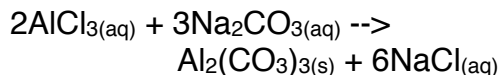


Name _____

Topic 3 - Moles and Stoichiometry

_____ 1. What type of reaction best describes the following chemical equation?

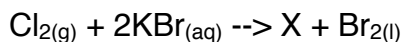


- 1) double replacement
- 2) decomposition
- 3) single replacement
- 4) synthesis

_____ 2. Which 1.0L sample has the *greatest* mass at STP?

- 1) $\text{CO}_2(\text{g})$
- 2) $\text{H}_2(\text{g})$
- 3) $\text{Cl}_2(\text{g})$
- 4) $\text{CH}_4(\text{g})$

_____ 3. Given the balanced equation



What represents the missing product X?

- 1) $2\text{KCl}(\text{aq})$
- 2) $\text{Cl}_2(\text{g})$
- 3) $2\text{K}(\text{aq})$
- 4) $2\text{H}_2\text{O}(\text{g})$

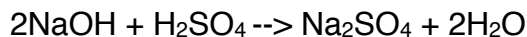
_____ 4. Which compound has the same empirical and molecular formula?

- 1) methane
- 2) ethane
- 3) acetylene
- 4) ethene

_____ 5. What is the percent by mass of water in the hydrate $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ (formula mass = 286)?

- 1) 214.5%
- 2) 6.89%
- 3) 62.9%
- 4) 26.1%

_____ 6. Given the reaction:



What is the total number of moles of NaOH needed to react completely with 2 moles of H_2SO_4 ?

- 1) 2
- 2) 0.5
- 3) 2
- 4) 4

_____ 7. What is the total number of moles contained in 115 grams of $\text{C}_2\text{H}_5\text{OH}$?

- 1) 1.00
- 2) 3.00
- 3) 2.50
- 4) 1.50

_____ 8. What is the mass, in grams, of 1.0 mole of $(\text{NH}_4)_2\text{S}$?

- 1) 54g
- 2) 64g
- 3) 68g
- 4) 50g

_____ 9. The percent by mass of oxygen in $\text{H}_2\text{C}_2\text{O}_4$ is equal to

A) $\frac{90}{64} \times 100$

C) $\frac{64}{90} \times 100$

B) $\frac{4}{8} \times 100$

D) $\frac{8}{4} \times 100$

_____ 10. The diagram below shows the data collected during the heating of a 5.0 gram sample of a hydrated salt.

Mass of Salt(grams)	Heating Time (minutes)
5.0	0.0
4.1	5.0
3.1	10
3.0	15
3.0	30
3.0	60

What is the percent water in the original sample?

- 1) 60%
- 2) 82%
- 3) 40%
- 4) 30%

_____ 11. Which equation illustrates conservation of mass?

- 1) $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$
- 2) $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$
- 3) $\text{H}_2 + \text{Cl}_2 \rightarrow \text{HCl}$
- 4) $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$

_____ 12. What is the gram formula mass of $(\text{NH}_4)_3\text{PO}_4$?

- 1) 149g
- 2) 404g
- 3) 121g
- 4) 113g

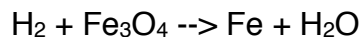
_____ 13. A compound contains 40% calcium, 12% carbon, and 48% oxygen. What is the empirical formula of this compound?

- 1) CaCO_3 2) CaC_2O_4
 3) CaC_3O_6 4) CaCO_2

_____ 14. A compound with an empirical formula of CH_2 has a molecular mass of 70. What is the molecular formula?

- 1) C_4H_8 2) C_2H_4
 3) C_5H_{10} 4) CH_2

_____ 15. When the equation:



is completely balanced using the *smallest* whole numbers, the coefficient of H_2 would be

- 1) 1 2) 2
 3) 3 4) 4

_____ 16. What is the total mass of oxygen, in grams, in 1.00 mole of $\text{Al}_2(\text{CrO}_4)_3$?

- 1) 64.0g 2) 192g
 3) 112g 4) 48.0g

_____ 17. What is the percent by mass of hydrogen in CH_3COOH (formula mass = 60.)?

- 1) 1.7% 2) 7.1%
 3) 6.7% 4) 5.0%

_____ 18. What is the percent by mass of oxygen in $\text{Ca}(\text{OH})_2$?

- 1) 22 2) 74 3) 43 4) 16

_____ 19. What is the ratio by mass of carbon to hydrogen in the compound C_2H_6 ?

- 1) 1:4 2) 4:1
 3) 2:6 4) 6:2

_____ 20. Which substance has the *greatest* molecular mass?

- 1) NO 2) H_2O_2
 3) CF_4 4) I_2

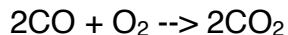
_____ 21. What is the percent by mass of aluminum in Al_2O_3 ?

- 1) 52.9 2) 35.4
 3) 18.9 4) 47.1

_____ 22. Which of the following is a correctly balanced equation for a reaction between hydrogen gas and oxygen gas?

- 1) $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 2) $2\text{H}_2 + 2\text{O}_2 \rightarrow \text{H}_2\text{O}$
 3) $\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 4) $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$

_____ 23 Given the reaction:



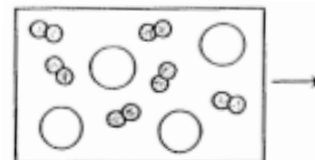
What is the minimum number of moles of O_2 required to produce one mole of CO_2 ?

- 1) 2.0 2) 0.25
 3) 0.50 4) 1.0

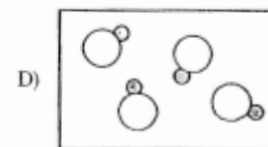
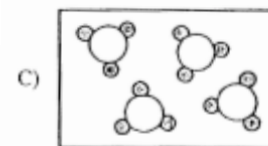
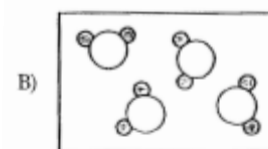
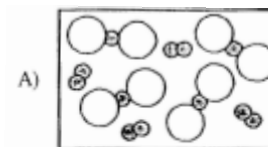
_____ 24. What is the total number of oxygen atoms present in 1 mole of $\text{Mg}(\text{ClO}_3)_2$?

- 1) 6 2) 3
 3) 2 4) 5

_____ 25. The particle diagram below represents a mixture of reactants.



Which diagram for the products of the reaction shows the Law of Conservation of Mass?



_____ 26. The data below was obtained by a student in order to determine the percent of water in a hydrate:

Mass of the Hydrate = 5.0g

Mass of the anhydrous compound = 3.2g

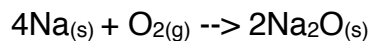
What is the percent water in a hydrate?

- 1) 64% 2) 56%
3) 22% 4) 36%

_____ 27. A compound is 86% carbon and 14% hydrogen by mass. What is the empirical formula of the compound?

- 1) CH₂ 2) CH₃
3) CH 4) CH₄

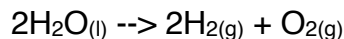
_____ 28. The chemical reaction



is *best* described as a

- 1) decomposition reaction
2) double replacement reaction
3) synthesis reaction
4) single replacement reaction

_____ 29. What type of reaction is illustrated by the following chemical equation?



- 1) decomposition
2) double replacement
3) synthesis
4) single replacement

_____ 30. What is the empirical formula of the compound whose molecular formula is P₄O₁₀?

- 1) PO 2) P₂O₅
3) PO₂ 4) P₈O₂₀

_____ 31. A compound has the empirical formula NO₂. Its molecular formula could be

- 1) N₄O₄ 2) N₂O
3) NO₂ 4) N₄O₂

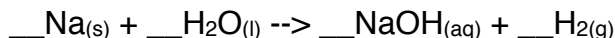
_____ 32. What is the empirical formula of a compound whose composition by mass is 40.% sulfur and 60.% oxygen?

- 1) SO₂ 2) S₂O₃
3) SO₃ 4) S₂O₇

_____ 33. The percent by mass of nitrogen in Mg(CN)₂ is equal to

- A) $\frac{28}{76} \times 100$ C) $\frac{14}{50} \times 100$
B) $\frac{14}{76} \times 100$ D) $\frac{28}{50} \times 100$

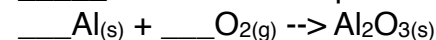
_____ 34. When the equation



is correctly balanced using the *smallest* whole numbers, the coefficient of water is

- 1) 1 2) 2 3) 3 4) 4

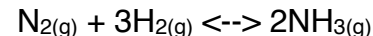
_____ 35. When the equation



is correctly balanced using the *smallest* whole numbers, the coefficient of Al_(s) is

- 1) 1 2) 2 3) 3 4) 4

_____ 36. Given the reaction:



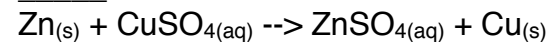
What is the ratio of moles of H_{2(g)} consumed to moles of NH_{3(g)} produced?

- 1) 1:2 2) 3:2
3) 2:3 4) 6:6

_____ 37. The empirical formula of a compound is CH₂O and the molecular mass is 180. What is the molecular formula of the compound?

- 1) C₄H₈O₄ 2) CH₂O
3) C₂H₄O₂ 4) C₆H₁₂O₆

_____ 38. The chemical reaction



is best described as a

- 1) synthesis reaction
2) combustion reaction
3) double replacement reaction
4) single replacement reaction

Constructed Response Questions

1. What is the gram formula mass of $\text{Ca}_3(\text{PO}_4)_2$? [*Round atomic masses from the periodic table to the nearest whole number. Show ALL work.*]

2. In a laboratory experiment, a student determined the mass of the product, $\text{KCl}_{(s)}$, to be 2.65 grams.
 - a. Calculate the gram formula mass of $\text{KCl}_{(s)}$.

 - b. Calculate the number of moles of $\text{KCl}_{(s)}$ produced. [*Show ALL work. Indicate the correct answer with an appropriate unit.*]

3. Acetylene, C_2H_2 , is a colorless gas which burns with a brilliant flame. Acetylene torches are used by welders for cutting and soldering metals. Acetylene is produced by the reaction of calcium carbide, CaC_2 , in water according to the following equation:
$$\text{CaC}_{2(s)} + 2\text{H}_2\text{O}_{(l)} \rightarrow \text{C}_2\text{H}_{2(g)} + \text{Ca}(\text{OH})_{2(aq)}$$
How many moles of $\text{CaC}_{2(s)}$ must react with water to produce 2.25 moles $\text{C}_2\text{H}_{2(g)}$?

4. The empirical formula of a compound is NO_2 and the molecular mass is 92.0 grams. What is the molecular formula of this compound? [*Show ALL work.*]

5. What is the percent by mass of zinc in ZnCO_3 ? [*Show ALL work.*]

6. What is the percent by mass of water in $\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$? [*Show ALL work.*]

7. Balance the following equation using the *smallest* whole number coefficients.
$$\underline{\hspace{1cm}} \text{Fe}_2\text{O}_{3(s)} + \underline{\hspace{1cm}} \text{CO}_{(g)} \rightarrow \underline{\hspace{1cm}} \text{Fe}_{(l)} + \underline{\hspace{1cm}} \text{CO}_{2(g)}$$

8. Balance the following equation using the *smallest* whole number coefficients.
$$\underline{\hspace{1cm}} \text{N}_{2(g)} + \underline{\hspace{1cm}} \text{O}_{2(g)} \rightarrow \underline{\hspace{1cm}} \text{N}_2\text{O}_{5(g)}$$

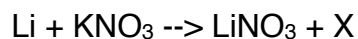
9. In the laboratory, a student performed an experiment to determine the percent by mass of water in a hydrate. The following data was recorded.

Mass of empty crucible + cover	11.70g
Mass of crucible + cover + hydrated salt before heating	14.90g
Mass of crucible + cover + anhydrous salt after thorough heating	14.53g

What is the approximate percent by mass of water in the hydrated salt. [Show ALL work.]

Questions 10 and 11 refer to the following:

Li and KNO_3 react according to the following equation:



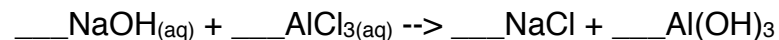
10. Write the formula for the missing product X.

11. What general type of reaction occurs between Li and KNO_3 ?

Questions 12 through 14 refer to the following:

The night operator at ACME *Chemical Company* left a 1,000 gallon reactor half-full of aqueous NaOH solution. The next morning, the day shift supervisor thought the reactor was empty and added an aqueous solution of AlCl_3 . Now, the employees cannot empty the reactor because a white solid is plugging the bottom outlet of the reactor.

NaOH and AlCl_3 react according to the following equation:



12. Balance the equation using the *smallest* whole number coefficients.

13. What general type of equation occurs between the NaOH and the AlCl_3 ?

14. What is the chemical formula of the white solid that accumulated at the bottom of the reactor?

-
15. In the equation below, $\text{Li}_2\text{CrO}_4(\text{aq})$ and $\text{BaCl}_2(\text{aq})$ undergo a double replacement reaction to produce a yellow precipitate.



Write the products that complete and balance the reaction.