

Practice Questions for Chapter 3 blank

Section 3.1 & 3.2

1. Balance the following equations, for this question, if the coefficient is 1[one], put that in the line as well. You will lose points if you leave the lines blank:
 - a) $\text{CCl}_4 + \text{O}_2 \rightarrow \text{COCl}_2 + \text{Cl}_2$
 - b) $\text{C}_9\text{H}_8\text{O}_4 + \text{O}_2 \rightarrow \text{H}_2\text{O} + \text{CO}_2$
 - c) $\text{Mg}_2\text{C}_3 + \text{H}_2\text{O} \rightarrow \text{Mg}(\text{OH})_2 + \text{C}_3\text{H}_4$
 - d) Do any of these reactions represent the decomposition process? Explain in one or two sentences why or why not.
2. Balance the following equations, for this question, if the coefficient is 1[one], put that in the line as well. You will lose points if you leave the lines blank:
 - a. $\text{BCl}_3 + \text{P}_4 + \text{H}_2 \rightarrow \text{BP} + \text{HCl}$
 - b. $\text{C}_9\text{H}_8\text{O}_4 + \text{O}_2 \rightarrow \text{H}_2\text{O} + \text{CO}_2$
 - c. $\text{NCl}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_3 + \text{HOCl}$
 - d. Do any of these reactions represent decomposition? Explain in one or two sentences.
 - e) Do any of these reactions represent combustion? Explain in one or two sentences.

Section 3.3

3. (4 points) One of the newly discovered materials that is a superconductor at about 90K is called a "123 compound" because its formula is $\text{YBa}_2\text{Cu}_3\text{O}_{(9-x)}$. Calculate the formula mass of the compound $\text{YBa}_2\text{Cu}_3\text{O}_7$ using the following atomic masses: Y 88.90585 amu, Ba 137.327 amu, Cu 63.546 amu, O 15.9994 amu respectively (Your answer will be wrong if you do not use these masses).

4. **(6 points)** Torbernite is a mineral structurally similar to mica, The formula unit is $\text{Cu}(\text{UO}_2)_2(\text{PO}_4) \cdot 10\text{H}_2\text{O}$. [There are 10 waters in the formula]
- a) What is formula mass of torbernite? Use the following atomic masses for your calculation.
- $\text{Cu} = 63.546 \text{ amu}$
 - $\text{U} = 238.02891 \text{ amu}$
 - $\text{O} = 15.9994 \text{ amu}$
 - $\text{P} = 30.973762 \text{ amu}$
 - $\text{H} = 1.00794 \text{ amu}$

Section 3.4

5. (5 points) Novocain, $\text{C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl}$, is a local anesthetic. A sample of Novocain contains 6.000×10^{25} atoms of carbon. Please show your setups for full credit.
- a. How many molecules of Novocain does the sample contain?
- b. How many moles of Novocain does this sample contain?
- c. What is the molar mass of Novocain? Use the following atomic masses to calculate your molar mass: Carbon: 12.010 7, nitrogen: 14.006 7, hydrogen: 1.007 94, oxygen: 15.999 4, chlorine: 35.452 7. (Your answer will be considered wrong if you do not use these masses; watch your units)
6. **(5 points)** Aspartame is used as an artificial sweetener. Answer the following question using the correct significant figures and units.
- a. What is the formula for Aspartame: 14 carbons; 18 hydrogens, 2 nitrogens and 5 oxygens?
- b. A sample of aspartame has 5.00×10^{28} oxygen atoms. How many aspartame molecules does this represent?
- c. Using the following values for atomic masses, calculate the molecular mass of aspartame: C: 12.01078 amu, H: 1.007947 amu, N: 14.00672 amu, O: 15.99943 amu
- d. A sample of aspartame has a mass of 3.6 mg. How many moles does this represent?
7. **(5 points)** Capsaicin is the pungent component of various species of *Capsicum*, including red and green chili peppers, especially *c. annuum* and is the active component of *paprika*. It has

several actions in the body when ingested, such as stimulation of the formation of endorphins in the brain and increased salivation when eating spicy food. The formula of capsaicin is $C_{18}H_{27}O_3N$. A sample of capsaicin contains 6.79×10^{20} molecules of capsaicin.

- a. How many moles of capsaicin does the sample contain?
- b. How many atoms of hydrogen does the sample contain?
- c. What is the molecular mass of capsaicin? Use the following values: C-12.011 amu; H-1.0079 amu; Cl-35.453 amu; O-15.9994 amu

305.412 amu

- d. What is the mass of this sample in grams? **Section 3.5**
8. **(8 points)** The characteristic odor of pineapple is due to ethyl butyrate, a compound containing carbon, hydrogen, and oxygen. Combustion of a 2.78 g sample of ethyl butyrate produces 6.32 g of carbon dioxide and 2.58 g of water. What is the empirical formula for this compound? [$CO_2 = 44.01$ amu; $H_2O = 18.02$ amu] C_3H_6O

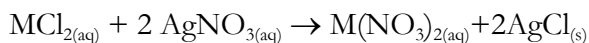
9. Eugenol is the major component in oil of cloves. It has a molar mass of 164.2 g/mol and is composed of 73.14% C and 7.37% H; the remainder is oxygen. What is the empirical and molecular formula for Eugenol?

10. The analysis of aniline, a common organic base used in some varnishes, is: 77.44% C, 15.0% N and the rest is hydrogen. What is the empirical formula for aniline?

11. **10 points**) A sample of an organic compound containing C, H, and O, which weights 1.213 g gives 3.06 g of CO₂ and 0.536 g of H₂O in combustion. Determine the empirical formula for this compound.

Section 3.6

12. **(6 point)** A metal, symbol M, was converted to the chloride, MCl₂. Then, a solution of the metal chloride was treated with silver nitrate to give silver chloride crystals, which were filtered from the solution. [MM AgNO₃ = 107.88 amu; MM Cl = 35.453 amu]



If 2.434 g of metal gave 7.964 g of silver chloride:

- (2 point) How many moles of silver chloride were made?
- (1 point) How many moles of MCl_{2(aq)} were used?
- (1 point) What is the mole relationship between the moles of metal and the moles of MCl_{2(aq)}?
- (2 point) What is the atomic weigh of the metal?

Section 3.7

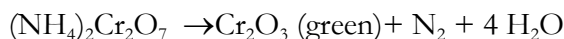
13. Acrylonitrile, C₃H₃N, is used to make acrylics. It can be made from propylene, C₃H₆, and nitric oxide, NO.



How many grams of acrylonitrile are obtained from 2.50 g of nitric oxide?

[NO = 30.0 amu; C₃H₃N = 53.06 amu]

14. **(5 points)** The decomposition of ammonium dichromate occurs as follows:



The green compound, chromium(III) oxide, is the pigment used in paper money dye. How many grams of ammonium dichromate would a counterfeiter have to use to produce 50.0 g of chromium(III) oxide?

15. **(6 points)** The complete combustion of nonane, C₉H₂₀(l), proceeds as follows. C₉H₂₀(l) + 14 O₂(g) → 9 CO₂(g) + 10 H₂O(l)

Nonane, C₉H₂₀(l), has a density of 0.789 g/mL at 20°C. How many grams of oxygen are required to burn 2.00 m³ of nonane? (MM nonane = 128.295 amu)

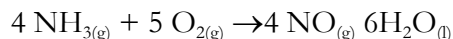
16. **(5 points)** When iron metal is reacted with potassium permanganate in acid, the following reaction occurs.



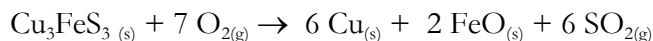
(5 points) What mass of iron (III) chloride, in grams, is made from the complete reaction of excess iron and hydrochloric acid with 2.56 g potassium permanganate?

Section 3.7

17. **(10 points)** The reaction of 750. g of each of NH_3 and O_2 was found to produce 560 g NO by the reaction below.

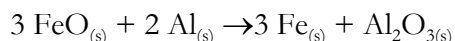


- (a) **(4 points)** Which is the limiting reagent. Show your reasoning (i.e. work) for full credit.
 - (a) **(2 points)** What is the mass of NO, in grams that is produced in the theoretical reaction?
 - (b) **(2 points)** How many grams of excess reagent remains?
 - (c) **(2 points)** What is the percent yield? $560/563 \times 100 = 99.5\%$
18. **(8 points)** One of the steps in the commercial process for collecting copper metal involves the reaction of bornite (Cu_3FeS_3) with oxygen.



In a certain experiment 3.00 g of $\text{Cu}_3\text{FeS}_3(s)$ reacts with 3.00 g of O_2 .

- a. Which reactant is the limiting reactant?(show your reasoning)
 - b. How many grams of copper form?
 - c. How many grams of the excess reagent remain after the limiting reactant is completely consumed?
19. A mixture of 7.45 g of iron(II) oxide and 0.111 mol of aluminum metal is placed in a crucible and heated in a high temperature oven, where the reduction of the oxide occurs. The reaction 2.4 g of iron.



- (4 points)** Which is the limiting reagent. Show your reasoning (i.e. work) for full credit.
- a. **(2 points)** What is the mass of Fe, in grams that is produced in the theoretical reaction?
 - b. **(2 points)** How many grams of excess reagent remains?
 - c. **(2 points)** What is the percent yield?