

**CHEM099 Final Exam Review**

## **Expected Outcomes**

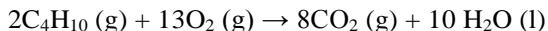
1. Use dimensional analysis to perform calculations and express results of calculations with correct units and number of significant figures.
  2. Identify the various states of matter and describe the common physical properties of each state.
  3. Identify and distinguish physical and chemical properties and changes.
  4. Describe the major components of the atom and write symbols for atoms, ions, and isotopes.
  5. Determine nomenclature and formulas for ionic and covalent compounds.
  6. Convert moles, masses, and numbers of particles.
  7. Determine percent composition and understand and apply mole concept to determine empirical and molecular formulas.
  8. Balance chemical equations, classify reaction types, and determine products of reactions.
  9. Use stoichiometry and balanced equations to determine amounts and masses of substances used up and produced in reactions as well as percent yields.
  10. Determine solution concentrations and calculate the amounts of materials involved in solution reactions.
  11. Analyze and solve problems that include a combination of concepts from various chapters.

## Review Questions

- Which of the following is a chemical change?  
(A) methane gas is burned  
(B) paper is shredded  
(C) water is vaporized  
(D) salt is dissolved in water
  - How many significant figures are in the measurement, 0.0005890 g?  
(A) 3  
(B) 4  
(C) 5  
(D) 7
  - 850 nm is equal to:  
(A)  $8.5 \times 10^9$  m  
(B)  $8.5 \times 10^{-9}$  m  
(C)  $8.5 \times 10^{-7}$  m  
(D)  $8.5 \times 10^{-10}$  m
  - What answer should be reported, with the correct number of significant figures, for the following calculation?  
$$(433.621 - 333.9) \times 11.90 =$$
  
(A)  $1.19 \times 10^3$   
(B)  $1.187 \times 10^3$   
(C)  $1.1868 \times 10^3$   
(D)  $1.18680 \times 10^3$
  - A temperature of  $-31.0^{\circ}\text{C}$  is equivalent to  
(A)  $-304.2\text{ K}$   
(B)  $304.24\text{ K}$   
(C)  $242.2\text{ K}$   
(D)  $329.2\text{ K}$
  - A piece of metal ore weighs 8.25 g. When placed into a graduated cylinder containing water, the liquid level rises from 21.25 mL to 26.47 mL. What is the density of the ore?  
(A) 0.312 g/mL  
(B) 0.633 g/mL  
(C) 1.58 g/mL  
(D) 3.21 g/mL
  - The density of mercury is 13.6 g/mL, calculate the volume of a 20.0 g sample of mercury.  
(A) 0.680 mL  
(B) 6.40 mL  
(C) 272 mL  
(D) 1.47 mL
  - A substance with a melting point of  $-218^{\circ}\text{C}$  and a boiling point of  $-182^{\circ}\text{C}$  is a \_\_\_\_\_ at  $20^{\circ}\text{C}$ .  
(A) Gas  
(B) Liquid  
(C) Solid  
(D) not enough info given



#25 and #26 refers to the following chemical equation.





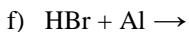
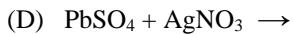
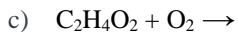
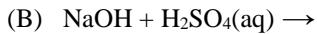
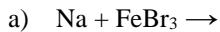

Symbol	# Protons	# Neutrons	# Electrons	Mass Number
$^{90}\text{Mo}^{+6}$				
	54		55	133

36. Balance the following equations.

$$a) \quad C_6H_{14} + O_2 \rightarrow CO_2 + H_2O$$

b)  $\text{KClO}_3 + \text{HCl} \rightarrow \text{KCl} + \text{Cl}_2 + \text{H}_2\text{O}$

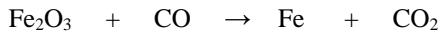
37. Complete the following chemical equations by predicting the products.



38. Complete the following table by providing chemical formula for given names and vice versa.

Chemical Name	Chemical Formula
zinc hydroxide	
	NiS
boric acid	
	Mg(CN) <sub>2</sub>
potassium fluoride	
	B <sub>2</sub> O <sub>3</sub>
gold (III) nitrate	
	H <sub>3</sub> PO <sub>4</sub> (aq)
tetraphosphorus hexasulfide	
	CuCO <sub>3</sub>
iodic acid	

39. Consider the reaction represented by the following unbalanced equation



- If 27.5 g of  $\text{Fe}_2\text{O}_3$  is reacted with 18.6 g of CO, what is the theoretical yield of Fe in grams?
- If the reaction produced 14.8 g of Fe, what was its percent yield?
- What is the limiting reactant?
- How many grams of the excess reactant is left over at the end of the reaction?

40. An organic compound contains carbon, hydrogen and oxygen and has a molar mass of ~306 g/mole. If it contains 47.01% of carbon and 5.99% hydrogen, what is its empirical **AND** molecular formula?

41. Consider the reaction between hydrochloric acid and zinc to produce zinc chloride and hydrogen gas.

- How many grams of zinc is needed to completely react with 25 mL of 4.0 M hydrochloric acid?
- How many mL of 0.35 M hydrochloric acid is needed to produce 0.234 kg of hydrogen gas?

42. An unknown element, X, has a molar mass of 112.45 g/mole and a density of 2.34 g/mL.

- If an 123 mL solution is 0.45 M in element X, how many actual number of X atoms does it contain?
- How many moles of element X is in a 6.70 L sample of element X?

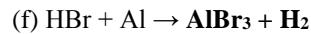
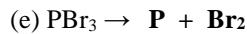
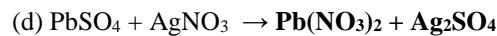
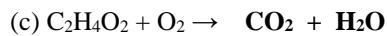
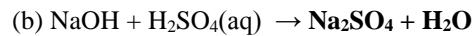
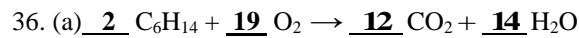
## ANSWERS

- |         |         |         |         |         |
|---------|---------|---------|---------|---------|
| 1. (A)  | 2. (B)  | 3. (C)  | 4. (A)  | 5. (C)  |
| 6. (C)  | 7. (D)  | 8. (A)  | 9. (B)  | 10. (A) |
| 11. (B) | 12. (D) | 13. (A) | 14. (A) | 15. (B) |
| 16. (D) | 17. (B) | 18. (B) | 19. (C) | 20. (D) |
| 21. (D) | 22. (C) | 23. (D) | 24. (A) | 25. (C) |
| 26. (B) | 27. (A) | 28. (C) | 29. (B) | 30. (D) |
| 31. (D) | 32. (A) | 33. (C) |         |         |

$$34. \frac{25.0 \text{ mi}}{\text{hr}} \times \frac{1.61 \text{ km}}{\text{mi}} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{10^2 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 1.12 \times 10^3 \text{ cm/sec}$$

35.

Symbol	# Protons	# Neutrons	# Electrons	Mass Number
<sup>90</sup> Mo <sup>+6</sup>	42	48	36	90
<sup>133</sup> Xe <sup>-</sup>	54	79	55	133



38.

Chemical Name	Chemical Formula
zinc hydroxide	Zn(OH) <sub>2</sub>
<b>nickel (II) sulfide</b>	NiS
boric acid	H <sub>3</sub> BO <sub>3</sub> (aq)
<b>magnesium cyanide</b>	Mg(CN) <sub>2</sub>
potassium fluoride	KF
<b>diboron trioxide</b>	B <sub>2</sub> O <sub>3</sub>
gold (III) nitrate	Au(NO <sub>3</sub> ) <sub>3</sub>
<b>phosphoric acid</b>	H <sub>3</sub> PO <sub>4</sub> (aq)
tetraphosphorus hexasulfide	P <sub>4</sub> S <sub>6</sub>
<b>copper (II) carbonate</b>	CuCO <sub>3</sub>
iodic acid	HIO <sub>3</sub> (aq)



a) ~~27.5 g Fe<sub>2</sub>O<sub>3</sub> × 1 mole Fe<sub>2</sub>O<sub>3</sub> × 2 mole Fe × 55.85 g Fe~~ = 19.2345 g Fe = **19.2 g Fe**

$$18.6 \text{ g CO} \times \frac{1 \text{ mole CO}}{28.011 \text{ g CO}} \times \frac{2 \text{ mole Fe}}{3 \text{ mole CO}} \times \frac{55.85 \text{ g Fe}}{1 \text{ mole Fe}} = 24.724 \text{ g Fe}$$

b)  $\frac{14.8 \text{ g Fe}}{19.23 \text{ g Fe}} \times 100 = 76.96\% = \mathbf{77.0\%}$

c) **Fe<sub>2</sub>O<sub>3</sub>**

d)  $27.5 \text{ g Fe}_2\text{O}_3 \times \frac{1 \text{ mole Fe}_2\text{O}_3}{159.7 \text{ g Fe}_2\text{O}_3} \times \frac{3 \text{ mole CO}}{1 \text{ mole Fe}_2\text{O}_3} \times \frac{28.011 \text{ g CO}}{1 \text{ mole CO}} = 14.470 \text{ g CO used}$

$18.6 \text{ g CO} - 14.470 \text{ g CO} = 4.13 \text{ g CO} = \mathbf{4.19 \text{ g CO left}}$

40. % O = 100% - 47.01% - 5.99% = 47.00% oxygen

$$47.01 \text{ g C} \times \frac{1 \text{ mole C}}{12.011 \text{ g C}} = 3.91 \text{ mole C} = \frac{3.91 \text{ mole C}}{2.94} \approx 1.33 \times 3 = 4 \text{ C}$$

$$5.99 \text{ g H} \times \frac{1 \text{ mole H}}{1.0079 \text{ g H}} = 5.94 \text{ mole H} = \frac{5.94 \text{ mole C}}{2.94} \approx 2.0 \times 3 = 6 \text{ H}$$

$$47.00 \text{ g O} \times \frac{1 \text{ mole O}}{16.00 \text{ g O}} = 2.94 \text{ mole O} = \frac{2.94 \text{ mole O}}{2.94} \approx 1.0 \times 3 = 3 \text{ O}$$

**Empirical formula: C<sub>4</sub>H<sub>6</sub>O<sub>3</sub>**

C<sub>4</sub>H<sub>6</sub>O<sub>3</sub>: 102.09 g/mole

$$n = \frac{\text{molar mass}}{\text{empirical formula mass}} = \frac{306 \text{ g/mole}}{102.09 \text{ g/mole}} \cong 3$$

**Molecular formula** = C<sub>4</sub>H<sub>6</sub>O<sub>3</sub> × 3 = **C<sub>12</sub>H<sub>18</sub>O<sub>9</sub>**

41. Balanced Reaction: 2 HCl (aq) + Zn → ZnCl<sub>2</sub> + H<sub>2</sub>

a)  $(25 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}})(4.0 \text{ M}) = 0.10 \text{ mole HCl}$

$$0.10 \text{ mole HCl} \times \frac{1 \text{ mole Zn}}{2 \text{ mole HCl}} \times \frac{65.39 \text{ g Zn}}{1 \text{ mole Zn}} = 3.2695 \text{ g Zn} = \mathbf{3.3 \text{ g Zn}}$$

b)  $0.234 \text{ kg H}_2 \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mole H}_2}{2.0158 \text{ g H}_2} \times \frac{2 \text{ mole HCl}}{1 \text{ mole H}_2} = 232.17 \text{ mole HCl}$

$$\frac{232.17 \text{ mole HCl}}{x} = 0.35 \text{ M} \quad x = 663.3 \text{ L}$$

$$663.3 \text{ L} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 663300 \text{ mL} = \mathbf{660000 \text{ mL}}$$

42. (A)  $0.123 \text{ L} (0.45 \text{ M}) = 0.123 \text{ L} \times 0.45 \text{ mole/L} = 0.05535 \text{ mole X}$

$$0.05535 \text{ mole X} \times \frac{6.02 \times 10^{23} \text{ atom X}}{1 \text{ mole X}} = 3.33 \times 10^{22} \text{ atom X} \\ = \mathbf{3.3 \times 10^{22} \text{ atom X}}$$

c)  $6.70 \text{ L} \times \frac{1000 \text{ mL}}{1 \text{ L}} \times \frac{2.34 \text{ g}}{1 \text{ mL}} \times \frac{1 \text{ mole}}{112.45 \text{ g}} = 139.42 \text{ mole} \\ = \mathbf{139 \text{ mole X}}$