UNIT 4

CHEMICAL EQUATIONS & STOICHIOMETRY

NAME: KEY

Unit 4: Chemical Equations and Stoichiometry

Estimated Time: 15 hours

In relation to this organizer, it is expected that students will explain transformations in matter and energy that occur during chemical reactions. Write and classify balanced chemical equations. Use mole ratios from balanced equations to calculate quantities of materials produced and consumed. Determine limiting and excess reagents, and use theoretical and experimental yields to calculate percent yields.

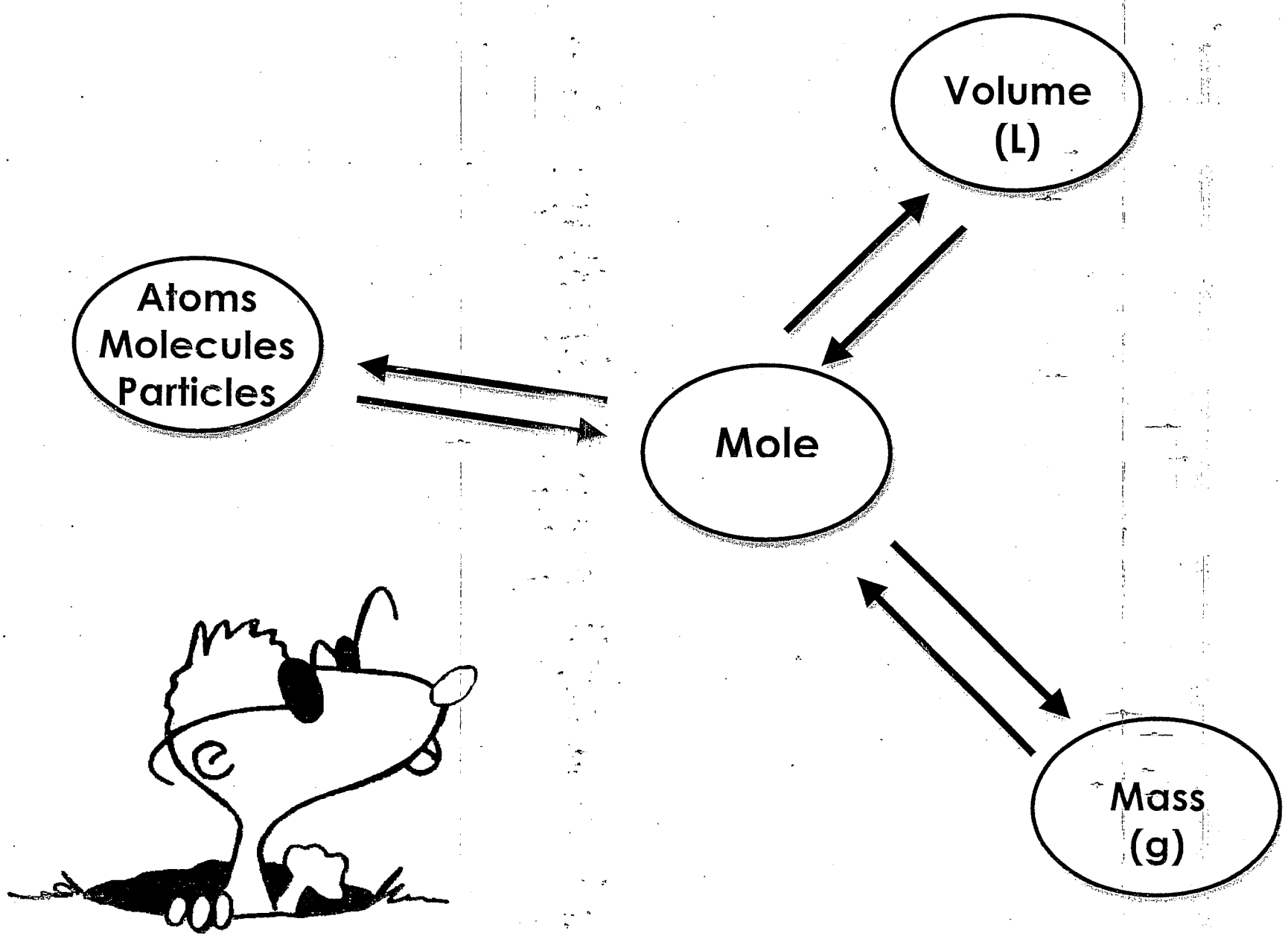
J: Chemical Equations	J1. balance formula equations J2. apply the law of conservation of mass to explain chemical reactions in terms of the rearrangement of atoms J3. translate word equations into formula equations J4. use subscripts (*s*, *l*, *g*, *aq*) to represent solids, liquids, gases, and aqueous J5. classify and predict the products of reactions involving synthesis, decomposition, single replacement, double replacement, acid-base neutralization, and combustion of C_xH_y and $C_xH_yO_z$ compounds
K: Energy Change in Chemical Reactions	K1. classify reactions as exothermic or endothermic based on experimental observations K2. use collision theory to explain that a chemical reaction is the result of a successful collision that can occur only when there is sufficient kinetic energy and correct geometry K3. use PE diagrams to show the potential energy barrier to all reactions and relate this to activation energy (E_a) K4. use PE diagrams to compare endothermic and exothermic reactions in terms of change in enthalpy (ΔH) K5. include an energy term (kJ) in chemical equations and relate this to the change in enthalpy (ΔH) K6. state that exothermic reactions have a strong tendency to be spontaneous, while endothermic reactions have a strong tendency to be non-spontaneous
L: Stoichiometry	L1 calculate moles of product formed given moles of one reactant and an excess of another reactant L2. perform calculations related to chemical reactions using any of the following: - moles - mass - gas volume at STP - solution concentration and volume L3. identify the excess reagent in a reaction and calculate the amount by which is in excess L4. identify the limiting reagent in a reaction and use this value to determine the theoretical yield L5. determine the experimental yield of a reaction in a laboratory setting L6. calculate the percent yield of a reaction

Unit 4 Outline Chemistry 11 - Mrs. Dildy

Chemical Equations

Date	Topic /Activity	Assignment

Mole Conversions



4.1 Balancing Equations

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1. 2 KNO_3 → 2 KNO_2 + 1 O_2
2. 1 CaC_2 + 2 O_2 → 1 Ca + 2 CO_2
3. 1 C_5H_{12} + 8 O_2 → 5 CO_2 + 6 H_2O
4. 1 K_2SO_4 + 1 $BaCl_2$ → 2 KCl + 1 $BaSO_4$
5. 2 KOH + 1 H_2SO_4 → 1 K_2SO_4 + 2 H_2O
6. 1 $Ca(OH)_2$ + 2 NH_4Cl → 2 NH_4OH + 1 $CaCl_2$
7. 5 C + 2 SO_2 → 1 CS_2 + 4 CO
8. 1 Mg_3N_2 + 6 H_2O → 3 $Mg(OH)_2$ + 2 NH_3
9. 1 V_2O_5 + 5 Ca → 5 CaO + 2 V
10. 2 Na_2O_2 + 2 H_2O → 4 NaOH + 1 O_2
11. 1 Fe_3O_4 + 4 H_2 → 3 Fe + 4 H_2O
12. 1 Cu + 2 H_2SO_4 → 1 $CuSO_4$ + 2 H_2O + 1 SO_2
13. 2 Al + 3 H_2SO_4 → 3 H_2 + 1 $Al_2(SO_4)_3$
14. 2 Si_4H_{10} + 13 O_2 → 8 SiO_2 + 10 H_2O
15. 4 NH_3 + 1 O_2 → 2 N_2H_4 + 2 H_2O
16. 2 $C_{15}H_{30}$ + 45 O_2 → 30 CO_2 + 30 H_2O
17. 2 BN + 3 F_2 → 2 BF_3 + 1 N_2
18. 1 $CaSO_4 \cdot 2H_2O$ + 2 SO_3 → 1 $CaSO_4$ + 2 H_2SO_4
19. 2 $C_{12}H_{26}$ + 37 O_2 → 24 CO_2 + 26 H_2O
20. 1 $C_7H_6O_3$ + 7 O_2 → 7 CO_2 + 3 H_2O

Complete and balance the following equations for which the correct word equations is given.

1. Iron + sulphur → Iron (II) sulphide

$Fe + S \rightarrow FeS$

2. Iron + oxygen → Iron (III) oxide

$4Fe + 3O_2 \rightarrow 2Fe_2O_3$

3. Magnesium + oxygen → magnesium oxide

$2Mg + O_2 \rightarrow 2MgO$

4. Sodium chlorate → sodium chloride + oxygen

$2NaClO_3 \rightarrow 2NaCl + 3O_2$

5. Aluminum + sulphuric acid → aluminum sulphate + hydrogen

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

6. Copper (II) oxide + hydrogen → copper + water

$CuO + H_2 \rightarrow Cu + H_2O$

7. Sodium Hydroxide + carbon dioxide → sodium carbonate + water

$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

8. Magnesium bromide + chlorine → magnesium chloride + bromine

$MgBr_2 + Cl_2 \rightarrow MgCl_2 + Br_2$

9. Carbon + steam → carbon monoxide + hydrogen

$C + H_2O \rightarrow CO + H_2$

10. Iron + hydrochloric acid → Iron (II) chloride + hydrogen

$Fe + 2HCl \rightarrow FeCl_2 + H_2$

11. Zinc + lead (II) acetate → lead + zinc acetate

$Zn + Pb(CH_3COO)_2 \rightarrow Pb + Zn(CH_3COO)_2$

12. Calcium hydroxide + ammonium sulphate → calcium sulphate + ammonia + water

$Ca(OH)_2 + (NH_4)_2SO_4 \rightarrow CaSO_4 + 2NH_3 + 2H_2O$

13. Tin (IV) oxide + carbon → tin + carbon monoxide

$SnO_2 + 2C \rightarrow Sn + 2CO$

14. Magnesium hydroxide + nitric acid → magnesium nitrate + water

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

15. Hydrogen + nitrogen → ammonia

$3H_2 + N_2 \rightarrow 2NH_3$

16. Ammonia + oxygen → nitric acid + water

$NH_3 + 2O_2 \rightarrow HNO_3 + H_2O$

17. Calcium chloride → calcium + chlorine

$CaCl_2 \rightarrow Ca + Cl_2$

18. Zinc + mercury (II) nitrate → zinc nitrate + mercury

$Zn + Hg(NO_3)_2 \rightarrow Zn(NO_3)_2 + Hg$

19. Ammonium hydroxide + aluminum chloride → aluminum hydroxide + ammonium chloride

$3NH_4OH + AlCl_3 \rightarrow Al(OH)_3 + 3NH_4Cl$

20. Copper (II) oxide + ammonia → copper + water + nitrogen

$3CuO + 2NH_3 \rightarrow 3Cu + 3H_2O + N_2$

4.3 Writing and Balancing Equations Chemistry 11 – Mrs. Dildy

Write a balanced chemical equation for each of the following:

1. Sulfuric acid reacts with sodium hydroxide to give sodium sulfate and water.

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

2. Sodium hydrogen carbonate reacts with sulfuric acid to produce sodium sulfate, water and carbon dioxide.

$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + 2H_2O$

3. Aluminum oxide and sulfuric acid produce water and aluminum sulfate.

$Al_2O_3 + 3H_2SO_4 \rightarrow 3H_2O + Al_2(SO_4)_3$

4. Sodium metal reacts with water to produce sodium hydroxide and hydrogen gas.

$2Na + 2H_2O \rightarrow 2NaOH + H_2$

5. The hydrocarbon, heptane (C_7H_{16}) burns in an atmosphere of oxygen to form carbon dioxide and water.

$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$

6. Nitrogen trifluoride and hydrogen react to form nitrogen and hydrofluoric acid.

$2NF_3 + 3H_2 \rightarrow N_2 + 6HF$

7. Calcium carbonate and hydrogen chloride react to form carbon dioxide, calcium chloride and water.

$CaCO_3 + 2HCl \rightarrow CO_2 + CaCl_2 + H_2O$

8. Boron trichloride reacts with steam to yield boron trihydroxide and hydrogen chloride.

$BCl_3 + 3H_2O \rightarrow B(OH)_3 + 3HCl$

9. Calcium hydride and water form hydrogen and calcium hydroxide.

$CaH_2 + 2H_2O \rightarrow 2H_2 + Ca(OH)_2$

10. Xenon hexafluoride reacts violently with water to form xenon trioxide and hydrogen fluoride.

$XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

4.4 Types of Chemical Reactions

Notes

Type of Reaction	Description	General Form/Example
Synthesis		
Decomposition		
Single Replacement		
Double Replacement		
Acid-Base		
Combustion		

4.5 Classifying Reactions and Balancing Equations Chemistry 11 – Mrs. Dildy

Classify each chemical reaction:

synthesis
decomposition
single replacement
double replacement
combustion
acid-base

Balance the equation using the simplest whole number.

S 1. $2\,Cu(s) + 1\,O_2(g) \rightarrow 2\,CuO(s)$

D 2. $2\,H_2O(l) \rightarrow 2\,H_2(g) + 1\,O_2(g)$

SR 3. $3\,Fe(s) + 4\,H_2O(l) \rightarrow 4\,H_2(g) + 1\,Fe_3O_4(s)$

DR 4. $2\,AsCl_3(aq) + 3\,H_2S(aq) \rightarrow 1\,As_2S_3(s) + 6\,HCl(aq)$

D 5. $1\,CuSO_4\,5H_2O(s) \rightarrow 1\,CuSO_4(s) + 5\,H_2O(l)$

SR 6. $1\,Fe_2O_3(s) + 3\,H_2(g) \rightarrow 2\,Fe(s) + 3\,H_2O(l)$

D 7. $1\,CaCO_3(s) \rightarrow 1\,CaO(s) + 1\,CO_2(g)$

S 8. $8\,Fe(s) + 1\,S_8(s) \rightarrow 8\,FeS(s)$

A-B 9. $1\,H_2S(aq) + 2\,KOH(aq) \rightarrow 2\,HOH(l) + 1\,K_2S(aq)$

D 10. $2\,NaCl(l) \rightarrow 2\,Na(l) + 1\,Cl_2(g)$

SR 11. $2\,Al(s) + 3\,H_2SO_4(aq) \rightarrow 3\,H_2(g) + 1\,Al_2(SO_4)_3(aq)$

A-B 12. $1\,H_3PO_4(aq) + 3\,NH_4OH(aq) \rightarrow 3\,HOH(l) + 1\,(NH_4)_3PO_4(aq)$

C 13. $1\,C_3H_8(g) + 5\,O_2(g) \rightarrow 3\,CO_2(g) + 4\,H_2O(g)$

S 14. $4\,Al(s) + 3\,O_2(g) \rightarrow 2\,Al_2O_3(s)$

C 15. $\_\,CH_4(g) + 2\,O_2(g) \rightarrow \_\,CO_2(g) + 2\,H_2O(g)$

A. Complete each reaction:

1. Reaction type: S

   Balanced equation: $2Na$ + Cl_2 → $2NaCl$

   Word equation: Sodium + chlorine → Sodium chloride

2. Reaction type: DR

   Balanced equation: 1 K_2S (aq) + 1 $CuBr_2$ (aq) → 1 CuS (aq) + 2 KBr (aq)

   Word equation: Potassium sulfide + Copper(II) bromide → Copper(II) sulfide + Potassium bromide

3. Reaction type: C

   Balanced equation: CH_4 + $2\ O_2$ → ___ CO_2 (g) + 2 H_2O (g)

   Word equation: methane + oxygen → Carbon dioxide + water

4. Reaction type: D

   Balanced equation: $2\ NH_3$ → N_2 + 3 H_2 (g)

   Word equation: ammonia → nitrogen + Hydrogen

5. Reaction type: S

   Balanced equation: SO_3 + H_2O → ___ H_2SO_4 (aq)

   Word equation: sulfur trioxide + water → Sulfuric Acid +

B. Predict the products, balance and classify each reaction.

1. 2 Ag + ___ $CuSO_4$ → No Reaction type : SR
2. 2 NaI + ___ $CaCl_2$ → $2NaCl + CaI_2$ type : DR
3. ___ $Pb(NO_3)_2$ + ___ K_2CrO_4 → $PbCrO_4 + 2KNO_3$ type : DR
4. 2 HNO_3 + ___ $Mn(OH)_2$ → $2H_2O + Mn(NO_3)_2$ type : A-B
5. 2 $AgNO_2$ + ___ $BaSO_4$ → $Ag_2SO_4 + Ba(NO_2)_2$ type : DR
6. 2 HCN + ___ $CuSO_4$ → $Cu(CN)_2 + H_2SO_4$ type : DR
7. ___ C_4H_8 + 6 O_2 → $4H_2O + 4CO_2$ type : C
8. 3 HNO_3 + ___ $Fe(OH)_3$ → $3H_2O + Fe(NO_3)_3$ type : A-B
9. 2 LiBr + ___ $Co(SO_3)_2$ → $Li_2SO_3 + CoBr_2$ type : DR
10. ___ $LiNO_3$ + ___ Ag → No Reaction type : SR
11. ___ Zn + ___ $Au(NO_2)_2$ → $Zn(NO_2)_2 + Au$ type : SR
12. 2 C_6H_6 + 15 O_2 → $12CO_2 + 6H_2O$ type : C