydrocyanic acid _____
- e. nitric acid _____
- f. sulfurous acid _____

36. **Mixed Bag.** The following compounds may be ionic, molecular, or acidic. Decide which type of compound it is first, then, name the compound correctly.

- a. $\text{Cr}(\text{ClO}_3)_3$ _____
- b. K_2O_2 _____
- c. NH_3 _____
- d. HIO_3 (aq) _____

- e. N_2O_5 _____
- f. HNO_2 (aq) _____
- g. Ag_2S _____
- h. KMnO_4 _____
- i. $\text{K}_2\text{Cr}_2\text{O}_7$ _____
- j. RbOH _____
- k. H_3PO_4 (aq) _____
- l. $(\text{NH}_4)_2\text{S}$ _____
- m. NaHCO_3 _____
- n. $\text{Pb}(\text{CN})_4$ _____
- o. C_4H_{10} _____
- p. KOH _____

Give the correct chemical formula for the following compounds.

- a. stannous fluoride _____
- b. oxalic acid _____
- c. lead (IV) nitrate _____
- d. sodium silicate _____
- e. cadmium phosphate _____
- f. hydrogen peroxide _____
- g. sodium selenide _____

c. How many formula units are there in 16.00 grams of magnesium chloride?

d. How many oxygen atoms are there in 3.560×10^{-3} moles of calcium chlorate?

e. How many grams are there in 25 nickel atoms?

38. **Percent Composition.** The key here is that your mass percent composition for any compound is always part \div whole. Answers must add up to very, very close to 100%. Each element will have a numerical answer followed by a percent sign.

a. What is the percent composition of sucrose, $C_{12}H_{22}O_{11}$?

b. A compound was produced from adding together 20.22 g of carbon, 2.93 g of hydrogen, and 1.86 g of oxygen. What is the percent composition of this substance?

40. **Empirical and Molecular Formulas:** An empirical formula is the lowest whole-number ratio of atoms or ions in a chemical formula. Ionic compounds (except for those containing mercury (I) and peroxide) are automatically written in lowest whole-number ratios. Molecular compounds, however, may or may not be empirical formulas. CO_2 is an empirical formula. C_4H_{10} is NOT an empirical formula. Reducing C_4H_{10} to its lowest whole-number ratio gives us an empirical formula of C_2H_5 .

Steps to determining an empirical formula. Take the % or mass given to you and divide by that atom's mass (to get molar ratios). Then divide all answers by the lowest number (to reduce to lowest whole-number ratios). Finally, you may have to multiply all your answers to get to whole numbers. Although I have not found the rule in writing, the general trend seems to be that if you have .20 or less, round down. If you have .80 or higher, round up to the next whole number.

a. What is the empirical formula for a compound that contains 10.52 g Ni, 4.38 g C, and 5.10 g N?

b. Thiobromine is chocolate flavoring, It consists of 46.66% C, 4.48%H, 31.1%N, and 17.76%O. What is the empirical formula for chocolate flavoring?

Molecular formulas are multiples of empirical formulas. To determine a molecular formula, you must first determine the empirical formula. Then divide the molar (molecular) mass by the empirical formula mass. If your calculations are correct, you will get VERY NEAR a whole number. This is what you multiply all your empirical formula subscripts by.

a. The hydrocarbon used in the manufacture of foam plastics is called styrene. Styrene is 92.25%C and 7.75%H and has a molar mass of 104 g/mol. Determine the molecular formula for styrene.

b. Analysis of a compound found it to contain 49.98 g of carbon and 10.47 g of hydrogen. The molar mass of the compound is 58.12 g/mol. Determine the molecular formula for this compound.

Hey, AP Chemistry students. Hope that you are having a fantastic summer!!!!

If you need help with the attached review, please:

1. email me. My school email address is: sharp@dadescschools.net.
2. Join the AP Chemistry Facebook site

I am really looking forward to a great and fun year in AP chemistry.

Sharp