

Recitation Worksheet Three

Name:

UGA ID:

Instructions:

- Please enter your first and last name as it appears on the eLC roster (do not use a nickname that is not reflected in eLC).
- Your UGA myID is a combination of letters and numbers (example: mine is jmj81738). Do *not* enter your 81x number.
- Download this worksheet and print it if you have a printer. Write the answers in the answer boxes and show your work when appropriate. Using the instructions in the Welcome module on eLC, convert your worksheet to a PDF and then upload it to Gradescope. If you have an iPhone or Android device, you can scan and upload directly through the Gradescope app. The pages must be in the correct order or Gradescope will not be able to read it.
- If you do not have a printer, download the worksheet and type your answers in the answer boxes and upload it to Gradescope. Write your work on separate sheets of paper, convert these pages to a PDF using the instructions in the Welcome module on eLC, then upload them to the dropbox on eLC for this worksheet.
- If you are using an app to annotate the worksheet, make sure the pages are in the correct order and have the same layout as the original or Gradescope will not be able to read it.
- Answers must be written in the corresponding answer box or no credit will be awarded.
- This worksheet is due no later than **11:59 PM on the Friday of the recitation week**.
- The instructions for uploading worksheets to Gradescope can be found in the Content area of eLC in the Welcome Module.
- **You must show your work to receive credit.**

1. Fill out the table below with either the proper name or formula.

| Compound Name | Formula |
|----------------------------|--|
| Calcium chloride dihydrate | CaCl₂·2H₂O $CaCl_2 \cdot 2H_2O$ |
| Iron(II) hydroxide | Fe(OH) ₂ |
| Sulfur hexafluoride | SF ₆ |
| iodous acid | HIO ₂ |
| Magnesium cyanide | Mg(CN) ₂ |

Fe = iron is a transition metal with variable oxidation state
 IO₂⁻ = iodite and -ite goes to -ous in acid names

2. Which of the following compounds is named correctly?

A

- A. CuCl; copper(I) chloride
- B. K_2SO_4 ; potassium(II) sulfate
- C. $MnCO_3$; magnesium carbonate
- D. $Al(CN)_3$; aluminum(III) cyanide
- E. More than one of the compounds is named correctly

3. Which of the following is the correct name for the compound PCl_3 ?

E

- A. Phosphorus(III) chloride
- B. Phosphorus tetrachloride
- C. Monophosphorus tetrachloride
- D. Phosphorus(III) trichloride
- E. Phosphorus trichloride

4. Which of the following compounds has their formula and name incorrectly matched? Choose all that apply, and answer with capital letters with no spaces in between (e.g. ABCDE).

CD

- A. Na_2SO_3 ; sodium sulfite
- B. $(NH_4)_2O$; ammonium oxide
- C. $Cu_2Cr_2O_7$; copper(II) chromate "dichromate"
- D. $Ca(SCN)_2$; carbon thiocyanate
- E. Li_3PO_4 ; lithium phosphate

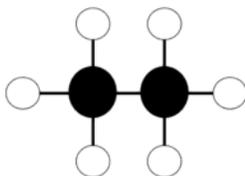
5. Which one of the following compounds is chromium(III) oxide?

B

- A. CrO_3
- B. Cr_2O_3
- C. Cr_3O_2
- D. Cr_3O
- E. Cr_2O_4



6. What is the name of the pictured compound if white spheres represent hydrogen and black spheres represent carbon?



C



- A. Dicarbon hexahydride
- B. Methane
- C. Ethane
- D. Methanol
- E. Ethanol

7. What is the name of the compound $\overset{5}{\text{C}}\overset{4}{\text{H}}\overset{3}{\text{C}}\overset{2}{\text{H}}\overset{1}{\text{C}}\overset{1}{\text{H}}\overset{2}{\text{C}}\overset{3}{\text{H}}\overset{4}{\text{C}}\overset{5}{\text{H}}\text{OH}$?

A

- A. Pentanol
- B. Hexanol
- C. Pentanoic acid
- D. Hexanoic acid

8. What is the name of the compound CH_3COOH ?

2 1

D

- A. Methanol
- B. Ethanol
- C. Methanoic acid
- D. Ethanoic acid

9. What is the name of the compound $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$?

5 4 3 2 1

D

- A. Pentacarbon decahydrogen dioxide
- B. Butanol
- C. Butanoic acid
- D. Pentanoic acid
- E. Pentanol

10. The theoretical element Hx has three isotopes: Hx-302, Hx-303, and Hx-305. If the average atomic mass for Hx is 304.300 amu, what is likely the most abundant isotope?

C

- A. Hx-302
- B. Hx-303
- C. Hx-305

average is closest to 305 despite all other isotopes being lower in mass

11. The hypothetical element "R" has two naturally occurring isotopes: ^{109}R and ^{110}R . What is the average atomic mass of "R" if the isotope ^{109}R has a natural abundance of 55.45%? The masses of both isotopes are provided in the table below.

| Isotope of "R" | Mass |
|------------------|----------------|
| ^{109}R | 109.112231 amu |
| ^{110}R | 110.718210 amu |

= 55.45%

= 100-55.45=44.55 %

amu

$$(109.112231 \times 0.5545) + (110.718210 \times 0.4455) = 109.827695$$

$$\underline{60.502932} \quad + \quad \underline{49.324963} \quad = 109.83$$

- 4 sig figs each multiplication.
- hundredths place addition.

12. What is the molar mass (g/mol) for the following compounds? Answer with five sig figs.

Zn(NO₃)₂ g/mol

CH₃COOH g/mol

O₂ g/mol

13. How many chromium atoms are in 46.8 g of lead(IV) dichromate?

$1.76E23$ $46.8 \text{ g Pb}(\text{Cr}_2\text{O}_7)_2 \times \frac{\text{mol}}{635.184 \text{ g}} \times \frac{6.022 \times 10^{23}}{\text{mol}} \times \frac{4 \text{ Cr atoms}}{\text{Pb}(\text{Cr}_2\text{O}_7)_2}$

14. What is the mass of an ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) sample containing 6.91×10^{22} molecules of ethanol?

5.29 $6.91 \times 10^{22} \text{ molecules} \times \frac{\text{mol}}{6.022 \times 10^{23} \text{ molecules}} \times \frac{46.08 \text{ g}}{\text{mol}}$

15. How many mercury atoms are in 1.50 mL of liquid elemental mercury? The density of liquid mercury is 13.5 g/cm^3 .

$6.08E22$ $d = \frac{m}{V} = \frac{13.5 \text{ g}}{\text{cm}^3} = \frac{m}{1.50 \text{ cm}^3}$ (1 mL = 1 cm³)
 $m = 13.5 \frac{\text{g}}{\text{cm}^3} \times 1.50 \text{ cm}^3 = 20.25 \text{ g Hg}$

1. find mass using density
2. solve for atoms

$20.25 \text{ g Hg} \times \frac{\text{mol}}{200.59 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ atoms}}{\text{mol}} = 6.08 \times 10^{22} \text{ atoms}$

16. What is the mass percent of manganese in manganese(VI) oxide?

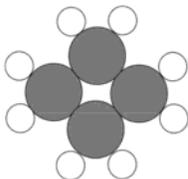
55.37 53.37 $\text{Mn}^{6+} \text{O}^{2-}$
 MnO_3
 $\% = \frac{M_n}{M_n + 3O} \times 100 = \frac{54.94}{54.94 + 3(16.00)} \times 100 = 55.37\%$

17. Heme, the portion of red blood cells that produce the red color, has a formula of $\text{C}_{34}\text{H}_{32}\text{FeN}_4\text{O}_4$. What is the mass percent of iron in heme?

9.06 $\% = \frac{\text{Fe}}{\text{C}_{34}\text{H}_{32}\text{FeN}_4\text{O}_4} \times 100 = \frac{55.85 \text{ g/mol}}{616.55 \text{ g/mol}} \times 100$

18. In the diagram below, gray circles represent atoms of element A and white circles represent atoms of element B. What is the correct **empirical formula** for the compound shown?

A



- A. AB_2
- B. AB
- C. AB_4
- D. A_4B_8

19. The molar mass of an unknown compound is 60.21 g/mol. If the compound is 6.71% hydrogen and 93.29% silicon by mass, what is the molecular formula?

Si_2H_4

① $6.71 \text{ g H} \times \frac{\text{mol}}{1.01 \text{ g}} = 6.64356 \text{ mol H}$

② $H: \frac{6.64356}{3.32111} = 2$

③ $93.29 \text{ g Si} \times \frac{\text{mol}}{28.09 \text{ g}} = 3.32111 \text{ mol Si}$

④ $Si: \frac{3.32111}{3.32111} = 1$

Empirical mass $SiH_2 = 30.11 \text{ g/mol}$

Molar Mass = 60.21 g/mol

⑤ $\frac{60.21}{30.11} = \frac{2}{1}$ MF = 2(empirical)

= Si_2H_4

1. find moles assuming 100g sample
2. divide by smallest moles
3. use whole number ratio to find empirical mass
4. divide molar mass by empirical mass
5. multiple the whole number ratio by empirical formula

20. A compound is 51.43% copper, 9.72% carbon, and 38.85% oxygen. What is the empirical formula?

$CuCO_3$

$51.43 \text{ g Cu} \times \frac{\text{mol}}{63.55 \text{ g}} = 0.809284 / 0.809284 = 1$

$9.72 \text{ g C} \times \frac{\text{mol}}{12.01 \text{ g}} = 0.809286 / 0.809284 = 1$

$38.85 \text{ g O} \times \frac{\text{mol}}{16.00 \text{ g}} = 2.428125 / 0.809284 = 3$



1. Assuming 100 g sample, grams = %mass.
2. solve for moles each and divide by smallest number of moles
3. whole number ratios give empirical formula

21. Which of the following is an empirical formula? Choose all that apply, and answer with capital letters with no spaces in between (e.g. ABCDE).

- A. C₂H₆O₂
- B. N₂O₃
- C. C₄H₈
- D. N₃O₉
- E. OCl₂

BE

others can be reduced

22. Amylose is a carbohydrate and a component of starch, which plants use to store energy. Carbohydrates are so named because they are complex molecules composed of carbon, hydrogen, and oxygen. Combustion analysis of 1.00 g of amylose yields 1.63 g CO₂ and 0.556 g H₂O.

in combustion analysis,
 1. all C comes from CO₂.
 2. all H comes from H₂O
 3. total - C - H = mass O

What is the mass of oxygen that was present in the original sample of amylose?

~~0.45~~ 0.493 grams

$$\textcircled{3} M_{\text{oxy}} = 1.00 \text{ g} - 0.444815 \text{ g} - 0.0623263 \text{ g} = 0.4928587 \text{ g}$$

What is the empirical formula of amylose?

C₆H₁₀O₅

$$\text{mol O} = 0.452855 \text{ g} \times \frac{\text{mol}}{16.00 \text{ g}} = 0.0283034 \text{ mol O}$$

$$\textcircled{1} 1.63 \text{ g CO}_2 \times \frac{\text{mol}}{44.01 \text{ g}} \times \frac{\text{mol C}}{\text{mol CO}_2} = 0.0370370 \text{ mol C} \times \frac{12.01 \text{ g}}{\text{mol C}} = 0.444815 \text{ g C}$$

$$\textcircled{2} 0.556 \text{ g H}_2\text{O} \times \frac{\text{mol}}{18.02 \text{ g}} \times \frac{2 \text{ H}}{\text{H}_2\text{O}} = 0.0617052 \text{ mol H} \times \frac{1.01 \text{ g}}{\text{mol H}} = 0.0623263 \text{ g H}$$

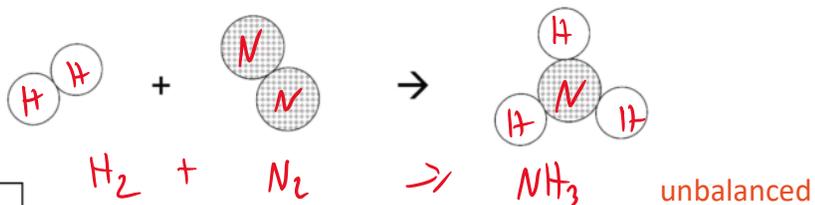
$$\textcircled{4} \text{Empirical} = \text{O} = \frac{0.0283037}{0.0283037} = 1 \times 5 = 5$$

$$\text{C} = \frac{0.0370370}{0.0283037} = 1.2 \times 5 = 6$$

$$\text{H} = \frac{0.0617052}{0.0283037} = 2 \times 5 = 10$$

- 4. convert to moles and find empirical formula like above.
- 5. The only difference is the need to multiply out by a whole number factor to the lowest whole number ratio of atoms

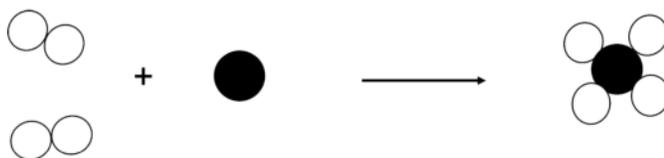
23. If the white circles represent hydrogen and the patterned circles represent nitrogen in the **unbalanced** image below, what is the correct, balanced equation?



B

- A. $H_2(g) + N_2(g) \rightarrow NH_3(g)$
- B. $3 H_2(g) + N_2(g) \rightarrow 2 NH_3(g)$
- C. $2 H(g) + 2 N(g) \rightarrow N(g) + 3 H(g)$
- D. $6 H(g) + 2 N(g) \rightarrow 2 N(g) + 6 H(g)$
- E. $2 H_2(g) + N_2(g) \rightarrow 2 NH_3(g)$

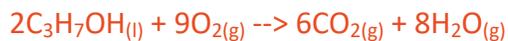
24. What is the balanced reaction depicted in the following image, given the black spheres represent carbon and the white spheres represent hydrogen?



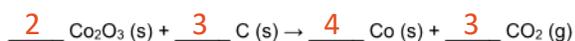
25. Write the balanced reaction of elemental aluminum with hydrochloric acid, which yields aluminum chloride salt and hydrogen gas. Make sure to include states of matter.



26. Write the balanced **combustion reaction** of propanol ($\text{C}_3\text{H}_7\text{OH}$). Make sure to include states of matter.

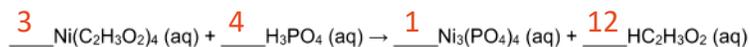


27. What is the coefficient for each compound when the following reaction is balanced? Write the integers in order, with no commas (e.g. 1287) on your answer sheet and include 1 even if it is usually left out.



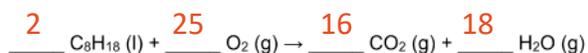
2343

28. What is the coefficient for each compound when the following reaction is balanced? Write the integers in order, with no commas (e.g. 1287) on your answer sheet and include 1 even if it is usually left out.



34112

29. A 500. mL sample of octane (C_8H_{18}) combusts with excess oxygen according to the **unbalanced** reaction below. If the density of octane is 0.70 g/mL, how many grams of carbon dioxide are produced?



grams $m = dV = 0.70 \frac{g}{mL} \times 500. mL = 350 g$

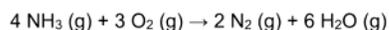
$$350 g \times \frac{mol}{114.26 g} \times \frac{16 mol CO_2}{2 mol C_8H_{18}} \times \frac{44.01 g}{mol CO_2} = 1.1 \times 10^3 g CO_2$$

30. A rod of 150. g of pure iron is exposed to air and rusts due to the presence of oxygen. How many grams of rust (iron(III) oxide) are produced?



$$150. g Fe \times \frac{mol}{55.85 g} \times \frac{2 mol Fe_2O_3}{4 mol Fe} \times \frac{157.63 g}{mol} = 214 g$$

31. When 8.00×10^{22} molecules of ammonia react with an excess of oxygen according to the balanced chemical equation shown below, how many grams of nitrogen gas are produced?



grams

$$8.00 \times 10^{22} NH_3 \times \frac{mol}{6.022 \times 10^{23}} \times \frac{2 mol N_2}{4 mol NH_3} \times \frac{28.02 g N_2}{mol N_2} = 1.86$$

32. Consider the following balanced reaction below. How many moles of oxygen are required to produce 2.33 moles of water? Assume that there is excess C_3H_7SH present.



3.50

moles $2.33 \text{ mol H}_2\text{O} \times \frac{6 O_2}{4 H_2O} = 3.50$