Name: ______________________ Class: __________________ Date: _________ ID: A

CH 12 PRACTICE TEST with ANSWERS

Matching

Match each item with the correct statement below.

a. actual yield
b. percent yield
c. theoretical yield
d. excess reagent
e. limiting reagent
f. mass
g. number of molecules
h. volume

____ 1. This quantity can always be used in the same way as moles when interpreting balanced chemical equations.

____ 2. This is conserved only in reactions where the temperature is constant and the number of moles of gaseous reactants is the same as that of gaseous products.

____ 3. This is conserved in every ordinary chemical reaction.

____ 4. the reactant that determines the amount of product that can be formed in a reaction

____ 5. the maximum amount of product that could be formed from given amounts of reactants

____ 6. the reactant that is not completely used up in a reaction

____ 7. the amount of product formed when a reaction is carried out in the laboratory

____ 8. the ratio of the actual yield to the theoretical yield

Multiple Choice

Identify the choice that best completes the statement or answers the question.

____ 9. The calculation of quantities in chemical equations is called ____.

a. stoichiometry
b. dimensional analysis
c. percent composition
d. percent yield

____ 10. If 1 egg and 1/3 cup of oil are needed for each bag of brownie mix, how many bags of brownie mix do you need if you want to use up all 3 eggs and 1 cup of oil?

a. 1
b. 2
c. 3
d. 4

____ 11. What is conserved in the reaction shown below?

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

a. mass only
b. mass and moles only
c. mass, moles, and molecules only
d. mass, moles, molecules, and volume

____ 12. What is conserved in the reaction shown below?

$N_2(g) + 3F_2(g) \rightarrow 2NF_3(g)$

a. atoms only
b. mass only
c. mass and atoms only
d. moles only

____ 13. In every chemical reaction, ____.

a. mass and molecules are conserved
b. moles and liters are conserved
c. mass and atoms are conserved
d. moles and molecules are conserved

____ 14. In a chemical reaction, the mass of the products ____.

a. is less than the mass of the reactants
b. is greater than the mass of the reactants
c. is equal to the mass of the reactants
d. has no relationship to the mass of the reactants

____ 15. In any chemical reaction, the quantities that are preserved are ____.

a. the number of moles and the volumes
b. the number of molecules and the volumes
c. mass and number of atoms
d. mass and moles

____ 16. The first step in most stoichiometry problems is to ____.

a. add the coefficients of the reagents
b. convert given quantities to moles
c. convert given quantities to volumes
d. convert given quantities to masses

____ 17. In the reaction $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$, what is the ratio of moles of oxygen used to moles of CO_2 produced?

a. 1:1
b. 2:1
c. 1:2
d. 2:2

____ 18. Which of the following is true about the total number of reactants and the total number of products in the reaction shown below?
$C_5H_{12}(l) + 8O_2(g) \rightarrow 5CO_2(g) + 6H_2O(g)$

a. 9 moles of reactants chemically change into 11 moles of product.
b. 9 grams of reactants chemically change into 11 grams of product.
c. 9 liters of reactants chemically change into 11 liters of product.
d. 9 atoms of reactants chemically change into 11 atoms of product.

____ 19. Which of the following is an INCORRECT interpretation of the balanced equation shown below?
$2S(s) + 3O_2(g) \rightarrow 2SO_3(g)$

a. 2 atoms S + 3 molecules $O_2 \rightarrow$ 2 molecules SO_3
b. 2 g S + 3 g $O_2 \rightarrow$ 2 g SO_3
c. 2 mol S + 3 mol $O_2 \rightarrow$ 2 mol SO_3
d. none of the above

____ 20. How many moles of aluminum are needed to react completely with 1.2 mol of FeO?
$2Al(s) + 3FeO(s) \rightarrow 3Fe(s) + Al_2O_3(s)$

a. 1.2 mol
b. 0.8 mol
c. 1.6 mol
d. 2.4 mol

____ 21. Calculate the number of moles of Al_2O_3 that are produced when 0.60 mol of Fe is produced in the following reaction.
$2Al(s) + 3FeO(s) \rightarrow 3Fe(s) + Al_2O_3(s)$

a. 0.20 mol
b. 0.40 mol
c. 0.60 mol
d. 0.90 mol

____ 22. How many moles of glucose, $C_6H_{12}O_6$, can be "burned" biologically when 10.0 mol of oxygen is available?
$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$

a. 0.938 mol
b. 1.67 mol
c. 53.3 mol
d. 60.0 mol

____ 23. Hydrogen gas can be produced by reacting aluminum with sulfuric acid. How many moles of sulfuric acid are needed to completely react with 15.0 mol of aluminum?
$2Al(s) + 3H_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$

a. 0.100 mol
b. 10.0 mol
c. 15.0 mol
d. 22.5 mol

____ 24. When iron rusts in air, iron(III) oxide is produced. How many moles of oxygen react with 2.4 mol of iron in the rusting reaction?
$4Fe(s) + 3O_2(g) \rightarrow 2Fe2O_3(s)$

a. 1.2 mol
b. 1.8 mol
c. 2.4 mol
d. 3.2 mol

____ 25. At STP, how many liters of oxygen are required to react completely with 3.6 liters of hydrogen to form water?
$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

a. 1.8 L
b. 3.6 L
c. 2.0 L
d. 2.4 L

____ 26. Which type of stoichiometric calculation does not require the use of the molar mass?

a. mass-mass problems
b. mass-volume problems
c. mass-particle problems
d. volume-volume problems

____ 27. The equation below shows the decomposition of lead nitrate. How many grams of oxygen are produced when 11.5 g NO_2 is formed?
$2Pb(NO_3)_2(s) \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$

a. 1.00 g
b. 2.00 g
c. 2.88 g
d. 32.0 g

____ 28. Iron(III) oxide is formed when iron combines with oxygen in the air. How many grams of Fe_2O_3 are formed when 16.7 g of Fe reacts completely with oxygen?
$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

a. 12.0 g
b. 23.9 g
c. 47.8 g
d. 95.6 g

____ 29. When glucose is consumed, it reacts with oxygen in the body to produce carbon dioxide, water, and energy. How many grams of carbon dioxide would be produced if 45 g of $C_6H_{12}O_6$ completely reacted with oxygen?

a. 1.5 g
b. 1.8 g
c. 11 g
d. 66 g

____ 30. Aluminum reacts with sulfuric acid to produce aluminum sulfate and hydrogen gas. How many grams of aluminum sulfate would be formed if 250 g H_2SO_4 completely reacted with aluminum?

$2Al(s) + 3H_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$

a. 0.85 g
b. 290 g
c. 450 g
d. 870 g

____ 31. Mercury can be obtained by reacting mercury(II) sulfide with calcium oxide. How many grams of calcium oxide are needed to produce 36.0 g of Hg?

$4HgS(s) + 4CaO(s) \rightarrow 4Hg(l) + 3CaS(s) + CaSO_4$

a. 1.80 g
b. 7.56 g
c. 10.1 g
d. 13.4 g

____ 32. How many moles of H_3PO_4 are produced when 71.0 g P_4O_{10} reacts completely to form H_3PO_4?

$P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(aq)$

a. 0.063 5 mol
b. 1.00 mol
c. 4.00 mol
d. 16.0 mol

____ 33. How many grams of H_3PO_4 are produced when 10.0 moles of water react with an excess of P_4O_{10}?

$P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(aq)$

a. 1.22 g
b. 6.7 g
c. 147 g
d. 653 g

____ 34. How many liters of hydrogen gas are needed to react with CS_2 to produce 2.50 L of CH_4 at STP?

$4H_2(g) + CS_2(l) \rightarrow CH_4(g) + 2H_2S(g)$

a. 2.50 L
b. 5.00 L
c. 7.50 L
d. 10.0 L

____ 35. Which conversion factor do you use first to calculate the number of grams of CO_2 produced by the reaction of 50.6 g of CH_4 with O_2? The equation for the complete combustion of methane is:

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

a. 1 mol CH_4/16.0 g CH_4
b. 2 mol O_2/1 mol CO_2
c. 16.0 g CH_4/1 mol CO_4
d. 44.0 g CO_2/2 mol CO_2

____ 36. Which of the following statements is true about the following reaction?

$3NaHCO_3(aq) + C_6H_8O_7(aq) \rightarrow 3CO_2(g) + 3H_2O(s) + Na_3C_6H_5O_7(aq)$

a. 22.4 L of $CO_2(g)$ are produced for every liter of $C_6H_8O_7(aq)$ reacted.
b. 1 mole of water is produced for every mole of carbon dioxide produced.
c. 6.02×10^{23} molecules of $Na_3C_6H_5O_7(aq)$ are produced for every mole of $NaHCO_3(aq)$ used.
d. 54 g of water are produced for every mole of $NaHCO_3(aq)$ produced.

____ 37. How many liters of NH_3 are needed to react completely with 30.0 L of NO (at STP)?

$4NH_3(g) + 6NO(g) \rightarrow 5N_2(g) + 6H_2O(g)$

a. 5.0 L
b. 20.0 L
c. 7.5 L
d. 120.0 L

____ 38. When 0.1 mol of calcium reacts with 880 g of water, 2.24 L of hydrogen gas form (at STP). How would the amount of hydrogen produced change if the volume of water was decreased to 440 mL (440 g)?

a. Only one half the volume of hydrogen would be produced.
b. The volume of hydrogen produced would be the same.
c. The volume of hydrogen produced would double.
d. No hydrogen would be produced.

____ 39. Glucose, $C_6H_{12}O_6$, is a good source of food energy. When it reacts with oxygen, carbon dioxide and water are formed. How many liters of CO_2 are produced when 126 g of glucose completely react with oxygen?

$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l) + 673\ \text{kcal}$

a. 4.21 L
b. 5.33 L
c. 15.7 L
d. 94.1 L

____ 40. Calcium oxide, or lime, is produced by the thermal decomposition of limestone in the reaction $CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g)$. What mass of lime can be produced from 1.5×10^3 kg of limestone?

a. 8.4×10^5 kg
b. 8.4×10^2 kg
c. 8.4 kg
d. none of the above

____ 41. When two substances react to form products, the reactant which is used up is called the ____.

a. determining reagent
b. limiting reagent
c. excess reagent
d. catalytic reagent

____ 42. Which of the following is NOT true about limiting and excess reagents?

a. The amount of product obtained is determined by the limiting reagent.
b. A balanced equation is necessary to determine which reactant is the limiting reagent.
c. Some of the excess reagent is left over after the reaction is complete.
d. The reactant that has the smallest given mass is the limiting reagent.

____ 43. How many grams of chromium are needed to react with an excess of $CuSO_4$ to produce 27.0 g Cu?

$2Cr(s) + 3CuSO_4(aq) \rightarrow Cr_2(SO_4)_3(aq) + 3Cu(s)$

a. 14.7 g
b. 18.0 g
c. 33.2 g
d. 81.5 g

____ 44. How many grams of beryllium are needed to produce 36.0 g of hydrogen? (Assume an excess of water.)

$Be(s) + 2H_2O(l) \rightarrow Be(OH)_2\ (aq) + H_2(g)$

a. 4.00 g
b. 36.0 g
c. 162 g
d. 324 g

Name: ______________________ ID: A

____ 45. How many liters of NH_3, at STP, will react with 5.3 g O_2 to form NO_2 and water?

$4NH_3(g) + 7O_2(g) \rightarrow 4NO_2 + 6H_2O(g)$

a. 0.004 23 L
b. 2.12 L
c. 3.03 L
d. 6.49 L

____ 46. How many liters of chlorine gas can be produced when 0.98 L of HCl react with excess O_2 at STP?

$4HCl(g) + O_2(g) \rightarrow 2Cl_2(g) + 2H_2O(g)$

a. 0.98 L
b. 0.49 L
c. 3.9 L
d. 2.0 L

____ 47. Identify the limiting reagent and the volume of CO_2 formed when 11 L CS_2 reacts with 18 L O_2 to produce CO_2 gas and SO_2 gas at STP.

$CS_2(g) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$

a. CS_2; 5.5 L CO_2
b. O_2; 6.0 L CO_2
c. CS_2; 11 L CO_2
d. O_2; 27 L CO_2

____ 48. What is the maximum number of grams of PH_3 that can be formed when 6.2 g of phosphorus reacts with 4.0 g of hydrogen to form PH_3?

$P_4(g) + 6H_2(g) \rightarrow 4PH_3(g)$

a. 0.43 g
b. 6.8 g
c. 270 g
d. 45 g

____ 49. Methane and hydrogen sulfide form when hydrogen reacts with carbon disulfide. Identify the excess reagent and calculate how much remains after 36 L of H_2 reacts with 12 L of CS_2.

$4H_2(g) + CS_2(g) \rightarrow CH_4(g) + 2H_2S(g)$

a. 3 L CS_2
b. 6 L CS_2
c. 9 L CS_2
d. 12 L H_2

____ 50. Metallic copper is formed when aluminum reacts with copper(II) sulfate. How many grams of metallic copper can be obtained when 54.0 g of Al react with 319 g of $CuSO_4$?

$Al + 3CuSO_4 \rightarrow Al_2(SO_4)_3 + 3Cu$

a. 21.2 g
b. 127 g
c. 162 g
d. 381 g

____ 51. Which statement is true if 12 mol CO and 12 mol Fe_2O_3 are allowed to react?

$3CO(g) + Fe_2O_3(s) \rightarrow 2Fe(s) + 3CO_2(g)$

a. The limiting reagent is CO and 8.0 mol Fe will be formed.
b. The limiting reagent is CO and 3.0 mol CO_2 will be formed.
c. The limiting reagent is Fe_2O_3 and 24 mol Fe will be formed.
d. The limiting reagent is Fe_2O_3 and 36 mol CO_2 will be formed.

Name: ______________________ ID: A

____ 52. Which of the following would be the limiting reagent in the reaction shown below?
$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

a. 50 molecules of H_2
b. 50 molecules of O_2
c. Neither a nor b is limiting.
d. Both a and b are considered limiting reagents.

____ 53. When an equation is used to calculate the amount of product that will form during a reaction, then the value obtained is called the ____.

a. actual yield
b. percent yield
c. theoretical yield
d. minimum yield

____ 54. Which of the following is NOT true about "yield"?

a. The value of the actual yield must be given in order for the percent yield to be calculated.
b. The percent yield is the ratio of the actual yield to the theoretical yield.
c. The actual yield may be different from the theoretical yield because reactions do not always go to completion.
d. The actual yield may be different from the theoretical yield because insufficient limiting reagent was used.

____ 55. Which of the following is NOT a reason why actual yield is less than theoretical yield?

a. impure reactants present
b. competing side reactions
c. loss of product during purification
d. conservation of mass

____ 56. Lead nitrate can be decomposed by heating. What is the percent yield of the decomposition reaction if 9.9 g $Pb(NO_3)_2$ are heated to give 5.5 g of PbO?

$2Pb(NO_3)_2(s) \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$

a. 44%
b. 56%
c. 67%
d. 82%

____ 57. Hydrogen gas is produced when zinc reacts with hydrochloric acid. If the actual yield of this reaction is 85%, how many grams of zinc are needed to produce 112 L of H_2 at STP?

$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(s) + H_2(g)$

a. 95 g
b. 180 g
c. 280 g
d. 380 g

____ 58. In a particular reaction between copper metal and silver nitrate, 12.7 g Cu produced 38.1 g Ag. What is the percent yield of silver in this reaction?
$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

a. 56.7%
b. 77.3%
c. 88.2%
d. 176%

Short Answer

59. If a tricycle factory ordered 33,432 wheels in 2002 and used all of them, how many tricycles did the factory produce?

60. If a total of 13.5 mol of $NaHCO_3$ and 4.5 mol of $C_6H_8O_7$ react, how many moles of CO_2 and $Na_3C_6H_5O_7$ will be produced?
$3NaHCO_3(aq) + C_6H_8O_7(aq) \rightarrow 3CO_2(g) + 3H_2O(s) + Na_3C_6H_5O_7(aq)$

61. If 8.00 mol of NH_3 reacted with 14.0 mol of O_2, how many moles of H_2O will be produced?
$4NH_3(g) + 7O_2(g) \rightarrow 4NO_2 + 6H_2O(g)$

62. If 8.6 L of H_2 reacted with 4.3 L of O_2 at STP, what is the volume of the gaseous water collected (assuming that none of it condenses)?
$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

63. What is the mole ratio of D to A in the generic chemical reaction?
$2A + B \rightarrow C + 3D$

64. Assuming STP and a stoichiometric amount of NH_3 and NO in an expandable container originally at 15 L, what is the final volume if the reaction goes to completion?
$4NH_3(g) + 6NO(g) \rightarrow 5N_2(g) + 6H_2O(g)$

65. How many grams of CO are needed to react with an excess of Fe_2O_3 to produce 209.7 g Fe?
$Fe_2O_3(s) + 3CO(g) \rightarrow 3CO_2(g) + 2Fe(s)$

66. How many liters of O_2 are needed to react completely with 45.0 L of H_2S at STP?
$2H_2S(g) + 3O_2(g) \rightarrow 2SO_2(g) + 2H_2O(g)$

67. If 5.0 g of H_2 are reacted with excess CO, how many grams of CH_3OH are produced, based on a yield of 86%?
$CO(g) + 2H_2(g) \rightarrow CH_3OH(l)$

68. For the reaction $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$, how many grams of NaCl could be produced from 103.0 g of Na and 13.0 L of Cl_2 (at STP)?

69. Solid sodium reacts violently with water, producing heat, hydrogen gas, and sodium hydroxide. How many molecules of hydrogen gas are formed when 48.7 g of sodium are added to water?
$2Na + 2H_2O \rightarrow 2NaOH + H_2$

70. The decomposition of potassium chlorate yields oxygen gas. If the yield is 95%, how many grams of $KClO_3$ are needed to produce 10.0 L of O_2?
$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$

71. Consider the following reaction:

$$2H_2S(g) + 3O_2(g) \rightarrow 2SO_2(g) + 2H_2O(g)$$

If O_2 was the excess reagent, 8.3 mol of H_2S were consumed, and 137.1 g of water were collected after the reaction has gone to completion, what is the percent yield of the reaction?

Essay

72. Describe an experience you've had making or building something where the amount of each ingredient or building block came in fixed ratios.

73. A chemical problem may be presented to you in units of moles, mass, or volume. Which one of these can be directly used in your arithmetic no matter what the conditions are?

74. What is the importance of the coefficients in a balanced chemical reaction?

75. What is the general procedure for solving a stoichiometric problem?

76. When a mixture of sulfur and metallic silver is heated, silver sulfide is produced. What mass of silver sulfide is produced from a mixture of 3.0 g Ag and 3.0 g S_8?
$16Ag(s) + S_8(s) \rightarrow 8Ag_2S(s)$

77. In which kind of stoichiometric calculation can the steps involving conversion to and from moles be omitted? Explain why it is possible to do so.

78. What is the limiting reagent when 150.0 g of nitrogen react with 32.1 g of hydrogen?
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

79. A 500-g sample of $Al_2(SO_4)_3$ is reacted with 450 g of $Ca(OH)_2$. A total of 596 g of $CaSO_4$ is produced. What is the limiting reagent in this reaction, and how many moles of excess reagent are unreacted?
$Al_2(SO_4)_3(aq) + 3Ca(OH)_2(aq) \rightarrow 2Al(OH)_3(s) + 3CaSO_4(s)$

80. Assuming no errors were made in measuring the yield, can the percent yield of a chemical reaction be greater than 100%?

CH 12 PRACTICE TEST with ANSWERS
Answer Section

MATCHING

1.	ANS: G	PTS: 1	DIF: L1	REF: p. 356
	OBJ: 12.1.2	STA: Ch.3.d		
2.	ANS: H	PTS: 1	DIF: L1	REF: p. 357
	OBJ: 12.1.2	STA: Ch.4.c		
3.	ANS: F	PTS: 1	DIF: L1	REF: p. 357
	OBJ: 12.1.2 | 12.1.3		STA: Ch.3.d	
4.	ANS: E	PTS: 1	DIF: L1	REF: p. 369
	OBJ: 12.3.1			
5.	ANS: C	PTS: 1	DIF: L1	REF: p. 369
	OBJ: 12.3.1			
6.	ANS: D	PTS: 1	DIF: L1	REF: p. 372
	OBJ: 12.3.2			
7.	ANS: A	PTS: 1	DIF: L1	REF: p. 372
	OBJ: 12.3.2			
8.	ANS: B	PTS: 1	DIF: L1	REF: p. 372
	OBJ: 12.3.2	STA: Ch.3.f		

MULTIPLE CHOICE

9.	ANS: A	PTS: 1	DIF: L1	REF: p. 354
	OBJ: 12.1.1	STA: Ch.3.d		
10.	ANS: C	PTS: 1	DIF: L1	REF: p. 354
	OBJ: 12.1.1			
11.	ANS: D	PTS: 1	DIF: L1	REF: p. 356
	OBJ: 12.1.2 | 12.1.3		STA: Ch.3.d	
12.	ANS: C	PTS: 1	DIF: L1	REF: p. 356
	OBJ: 12.1.2 | 12.1.3		STA: Ch.3.d	
13.	ANS: C	PTS: 1	DIF: L1	REF: p. 356
	OBJ: 12.1.2 | 12.1.3		STA: Ch.3.d	
14.	ANS: C	PTS: 1	DIF: L1	REF: p. 356
	OBJ: 12.1.2	STA: Ch.3.d		
15.	ANS: C	PTS: 1	DIF: L1	REF: p. 356
	OBJ: 12.1.2	STA: Ch.3.d		
16.	ANS: B	PTS: 1	DIF: L1	REF: p. 356
	OBJ: 12.1.2	STA: Ch.3.d		
17.	ANS: C	PTS: 1	DIF: L1	REF: p. 356
	OBJ: 12.1.2	STA: Ch.4.c		
18.	ANS: A	PTS: 1	DIF: L2	REF: p. 356
	OBJ: 12.1.2	STA: Ch.3.d		
19.	ANS: B	PTS: 1	DIF: L2	REF: p. 356
	OBJ: 12.1.2	STA: Ch.3.a		

20.	ANS: B	PTS: 1	DIF: L1	REF: p. 359 | p. 360
	OBJ: 12.2.1	STA: Ch.3.d		
21.	ANS: A	PTS: 1	DIF: L1	REF: p. 359 | p. 360
	OBJ: 12.2.1	STA: Ch.3.d		
22.	ANS: B	PTS: 1	DIF: L2	REF: p. 359 | p. 360
	OBJ: 12.2.1	STA: Ch.3.d		
23.	ANS: D	PTS: 1	DIF: L2	REF: p. 359 | p. 360
	OBJ: 12.2.1	STA: Ch.3.d		
24.	ANS: B	PTS: 1	DIF: L2	REF: p. 359 | p. 360
	OBJ: 12.2.1	STA: Ch.3.d		
25.	ANS: A	PTS: 1	DIF: L1	REF: p. 363 | p. 364 | p. 365 | p. 366
	OBJ: 12.2.2	STA: Ch.3.d		
26.	ANS: D	PTS: 1	DIF: L1	REF: p. 365
	OBJ: 12.2.2	STA: Ch.3.d		
27.	ANS: B	PTS: 1	DIF: L2	REF: p. 360 | p. 361 | p. 362
	OBJ: 12.2.2	STA: Ch.3.d		
28.	ANS: B	PTS: 1	DIF: L2	REF: p. 360 | p. 361 | p. 362
	OBJ: 12.2.2	STA: Ch.3.d		
29.	ANS: D	PTS: 1	DIF: L2	REF: p. 360 | p. 361 | p. 362
	OBJ: 12.2.2	STA: Ch.3.d		
30.	ANS: B	PTS: 1	DIF: L2	REF: p. 360 | p. 361 | p. 362
	OBJ: 12.2.2	STA: Ch.3.d		
31.	ANS: C	PTS: 1	DIF: L2	REF: p. 360 | p. 361 | p. 362
	OBJ: 12.2.2	STA: Ch.3.d		
32.	ANS: B	PTS: 1	DIF: L2	REF: p. 360 | p. 361 | p. 362
	OBJ: 12.2.2	STA: Ch.3.d		
33.	ANS: D	PTS: 1	DIF: L2	REF: p. 360 | p. 361 | p. 362
	OBJ: 12.2.2	STA: Ch.3.d		
34.	ANS: D	PTS: 1	DIF: L2	REF: p. 363 | p. 364 | p. 365 | p. 366
	OBJ: 12.2.2	STA: Ch.3.d		
35.	ANS: A	PTS: 1	DIF: L2	REF: p. 360 | p. 361 | p. 362
	OBJ: 12.2.2	STA: Ch.3.d		
36.	ANS: B	PTS: 1	DIF: L2	REF: p. 363 | p. 364 | p. 365 | p. 366
	OBJ: 12.2.2	STA: Ch.3.d		
37.	ANS: B	PTS: 1	DIF: L2	REF: p. 363 | p. 364 | p. 365 | p. 366
	OBJ: 12.2.2	STA: Ch.3.d		
38.	ANS: B	PTS: 1	DIF: L2	REF: p. 363 | p. 364 | p. 365 | p. 366
	OBJ: 12.2.2	STA: Ch.3.d		
39.	ANS: D	PTS: 1	DIF: L2	REF: p. 363 | p. 364 | p. 365 | p. 366
	OBJ: 12.2.2	STA: Ch.3.d		
40.	ANS: B	PTS: 1	DIF: L2	REF: p. 363 | p. 364 | p. 365 | p. 366
	OBJ: 12.2.2	STA: Ch.3.d		
41.	ANS: B	PTS: 1	DIF: L1	REF: p. 369
	OBJ: 12.3.1			
42.	ANS: D	PTS: 1	DIF: L1	REF: p. 369
	OBJ: 12.3.1			

43. ANS: A	PTS: 1	DIF: L2	REF: p. 371
OBJ: 12.3.1	STA: Ch.3.d		
44. ANS: C	PTS: 1	DIF: L2	REF: p. 371
OBJ: 12.3.1	STA: Ch.3.d		
45. ANS: B	PTS: 1	DIF: L2	REF: p. 371
OBJ: 12.3.1	STA: Ch.3.d		
46. ANS: B	PTS: 1	DIF: L2	REF: p. 371
OBJ: 12.3.1	STA: Ch.3.d		
47. ANS: B	PTS: 1	DIF: L2	REF: p. 371
OBJ: 12.3.1	STA: Ch.3.d		
48. ANS: B	PTS: 1	DIF: L2	REF: p. 371
OBJ: 12.3.1	STA: Ch.3.d		
49. ANS: A	PTS: 1	DIF: L2	REF: p. 371
OBJ: 12.3.1	STA: Ch.3.d		
50. ANS: B	PTS: 1	DIF: L2	REF: p. 371
OBJ: 12.3.1	STA: Ch.3.d		
51. ANS: A	PTS: 1	DIF: L2	REF: p. 369
OBJ: 12.3.1	STA: Ch.3.d		
52. ANS: B	PTS: 1	DIF: L2	REF: p. 369
OBJ: 12.3.1			
53. ANS: C	PTS: 1	DIF: L1	REF: p. 372
OBJ: 12.3.2			
54. ANS: D	PTS: 1	DIF: L1	REF: p. 372
OBJ: 12.3.2			
55. ANS: D	PTS: 1	DIF: L1	REF: p. 373
OBJ: 12.3.2			
56. ANS: D	PTS: 1	DIF: L2	REF: p. 375
OBJ: 12.3.2	STA: Ch.3.f		
57. ANS: D	PTS: 1	DIF: L2	REF: p. 374
OBJ: 12.3.2	STA: Ch.3.d		
58. ANS: C	PTS: 1	DIF: L2	REF: p. 375
OBJ: 12.3.2	STA: Ch.3.f		

SHORT ANSWER

59. ANS:

$$\frac{33{,}432 \text{ wheels}}{3 \text{ wheels/tricycle}} = 11{,}144 \text{ tricycles}$$

PTS: 1 DIF: L1 REF: p. 354 OBJ: 12.1.1

60. ANS:

13.5 mol of CO_2; 4.5 mol of $Na_3C_6H_5O_7$

PTS: 1 DIF: L1 REF: p. 359 OBJ: 12.2.1
STA: Ch.3.d

61. ANS:
12.0 mol of H_2O

PTS: 1 DIF: L2 REF: p. 359 OBJ: 12.2.1
STA: Ch.3.d

62. ANS:
8.6 L H_2/ (22.4 L/1 mol) × 2 mol H_2O/2 mol H_2 × 22.4 L/ 1 mol = 8.6 L H_2O

PTS: 1 DIF: L2 REF: p. 363 OBJ: 12.2.2
STA: Ch.3.d

63. ANS:
3/2

PTS: 1 DIF: L1 REF: p. 359 OBJ: 12.2.1
STA: Ch.3.d

64. ANS:
15 L of given reactants × 11 L of products/10 L of reactants = 16.5 L

PTS: 1 DIF: L3 REF: p. 363 OBJ: 12.2.2
STA: Ch.4.c

65. ANS:
209.7 g Fe × 1 mol Fe/55.85 g Fe × 3 mol CO/2 mol Fe × 28.01 g CO/1 mol CO = 157.8 g CO

PTS: 1 DIF: L2 REF: p. 371 OBJ: 12.3.1
STA: Ch.3.d

66. ANS:
45.0 L H_2S × 1 mol H_2S/22.4 L H_2S × 3 mol O_2/2 mol H_2S × 22.4 L O_2/1 mol O_2 = 67.5 L O_2

PTS: 1 DIF: L3 REF: p. 371 OBJ: 12.3.1
STA: Ch.4.c

67. ANS:
Theoretical yield:
5.0 g H_2 × 1 mol H_2/2.0 g H_2 × 1 mol CH_3OH/2 mol H_2 × 32 g CH_3OH/1 mol CH_3OH
= 40 g CH_3OH
40 g CH_3OH × 86% = 34 g CH_3OH

PTS: 1 DIF: L3 REF: p. 371 OBJ: 12.3.1
STA: Ch.4.c

68. ANS:
13.0 L Cl_2 × 1 mol Cl_2/22.4 L Cl_2 = 0.580 mol Cl_2
103.0 g Na × 1 mol Na/23 g Na = 4.48 mol Na
Cl_2 is limiting reagent: 0.580 mol Cl_2 × 2 mol NaCl/1 mol Cl_2 = 1.16 mol NaCl
1.16 mol NaCl × 58 g NaCl/1 mol NaCl = 67.3 g NaCl

PTS: 1 DIF: L3 REF: p. 371 OBJ: 12.3.1
STA: Ch.3.d

69. ANS:
Assume the sodium is limiting:

48.7 g Na × 1 mol Na/23.0 g Na × 1 mol H_2/2 mol Na × (6.02 × 10^{23} molecules H_2)/1 mol H_2

= 6.37 × 10^{23} molecules H_2

PTS: 1 DIF: L3 REF: p. 371 OBJ: 12.3.1
STA: Ch.3.d

70. ANS:
10.0 L × 100%/95% = 10.5 L theoretical yield
10.5 L O_2 × 1 mol O_2/22.4 L O_2 × 2 mol $KClO_3$/3 mol O_2 × 122.6 g $KClO_3$/1mol $KClO_3$
= 38.4 g $KClO_3$

PTS: 1 DIF: L3 REF: p. 374 OBJ: 12.3.2
STA: Ch.3.d

71. ANS:
8.3 mol H_2S × 2 mol H_2O/2 mol H_2S × 18 g H_2O/1 mol = 149.4 g H_2O theoretical yield
percent yield = 137.1 g/149.4 g × 100% = 92%

PTS: 1 DIF: L3 REF: p. 373 OBJ: 12.3.2
STA: Ch.3.f

ESSAY

72. ANS:
Answers will vary. A sample answer includes building a model airplane. For each model, there will be two wings and three wheels. In order for the model to look correct or work properly, there must be a certain, unvarying number of wings and wheels.

PTS: 1 DIF: L2 REF: p. 354 OBJ: 12.1.1

73. ANS:
Moles can be directly used. The number of molecules or moles is the basic unit used in solving chemical problems. When the number of moles are known, the mass and volume can be determined.

PTS: 1 DIF: L2 REF: p. 357 OBJ: 12.1.2
STA: Ch.3.d

74. ANS:
The coefficients in a balanced chemical equation indicate the relative number of moles of reactants and products. From this information, the amounts of reactants and products can be calculated. The number of moles may be converted to mass, volume, or number of representative particles.

PTS: 1 DIF: L3 REF: p. 356 OBJ: 12.1.2
STA: Ch.3.d

75. ANS:
The coefficients from the balanced equation are used to write mole ratios. The mole ratios relate the moles of reactants to the moles of product. By multiplying the number of moles of the reactant by the mole ratio, you can determine the number of moles of the product.

PTS: 1 DIF: L2 REF: p. 359 OBJ: 12.2.1
STA: Ch.3.d

76. ANS:
The limiting reagent is silver.
3.0 g Ag × 1 mol Ag/108 g Ag = 0.03 mol Ag
3.0 g S_8 × 1 mol S_8/256 g S_8 = 0.01 mol S_8
0.03 mol Ag × 8 mol Ag_2S/16 mol Ag × 248 g Ag_2S/1 mol Ag_2S = 3.72 g Ag_2S
3.72 g of silver sulfide is produced.

PTS: 1 DIF: L3 REF: p. 363 | p. 364 | p. 365 | p. 366
OBJ: 12.2.2 STA: Ch.3.d

77. ANS:
Volume-volume conversions between gases do not require mole conversions. Molar volumes of all gases at STP are the same. The coefficients in a balanced equation indicate the relative number of moles and the relative volumes of interacting gases.

PTS: 1 DIF: L3 REF: p. 365 OBJ: 12.2.2
STA: Ch.4.c

78. ANS:
150.0 g N_2 × 1 mol N_2/28 g N_2 = 5.36 mol N_2
32.1 g H_2 × 1 mol H_2/2 g H_2 = 16.1 mol H_2
5.36 mol N_2/16.1 mol H_2 = 1 mol N_2/3 mol H_2
There is no limiting reagent. The mole ratio of the reactants is exactly 1 mol N_2 to 3 mol H_2.

PTS: 1 DIF: L3 REF: p. 370 OBJ: 12.3.1
STA: Ch.3.d

79. ANS:
500 g $Al_2(SO_4)_3$ × 1 mol $Al_2(SO_4)_3$/342 g $Al_2(SO_4)_3$ × 3 mol $Ca(OH)_2$/1 mol $Al_2(SO_4)_3$ × 74 g $Ca(OH)_2$/1 mol $Ca(OH)_2$ = 325 g $Ca(OH)_2$
450 g − 325 g = 125 g
There are 125 g excess $Ca(OH)_2$. $Al_2(SO_4)_3$ is the limiting reagent.
125 g $Ca(OH)_2$ × 1 mol $Ca(OH)_2$/74 g $Ca(OH)_2$ = 1.69 mol $Ca(OH)_2$
There are 1.69 mol Ca(OH)2 remaining of unreacted excess reagent.

PTS: 1 DIF: L3 REF: p. 370 OBJ: 12.3.1
STA: Ch.3.d

80. ANS:

No: percent yield = actual yield/theoretical yield × 100%. The theoretical yield is the maximum amount of product that could be formed from given amounts of products. The actual yield must be less than or equal to the theoretical yield.

PTS: 1 DIF: L3 REF: p. 372 | p. 373
OBJ: 12.3.2 STA: Ch.3.f