

Unit 4

Test

JKL: Chemical Equations and Stoichiometry

Total Marks: 55

Name _____

1. What is the mole ratio of barium hydroxide to water in the following equation?



- A. 2 to 3
- B. 6 to 3
- C. 3 to 6
- D. 6 to 2



2. The symbol used in equations to indicate that a substance is dissolved in water is

- A. (l)
- B. (aq)
- C. (H₂O)
- D. (w)

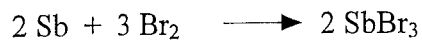
3. Any reaction that consumes energy is

- A. combustion
- B. endothermic
- C. very fast
- D. exothermic

4. Chemical substances written to the right of the arrow in an equation are called

- A. coefficients
- B. subscripts
- C. products
- D. reactants

5. How many moles of Bromine will react with 4 moles of Antimony in the following reaction?



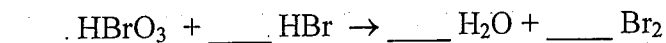
- A 3
- B 4
- C 6
- D 8

6. Consider the following reaction. Which calculation shows the number moles of tin that are produced when 3.8 mol of chromium react with an excess of tin (IV) chloride?



- A. $3.8 \text{ mol Cr} \times \frac{3 \text{ mol SnCl}_4}{4 \text{ mol Cr}}$
- B. $3.8 \text{ mol Cr} \times \frac{3 \text{ mol Sn}}{3 \text{ mol SnCl}_4}$
- C. $3.8 \text{ mol Cr} \times \frac{3 \text{ mol Sn}}{4 \text{ mol Cr}}$
- D. $3.8 \text{ mol Cr} \times \frac{4 \text{ mol Cr}}{3 \text{ mol Sn}}$

7. Consider the following reaction:



The coefficient for H₂O in the above equation is

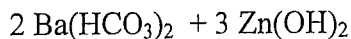
- A. 1
- B. 2
- C. 3
- D. 4



8. A single replacement reaction that proceeds spontaneously is

- A. $\text{Fe} + \text{CuSO}_4 \longrightarrow \text{FeSO}_4 + \text{Cu} + \text{energy}$
- B. $\text{K} + 2 \text{H}_2\text{O} + \text{energy} \longrightarrow 2 \text{KOH} + \text{H}_2$
- C. $\text{C}_3\text{H}_8 + 5 \text{O}_2 \longrightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O} + \text{energy}$
- D. $2 \text{NH}_4\text{Cl} + \text{Ca}(\text{OH})_2 + \text{energy} \longrightarrow 2 \text{NH}_4\text{OH} + \text{CaCl}_2$

9. Consider the following:



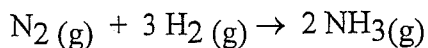
The total number of atoms of oxygen represented above is

- A. 4
- B. 10
- C. 15
- D. 18

10. When two substances react with each other, the substance that remains when the other runs out is called the:

- A. actual reactant
- B. excess reactant
- C. limiting reactant
- D. theoretical reactant

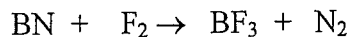
11. Consider the following reaction:



What mass of hydrogen will react with 2.00 mol of nitrogen?

- A. 2.00 g
- B. 3.00 g
- C. 6.00 g
- D. 12.0 g

12. Consider the following reaction:

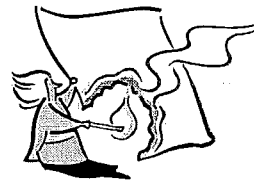


What is mass of boron trifluoride is produced when 4.50 mol of fluorine react?

- A. 0.442 g
- B. 203 g
- C. 407 g
- D. 458 g

13. The quantity of O_2 required for the complete combustion of 1.0 mol of C_2H_2 is

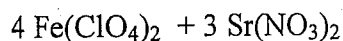
- A. 0.40 mol
- B. 1.0 mol
- C. 2.5 mol
- D. 3.5 mol



Written Response

Instructions: You will be expected to communicate your knowledge and understanding of chemical principles in a clear and logical manner.
Your steps and assumptions leading to a solution must be written in the spaces below the questions.
You must include units where appropriate and answers must be given to the correct number of significant figures.
For questions involving calculation, full marks will NOT be given for providing only the answer.

Count the number of each kind of atom listed below: (2 marks)



1. Number of Fe atoms _____
2. Number of O atoms _____

Balance each equation: (1 mark each)

3. _____ CaC_2 + _____ O_2 \rightarrow _____ Ca + _____ CO_2
4. _____ C_9H_{18} + _____ O_2 \rightarrow _____ CO_2 + _____ H_2O
5. _____ NH_3 + _____ O_2 \rightarrow _____ NO + _____ H_2O

Predict the formulas of the products for each reaction and WRITE them in the spaces below, but do NOT balance. Also, state the FULL name of the reaction type for each reaction. (2 marks each)

	Products	Reaction Type
6. $\text{Li} + \text{Cl}_2 \rightarrow$	_____	_____
7. $\text{C}_{35}\text{H}_{72} + \text{O}_2 \rightarrow$	_____	_____
8. $\text{H}_2\text{SO}_4 + \text{Al}(\text{OH})_3 \rightarrow$	_____	_____
9. $\text{K}_3\text{N} + \text{Pb}(\text{NO}_3)_2 \rightarrow$	_____	_____

Write balanced formula equations for each of the reactions in Questions 10 – 12.

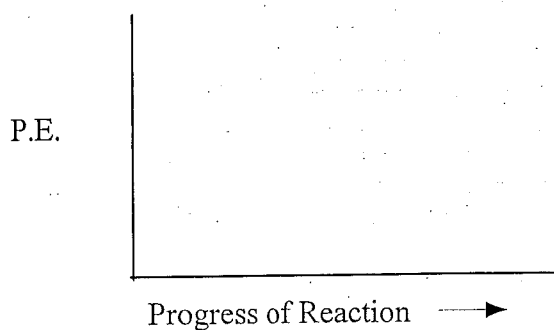
- Use symbols to indicate the state (ie: solid, liquid, etc) of each substance.
- Use whole numbers as coefficients.
- **Minus one mark: for each incorrect formula; missing or wrong states; balancing errors**

10. Solid beryllium metal and aqueous hydrogen fluoride react to produce aqueous beryllium fluoride and hydrogen gas. (3 marks)

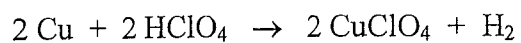
11. Aqueous ammonium oxide and aqueous lead (II) phosphate are mixed together. They react yielding aqueous ammonium phosphate and solid lead (II) oxide. (3 marks)

12. The combustion of solid sucrose $C_{12}H_{22}O_{11}$ in the presence of oxygen gas produces a gas, a liquid, and heat. Include the word "energy" in the proper place in the equation. (4 marks)

13. Sketch a PE diagram to represent an endothermic reaction. Label the activation energy and the ΔH . (3 marks)



14. What volume of hydrogen gas is produced when 7.3 moles of copper are reacted with an excess of perchloric acid? The balanced equation for the reaction is: **(2 marks)**

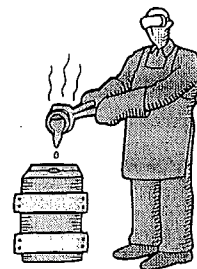


15. How many moles of fluorine, will be needed to produce 4.1 g of cobalt (III) fluoride, by reaction with cobalt? **(3 marks)**

16. Assume that 4.7 moles of oxygen gas are reacted with 3.5 moles of S to produce sulfur trioxide, SO_3 . Determine which reactant is in excess, and by how many moles. **(3 marks)**



17. a) If 30.0 g of nickel is reacted with sufficient oxygen to react with all the nickel, how many grams of nickel (III) oxide would be expected to form? **(3 marks)**



b) Suppose the reaction in part a) involving this same 30.0g of nickel produced only 25.6 g of nickel (III) oxide. Calculate the percent yield. **(1 mark)**

18. When 8.00 g of magnesium metal is placed in a 3.15 L solution of 0.180 M solution of silver nitrate solution, a spontaneous reaction occurs to produce silver metal. How many grams of Ag are produced? **(4 marks)**

The End !!!

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3. Any reaction that consumes energy is

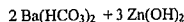
- A. combustion
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- 1 -

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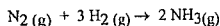
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10. When two substances react with each other, the substance that remains when the other runs out is called the:

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11. Consider the following reaction:

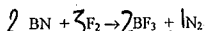


What mass of hydrogen will react with 2.00 mol of nitrogen?

- A. 2.00 g
B. 3.00 g
C. 6.00 g
D. 12.0 g

$$2.00 \text{ mol N}_2 \times \frac{3 \text{ mol H}_2}{1 \text{ mol N}_2} \times \frac{2.0 \text{ g}}{\text{mol}} = 12.00 \text{ mol}$$

12. Consider the following reaction:



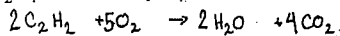
What is mass of boron trifluoride is produced when 4.50 mol of fluorine react?

- A. 0.442 g
B. 203 g
C. 407 g
D. 458 g

$$4.50 \text{ mol F}_2 \times \frac{2 \text{ mol BF}_3}{3 \text{ mol F}_2} \times \frac{67.8 \text{ g}}{1 \text{ mol BF}_3} = 203.4$$

13. The quantity of O₂ required for the complete combustion of 1.0 mol of C₂H₂ is

- A. 0.40 mol
B. 1.0 mol
C. 2.5 mol
D. 3.5 mol



$$1.0 \text{ mol C}_2\text{H}_2 \times \frac{5 \text{ mol O}_2}{2 \text{ mol C}_2\text{H}_2} = 2.5 \text{ mol O}_2$$

- 3 -

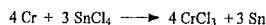
5. How many moles of Bromine will react with 4 moles of Antimony in the following reaction?



- A. 3
B. 4
C. 6
D. 8

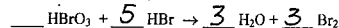
$$4 \text{ mol Sb} \times \frac{3 \text{ mol Br}_2}{2 \text{ mol Sb}}$$

6. Consider the following reaction. Which calculation shows the number moles of tin that are produced when 3.8 mol of chromium react with an excess of tin (IV) chloride?



- A. $3.8 \text{ mol Cr} \times \frac{3 \text{ mol SnCl}_4}{4 \text{ mol Cr}}$
B. $3.8 \text{ mol Cr} \times \frac{3 \text{ mol Sn}}{3 \text{ mol SnCl}_4}$
C. $3.8 \text{ mol Cr} \times \frac{3 \text{ mol Sn}}{4 \text{ mol Cr}}$
D. $3.8 \text{ mol Cr} \times \frac{4 \text{ mol Cr}}{3 \text{ mol Sn}}$

7. Consider the following reaction:



The coefficient for H₂O in the above equation is

- A. 1
B. 2
C. 3
D. 4

8. A single replacement reaction that proceeds spontaneously is

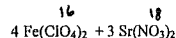
- A. $\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu} + \text{energy}$ *exothermic*
B. $\text{K} + 2 \text{H}_2\text{O} + \text{energy} \rightarrow 2 \text{KOH} + \text{H}_2$ *produces energy*
C. $\text{C}_2\text{H}_6 + 5 \text{O}_2 \rightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O} + \text{energy}$
D. $2 \text{NH}_4\text{Cl} + \text{Ca(OH)}_2 + \text{energy} \rightarrow 2 \text{NH}_4\text{OH} + \text{CaCl}_2$

- 2 -

Written Response

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Count the number of each kind of atom listed below: (2 marks)



1. Number of Fe atoms 4
2. Number of O atoms 50

Balance each equation: (1 mark each)

3. $1 \text{ CaC}_2 + 2 \text{ O}_2 \rightarrow 1 \text{ Ca} + 2 \text{ CO}_2$
4. $2 \text{ C}_2\text{H}_6 + 7 \text{ O}_2 \rightarrow 4 \text{ CO}_2 + 6 \text{ H}_2\text{O}$
5. $4 \text{ NH}_3 + 5 \text{ O}_2 \rightarrow 4 \text{ NO} + 6 \text{ H}_2\text{O}$

Predict the formulas of the products for each reaction and WRITE them in the spaces below, but do NOT balance. Also, state the FULL name of the reaction type for each reaction. (2 marks each)

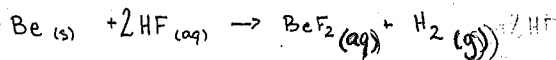
- | | Products | Reaction Type |
|--|--|---------------------------------|
| 6. $\text{Li} + \text{Cl}_2 \rightarrow$ | <u>LiCl</u> | <u>synthesis</u> |
| 7. $\text{C}_3\text{H}_8 + \text{O}_2 \rightarrow$ | <u>CO}_2 + \text{H}_2\text{O}</u> | <u>combustion</u> |
| 8. $\text{H}_2\text{SO}_4 + \text{Al(OH)}_3 \rightarrow$ | <u>H}_2\text{O} + \text{Al}_2(\text{SO}_4)_3</u> | <u>acid-base neutralization</u> |
| 9. $\text{K}_3\text{N} + \text{Pb(NO}_3)_2 \rightarrow$ | <u>Pb}_3\text{N}_2 + \text{KNO}_3</u> | <u>double replacement</u> |

- 4 -

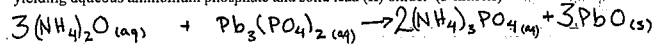
Write balanced formula equations for each of the reactions in Questions 10 – 12.

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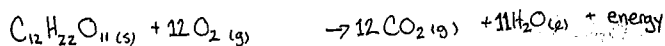
10. Solid beryllium metal and aqueous hydrogen fluoride react to produce aqueous beryllium fluoride and hydrogen gas. (3 marks)



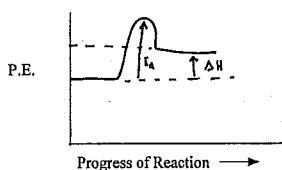
11. Aqueous ammonium oxide and aqueous lead (II) phosphate are mixed together. They react yielding aqueous ammonium phosphate and solid lead (II) oxide. (3 marks)



12. The combustion of solid sucrose $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ in the presence of oxygen gas produces a gas, a liquid, and heat. Include the word "energy" in the proper place in the equation. (4 marks)

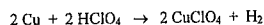


13. Sketch a PE diagram to represent an endothermic reaction. Label the activation energy and the ΔH . (3 marks)



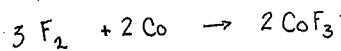
- 5 -

14. What volume of hydrogen gas is produced when 7.3 moles of copper are reacted with an excess of perchloric acid? The balanced equation for the reaction is: (2 marks)



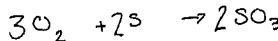
$$7.3 \text{ mol Cu} \times \frac{1 \text{ mol H}_2}{2 \text{ mol Cu}} \times \frac{22.4 \text{ L}}{\text{mol}} = 81.76 = \underline{\underline{82 \text{ L}}}$$

15. How many moles of fluorine, will be needed to produce 4.1 g of cobalt (III) fluoride, by reaction with cobalt? (3 marks)



$$4.1 \text{ g CoF}_3 \times \frac{\text{mol}}{118.9 \text{ g}} = 0.03538 \text{ mol CoF}_3 \times \frac{3 \text{ mol F}_2}{2 \text{ mol CoF}_3} = \underline{\underline{0.053 \text{ mol}}}$$

16. Assume that 4.7 moles of oxygen gas are reacted with 3.5 moles of S to produce sulfur trioxide, SO_3 . Determine which reactant is in excess, and by how many moles. (3 marks)



O_2	S
4.7 mol	3.5 mol
5.25 mol	3.5 mol

LR →

O_2 is limiting

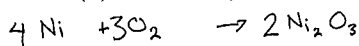
S is excess by 0.37 mol



$$\begin{array}{r} 3.5 \\ - 3.13 \\ \hline 0.37 \end{array}$$

- 6 -

17. a) If 30.0 g of nickel is reacted with sufficient oxygen to react with all the nickel, how many grams of nickel (III) oxide would be expected to form? (3 marks)



$$30.0 \text{ g Ni} \times \frac{\text{mol Ni}}{58.7 \text{ g}} \times \frac{2 \text{ mol Ni}_2\text{O}_3}{4 \text{ mol Ni}} \times \frac{165.4 \text{ g}}{\text{mol Ni}_2\text{O}_3} = \underline{\underline{42.3 \text{ g}}}$$

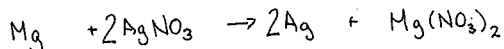


b) Suppose the reaction in part a) involving this same 30.0g of nickel produced only 25.6 g of nickel (III) oxide. Calculate the percent yield. (1 mark)

$$\% \text{ yield} = \frac{\text{experimental}}{\text{theoretical}} \times 100$$

$$= \frac{25.6 \text{ g}}{42.3 \text{ g}} \times 100 = \underline{\underline{60.5 \%}}$$

18. When 8.00 g of magnesium metal is placed in a 3.15 L solution of 0.180 M solution of silver nitrate solution, a spontaneous reaction occurs to produce silver metal. How many grams of Ag are produced? (4 marks)



$$n = CV$$

$$= 0.180 \text{ M} \times 3.15 \text{ L}$$

$$= 0.567 \text{ mol AgNO}_3$$

$$0.567 \text{ mol AgNO}_3 \times \frac{2 \text{ mol Ag}}{2 \text{ mol AgNO}_3} = 0.567 \text{ mol Ag}$$

$$0.567 \text{ mol Ag} \times \frac{107.9 \text{ g}}{\text{mol}} = \underline{\underline{61.2 \text{ g Ag}}}$$

The End !!!

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