CHAPTER 7 BLM ANSWER KEY

BLM 7-2: Particle Relationships in Chemical Equations

Answers

1. (a) $2\ NaClO_3 \rightarrow 2\ NaCl + 3\ O_2$ (decomposition)
(b) $K_2O + H_2O \rightarrow 2\ KOH$ (synthesis)
(c) $KOH + HBr \rightarrow H_2O + KBr$ (double displacement)
(d) $C_2H_2 + Br_2 \rightarrow C_2H_2Br_2$ (synthesis)
(e) $2\ NaI + Cl_2 \rightarrow 2\ NaCl + I_2$ (single displacement)

2. (a) $Mg(OH)_2 + 2\ HNO_3 \rightarrow Mg(NO_3)_2 + 2\ H_2O$

(b)

Products		Reactants	
Atom Type	Number of Atoms	Atom Type	Number of Atoms
Mg	1	Mg	1
O	8	O	8
H	4	H	4
N	2	N	2

(c) 1 formula unit $Mg(OH)_2$: 2 molecules HNO_3
(d) 1 formula unit $Mg(NO_3)_2$: 2 molecules H_2O
(e) N = 8000 molecules of H_2O
(f) The known ratio comes from the coefficients in the balanced chemical equation, and the unknown ratio comes from the information given in the problem.

BLM 7-4: Mass/Mass Problems

Answers

1.

	$4Fe_{(s)}$	$+ 3O_{2(g)}$	$\rightarrow$	$2Fe_2O_{3(s)}$
mole ratio	4	3		2
molar mass	55.85 g	32.00 g		159.70 g
given	500 g			*m*

Amount Fe = 8.95 mol
Amount Fe_2O_3 = 4.48 mol
Mass of Fe_2O_3 = 715 g
Therefore, 715 g of Fe_2O_3 should be produced from 500 g of iron.

2.

	$2AgNO_{3(aq)}$	$+ Na_2S_{(aq)}$	$\rightarrow$	$Ag_2S_{(s)}$	$+ 2NaNO_{3(aq)}$
mole ratio	2	1		1	2
molar mass	169.88 g			247.81 g	
given	2.00 g			*m*	

Amount $AgNO_3$ = 0.0118 mol
Amount Ag_2S = 0.00589 mol
Mass of Ag_2S = 1.46 g
Therefore, 1.46 g of Ag_2S are expected to be produced.

3.

	$CH_{4(g)}$	$+ 2O_{2(g)}$	$\rightarrow$	$2H_2O_{(g)}$	$+ CO_{2(g)}$
mole ratio	1	2		2	1
molar mass	16.05 g			18.02 g	
given	1.00 g			*m*	

Amount CH_4 = 0.0623 mol
Amount H_2O = 0.125 mol
Mass of H_2O = 2.25 g
Therefore, 2.25 g of water vapour will be produced.

BLM 7-5: Stoichiometric Quiz

Answers

1. (a) $Li_3N + 3H_2O \rightarrow NH_3 + 3LiOH$
(b) 1:3:1:3
(c) 14 184 molecules of water
(d) 3.81 mol of LiOH
(e) Amount NH_3 = 2.08 mol
Amount Li_3N required = 2.08 mol
Mass of Li_3N required = 72.4 g

BLM 7-6: Molecular Representation of Limiting Reactants

Answers

$12NO;\ 6O_2;\ NO;\ 12NO_2$

BLM 7-7: Magnesium and Hydrochloric Acid Demonstration

Answers to Pre-lab

1. Concentration is a quantitative value expressing how much solute is dissolved in a given quantity of solvent. Typical units for this are g/mL or mol/L. The HCl used for this demo has a concentration of 1 mol/L. This means that there is one mol of HCl dissolved in one litre of solvent (water).

2. The purpose of the balloon is to show that a gas is indeed produced.

Answers to Analysis

Balanced Equation:
$Mg_{(s)} + 2\ HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$
Note: each flask contains 0.1 mol of HCl.

	Flask 1	Flask 2	Flask 3
mass of Mg	0.6 g	1.2 g	2.4 g
limiting reactant (from observation)	Mg	HCl or Mg	HCl
limiting reactant (from calculation)	Mg	stoichiometric equivalence	HCl

CHAPTER 7 BLM ANSWER KEY

BLM 7-8: Limiting Reactant and Percentage Yield

Answers

1. (a)

	$Fe_2O_{3(aq)}$	$+3H_{2(g)}$	→	$2Fe_{(s)}$	$+3H_2O_{(\ell)}$
mole ratio	1	3		2	3
molar mass	159.70 g	2.02 g		55.85 g	18.02 g
given	27.34 g	3.2 g		*m*	

Amount Fe_2O_3 = 0.171 mol
Amount H_2 = 1.6 mol
Amount Fe to be produced based on:
Fe_2O_3 → 0.342 mol Fe
H_2 → 1.1 mol Fe
Fe_2O_3 is the limiting reactant.
Mass of Fe produced = 19.1 g

(b) Percentage yield = $\frac{10.00\text{ g}}{19.1\text{ g}} \times 100\%$

Percentage yield = 52.4%

2. Theoretical mass of ethene 500 g × 0.685 = 343 g

Number of mol of ethene = $\frac{343\text{ g}}{28.06\text{ g/mol}}$ = 12.2 mol

Number of mol of ethanol initially = 12.2 mol
Mass of ethanol required
= 12.2 mol × 46.08 g/mol = 562 g

BLM 7-10: Chapter 7 Test

1. (a) limiting reactant: Limiting reactant is the reactant completely used up in a chemical reaction.

(b) excess reactant: Excess reactant is the reactant that remains after the reaction has completed.

(c) percentage yield: Percentage yield is a mathematical comparison between the actual mass of product obtained from experimentation and the theoretical yield calculated from the balanced chemical equation.

(d) percentage purity: Percentage purity is the proportion of a sample composed of a specific element or compound.

(e) stoichiometry: Stoichiometry is the study of relative quantities of reactants and products in chemical reactions.

2. Two formula units of Al_2O_3 should be produced.

3.

	$3Cu_{(s)}$	$+ 8HNO_{3(aq)}$	→	$3Cu(NO_3)_{2(aq)}$	$+2NO_{(g)}$	$+4H_2O_{(\ell)}$
mole ratio	1	8		3	2	4
molar mass	63.55 g			187.57 g		
given	35.5 g			*m*		

Amount Cu = 0.559 mol
Amount $Cu(NO_3)_2$ = 1.68 mol
Amount $Cu(NO_3)_2$ = 315 g

4. (a)

	$P_{4(g)}$	$+ 6H_{2(g)}$	→	$4PH_{3(g)}$
mole ratio	1	6		4
molar mass	123.88 g	2.02 g		34.00 g
given	62.0 g	4.00 g		*m*

Amount P_4 = 0.500 mol
Amount H_2 = 1.98 mol
Amount PH_3 to be produced based on:
P_4 → 2.00 mol
H_2 → 1.32 mol
H_2 is the limiting reactant.
Mass of PH_3 = 44.9 g

(b) Percentage yield = $\frac{34.0\text{ g}}{44.9\text{ g}} \times 100\%$

Percentage yield = 75.7%

5. Reasons why high percentage yield is required in industrial applications:

- working with large quantities, therefore high conversion is required or there will be unwanted waste
- initial reactants cost money, therefore maximizing product will minimize cost
- some processes are step-wise, if the yield is low from one step to the next, then the overall yield for the entire process will be very low.

Notes