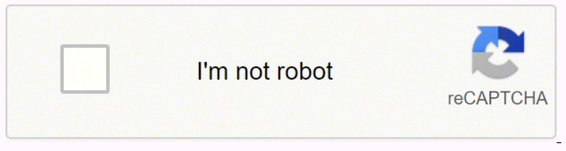

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Balancing Chemical Equations

A chemical reaction is a process by which one set of chemicals is transformed into a new set of chemicals.

A chemical equation uses standard chemical symbols to describe the changes occurring during a reaction

General form: reactants → products

Example: Water

Skeletal equation $H_2 + O_2 \rightarrow H_2O$

Hydrogen and oxygen combine to form water. But the equation is not balanced.

There are 2 oxygen atoms on the reactant side of the equation, but only one on the product side. If we place a 2 in front of the water on the product side, we will balance the oxygens.

$$H_2 + O_2 \rightarrow 2H_2O$$

We now need to balance the hydrogens

→ Place a 2 before the hydrogens on the reactant side of the equation

$2H_2 + O_2 \rightarrow 2H_2O$ *Balanced*

Note: Diatomic molecules

Equation for formation of water included hydrogens and oxygens with subscript 2.

Other elements which occur in this way are Nitrogen, Fluorine, Chlorine, Bromine and Iodine.

These elements occur naturally as diatomic (meaning 2 atoms) molecules

The stoichiometric coefficients multiplying the chemical formulas tell you the relative numbers of moles of each substance that reacts or is

Balancing Chemical Equations Worksheet 1

1. $H_2 + O_2 \rightarrow H_2O$
2. $Na + Cl_2 \rightarrow NaCl$
3. $N_2O_5 \rightarrow NO_2$
4. $Mg + O_2 \rightarrow MgO$
5. $H_2O_2 \rightarrow H_2O + O_2$
6. $Ca + N_2 \rightarrow Ca_3N_2$
7. $Li + F_2 \rightarrow LiF$
8. $Mg + N_2 \rightarrow Mg_3N_2$
9. $NH_3 \rightarrow N_2 + H_2$
10. $HCl \rightarrow H_2 + Cl_2$
11. $NI_3 \rightarrow N_2 + I_2$
12. $HI \rightarrow H_2 + I_2$
13. $Al + O_2 \rightarrow Al_2O_3$
14. $K + S \rightarrow K_2S$
15. $Li + Cl_2 \rightarrow LiCl$
16. $HgO \rightarrow Hg + O_2$
17. $Al + I_2 \rightarrow AlI_3$
18. $Al + S \rightarrow Al_2S_3$
19. $Na + H_2O \rightarrow NaOH + H_2$
20. $NO + O_2 \rightarrow NO_2$
21. $Na_2O + H_2O \rightarrow NaOH$
22. $CH_4 + O_2 \rightarrow CO_2 + H_2O$
23. $PbO + C \rightarrow Pb + CO_2$
24. $C + O_2 \rightarrow CO$
25. $CO + O_2 \rightarrow CO_2$

Balancing Equations Practice Worksheet

Balance the following equations:

1) ___ $NaNO_3$ + ___ PbO → ___ $Pb(NO_3)_2$ + ___ Na_2O

2) ___ AgI + ___ $Fe_2(CO_3)_3$ → ___ FeI_3 + ___ Ag_2CO_3

3) ___ $C_2H_4O_2$ + ___ O_2 → ___ CO_2 + ___ H_2O

4) ___ $ZnSO_4$ + ___ Li_2CO_3 → ___ $ZnCO_3$ + ___ Li_2SO_4

5) ___ V_2O_5 + ___ CaS → ___ CaO + ___ V_2S_5

6) ___ $Mn(NO_2)_2$ + ___ $BeCl_2$ → ___ $Be(NO_2)_2$ + ___ $MnCl_2$

7) ___ AgBr + ___ $GaPO_4$ → ___ Ag_3PO_4 + ___ $GaBr_3$

8) ___ H_2SO_4 + ___ $B(OH)_3$ → __ $B_2(SO_4)_3$ + ___ H_2O

9) ___ S_8 + ___ O_2 → ___ SO_2

10) ___ Fe + ___ $AgNO_3$ → ___ $Fe(NO_3)_2$ + ___ Ag

3. ____ S_8 + 12 O_2 → 8 SO_3

4. 2 N_2 + ____ O_2 → 2 N_2O

5. 2 HgO → 2 Hg + ____ O_2

6. 6 CO_2 + 6 H_2O → ____ $C_6H_{12}O_6$ + 6 O_2

7. ____ Zn + 2 HCl → ____ $ZnCl_2$ + ____ H_2

8. ____ $SiCl_4$ + 4 H_2O → ____ H_4SiO_4 + 4 HCl

9. 2 Na + 2 H_2O → 2 NaOH + ____ H_2

10. 2 H_3PO_4 → ____ $H_4P_2O_7$ + ____ H_2O

11. ____ $C_{10}H_{16}$ + 8 Cl_2 → 10 C + 16 HCl

12. ____ CO_2 + 2 NH_3 → ____ $OC(NH_2)_2$ + ____ H_2O

13. 4 Si_2H_3 + 17 O_2 → 8 SiO_2 + 6 H_2O_3

14. 2 $Al(OH)_3$ + 3 H_2SO_4 → ____ $Al_2(SO_4)_3$ + 6 H_2O

15. 4 Fe + 3 O_2 → 2 Fe_2O_3

16. ____ $Fe_2(SO_4)_3$ + 6 KOH → 3 K_2SO_4 + 2 $Fe(OH)_3$

17. 2 $C_7H_6O_2$ + 15 O_2 → 14 CO_2 + 6 H_2O

18. ____ H_2SO_4 + 8 HI → ____ H_2S + 4 I_2 + 4 H_2O

19. 4 FeS_2 + 11 O_2 → 2 Fe_2O_3 + 8 SO_2

20. 2 Al + 3 FeO → ____ Al_2O_3 + 3 Fe

21. ____ Fe_2O_3 + 3 H_2 → 2 Fe + 3 H_2O

22. ____ Na_2CO_3 + 2 HCl → 2 NaCl + ____ H_2O + ____ CO_2

Worksheet: Writing and Balancing Chemical Reactions

1. Balance the following equations and indicate the type of reaction as formation, decomposition, single replacement, double replacement, hydrocarbon combustion, or other.

a. ____ $Cu_{(s)}$ + ____ $O_{2(g)}$ → ____ $CuO_{(s)}$
b. ____ $H_2O_{(l)}$ → ____ $H_{2(g)}$ + ____ $O_{2(g)}$
c. ____ $Fe_{(s)}$ + ____ $H_2O_{(g)}$ → ____ $H_{2(g)}$ + ____ $Fe_3O_{4(s)}$
d. ____ $AsCl_{3(aq)}$ + ____ $H_2S_{(aq)}$ → ____ $As_2S_{3(s)}$ + ____ $HCl_{(aq)}$
e. ____ $CuSO_4 \cdot 5H_2O_{(s)}$ → ____ $CuSO_{4(s)}$ + ____ $H_2O_{(g)}$
f. ____ $Fe_2O_{3(s)}$ + ____ $H_{2(g)}$ → ____ $Fe_{(s)}$ + ____ $H_2O_{(l)}$
g. ____ $CaCO_{3(s)}$ → ____ $CaO_{(s)}$ + ____ $CO_{2(g)}$
h. ____ $Fe_{(s)}$ + ____ $S_{8(s)}$ → ____ $FeS_{(s)}$
i. ____ $H_2S_{(aq)}$ + ____ $KOH_{(aq)}$ → ____ $H_2O_{(l)}$ + ____ $K_2S_{(aq)}$
j. ____ $NaCl_{(l)}$ → ____ $Na_{(l)}$ + ____ $Cl_{2(g)}$
k. ____ $Al_{(s)}$ + ____ $H_2SO_{4(aq)}$ → ____ $H_{2(g)}$ + ____ $Al_2(SO_4)_{3(aq)}$
l. ____ $H_3PO_{4(aq)}$ + ____ $NH_4OH_{(aq)}$ → ____ $H_2O_{(l)}$ + ____ $(NH_4)_3PO_{4(aq)}$
m. ____ $C_3H_{8(g)}$ + ____ $O_{2(g)}$ → ____ $CO_{2(g)}$ + ____ $H_2O_{(l)}$
n. ____ $Al_{(s)}$ + ____ $O_{2(g)}$ → ____ $Al_2O_{3(s)}$
o. ____ $CH_{4(g)}$ + ____ $O_{2(g)}$ → ____ $CO_{2(g)}$ + ____ $H_2O_{(l)}$
p. ____ $K_2SO_{4(aq)}$ + ____ $BaCl_{2(aq)}$ → ____ $KCl_{(aq)}$ + ____ $BaSO_{4(s)}$
q. ____ $C_5H_{12(l)}$ + ____ $O_{2(g)}$ → ____ $CO_{2(g)}$ + ____ $H_2O_{(g)}$
r. ____ $Ca(OH)_{2(aq)}$ + ____ $NH_4Cl_{(aq)}$ → ____ $NH_4OH_{(aq)}$ + ____ $CaCl_{2(aq)}$
s. ____ $V_2O_{5(s)}$ + ____ $Ca_{(s)}$ → ____ $CaO_{(s)}$ + ____ $V_{(s)}$
t. ____ $Na_{(s)}$ + ____ $ZnI_{2(aq)}$ → ____ $NaI_{(aq)}$ + ____ $Zn_{(s)}$
u. ____ $C_7H_6O_{3(l)}$ + ____ $O_{2(g)}$ → ____ $CO_{2(g)}$ + ____ $H_2O_{(l)}$
v. ____ $Ca_{(s)}$ + ____ $N_{2(g)}$ → ____ $Ca_3N_{2(s)}$
w. ____ $Fe_2O_{3(s)}$ + ____ $H_{2(g)}$ → ____ $Fe_{(s)}$ + ____ $H_2O_{(l)}$
x. ____ $C_{15}H_{30(l)}$ + ____ $O_{2(g)}$ → ____ $CO_{2(g)}$ + ____ $H_2O_{(g)}$
y. ____ $BN_{(s)}$ + ____ $F_{2(g)}$ → ____ $BF_{3(s)}$ + ____ $N_{2(g)}$
z. ____ $C_{12}H_{26(l)}$ + ____ $O_{2(g)}$ → ____ $CO_{2(g)}$ + ____ $H_2O_{(g)}$

2. Predict the product(s) along with the states, indicate the type of reaction, and balance the following chemical reactions.

a. A solution of lead (II) nitrate is mixed with a solution of sodium iodide.
b. Solid zinc sulfide reacts with oxygen in the air.
c. Liquid butane ($C_4H_{10(l)}$) is used as a fuel to ignite a lighter.
d. Barium hydroxide solution is neutralized by adding hydrochloric acid ($HCl_{(aq)}$).
e. Copper metal is placed in a solution of silver nitrate.
f. Sulfur burns in oxygen to make sulfur dioxide gas.
g. A solution of aluminum sulfate is mixed with a solution of calcium hydroxide.
h. Zinc metal is placed in sulfuric acid ($H_2SO_{4(aq)}$).
i. Aluminum powder is placed in a container filled with chlorine gas.
j. Sucrose undergoes cellular respiration.

Xe + F2 → XeF6 Exercise 9. Perform the following check: Add up the numbers of each type of atom. For example, in 7 Al2(SO4)3, the number 7 is a coefficient. NaCl + NH3 + CO2 + H2O → NaHCO3 + NH4Cl Exercise 5. We still need more H atoms on the right. (But things don't always turn out so easy.) The final answer is: N2 + 3 F2 → 2 NF3 Check your answer by counting atoms on both sides: • 2 N atoms on both sides. When a subscript follows parentheses, multiply that subscript by all of the subscripts inside the parentheses. Br2 + F2 → BrF5 Exercise 38. Al2O3 → Al + O2 Exercise 42. Al2(SO4)3 + 3 Ca(OH)2 Exercise 18. CaO + P4O10 → Ca3(PO4)2 Exercise 14. Example 3. Example 1. Here are a few examples: • 3 H2O represents 3 water molecules, consisting of 6 H atoms (since 3 × 2 = 6) and 3 O atoms (since 3 × 1 = 3). 2 Cl atoms on the right. For example, if you could divide all of the coefficients on both sides of the equation by 2, then you may have a balanced equation, but not the simplest balanced equation. Ca3(PO4)2 + SiO2 + C → CaSiO3 + CO + P Exercise 11. The examples start out simple and grow progressively more challenging. Ca3P2 + H2O → Ca(OH)2 + PH3 Exercise 14. Another example of a chemical word is GeNiUS. B5H9 + O2 → B2O3 + H2O Exercise 42. The guidelines suggest dealing with Mg and P before working with H and O. • Realize that you may need to change inserted coefficients over the course of balancing a chemical reaction. Cr + O2 → Cr2O3 Exercise 41. 2 N atoms on the right. FeS2 + H2O + O2 → Fe2(SO4)3 + H2SO4 Exercise 28. SO2 + O2 → SO3 Exercise 19. Make sure you can't factor out the coefficients. C2H6 + O2 → CO2 + H2O Exercise 35. Na3PO4 + Ba(NO3)2 → NaNO3 + Ba3(PO4)2 Exercise 22. H2SO3 + O2 → H2SO4 Exercise 8. N2H4 + NO2 → N2 + H2O Exercise 11. • One chapter devoted to pre-balancing exercises. KO2 + H2O → KOH + O2 Exercise 27. Cu + H2SO4 → CuSO4 + SO2 + H2O Exercise 9. Al + 3 Pb(NO3)2 → Pb + 2 Al(NO3)3 (unbalanced) Let's count atoms again to see where we stand: • 1 Al atom on the left. The following equation would balance the reaction, but that .5 is a problem: C2H6 + 3.5 O2 → 2 CO2 + 3 H2O (unfinished) The solution is to multiply every coefficient by 2 to remove the half: • C2H6 becomes 2 C2H6 (since 2 × 1 = 2). H2 + O2 → H2O Exercise 35. 6 H atoms on the right. C6H10O4 + NH3 + H2 → C6H16N2 + H2O Exercise 30. Cu + Cu(NH3)4Cl2 + NH3 → Cu(NH3)4Cl Exercise 21. KClO3 → KCl + O2 Exercise 6. 6 H2SO4 Exercise 11. • 6 O atoms on the left. N2 + F2 → NF3 First count atoms on both sides: • 2 N atoms on the left. Balance H by inserting a 3 before H2O. Look for Chapter 2 Answers. (Note that 2 × 2 + 3 = 4 + 3 = 7 on the right.) Although C and H are balanced, O isn't. Example 4. • 2 N atoms on the left. Balancing Examples (with Math and Explanations) The following examples illustrate the strategy for balancing chemical reactions. • 8 H atoms on both sides. Al2(SO4)3 + Ca(OH)2 → Al(OH)3 + CaSO4 Exercise 11. 1 H atom on the right. N2O4 → NO2 Note: The answers are tabulated at the back of the book. (NH4)2SO4 Exercise 8. NaN3 + KNO3 + SiO2 → Na4SiO4 + K4SiO4 + N2 Exercise 10. • 3 Pb atoms on both sides. 3 N2 Exercise 9. • Problems grow progressively more challenging and involved. C3H6 + NO → C3H3N + H2O + N2 Exercise 14. NaClO2 + H2SO4 → Na2SO4 + ClO2 + HCl + H2O Exercise 8. 5 C12H22O11 Exercise 12. C7H6O3 + C4H6O3 → C9H8O4 + H2O Exercise 31. K2CO3 + CH4 + H2O + N2 + O2 → KHCO3 + NH3 Exercise 18. Ca3(PO4)2 + H3PO4 → Ca(H2PO4)2 Exercise 13. The total number of atoms in a balanced equation will be the same on both sides of the equation. C3H8 + O2 → CO2 + H2O Exercise 34. C7H5N3O6 → CO + C + H2 + N2 Exercise 32. N2H4 + H2O2 → 2 H2O + N2 (unbalanced) Although both N and O are now balanced, H isn't. Practice can help students develop fluency with balancing chemical equations. This chemistry workbook isn't just for students. 4 O atoms on the right (since 3 + 1 = 4). The 7 multiplies each atom in the term. Al2O3 + HI → AlI3 + H2O Exercise 9. 1 N atom on the right. We can balance O by inserting a coefficient of 2 before H2O. C + H2O → CH4 + CO2 Exercise 4. C12H26 + O2 → CO2 + H2O Exercise 45. NO2 + O3 → N2O5 + O2 Note: The answers are tabulated at the back of the book. C2H6 + O2 → 2 CO2 + H2O (unbalanced) Work with H before O because O appears in a single-element term, unlike H. 6 O atoms on the right. SiCl4 + H2O → SiO2 + HCl Exercise 9. H2O → H2 + O2 Exercise 21. BrF + S8 → SF4 + Br2 5 Intermediate Structure with 3 Terms Exercise 1. Educator. Example 2. • 5 Fe2(SO4)3 consists of 10 Fe atoms (since 5 × 2 = 10), 15 S atoms (since 5 × 3 × 1 = 15), and 60 O atoms (since 5 × 3 × 4 = 60). C + O2 → CO Exercise 7. BaCl2 + H2SO4 → BaSO4 + HCl Exercise 24. Al2O3 Exercise 4. We need twice as many O atoms on the right, so insert a coefficient of 2 before H2O. C21H44 + O2 → CO2 + H2O Exercise 46. H2 + F2 → HF Exercise 8. NO + O2 → NO2 Exercise 16. 2 C6H14 + 19 O2 Exercise 17. Fe + Cl2 → FeCl3 Exercise 40. C + O2 → CO2 Exercise 6. 15: 304–308. PCl5 + H2O → H3PO4 + HCl Exercise 4. After all, a chemical equation is basically balanced by counting atoms while inserting coefficients as needed to make the numbers the same on both sides. • 3 Pb atoms on the left. It's okay to make a mistake. In chemistry, it's important to be able to recognize when equations are balanced, when they are not balanced, and how to balance them.A balanced equation contains the same number of each type of atoms on both the left and right sides of the reaction arrow.To write a balanced equation, the reactants go on the left side of the arrow, while the products go on the right side of the arrow.Coefficients (number in front of a chemical formula) indicate moles of a compound. Water and carbon dioxide are the reactants (these substances react together), while glucose and diatomic oxygen gas are the products (these substances are formed by the reaction). Al + NH4ClO4 → Al2O3 + AlCl3 + NO + H2O Exercise 3. 1 P atom on the right. C + As2O3 → CO2 + As Exercise 12. 3 Mg atoms on the right. Subscripts (numbers below an atom) indicate the number of atoms in a single molecule.To calculate the number of atoms, multiply the coefficient and the subscript. When a coefficient appears in conjunction with a subscript following parentheses, both the coefficient and the subscript multiply all of the subscripts inside the parentheses. P4 + O2 → P4O10 Exercise 36. Au + KCN + H2O + O2 → KAu(CN)2 + KOH Exercise 14. For example, consider the following chemical reaction: 2 Na + F2 → 2 NaF According to the above chemical equation, 2 sodium (Na) atoms react with one diatomic fluorine molecule (F2) to yield 2 sodium fluoride (NaF) molecules. Cu + HNO3 → Cu(NO3)2 + NO + H2O Exercise 22. A stressed-out student is likely to be told to throw some bananas at monkeys, smile, and think happy physics thoughts. C6H12 + O2 → H2C6H8O4 + H2O Exercise 29. Na2Cr2O7 + C6H10 + H2SO4 → Na2SO4 + Cr2(SO4)3 + C6H10O4 + H2O Answer Key Chapter 2 Answers #1) F2 2 F #2) CH4 1 C 4 H #3) Al2O3 2 Al 3 O #4) C2H5OH 2 C 6 H 1 O #5) Pb(NO3)2 1 Pb 2 N 6 O #6) Hg3(PO4)2 3 Hg 2 P 8 O #7) (NH4)2SO4 2 N 8 H 1 S 4 O #8) 3 N2 6 N #9) 4 Na2O 8 Na 4 O #10) 6 H2SO4 12 H 6 S 24 O #11) 5 C12H22O11 60 C 110 H 55 O #12) 2 Al2(CO3)3 4 Al 6 C 18 O #13) 4 Sn(NO3)2 4 Sn 8 N 24 O #14) 5 (NH4)2S 10 N 40 H 5 S #15) 2 Fe + 3 Cl2 2 Fe 6 Cl #16) 2 C6H14 + 19 O2 12 C 28 H 38 O #17) Al2(SO4)3 + 3 Ca(OH)2 2 Al 3 S 18 O 3 Ca 6 H #18) 4Pb(CH3COO)2 + 4H2S 4 Pb 16 C 32 H 16 O 4 S Chapter 3 Answers #1) N2O4 → 2 NO2 #2) 3 O2 → 2 O3 #3) C6H6 → 3 C2H2 #4) C6H12O6 → 6 CH2O #5) C + O2 → CO2 (already balanced) #6) 2 C + O2 → 2 CO #7) H2 + F2 → 2 HF #8) Xe + 3 F2 → XeF6 #9) 2 Fe + O2 → 2 FeO #10) C + 2 F2 → CF4 #11) U + 3 F2 → UF6 #12) CH4 → C + 4 H #13) 2 Ca + O2 → 2 CaO #14) 3 Mg + N2 → Mg3N2 #15) 2 NO + O2 → 2 NO2 #16) 2 P + 3 Cl2 → 2 PCl3 #17) 3 H2 + O3 → 3 H2O #18) 2 SO2 + O2 → 2 SO3 #19) N2 + 3 H2 → 2 NH3 #20) 2 H2O → 2 H2 + O2 #21) 2 Co + 3 F2 → 2 CoF3 #22) 2 Na + Cl2 → 2 NaCl #23) 3 Fe + C → Fe3C #24) 2 HgO → 2 Hg + O2 #25) Br2 + 3 F2 → 2 BrF3 #26) 2 Mg + O2 → 2 MgO #27) 2 Al + 3 Cl2 → 2 AlCl3 #28) 2 SO3 → 2 SO2 + O2 #29) Sn + 2 Cl2 → SnCl4 #30) 2 NaN3 → 2 Na + 3 N2 #31) P4 + 3 O2 → P4O6 #32) 2 P + 5 F2 → 2 PF5 #33) 2 N2O5 → 4 NO2 + O2 #34) 2 H2 + O2 → 2 H2O #35) P4 + 5 O2 → P4O10 #36) 8 Zn + S8 → 8 ZnS #37) Br2 + 5 F2 → 2 BrF5 #38) 4 FeO + O2 → 2 Fe2O3 #39) 2 Fe + 3 Cl2 → 2 FeCl3 #40) 4 Cr + 3 O2 → 2 Cr2O3 #41) 2 Al2O3 → 4 Al + 3 O2 #42) 4 PH3 → P4 + 6 H2 #43) 4 B + 3 O2 → 2 B2O3 #44) 6 Li + N2 → 2 Li3N #45) 4 Fe + 3 O2 → 2 Fe2O3 #46) P4 + 6 Br2 → 4 PBr3 #47) 4 Al + 3 O2 → 2 Al2O3 #48) 2 V2O5 → 4 V + 5 O2 #49) 16 Rb + S8 → 8 Rb2S Chapter 4 Answers #1) Zn + 2 HCl → ZnCl2 + H2 #2) CH4 + H2O → CO + 3 H2 #3) 2 C + 2 H2O → CH4 + CO2 #4) 2 KBr + Cl2 → 2 KCl + Br2 #5) CS2 + 3 O2 → CO2 + 2 SO2 #6) WO3 + 3 H2 → W + 3 H2O #7) CH4 + 2 O2 → CO2 + 2 H2O #8) CH4 + 4 Cl2 → CCl4 + 4 HCl #9) 2 Al + 3 ZnCl2 → 3 Zn + 2 AlCl3 #10) CO2 + H2 → CO + H2O (already balanced) #11) 2 CuS + 3 O2 → 2 CuO + 2 SO2 #12) 2 H2O + 2 F2 → 4 HF + O2 #13) 2 TbF3 + 3 Ca → 2 Tb + 3 CaF2 #14) 2 CoCl2 + 2 ClF3 → 2 CoF3 + 3 Cl2 #15) 2 H2S + 3 O2 → 2 H2O + 2 SO2 #16) 4 HCl + O2 → 2 Cl2 + 2 H2O #17) 2 ZnS + 3 O2 → 2 ZnO + 2 SO2 #18) 2 Al + 6 HCl → 2 AlCl3 + 3 H2 #19) 3 F2 + 3 H2O → 6 HF + O3 #20) 2 NO2 + 7 H2 → 2 NH3 + 4 H2O #21) 4 NH3 + 5 O2 → 4 NO + 6 H2O #22) 4 NH3 + 6 NO → 5 N2 + 6 H2O #23) 2 MoS2 + 7 O2 → 2 MoO3 + 4 SO2 #24) 4 PBr3 + 6 H2 → P4 + 12 HBr #25) 8 SO2 + 16 H2S → 3 S8 + 16 H2O #26) 32 BrF + S8 → 8 SF4 + 16 Br2 Chapter 5 Answers #1) N2O + NO2 → 3 NO #2) C2H4 + H2 → C2H6 (already balanced) #3) 5 C + 6 H2 → C5H12 #4) K2O + H2O → 2 KOH #5) 2 KClO3 → 2 KCl + 3 O2 #6) Na2O + H2O → 2 NaOH #7) 2 H2SO3 + O2 → 2 H2SO4 #8) P4O10 + 6 H2O → 4 H3PO4 #9) Ni(CO)4 → Ni + 4 CO #10) 3 CaO + P2O5 → Ca3(PO4)2 #11) 2 NH3 + H2SO4 → (NH4)2SO4 #12) Ca3(PO4)2 + 4 H3PO4 → 3 Ca(H2PO4)2 #13) 6 CaO + P4O10 → 2 Ca3(PO4)2 #14) NH4NO3 → N2O + 2 H2O #15) 8 Na2SO3 + S8 → 8 Na2S2O3 #16) C6H12O6 → 2 C2H5OH + 2 CO2 #17) C12H22O11 → 12 C + 11 H2O Chapter 6 Answers #1) 2 NO2 + O3 → N2O5 + O2 #2) CS2 + 3 Cl2 → CCl4 + S2Cl2 #3) 2 Al + Fe2O3 → 2 Fe + Al2O3 #4) UO2 + 4 HF → UF4 + 2 H2O #5) Fe2O3 + 3 C → 2 Fe + 3 CO #6) Fe2O3 + 3 CO → 2 Fe + 3 CO2 #7) 2 N2H4 + N2O4 → 3 N2 + 4 H2O #8) SiCl4 + 2 H2O → SiO2 + 4 HCl #9) 2 Al2O3 + 3 C → 4 Al + 3 CO2 #10) 2 N2H4 + 2NO2 → 3 N2 + 4 H2O #11) 3 C + 2 As2O3 → 3 CO2 + 4 As #12) 3 Fe + 4 H2O → Fe3 O4 + 4 H2 #13) I2O5 + 5 CO → I2 + 5 CO2 #14) C2H4 + 6 F2 → 2 CF4 + 4 HF #15) 2 Fe2O3 + 3 S → 4 Fe + 3 SO2 #16) 6 Na + Fe2O3 → 2 Fe + 3 Na2O #17) 2 Cr2O3 + 3 Si → 4 Cr + 3 SiO2 #18) 3 C2F4 + 2 BrF3 → 3 C2F6 + Br2 #19) 5 Ca + V2O5 → 2 V + 5 CaO #20) 2 Fe2O3 + 6 Cl2 → 4 FeCl3 + 3 O2 #21) 8 Al + 3 Fe3O4 → 9 Fe + 4 Al2O3 #22) 2 Na + 2 H2O → 2 NaOH + H2 #23) BaCl2 + H2SO4 → BaSO4 + 2 HCl #24) 2 K + 2 H2O → 2 KOH + H2 #25) AgNO3 + KI → AgI + KNO3 (already balanced) #26) 4 KO2 + 2 H2O → 4 KOH + 3 O2 #27) 2 Fe + 3 CuSO4 → 3 Cu + Fe2(SO4)3 #28) 2 KI + Pb(NO3)2 → PbI2 + 2 KNO3 #29) 2 Al + 3 H2SO4 → Al2(SO4)3 + 3 H2 #30) 4 Fe + 6 H2O + 3 O2 → 4 Fe(OH)3 #31) 10 Fe2O3 + 12 P → 20 Fe + 3 P4O10 #32) B2H6 + 3 O2 → B2O3 + 3 H2O #33) C3H8 + 5 O2 → 3 CO2 + 4 H2O #34) 2 C2H6 + 7 O2 → 4 CO2 + 6 H2O #35) 2 C4H10 + 13 O2 → 8 CO2 + 10 H2O #36) 2 Bi2S3 + 9 O2 → 2 Bi2O3 + 6 SO2 #37) P4S3 + 8 O2 → P4O10 + 3 SO2 #38) 2 C2H2 + 5 O2 → 4 CO2 + 2 H2O #39) C5H12 + 8 O2 → 5 CO2 + 6 H2O #40) 2 C8H18 + 25 O2 → 16 CO2 + 18 H2O #41) 2 B5H9 + 12 O2 → 5 B2O3 + 9 H2O #42) 2 C6H14 + 19 O2 → 12 CO2 + 14 H2O #43) 4 FeS2 + 11 O2 → 2 Fe2O3 + 8 SO2 #44) 2 C12H26 + 37 O2 → 24 CO2 + 26 H2O #45) C21H44 + 32 O2 → 21 CO2 + 22 H2O #46) 2 C10H22 + 31 O2 → 20 CO2 + 22 H2O Chapter 7 Answers #1) PBr3 + 3 H2O → H3PO3 + 3 HBr #2) Al2O3 + 6 HCl → 2 AlCl3 + 3 H2O #3) PCl5 + 4 H2O → H3PO4 + 5 HCl #4) SiO2 + 6 HF → H2SiF6 + 2 H2O #5) PbS + 4 H2O2 → PbSO4 + 4 H2O #6) Fe2O3 + 6 HCl → 2 FeCl3 + 3 H2O #7) N2H4 + 6 H2O2 → 2 NO2 + 8 H2O #8) Al2O3 + 6 HI → 2 AlI3 + 3 H2O #9) Mg(OH)2 + 2 HNO3 → Mg(NO3)2 + 2 H2O #10) Al2(SO4)3 + 3 Ca(OH)2 → 2 Al(OH)3 + 3 CaSO4 #11) Mg3N2 + 4 H2SO4 → 3 MgSO4 + (NH4)2SO4 #12) Ca3(PO4)2 + 3 H2SO4 → 3 CaSO4 + 2 H3PO4 #13) Ca3P2 + 6 H2O → 3 Ca(OH)2 + 2 PH3 #14) (NH4)2Cr2O7 → Cr2O3 + 4 H2O + N2 #15) Al2S3 + 6 H2O → 2 Al(OH)3 + 3 H2S #16) Al4C3 + 12 H2O → 4 Al(OH)3 + 3 CH4 #17) 2 Al(OH)3 + 3 H2SO4 → Al2(SO4)3 + 6 H2O #18) Ba(OH)2 + 2 CH3CO2H → Ba (CH3CO2)2 + 2 H2O #19) 2 Fe(OH)3 + 3 H2SO4 → Fe2(SO4)3 + 6 H2O #20) Cu + Cu(NH3)4Cl2 + 4 NH3 → 2 Cu(NH3)4Cl #21) 2 Na3PO4 + 3 Ba(NO3)2 → 6 NaNO3 + Ba3(PO4)2 #22) Pb(CH3COO)2 + H2S → PbS + 2 CH3COOH #23) 3 CuCl2 + 2 (NH4)3PO4 → Cu3(PO4)2 + 6 NH4Cl #24) 2 NH4NO3 → 4 H2O + 2 N2 + O2 #25) 4 C + 6 H2 + O2 → 2 C2H5OH #26) C2H5OH + 3 O2 → 2 CO2 + 3 H2O #27) C4H10O + 6 O2 → 4 CO2 + 5 H2O #28) 2 C6H12 + 5 O2 → 2 H2C6H8O4 + 2 H2O #29) C7H6O3 + C4H6O3 → C9H8O4 + HC2H3O2 (already balanced) #30) 2 C7H6O3 + C4H6O3 → 2 C9H8O4 + H2O #31) 2 CH3OH + 3 O2 → 2 CO2 + 4 H2O #32) C3H7COOH + 5 O2 → 4 CO2 + 4 H2O #33) 6 CO2 + 6 H2O → C6H12O6 + 6 O2 #34) 2 C5H10O2 + 13 O2 → 10 CO2 + 10 H2O #35) 12 CO2 + 11 H2O → C12H22O11 + 12 O2 #36) 2 C45H86O6 + 127 O2 → 90 CO2 + 86 H2O #37) 2 C57H110O6 + 163 O2 → 114 CO2 + 110 H2O Chapter 8 Answers #1) MnO2 + 4 HCl → MnCl2 + 2 H2O + Cl2 #2) Si3N4 + 5 CO2 → 3 SiO + 2 N2O + 5 CO #3) 2 NF3 + 3 H2O → 6 HF + NO + NO2 #4) MnO2 + 4 HBr → MnBr2 + 2 H2O + Br2 #5) 3 FeCl2 + 4 H2O → Fe3O4 + 6 HCl + H2 #6) Si3N4 + 8 CO2 → 3 SiO2 + 2 N2O + 8 CO #7) 2 CH4 + O2 + 4 Cl2 → 8 HCl + 2 CO #8) Cu + 2 H2SO4 → CuSO4 + SO2 + 2 H2O #9) 2 C3H6 + 2 NH3 + 3 O2 → 2 C3H3N + 6 H2O #10) 4 KO2 + 4 CO2 + 2 H2O → 4 KHCO3 + 3 O2 #11) 2 CuFeS2 + 5 O2 → 2 Cu + 2 FeO + 4 SO2 #12) CaSiO3 + 8 HF → CaF2 + H2SiF6 + 3 H2O #13) 4 C3H6 + 6 NO → 4 C3H3N + 6 H2O + N2 #14) 3 H2S + 2 HNO3 → 2 NO + 4 H2O + 3 S #15) Na2SiO3 + 8 HF → 2 NaF + H2SiF6 + 3 H2O #16) 2 NaOH + 4 H2O2 + H2S → Na2SO4 + 6 H2O #17) 4 CH3NH2 + 2 H2O → 3 CH4 + CO2 + 4 NH3 #18) 8 HNO3 + H2S → H2SO4 + 8 NO2 + 4 H2O #19) 2 Al + 2 NaOH + 2 H2O → 2 NaAlO2 + 3 H2 #20) Cu + 4 HNO3 → Cu(NO3)2 + 2 NO2 + 2 H2O #21) 3 Cu + 8 HNO3 → 3 Cu(NO3)2 + 2 NO + 4 H2O #22) Al + 4 HNO3 → Al(NO3)3 + NO + 2 H2O #23) 3 NaOH + Al(OH)3 + 6 HF → Na3AlF6 + 6 H2O #24) 3 Pb + 8 HNO3 → 3 Pb(NO3)2 + 2 NO + 4 H2O #25) 4 (CH3)3N + 6 H2O → 9 CH4 + 3 CO2 + 4 NH3 #26) 2 Al + 2 NaOH + 6 H2O → 2 NaAl(OH)4 + 3 H2 #27) 4 FeS2 + 2 H2O + 15 O2 → 2 Fe2(SO4)3 + 2 H2SO4 #28) 2 NH4ClO4 → 4 H2O + N2 + Cl2 + 2 O2 #29) C6H10O4 + 2 NH3 + 4 H2 → C6H16N2 + 4 H2O #30) 4 C2H5NO2 + 9 O2 → 8 CO2 + 10 H2O + 2 N2 #31) 2 C7H5N3O6 → 12 CO + 2 C + 5 H2 + 3 N2 #32) 4 C3H5N3O9 → 12 CO2 + 10 H2O + 6 N2 + O2 #33) 2 C8H10N4O2 + 15 O2 → 16 CO + 10 H2O + 8 NO #34) 8 KClO3 + C12H22O11 → 8 KCl + 12 CO2 + 11 H2O #35) 2 C8H10N4O2 + 27 O2 → 16 CO2 + 10 H2O + 8 NO2 #36) 3 NaHCO3 + H3C6H5O7 → Na3C6H5O7 + 3 CO2 + 3 H2O #37) 3 ZnCO3 + 2 C6H8O7 → Zn3(C6H5O7)2 + 3 CO2 + 3 H2O #38) 4 C3H5(NO3)3 → 12 CO2 + 10 H2O + 6 N2 + O2 #39) (CH3)2NNH2 + 4 O2 → N2 + 2 CO2 + 4 H2O #40) Ca10F2(PO4)6 + 7 H2SO4 → 3 Ca(H2PO4)2 + 7 CaSO4 + 2 HF Chapter 9 Answers #1) 16 KNO3 + 24 C + S8 → 8 K2S + 24 CO2 + 8 N2 #2) 3 Al + 3 NH4ClO4 → Al2O3 + AlCl3 + 3 NO + 6 H2O #3) 24 H2S + 6 CO2 + 6 O2 → C6H12O6 + 24 S + 18 H2O #4) NaCl + NH3 + CO2 + H2O → NaHCO3 + NH4Cl (already balanced) #5) 3 KOH + C6H5NH2 + CHCl3 → 3 KCl + C6H5NC + 3 H2O #6) 2 KMnO4 + 16 HCl → 2 KCl + 2 MnCl2 + 8 H2O + 5 Cl2 #7) 10 NaClO2 + 5 H2SO4 → 5 Na2SO4 + 8 ClO2 + 2 HCl + 4 H2O #8) 3 NH4NO3 + C10H22 + 14 O2 → 10 CO2 + 17 H2O + 3 N2 #9) 20 NaN3 + 4 KNO3 + 6 SiO2 → 5 Na4SiO4 + K4SiO4 + 32 N2 #10) Ca3(PO4)2 + 3 SiO2 + 5 C → 3 CaSiO3 + 5 CO + 2 P #11) 2 NaHCO3 + Ca(H2PO4)2 → Na2HPO4 + CaHPO4 + 2 CO2 + 2 H2O #12) (CH3)2N2H2 + 2 N2H4 + 3 N2O4 → 2 CO2 + 8 H2O + 6 N2 #13) 4 Au + 8 KCN + 2 H2O + O2 → 4 KAu(CN)2 + 4 KOH #14) 2 Ca3(PO4)2 + 6 SiO2 + 10 C → 6 CaSiO3 + 10 CO + P4 #15) 2 AgBr + 2 NaOH + C6H6O2 → 2 Ag + 2 NaBr + C6H4O2 + 2 H2O #16) 2 KMnO4 + 5 H2C2O4 + 3 H2SO4 → K2SO4 + 2 MnSO4 + 10 CO2 + 8 H2O #17) 7 K2CO3 + 7 CH4 + 17 H2O + 8 N2 + 2 O2 → 14 KHCO3 + 16 NH3 #18) 6 FeSO4 + K2Cr2O7 + 7 H2SO4 → 3 Fe2(SO4)3 + K2SO4 + Cr2(SO4)3 + 7 H2O #19) 4 Na2Cr2O7 + 3 C6H10 + 16 H2SO4 → 4 Na2SO4 + 4 Cr2(SO4)3 + 3 C6H10O4 + 16 H2O About the Author Chris McMullen is a physics instructor at Northwestern State University of Louisiana and also an author of academic books. (Note that 3 × 2 + 1 = 7 on the left, while 2 × 3 + 1 = 7 on the right.) Example 7. When you see subscripts of 2 and 3 on the same element, it's often helpful to make 6 of each by multiplying 2 by 3 and multiplying 3 by 2 (since 2 × 3 and 3 × 2 both equal 6). Mg3P2 + H2O → 3 Mg(OH)2 + 2 PH3 (unbalanced) Let's count atoms again to see where we stand: • 3 Mg atoms on the left. We now need 2 more H atoms and 2 more O atoms on the left-hand side. Co + F2 → CoF3 Exercise 22. N2 + H2 → NH3 Exercise 20. • 6 H atoms on the left (since 4 + 2 = 6). C3H5(NO3)3 → CO2 + H2O + N2 + O2 Exercise 39. ZnS + O2 → ZnO + SO2 Exercise 18. Mg + O2 → MgO Exercise 27. • One molecule of Mg3N2 consists of 3 Mg atoms and 2 N atoms. Al + HNO3 → Al(NO3)3 + NO + H2O Exercise 23. This way, chemists can prepare the right amount of reactants in the laboratory in order to form the desired amount of products. CH4 Exercise 3. A chemical word is made up not of letters, but of elements of the periodic table. K + H2O → KOH + H2 Exercise 25. CaO + P2O5 → Ca3(PO4)2 Exercise 11. • 2 P atoms on both sides. • It's generally better to save H and O for last. B + O2 → B2O3 Exercise 44. Al(OH)3 + H2SO4 → Al2(SO4)3 + H2O Exercise 18. HCl + O2 → Cl2 + H2O Exercise 17. (Note that 3 × 2 × 3 = 18 on the left, while 2 × 3 × 3 = 18 on the right.) Example 9. MnO2 + HCl → MnCl2 + H2O + Cl2 Note: The answers are tabulated at the back of the book. Mg3P2 + H2O → Mg(OH)2 + PH3 First count atoms on both sides: • 3 Mg atoms on the left. In this case, this happens to balance N at the same time. • 2 H atoms on both sides. KBr + Cl2 → KCl + Br2 Exercise 5. C12H22O11 → C + H2O 6 Intermediate Structure with 4 Terms Exercise 1. • 2 O atoms on both sides. NH4NO3 → H2O + N2 + O2 Exercise 25. 2 Al2(CO3)3 Exercise 13. 4 Na2O Exercise 10. Al2O3 + C → Al + CO2 Exercise 10. FeO + O2 → Fe2O3 Exercise 39. 2 O atoms on the right. (CH3)2N2H2 + N2H4 + N2O4 → CO2 + H2O + N2 Exercise 13. As a physics teacher, Dr. McMullen observed that many students lack fluency in fundamental math skills. H2 + Cl2 → HCl First count atoms on both sides: • 2 H atoms on the left. C57H110O6 + O2 → CO2 + H2O 8 Advanced Structure with 5 Terms Exercise 1. Look for Chapter 6 Answers. Ca + O2 → CaO Exercise 14. Look for Chapter 3 Answers. 2 Al atoms on the right. N2H4 + H2O2 → NO2 + H2O Exercise 8. C3H7COOH + O2 → CO2 + H2O Exercise 33. • 14 O atoms on both sides. C2H5OH + O2 → CO2 + H2O Exercise 27. H2 + O3 → H2O Exercise 18. CS2 + Cl2 → CCl4 + S2Cl2 Exercise 3. • If you find yourself needing to insert a fractional coefficient at the end, multiply every coefficient by the denominator of that fraction. C5H10O2 + O2 → CO2 + H2O Exercise 35. A coefficient is a number indicating how much of a substance there is. Balance H by adding another coefficient of 2, this time before H2. CuCl2 + (NH4)3PO4 → Cu3(PO4)2 + NH4Cl Exercise 24. The separate Na atoms and Cl2 molecules change chemical composition in forming NaCl molecules. How many atoms of each kind are there in the following expression? Each answer to a VErBAl ReAcTiON is not merely a word, it's a chemical word. • 2 O atoms on the left. When there are two or more atoms, a subscript is used. HgO → Hg + O2 Exercise 25. • 3 H2O becomes 6 H2O (since 2 × 3 = 6). • K2CO3 represents 1 potassium carbonate molecule, consisting of 2 K atoms (since 1 × 2 = 2), 1 C atom (since 1 × 1 = 1), and 3 O atoms (since 1 × 3 = 3). We can solve this problem by inserting a coefficient of 2 before Al and a coefficient of 3 before Pb. The final answer is: 2 Al + 3 Pb(NO3)2 → 3 Pb + 2 Al(NO3)3 Check your answer by counting atoms on both sides: • 2 Al atoms on both sides. [*] However, the law of conservation of mass doesn't hold true for all types of reactions. • 2 H atoms on the left. The Law of Conservation of Mass states the mass is the same before and after a chemical reaction. Apache/2.4.41 (Ubuntu) Server at who.dhis2.org Port 443 © 1996-2014, Amazon.com, Inc. PBr3 + H2O → H3PO3 + HBr Note: The answers are tabulated at the back of the book. Pre-balancing Skills Before we learn how to balance a chemical reaction, let us first consider how to count atoms in various terms, using subscripts, parentheses, and coefficients. 8 H atoms on the right. AgBr + NaOH + C6H6O2 → Ag + NaBr + C6H4O2 + H2O Exercise 16. If there is no subscript, there is one atom. (CH3)3N + H2O → CH4 + CO2 + NH3 Exercise 26. It indicates that there are 7 aluminum sulfate molecules. • One molecule of Ca(OH)2 consists of 1 Ca atom, 2 O atoms (since 1 × 2 = 2), and 2 H atoms (since 1 × 2 = 2). Balance Mg by inserting a coefficient of 3 before Mg(OH)2, and balance P by inserting a coefficient of 2 before PH3. 9 O atoms on the right. 3 O atoms on the right. • 7 O atoms on both sides. When there are two or more molecules, a coefficient is used. H2 + O2 → H2O First count atoms on both sides: • 2 H atoms on the left. (Note that 4 + 2 × 2 = 8 on the left.) • 4 O atoms on both sides. Mg3N2 + H2SO4 → MgSO4 + (NH4)2SO4 Exercise 12. Cr2O3 + Si → Cr + SiO2 Exercise 18. P + F2 → PF5 Exercise 33. Br2 + F2 → BrF3 Exercise 26. It's more than just applying mathematics: It combines trial and error with reasoning skills. "An Innovative Approach to Balancing Chemical-Reaction Equations: A Simplified Matrix-Inversion Technique for Determining the Matrix Null Space". Fe2O3 + CO → Fe + CO2 Exercise 7. In this case, sodium, chlorine, and sodium chloride undergo mutual chemical changes. (Recall the words 'coefficient' and 'term' defined earlier in this chapter.) If there is no coefficient, there is one molecule. (Note that 3 × 2 + 2 × 3 = 6 + 6 = 12 on the right.) • 6 O atoms on both sides. • 2 P atoms on the left. Fe(OH)3 + H2SO4 → Fe2(SO4)3 + H2O Exercise 20. Al + NaOH + H2O → NaAlO2 + H2 Exercise 20. • 2 Cl atoms on the left. C8H10N4O2 + O2 → CO + H2O + NO Exercise 34. Balancing Strategy (in Words) Goal: Add coefficients to each term, as needed, such that the total number of each atom on both sides of the chemical equation matches up exactly. Mg + N2 → Mg3N2 Exercise 15. • Answers to every problem. • 2 (NH4)3PO4 consists of 6 N atoms (since 2 × 3 × 1 = 6), 24 H atoms (since 2 × 3 × 4 = 24), 2 P atoms (since 2 × 1 = 2), and 8 O atoms (since 2 × 4 = 8). C2H5NO2 + O2 → CO2 + H2O + N2 Exercise 31. Look for Chapter 5 Answers. CaSiO3 + HF → CaF2 + H2SiF6 + H2O Exercise 13. Balance the following reaction. 2 P atoms on the right. A chemical reaction occurs when two or more substances undergo mutual chemical changes. (We'll learn more about this concept later in this chapter.) A chemical reaction is said to be balanced when there are the same number of each type of atom on both sides of the chemical equation. Anyone who enjoys math or science puzzles may enjoy balancing chemical reactions in the spirit of solving puzzles. Na + Cl2 → NaCl Exercise 23. Fe + O2 → FeO Exercise 10. Additionally, a 404 Not Found error was encountered while trying to use an ErrorDocument to handle the request. KMnO4 + HCl → KCl + MnCl2 + H2O + Cl2 Exercise 7. N2O + NO2 → NO Note: The answers are tabulated at the back of the book. This includes a cool idea called VErBAl ReAcTiONS. Balance C by inserting a 2 before CO2. F2 + H2O → HF + O3 Exercise 20. The guidelines suggest balancing C before dealing with H and O. Let's try the trick from Example 3. The coefficient multiplies the number of atoms in a molecule. CO2 + H2 → CO + H2O Exercise 11. Author, Chris McMullen, Ph.D. Improve Your Math Fluency This series of math workbooks is geared toward practicing essential math skills: • Algebra and trigonometry • Fractions, decimals, and percents • Long division • Multiplication and division • Addition and subtraction www.improveyourmathfluency.com www.chrismcmullen.com Dr. McMullen has published a variety of science books, including: • Basic astronomy concepts • Basic chemistry concepts • Creative physics problems • Calculus-based physics Chris McMullen enjoys solving puzzles. NaOH + Al(OH)3 + HF → Na3AlF6 + H2O Exercise 24. or its affiliates Balancing Chemical Equations Worksheets 2 C2H6 + 7 O2 → 4 CO2 + 6 H2O With 200 Reactions to Balance Chemistry Essentials Practice Workbook with Answers Chris McMullen, Ph.D. Balancing Chemical Equations Worksheets With 200 Reactions to Balance Chemistry Essentials Practice Workbook with Answers Copyright © 2016 Chris McMullen All rights reserved. Ba(OH)2 + CH3CO2H → Ba (CH3CO2)2 + H2O Exercise 19. CH4 + O2 + Cl2 → HCl + CO Exercise 8. • 3.5 O2 becomes 7 O2 (since 2 × 3.5 = 7). Fe2O3 + S → Fe + SO2 Exercise 16. • 2 CO2 + 3 H2O consists of 2 C atoms, 6 H atoms (since 3 × 2 = 6), and 7 O atoms (since 2 × 2 + 3 × 1 = 4 + 3 = 7). In an effort to help students of all ages and levels master basic math skills, he published a series of math workbooks on arithmetic, fractions, and algebra called the Improve Your Math Fluency Series. (Note that 3 × 2 + 2 × 3 = 6 + 6 = 12 on the right.) • 1 O atom on the left. CH4 + H2O → CO + H2 Exercise 3. Now all of the coefficients are integers. HNO3 + H2S → H2SO4 + NO2 + H2O Exercise 19. CH4 + Cl2 → CCl4 + HCl Exercise 9. NH3 + NO → N2 + H2O Exercise 23. Ca + V2O5 → V + CaO Exercise 20. Al + Pb(NO3)2 → Pb + Al(NO3)3 First count atoms on both sides: • 1 Al atom on the left. C2H5OH Exercise 5. PbS + H2O2 → PbSO4 + H2O Exercise 6. Following are a few examples: • 4 Ba(NO3)2 consists of 4 Ba atoms (since 4 × 1 = 4), 8 N atoms (since 4 × 2 × 1 = 8), and 24 O atoms (since 4 × 2 × 3 = 24). Fe + CuSO4 → Cu + Fe2(SO4)3 Exercise 28. Na + H2O → NaOH + H2 Exercise 23. C6H12O6 → CH2O Exercise 5. U + F2 → UF6 Exercise 12. AgNO3 + KI → AgI + KNO3 Exercise 26. C3H6 + NH3 + O2 → C3H3N + H2O Exercise 10. The products of a chemical reaction are the final substances. C8H18 + O2 → CO2 + H2O Exercise 41. 1 Cl atom on the right. Dr. McMullen is very passionate about teaching. (NH4)2Cr2O7 → Cr2O3 + H2O + N2 Exercise 15. An example of a chemical change is when carbon (C) and diatomic oxygen gas (O2) get together to form a new gas called carbon dioxide (CO2). 6 N atoms on the right. NO2 + H2O → HNO3 + NO First count atoms on both sides: • 1 N atom on the left. At the molecular level, two oxygen atoms are bound to each carbon atom in carbon dioxide. H2 + O2 → 2 H2O (unbalanced) While the coefficient balanced O, it messed up H. Ni(CO)4 → Ni + CO Exercise 10. C45H86O6 + O2 → CO2 + H2O Exercise 37. Al + O2 → Al2O3 Exercise 48. Dr. McMullen is well-known for drawing monkeys and using them in his physics examples and problems, applying his creativity to inspire students. (But things don't always turn out so easy.) The final answer is: 3 NO2 + H2O → 2 HNO3 + NO Check your answer by counting atoms on both sides: • 3 N atoms on both sides. We can achieve this by inserting a coefficient of 2 before H2O2. Fe2O3 + C→ Fe + CO Exercise 6. Many students and observers have been impressed with the transformation that occurs when he walks into the classroom, and the interactive engaged discussions that he leads during class time. 2 C atoms on the right. NH4ClO4 → H2O + N2 + Cl2 + O2 Exercise 29. C8H10N4O2 + O2 → CO2 + H2O + NO2 Exercise 36. • 2 Cl atoms on both sides. Whether in the classroom or as a writer, Dr. McMullen loves sharing knowledge and the art of motivating and engaging students. Si + O2 → SiO2 First count atoms on both sides: • 1 Si atom on the left. CO2 + H2O → C6H12O6 + O2 Exercise 34. CoCl2 + ClF3 → CoF3 + Cl2 Exercise 15. TbF3 + Ca → Tb + CaF2 Exercise 14. Si3N4 + CO2 → SiO + N2O + CO Exercise 3. PBr3 + H2 → P4 + HBr Exercise 25. (That trick doesn't always work, but it's worth testing it out when you see a subscript of 2 on one side and a subscript of 3 on the other side attached to the same element.) Insert a coefficient of 3 before NO2 and a coefficient of 2 before HNO3. Use device navigation to check the answer key. V2O5 → V + O2 Exercise 49. The reactants are NaOH and HCl, while the products are NaCl and H2O. If you enjoy anagrams and like science or math, these puzzles are tailor-made for you. Bi2S3 + O2 → Bi2O3 + SO2 Exercise 37. • 4 N2O3 represents 4 dinitrogen trioxide molecules, consisting of 8 N atoms (since 4 × 2 = 8) and 12 O atoms (since 4 ×

3 = 12). CuS + O2 → CuO + SO2 Exercise 12. The final answer is: Si + O2 → SiO2 Example 5. CH3NH2 + H2O → CH4 + CO2 + NH3 Exercise 18. C6H14 + O2 → CO2 + H2O Exercise 43. Mg(OH)2 + HNO3 → Mg(NO3)2 + H2O Exercise 10. 1 C atom on the right. C10H22 + O2 → CO2 + H2O 7 Advanced Structure with 4 Terms Exercise 1. CH3OH + O2 → CO2 + H2O Exercise 32. Elements present on one side of the equation need to be present on the other side of the equation. (The coefficient of C applies only to the first term. Al + Fe3O4 → Fe + Al2O3 Exercise 22. KClO3 + C12H22O11 → KCl + CO2 + H2O Exercise 35. 6 CO2 + 6 H2O → C6H12O6 + 6 O2 (balanced equation for photosynthesis)6 carbon dioxide + 6 water yields 1 glucose + 6 oxygen 2 AgI + Na2S → Ag2S + 2 NaI2 silver iodide + 1 sodium sulfide yields 1 silver sulfide + 2 sodium iodide Ba3N2 + 6 H2O → 3 Ba(OH)2 + 2 NH3 3 CaCl2 + 2 Na3PO4 → Ca3(PO4)2 + 6 NaCl 4 FeS + 7 O2 → 2 Fe2O3 + 4 SO2 PCl5 + 4 H2O → H3PO4 + 5 HCl 2 As + 6 NaOH → 2 Na3AsO3 + 3 H2 3 Hg(OH)2 + 2 H3PO4 → Hg3(PO4)2 + 6 H2O 12 HClO4 + P4O10 → 4 H3PO4 + 6 Cl2O7 8 CO + 17 H2 → C8H18 + 8 H2O 10 KClO3 + 3 P4 → 3 P4O10 + 10 KCl SnO2 + 2 H2 → Sn + 2 H2O 3 KOH + H3PO4 → K3PO4 + 3 H2O 2 KNO3 + H2CO3 → K2CO3 + 2 HNO3 Na3PO4 + 3 HCl → 3 NaCl + H3PO4 TiCl4 + 2 H2O → TiO2 + 4 HCl C2H6O + 3 O2 → 2 CO2 + 3 H2O 2 Fe + 6 HC2H3O2 → 2 Fe(C2H3O2)3 + 3 H2 4 NH3 + 5 O2 → 4 NO + 6 H2O B2Br6 + 6 HNO3 → 2 B(NO3)3 + 6 HBr 4 NH4OH + KAl(SO4)2·12H2O → Al(OH)3 + 2 (NH4)2SO4 + KOH + 12 H2O When you balance a chemical equation, it's always a good idea to check the final equation to make sure it works out. James E. 7 O atoms on the right. P4 + O2 → P4O6 Exercise 32. 18 O atoms on the right. FeSO4 + K2Cr2O7 + H2SO4 → Fe2(SO4)3 + K2SO4 + Cr2(SO4)3 + H2O Exercise 19. (2010). (Note that 4 × 2 + 6 = 8 + 6 = 14 on the right.) 2 Pre-Balancing Practice Exercise 1. • Insert one coefficient at a time, attempting to balance one element at a time. The final answer is: Mg3P2 + 6 H2O → 3 Mg(OH)2 + 2 PH3 Check your answer by counting atoms on both sides: • 3 Mg atoms on both sides. For example, in photosynthesis, plants combine water (H2O) and carbon dioxide (CO2) to form carbohydrates, such as glucose (C6H12O6), and diatomic oxygen gas (O2). An example of a chemical reaction is the synthesis of sodium chloride (NaCl) from sodium (Na) and diatomic chlorine gas (Cl2). KO2 + CO2 + H2O → KHCO3 + O2 Exercise 11. NaOH + H2O2 + H2S → Na2SO4 + H2O Exercise 17. Pb(NO3)2 Exercise 6. C6H6 → C2H2 Exercise 4. • One molecule of C4H6O3 consists of 4 C atoms, 6 H atoms, and 3 O atoms. • 2 CO2 becomes 4 CO2 (since 2 × 2 = 4). We have a problem: A coefficient of 3.5 before O2 would balance the reaction (since 3.5 O2 would make 7 O atoms because 3.5 × 2 = 7), but you can't have half a molecule. Here are a few examples: • 2 C + O2 consists of 2 C atoms and 2 O atoms. • 6 F atoms on both sides. Al + ZnCl2 → Zn + AlCl3 Exercise 10. 3 N atoms on the right. NF3 + H2O → HF + NO + NO2 Exercise 4. (Note that 3 × 2 × 3 = 18 on the left, while 2 × 3 × 3 = 18 on the right.) Now N and O are both balanced, but Al and Pb are no longer balanced. Steps: Follow these guidelines to balance a chemical reaction: • Begin by counting the number of each type of atom on each side of the chemical equation. FeCl2 + H2O → Fe3O4 + HCl + H2 Exercise 6. NaHCO3 + Ca(H2PO4)2 → Na2HPO4 + CaHPO4 + CO2 + H2O Exercise 12. P4S3 + O2 → P4O10 + SO2 Exercise 38. PH3 → P4 + H2 Exercise 43. A VErBAl ReAcTiON expresses word scrambles so that they look like chemical reactions. Here are a few examples: • One molecule of CO2 consists of 1 C atom and 2 O atoms. Look for Chapter 8 Answers. A coefficient multiplies the numbers of all atoms in the same term. Note that O2 is on the left and O3 is on the right. 1 How to Balance Chemical Reactions Definitions Let us begin by defining terms that are relevant to chemical reactions. (See Example 10 at the end of this chapter.) Check: When you finish balancing a chemical equation, add up the total number of each atom on each side to make sure they are the same on both sides. It's made up of germanium (Ge), nickel (Ni), uranium (U), and sulfur (S). Mg + HCl → MgCl2 + H2 First count atoms on both sides: • 1 Mg atom on the left. C7H6O3 + C4H6O3 → C9H8O4 + HC2H3O2 Exercise 30. Zn + HCl → ZnCl2 + H2 Note: The answers are tabulated at the back of the book. (Note that 2 + 1 = 3 on the right.) • 2 H atoms on both sides. You don't need to do anything to balance the equation, but you should show your work by counting atoms on each side and stating that it's already balanced (because an instructor might penalize you for leaving an exercise blank). (We'll learn how to count atoms later in this chapter.) According to the law of conservation of mass, atoms are neither created nor destroyed during a chemical reaction. The word equations for a few of these reactions have been provided, though most likely you'll be asked to provide only the standard chemical equations. • Use trial and error. Jespersen (2007). • 3 O atoms on the left (since 2 + 1 = 3). John Wiley & Sons. ZnCO3 + C6H8O7 → Zn3(C6H5O7)2 + CO2 + H2O Exercise 38. 2 Fe + 3 Cl2 Exercise 16. (Note that 3 × 2 × 1 = 6 on the left, while 2 × 3 × 1 = 6 on the right.) • 18 O atoms on the left. Na2SiO3 + HF → NaF + H2SiF6 + H2O Exercise 16. 1 Si atom on the right. C4H10 + O2 → CO2 + H2O Exercise 36. We need 2 H and 2 Cl atoms on the right, so simply add a coefficient of 2 before the HCl. The final answer is: H2 + Cl2 → 2 HCl (Note that we don't write 1's in front of H2 or Cl2. Chem. C6H12O6 → C2H5OH + CO2 Exercise 17. C3H5N3O9 → CO2 + H2O + N2 + O2 Exercise 33. KOH + C6H5NH2 + CHCl3 → KCl + C6H5NC + H2O Exercise 6. ISBN 9780470120941.Thorne, Lawrence R. 2 H atoms on the right. • 1 Pb atom on the left. 5 H atoms on the right. NH3 + H2SO4 → (NH4)2SO4 Exercise 12. C + F2 → CF4 Exercise 11. C4H10O + O2 → CO2 + H2O Exercise 28. Example 8. (Note that 3 × 2 × 1 = 6 on the left, while 2 × 3 × 1 = 6 on the right.) • 18 O atoms on both sides. Look for Chapter 9 Answers. NH4NO3 → N2O + H2O Exercise 15. Changing the coefficient from a 2 to a 3 won't work because we won't be able to make 3 O atoms on the left (since you can't multiply O2 by an integer to make 3 O atoms). So let's try changing the coefficient on the right-hand side from a 2 to a 4: N2H4 + H2O2 → 4 H2O + N2 (unbalanced) Let's count atoms again to see where we stand: • 2 N atoms on the left. NH3 + O2 → NO + H2O Exercise 22. • One molecule of Mg3(PO4)2 consists of 3 Mg atoms, 2 P atoms (since 1 × 2 = 2), and 8 O atoms (since 4 × 2 = 8). Ca3(PO4)2 + H2SO4 → CaSO4 + H3PO4 Exercise 13. According to the guidelines, we should deal with N before O. Na2O + H2O → NaOH Exercise 7. WO3 + H2 → W + H2O Exercise 7. Fe + O2 → Fe2O3 Exercise 46. Hg3(PO4)2 Exercise 7. Education > Science > Chemistry > Workbooks Contents Introduction 1 How to Balance Chemical Reactions Definitions The Significance of Balancing Reactions Pre-balancing Skills Balancing Strategy (in Words) Balancing Examples (with Math and Explanations) 2 Pre-Balancing Practice 3 Basic Structure with 3 Terms or Less 4 Basic Structure with 4 Terms 5 Intermediate Structure with 3 Terms 6 Intermediate Structure with 4 Terms 7 Advanced Structure with 4 Terms 8 Advanced Structure with 5 Terms 9 Advanced Structure with 6 or More Terms Answer Key About the Author Introduction The art of balancing chemical equations challenges students' problem-solving abilities. N2H4 + N2O4 → N2 + H2O Exercise 8. Al + Fe2O3 → Fe + Al2O3 Exercise 4. P + Cl2 → PCl3 Exercise 17. Fe + H2O → Fe3 O4 + H2 Exercise 13. Sn + Cl2 → SnCl4 Exercise 30. Pb(CH3COO)2 + H2S → PbS + CH3COOH Exercise 23. NaHCO3 + H3C6H5O7 → Na3C6H5O7 + CO2 + H2O Exercise 37. The terms of a chemical reaction are separated by plus (+) and yield (→) signs. We need 2 H and 2 Cl atoms on the left, so simply add a coefficient of 2 before the HCl. The final answer is: Mg + 2 HCl → MgCl2 + H2 Check your answer by counting atoms on both sides: • 1 Mg atom on both sides. He once taught a threeweek summer course on puzzles. They react together to produce new substances with different compositions. His favorite puzzle is Kakuro (kind of like a cross between crossword puzzles and Sudoku). According to the guidelines, we should balance O before H since O appears only in one term on each side. They are the new substances that are produced by the reaction. The law of conservation of mass applies to ordinary chemical reactions.[*] The Significance of Balancing Reactions The significance of a balanced chemical equation is that the relative amounts of the reactants and products come in the same proportion as the coefficients in the chemical equation. 12 H atoms on the right. • 2 F atoms on the left. The requested URL was not found on this server. Look for Chapter 7 Answers. Although the guidelines suggest saving H and O for last, in this case it turns out to be easier to work with O first. So, if all the coefficients can be divided by 2 or 3, do this before finalizing the reaction. • 1 H atom on the left. Originally from California, Dr. McMullen earned his Master's degree from California State University, Northridge, where his thesis was in the field of electron spin resonance. The reactants of a chemical reaction are the initial substances. KMnO4 + H2C2O4 + H2SO4 → K2SO4 + MnSO4 + CO2 + H2O Exercise 17. C2H2 + O2 → CO2 + H2O Exercise 39. H2S + HNO3 → NO + H2O + S Exercise 15. C2H6 + O2 → 2 CO2 + 3 H2O (unbalanced) Let's count atoms again to see where we stand: • 2 C atoms on the left. FeS2 + O2 → Fe2O3 + SO2 Exercise 44. C2F4 + BrF3 → C2F6 + Br2 Exercise 19. Si3N4 + CO2 → SiO2 + N2O + CO Exercise 7. NO2 + H2 → NH3 + H2O Exercise 21. Make sure you accounted for all types of atoms. For example, the following chemical equation is balanced: 2 Cu2S + 3 O2 → 2 Cu2O + 2 SO2 There are 4 copper (Cu) atoms on each side, 2 sulfur (S) atoms on each side, and 6 oxygen (O) atoms on each side (since 3 × 2 = 6 on the left and 2 + 2 × 2 = 6 on the right). 3 F atoms on the right. The composition of carbon dioxide is thus different from that of separate carbon and oxygen atoms. Although H is already balanced, O isn't. The final answer is: 2 H2 + O2 → 2 H2O Check your answer by counting atoms on both sides: • 4 H atoms on both sides. If something doesn't work out, you can always go back and change it, and try something else instead. In this case, this happens to also balance N and H at the same time. K2O + H2O → KOH Exercise 5. For example, in nuclear reactions such as 233U 229Th + 4He, the atoms themselves may change identity. Example 6. 1 Mg atom on the right. N2H4 + H2O2 → H2O + N2 First count atoms on both sides: • 2 N atoms on the left. He earned his Ph.D. in phenomenological high-energy physics (particle physics) from Oklahoma State University in 2002. • 6 H atoms on the left. Exercise 2. Brady; Frederick Senese; Neil D. Cu + HNO3 → Cu(NO3)2 + NO2 + H2O Exercise 21. 4Pb(CH3COO)2 + 4H2S 3 Basic Structure with 3 Terms or Less Exercise 1. In this case, SUCCEsS is made up of sulfur (S), uranium (U), carbon (C), and Einsteinium (Es). Writing balanced chemical equations is essential for chemistry class. B2H6 + O2 → B2O3 + H2O Exercise 33. 1 Pb atom on the right. A subscript denotes the number of atoms present in one molecule. I2O5 + CO → I2 + CO2 Exercise 14. Al + NaOH + H2O → NaAl(OH)4 + H2 Exercise 27. Fe2O3 + HCl → FeCl3 + H2O Exercise 7. CO2 + H2O → C12H22O11 + O2 Exercise 36. We can balance both H and O by inserting a coefficient of 6 before H2O. Fe + H2O + O2 → Fe(OH)3 Exercise 31. C + H2 + O2 → C2H5OH Exercise 26. An example of a chemical equation is: NaOH + HCl → NaCl + H2O The above chemical equation represents the following chemical reaction: Sodium hydroxide (NaOH) reacts together with hydrochloric acid (HCl) to yield sodium chloride (NaCl) and water (H2O). 1 Al atom on the right. (Note that 2 + 3 = 5 on the right.) • 1 O atom on the left. Ca3(PO4)2 + SiO2 + C → CaSiO3 + CO + P4 Exercise 15. Example 10. H2S + O2 → H2O + SO2 Exercise 16. Look for Chapter 4 Answers. The reasoning behind this is that 3 × 2 and 2 × 3 both equal 6. For example, consider the following chemical reaction: FeS + 2 HCl → FeCl2 + H2S The above chemical equation consists of 4 terms: FeS, 2 HCl, FeCl2, and H2S. This chemistry workbook provides ample practice: • Step-by-step examples with explanations. • 12 H atoms on both sides. MoS2 + O2 → MoO3 + SO2 Exercise 24. Li + N2 → Li3N Exercise 45. If you enjoy mathematical pattern puzzles, you might appreciate: 300+ Mathematical Pattern Puzzles Number Pattern Recognition & Reasoning • pattern recognition • visual discrimination • analytical skills • logic and reasoning • analogies • mathematics Chris McMullen has coauthored several word scramble books. P4O10 + H2O → H3PO4 Exercise 9. CH4 → C + H Exercise 13. Note that if you have "1" of something, it does not get a coefficient or subscript. • A concise review of pertinent concepts and ideas. Fe2O3 + P → Fe + P4O10 Exercise 32. • 2 C6H12O6 represents 2 glucose molecules, consisting of 12 C atoms (since 2 × 6 = 12), 24 H atoms (since 2 × 12 = 24), and 12 O atoms (since 2 × 6 = 12). Insert a coefficient of 3 before F2 and a coefficient of 2 before NF3 to balance F. SO3 → SO2 + O2 Exercise 29. Al2O3 + HCl → AlCl3 + H2O Exercise 3. H2O + F2 → HF + O2 Exercise 13. Following are a few examples: • One molecule of Fe2(SO4)3 consists of 2 Fe atoms, 3 S atoms (since 1 × 3 = 3), and 12 O atoms (since 4 × 3 = 12). F2 Note: The answers are tabulated at the back of the book. This is why chemical reactions need to be balanced: to ensure that the reaction has the same number of each type of atom on both sides of the chemical equation. Fe2O3 + Cl2 → FeCl3 + O2 Exercise 21. Because the proportions are the same at any scale, the same chemical equation tells us that 2 moles of sodium react with one mole of diatomic fluorine gas to yield 2 moles of sodium fluoride, for example. 4 O atoms on the right. C2H4 + F2 → CF4 + HF Exercise 15. N2O5 → NO2 + O2 Exercise 34. • Over 200 chemical reactions to balance. When every element has the same number of atoms on each side of the reaction, the equation is balanced. MnO2 + HBr → MnBr2 + H2O + Br2 Exercise 5. Chemistry: Matter and Its Changes. C2H6 + O2 → CO2 + H2O First count atoms on both sides: • 2 C atoms on the left. Al2S3 + H2O → Al(OH)3 + H2S Exercise 16. The final answer is: 2 C2H6 + 7 O2 → 4 CO2 + 6 H2O Check your answer by counting atoms on both sides: • 4 C atoms on both sides. CuFeS2 + O2 → Cu + FeO + SO2 Exercise 12. We only write coefficients when they don't equal one.) Check your answer by counting atoms on both sides: • 2 H atoms on both sides. SO2 + H2S → S8 + H2O Exercise 26. Dr. McMullen has also published a variety of science books, including introductions to basic astronomy and chemistry concepts in addition to physics textbooks. The coefficient appears to the left of the molecule. The final answer is: N2H4 + 2 H2O2 → 4 H2O + N2 Check your answer by counting atoms on both sides: • 2 N atoms on both sides. • 6 N atoms on both sides. • Work with elements that appear in compounds like NaCl or H2O before working with elements that appear isolated like N2 or Al. • Work with elements that appear only once on each side of the equation before dealing with elements that appear two or more times on the same side. 4 Sn(NO3)2 Exercise 14. Al + H2SO4 → Al2(SO4)3 + H2 Exercise 30. Coefficients do not extend past + or → signs.) • 3 Fe + 4 H2O consists of 3 Fe atoms, 8 H atoms (since 4 × 2 = 8), and 4 O atoms. A chemical equation represents a chemical reaction in symbolic form, with the reactants added together on the left-hand side, the products added together on the right-hand side, and a yield symbol (→) in between. O2 → O3 Exercise 3. If the atom appears in more than one reactant or product, add together all the atoms on each side of the arrow.If there is only one mole or one atom, then the coefficient or subscript "1" is implied, but is not written.A balanced equation is reduced to the lowest whole number coefficients. KNO3 + C + S8 → K2S + CO2 + N2 Note: The answers are tabulated at the back of the book. A chemical change occurs when a new substance is formed with a different composition. When two or more terms are added together (with + signs in between), first treat each term separately and then add all of the atoms together. UO2 + HF → UF4 + H2O Exercise 5. NH4NO3 + C10H22 + O2 → CO2 + H2O + N2 Exercise 9. With 2 N on the left and 3 N on the right, we can use the trick from Example 3 to balance N: Insert a coefficient of 3 before Pb(NO3)2 and a coefficient of 2 before Al(NO3)3. Al + Cl2 → AlCl3 Exercise 28. Na + Fe2O3 → Fe + Na2O Exercise 17. CS2 + O2 → CO2 + SO2 Exercise 6. Here is an example: 2 C + U + 2 S + Es → S U C C Es S The left side of the reaction indicates that the answer has 2 C's, 1 U, 2 S's, and 1 Es. Rearrange CCUSSEs to form SUCCEsS. Al4C3 + H2O → Al(OH)3 + CH4 Exercise 17. C + H2 → C5H12 Exercise 4. Rb + S8 → Rb2S 4 Basic Structure with 4 Terms Exercise 1. SiO2 + HF → H2SiF6 + H2O Exercise 5. Na2SO3 + S8 → Na2S2O3 Exercise 16. This is a trick question: It's already balanced. • 1 Cl atom on the left. P4 + Br2 → PBr3 Exercise 47. C2H4 + H2 → C2H6 Exercise 3. H2S + CO2 + O2 → C6H12O6 + S + H2O Exercise 4. 2 N atoms on the right (since N appears in both terms on the right). KI + Pb(NO3)2 → PbI2 + KNO3 Exercise 29. Pb + HNO3 → Pb(NO3)2 + NO + H2O Exercise 25. Fe + C → Fe3C Exercise 24. Since N is already balanced, we need to deal with H and O first. Ca10F2(PO4)6 + H2SO4 → Ca(H2PO4)2 + CaSO4 + HF 9 Advanced Structure with 6 or More Terms Exercise 1. NaN3 → Na + N2 Exercise 31. CH4 + O2 → CO2 + H2O Exercise 8. • 6 N atoms on the left. 5 (NH4)2S Exercise 15. Here are examples of balanced equations you can review or use for homework. (CH3)2NNH2 + O2 → N2 + CO2 + H2O Exercise 40. 1 O atom on the right. C5H12 + O2 → CO2 + H2O Exercise 40. Al + HCl → AlCl3 + H2 Exercise 19. Zn + S8 → ZnS Exercise 37.

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