Atomic Mass

①

	Mass	%
^{10}B	10.01	x
^{11}B	11.01	y

$x + y = 1$

$y = 1 - x$

$y = 1 - 0.2$

$y = 0.8$

$10.01x + 11.01y = 10.81$

$10.01x + 11.01(1-x) = 10.81$

$10.01x + 11.01 - 11.01x = 10.81$

$-x + 11.01 = 10.81$

$x = 11.01 - 10.81$

$x = 0.2$

^{10}B 20% ^{11}B 80%

②

^{63}Cu	62.930	x
^{65}Cu	64.928	y

$x + y = 1$

$y = 1 - x$

$= 1 - 0.695$

$y = 0.305$

$62.93x + 64.928y = 63.54$

$62.93x + 64.928(1-x) = 63.54$

$62.93x + 64.928 - 64.928x = 63.54$

$64.928 - 1.998x = 63.54$

$1.998x = 1.388$

$x = 0.695$

^{63}Cu 69.5% ^{65}Cu 30.5%

(3)

^{85}Rb	84.91	x
^{87}Rb	86.92	y

$x + y = 1$

$y = 1 - x$

$= 1 - 0.721$

$y = 0.279$

$84.91x + 86.92y = 85.47$

$84.91x + 86.92(1-x) = 85.47$

$84.91x + 86.92 - 86.92x = 85.47$

$86.92 - 2.01x = 85.47$

$2.01x = 1.45$

$x = 0.721$

^{85}Rb 72.1% ^{87}Rb 27.9%

(4)

^{79}Br	78.91	x
^{81}Br	80.916	y

$x + y = 1$

$y = 1 - x$

$= 1 - 0.504$

$y = 0.496$

$78.91x + 80.916y = 79.904$

$78.91x + 80.916(1-x) = 79.904$

$78.91x + 80.916 - 80.916x = 79.904$

$80.916 - 2.006x = 79.904$

$2.006x = 1.012$

$x = 0.504$

^{79}Br 50.4% ^{81}Br 49.6%

⑤ $(0.787)(24) + (0.101)(25) + (0.112)(26)$

$= 24.325$ amu

⑥ $(0.5725)(120.9) + (0.4275)(122.9)$

$= 121.755$ amu

⑦ $(0.604)(68.9) + (0.396)(70.9)$

$= 69.692$ amu

⑧ $(0.92)(28) + (0.05)(29) + (0.03)(30)$

$= 28.11$ amu

⑨

^{35}Cl	34.96885	x
^{37}Cl	36.96590	y

$x + y = 1$

$y = 1 - x$

$= 1 - 0.767$

$y = 0.233$

$34.96885x + 36.96590y = 35.435$

$34.96885x + 36.96590(1-x) = 35.435$

$34.96885x + 36.96590 - 36.96590x = 35.435$

$36.96590 - 1.99705x = 35.435$

$1.99705x = 1.5359$

$x = 0.767$

^{35}Cl 76.7% ^{37}Cl 23.3%

⑩ $(0.99759)(15.99491) + (0.00037)(16.99914) + (0.00204)(17.99916)$

$= 15.9994$ amu

Naming Worksheet

(From http://www.palomar.edu/chemistry/docs/Name_of_Chemical_Compounds.html)

Name the following compounds:

1. ZnS zinc sulfide
2. $MgCl_2$ magnesium chloride
3. $Ca(ClO_3)_2$ calcium chlorate
4. $CaSO_4$ calcium sulfate
5. $AgNO_3$ silver nitrate
6. H_2S hydrogen sulfide
7. CaO calcium oxide
8. H_2CO_3 hydrogen carbonate
9. $Mg_3(PO_4)_2$ magnesium phosphate
10. KCl potassium chloride
11. K_2O potassium oxide
12. $Al(NO_2)_3$ aluminum nitrite
13. MgO magnesium oxide
14. SnI_2 tin (II) iodide
15. $AsCl_5$ arsenic (V) chloride
16. $CuSO_3$ copper (II) sulfite
17. HF hydrogen fluoride
18. $FeSO_4$ iron (II) sulfate
19. $SnCl_4$ tin (IV) chloride
20. $AsCl_3$ arsenic (III) chloride
21. KCN potassium cyanide
26. $CuCl_2$ copper (II) chloride
27. PCl_5 phosphorus pentachloride
28. $LiNO_2$ lithium nitrite
29. KH_2PO_4 potassium dihydrogen phosphate
30. $CuCN$ copper (I) cyanide
31. $KHCO_3$ potassium hydrogen carbonate
32. ~~$NaHSO_3$~~ sodium hydrogen sulfite
33. Li_2HPO_4 lithium hydrogen phosphate
34. ~~H_3PO_5~~
35. $MgSO_4$ magnesium sulfate
36. ~~$Ca(IO_2)_2$~~ calcium iodite **
37. SiO_2 silicon dioxide
38. $CuCl$ copper (I) chloride
39. $KClO_2$ potassium chlorite
40. $CaSO_3$ calcium sulfite
41. $NaBr$ sodium bromide
42. P_2O_3 diphosphorus trioxide
43. $HClO$ hydrogen hypochlorite
44. NO_2 nitrogen dioxide
45. NaH sodium hydride
46. ZnS zinc sulfide

** IO_2^- = iodite

22. NH_4OH ammonium hydroxide 47. $Pb(NO_3)_2$ lead(II) nitrate

23. $Fe(ClO_4)_3$ iron(III) perchlorate 48. H_2Se dihydrogen selenide

24. HNO_2 hydrogen nitrite ~~49. H_3PO_4~~ _____

25. CS_2 carbon disulfide 50. CaH_2 calcium hydride

Write the formulas for the following compounds:

51. lithium chloride $LiCl$ 76. strontium carbonate $SrCO_3$

52. phosphoric acid _____ 77. calcium nitrate $Ca(NO_3)_2$

53. boron trichloride BCl_3 78. disulfur dichloride S_2Cl_2

54. ferric chloride _____ 79. tin (IV) oxide SnO_2

55. carbon tetrachloride CCl_4 80. sodium bicarbonate $NaHCO_3$ *

56. silver sulfide Ag_2S 81. strontium chlorate $Sr(ClO_3)_2$

57. antimony trichloride $SbCl_3$ 82. aluminum hydroxide $Al(OH)_3$

58. barium carbonate $BaCO_3$ 83. cadium nitrate $Cd(NO_3)_2$

59. iodine monochloride ICl 84. diphosphorus trioxide P_2O_3

60. aluminum nitride AlN 85. sodium hydride NaH

61. lead sulfate $PbSO_4$ 86. calcium nitride Ca_2N_3

62. ammonium chloride NH_4Cl 87. sulfur trioxide SO_3

63. hydrogen fluoride HF 88. aluminum nitrate $Al(NO_3)_3$

64. hydrobromic acid _____ 89. silver oxide Ag_2O

65. tin (II) bromide $SnBr_2$ 90. ammonium phosphate $(NH_4)_3PO_4$

66. cuprous oxide _____ 91. cupric sulfate _____

67. calcium bicarbonate $Ca(HCO_3)_2$ * 92. lithium fluoride LiF

* bicarbonate is the same as hydrogen carbonate

68. copper (II) cyanide $Cu(CN)_2$ 93. sodium sulfate Na_2SO_4

69. cesium fluoride CsF 94. radium carbonate $RaCO_3$

70. zinc phosphate Zn_3PO_4 95. copper (II) oxide CuO

71. dinitrogen pentoxide N_2O_5 96. iron (III) sulfate $Fe_2(SO_3)_3$

72. iron (II) sulfate $FeSO_4$ 97. magnesium perchlorate $Mg(ClO_4)_2$

73. magnesium oxide MgO 98. potassium hypochlorite $KClO$

74. hydrogen chloride HCl 99. lithium hydride LiH

75. potassium cyanide KCN 100. potassium nitrate KNO_3

Formula Mass

A. ① Determine the Formula
② Find the mass of each element
③ Sum all the masses

B. ① $22.99 + 35.45 = 58.44$ amu

② $2(39.1) + (32.07) = 110.27$ amu

③ $2(132.91) + 32.07 + 4(16) = 361.89$ amu

④ $140.91 + 3(16) + 3(1.01) = 191.94$ amu

⑤ $4(39.1) + 55.85 + 6(12.01) + 6(14.01) = 368.37$ amu

⑥ $2(14.01) + 8(1.01) + 32.07 + 4(16) = 132.17$ amu

⑦ CuS $63.55 + 32.07 = 95.62$ amu

⑧ MgF_2 $24.31 + 2(19) = 62.31$ amu

⑨ $Cu(NO_3)_2$ $63.55 + 2(14.01) + 6(16) = 187.57$ amu

⑩ $Fe_3(PO_4)_2$ $3(55.85) + 2(30.97) + 8(16) = 357.49$ amu

⑪ $Al(NO_3)_3$ $26.98 + 3(14.01) + 9(16) = 213.01$ amu

⑫ Mg_3N_2 $3(24.31) + 2(14.01) = 100.95$ amu

Balancing Equations Race - Solutions

1) $\underline{1}\ C_3H_8 + \underline{5}\ O_2 \rightarrow \underline{3}\ CO_2 + \underline{4}\ H_2O$

2) $\underline{2}\ Al + \underline{1}\ Fe_3N_2 \rightarrow \underline{2}\ AlN + \underline{3}\ Fe$

3) $\underline{2}\ Na + \underline{1}\ Cl_2 \rightarrow \underline{2}\ NaCl$

4) $\underline{2}\ H_2O_2 \rightarrow \underline{2}\ H_2O + \underline{1}\ O_2$

5) $\underline{1}\ C_6H_{12}O_6 + \underline{6}\ O_2 \rightarrow \underline{6}\ H_2O + \underline{6}\ CO_2$

6) $\underline{4}\ H_2O + \underline{7}\ CO_2 \rightarrow \underline{1}\ C_7H_8 + \underline{9}\ O_2$

7) $\underline{2}\ NaClO_3 \rightarrow \underline{2}\ NaCl + \underline{3}\ O_2$

8) $\underline{4}\ (NH_4)_3PO_4 + \underline{3}\ Pb(NO_3)_4 \rightarrow \underline{1}\ Pb_3(PO_4)_4 + \underline{12}\ NH_4NO_3$

9) $\underline{2}\ BF_3 + \underline{3}\ Li_2SO_3 \rightarrow \underline{1}\ B_2(SO_3)_3 + \underline{6}\ LiF$

10) $\underline{4}\ C_7H_{17} + \underline{45}\ O_2 \rightarrow \underline{28}\ CO_2 + \underline{34}\ H_2O$

11) $\underline{3}\ CaCO_3 + \underline{2}\ H_3PO_4 \rightarrow \underline{1}\ Ca_3(PO_4)_2 + \underline{3}\ H_2CO_3$

12) $\underline{8}\ Ag_2S \rightarrow \underline{16}\ Ag + \underline{1}\ S_8$

13) $\underline{3}\ KBr + \underline{1}\ Fe(OH)_3 \rightarrow \underline{3}\ KOH + \underline{1}\ FeBr_3$

14) $\underline{2}\ KNO_3 + \underline{1}\ H_2CO_3 \rightarrow \underline{1}\ K_2CO_3 + \underline{2}\ HNO_3$

15) $\underline{1}\ Pb(OH)_4 + \underline{2}\ Cu_2O \rightarrow \underline{1}\ PbO_2 + \underline{4}\ CuOH$

16) $\underline{1}\ Cr(NO_2)_2 + \underline{1}\ (NH_4)_2SO_4 \rightarrow \underline{1}\ CrSO_4 + \underline{2}\ NH_4NO_2$

17) $\underline{6}\ KOH + \underline{1}\ Co_3(PO_4)_2 \rightarrow \underline{2}\ K_3PO_4 + \underline{3}\ Co(OH)_2$

18) $\underline{3}\ Sn(NO_2)_4 + \underline{1}\ Pt_3N_4 \rightarrow \underline{1}\ Sn_3N_4 + \underline{3}\ Pt(NO_2)_4$

19) $\underline{1}\ B_2Br_6 + \underline{6}\ HNO_3 \rightarrow \underline{2}\ B(NO_3)_3 + \underline{6}\ HBr$

20) $\underline{3}\ ZnS + \underline{2}\ AlP \rightarrow \underline{1}\ Zn_3P_2 + \underline{1}\ Al_2S_3$

Six Types of Chemical Reaction Worksheet

Answers

Balance the following reactions and indicate which of the six types of chemical reaction are being represented:

1) **2** $NaBr$ + **1** $Ca(OH)_2$ → **1** $CaBr_2$ + **2** $NaOH$

Type of reaction: **double displacement**

2) **2** NH_3 + **1** H_2SO_4 → **1** $(NH_4)_2SO_4$

Type of reaction: **synthesis**

3) **4** C_5H_9O + **27** O_2 → **20** CO_2 + **18** H_2O

Type of reaction: **combustion**

4) **3** Pb + **2** H_3PO_4 → **3** H_2 + **1** $Pb_3(PO_4)_2$

Type of reaction: **single displacement**

5) **1** Li_3N + **3** NH_4NO_3 → **3** $LiNO_3$ + **1** $(NH_4)_3N$

Type of reaction: **double displacement**

6) **3** HBr + **1** $Al(OH)_3$ → **3** H_2O + **1** $AlBr_3$

Type of reaction: **acid-base**

7) What's the main difference between a double displacement reaction and an acid-base reaction?
Acid-base reactions form water.

8) Combustion reactions always result in the formation of water. What other types of chemical reaction may result in the formation of water? Write examples of these reactions on the opposite side of this paper.
Acid-base: $HCl + NaOH \rightarrow H_2O + NaCl$
Synthesis: $2\ H_2 + O_2 \rightarrow 2\ H_2O$
Decomposition: $NH_4OH \rightarrow NH_3 + H_2O$
Single displacement: $H_2 + 2\ NaOH \rightarrow 2\ Na + 2\ H_2O$ (not common)

Molar Mass

A. ① Determine Formula
② Find molar mass of each element
③ Sum the masses

B. ① $12.01 + 16 = 28.01$ g/mol

② $32.07 + 2(16) = 64.07$ g/mol

③ $1.01 + 14.01 + 3(16) = 63.02$ g/mol

④ $2(144.24) + 3(16) = 336.48$ g/mol

⑤ $55.85 + 4(12.01) + 6(1.01) + 4(16) = 173.95$ g/mol

⑥ $121.76 + 3(14.01) + 9(16) = 307.79$ g/mol

⑦ KBr $39.1 + 79.9 = 119$ g/mol

⑧ H_2O $2(1.01) + 16 = 18.02$ g/mol

⑨ Na_2SO_3 $2(22.99) + 32.07 + 3(16) = 126.05$ g/mol

⑩ NH_4Br $14.01 + 4(1.01) + 79.9 = 97.95$ g/mol

⑪ $Ca(HCO_3)_2$ $40.08 + 2(1.01) + 2(12.01) + 6(16) = 162.12$ g/mol

⑫ K_2SO_4 $2(39.1) + 32.07 + 4(16) = 174.27$ g/mol

Mole Conversions

① $\frac{3.01 \times 10^{22}}{6.02 \times 10^{23}} = 0.05$ mol

③ $4\,(6.02 \times 10^{23}) = 2.408 \times 10^{24}$ molecules

③ $\frac{1.20 \times 10^{25}}{6.02 \times 10^{23}} = 19.9$ mol

④ $0.75\,(6.02 \times 10^{23}) = 4.515 \times 10^{23}$ atoms

⑤ $0.4\,(6.02 \times 10^{23}) = 2.408 \times 10^{23}$ molecules

⑥ CO_2 $12.01 + 2(16) = 44.01$ g/mol

$\frac{28\text{ g}}{44.01\text{ g/mol}} = 0.636$ mol

⑦ Fe_2O_3 $2(55.85) + 3(16) = 159.7$ g/mol

$5\,(159.7) = 798.5$ g

⑧ Ar 39.95 g/mol

$\frac{452}{39.95} = 11.31$ mol

⑨ $HC_2H_3O_2$ $4(1.01) + 2(12.01) + 2(16) = 60.06$ g/mol

$(1.26 \times 10^{-4})(60.06) = 0.0076$ mol

⑩ LiBr $6.94 + 79.9 = 86.84$ g/mol

$2.6\,(86.84) = 225.78$ g.

⑪ $0.03\,(22.4) = 0.672$ L

⑫ $\frac{11.2\text{ L}}{22.4} = 0.5$ mol

(13) $0.05\ (22.4) = 1.12\ L$

(14) $1.2\ (22.4) = 26.88\ L$

(15) $\frac{3.36\ L}{22.4} = 0.15\ mol\ O_2$

$0.15\ (6.02 \times 10^{23}) = 9.03 \times 10^{22}$ molecules O_2

(16) $\frac{2.00 \times 10^{23}}{6.02 \times 10^{23}} = 0.332\ mol\ F_2$

$F_2\ \ 2(19) = 38\ g/mol$

$0.332\ (38) = 12.6\ g$

(17) $N_2 \quad 2(14.01) = 28.02\ g/mol$

$\frac{14\ g}{28.02} = 0.5\ mol$

$0.5\ (22.4) = 11.2\ L$

(18) $N_2 \quad 2(14.01) = 28.02\ g/mol$

$\frac{1.00 \times 10^{23}}{6.02 \times 10^{23}} = 0.166\ mol$

$0.166\ (28.02) = 4.65\ g$

(19) $\frac{1.43}{233} = 0.0061\ mol$

$0.0061\ (6.02 \times 10^{23}) = 3.69 \times 10^{21}$ particles

(20) a) $14(12.01) + 18(1.01) + 2(14.01) + 5(16)$

$= 294.34 \text{ g/mol}$

b) $\frac{10 \text{ g}}{294.34 \text{ g/mol}} = 0.03397 \text{ mol}$

c) $1.56 \text{ mol} (294.34 \text{ g/mol}) = 459.2 \text{ g}$

d) $5 \text{ mg} = 0.005 \text{ g}$

$\frac{0.005 \text{ g}}{294.34 \text{ g/mol}} = 1.699 \times 10^{-5} \text{ mol}$

$(1.699 \times 10^{-5})(6.02 \times 10^{23}) = 1.02 \times 10^{19} \text{ molecules}$

e) $\frac{1.2 \text{ g}}{294.34 \text{ g/mol}} = 0.0041 \text{ mol Aspartame}$

$0.0041 \text{ mol Aspartame} \rightarrow 0.0082 \text{ mol N}$

$0.0082 (6.02 \times 10^{23}) = 4.91 \times 10^{21} \text{ atoms of N}$

Molar Volume

① @ STP 2 mol × 22.4 L/mol = 44.8 L

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{(1)(44.8)}{(273)} = \frac{P_2(0.5)}{(303)}$$

$P_2 = 99.45$ atm $= 10\,074$ kPa

② 12.5 mol × 22.4 L/mol = 280 L

③ $\frac{2.5\text{ L}}{22.4\text{ L/mol}} = 0.112$ mol

④

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{(1)V_1}{(273)} = \frac{(1.5)(5)}{(373)}$$

$V_1 = 5.49$ L

$\frac{5.49\text{ L}}{22.4\text{ L/mol}} = 0.245$ mol

$M = \frac{4.94\text{ g}}{0.245\text{ mol}} = 20.2$ g/mol

The gas is Neon.

⑤ @ STP 1 mol O_2 → 22.4 L

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{95 \text{ kPa}}{101.3} = 0.94 \text{ atm}$

$\frac{(1)(22.4)}{(273)} = \frac{(0.94)V_2}{(303)}$

$V_2 = 26.5 \text{ L}$

molar mass of O_2 = 32 g/mol

$D = \frac{M}{V} = \frac{32 \text{ g/mol}}{26.5 \text{ L/mol}}$

$D = 1.21 \text{ g/L}$

⑥ @ STP 4 mol × 22.4 L = 89.6 L

$\frac{(1)(89.6)}{(273)} = \frac{(5.4)(120)}{T_2}$

$T_2 = 1974 \text{ K}$ or $1701^\circ C$

⑦ a) $P_1V_1 = P_2V_2$

$(1.25)(2.5) = (95)V_2$

$V_2 = 0.0329 \text{ L}$

b) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{2.99 \text{ L}}{22.4 \text{ L/mol}} = 0.133 \text{ mol}$

$\frac{(1)V_1}{(273)} = \frac{(1.25)(2.5)}{(285)}$

$V_1 = 2.99 \text{ L}$

Percent Comp

A ① Cr_2O_3 152 g/mol

Cr: $\frac{2(52)}{152} \times 100 = 68.4\%$

O: $\frac{3(16)}{152} \times 100 = 31.6\%$

② $Ca_3(PO_4)_2$ 310.3 g/mol

Ca: $\frac{3(40.1)}{310.3} \times 100 = 38.8\%$

P: $\frac{2(31.0)}{310.3} \times 100 = 20.0\%$

O: $\frac{8(16.0)}{310.3} \times 100 = 41.2\%$

B ③ Fe_2O_3 159.6 g/mol

Fe: $\frac{2(55.8)}{159.6} \times 100 = 69.9\%$

O: $\frac{3(16.0)}{159.6} \times 100 = 30.1\%$

④ FeO 71.8 g/mol

Fe: $\frac{55.8}{71.8} \times 100 = 77.7\%$

O: $\frac{16.0}{71.8} \times 100 = 22.3\%$

C ⑤ C: $\frac{0.0130 \text{ mol}}{0.0065} = 2$

H: $\frac{0.0390 \text{ mol}}{0.0065} = 6$

O: $\frac{0.0065 \text{ mol}}{0.0065} = 1$ C_2H_6O

⑥ Mg: $\frac{72.2 \text{ g}}{24.3 \text{ g/mol}} = 3$

N: $\frac{27.8 \text{ g}}{14 \text{ g/mol}} = 2$ Mg_3N_2

⑦ C: $\frac{40 \text{ g}}{12 \text{ g/mol}} = \frac{3.33}{3.33} = 1$

H: $\frac{6.7 \text{ g}}{1.0 \text{ g/mol}} = \frac{6.7}{3.33} = 2$

O: $\frac{53.3 \text{ g}}{16.0 \text{ g/mol}} = \frac{3.33}{3.33} = 1$

CH_2O

⑧ H: $\frac{0.3086 \text{ g}}{10.0006 \text{ g}} \times 100 = 3.1\%$

P: $\frac{3.161 \text{ g}}{10.0006 \text{ g}} \times 100 = 31.6\%$

O: $\frac{6.531 \text{ g}}{10.0006 \text{ g}} \times 100 = 65.3\%$

continued on next page

⑧ H $\frac{3.1\text{ g}}{1\text{ g/mol}} = 3$

P $\frac{31.6\text{ g}}{31\text{ g/mol}} = 1$

O $\frac{67.3\text{ g}}{16\text{ g/mol}} = 4$

H_3PO_4

⑨ NO_2 46 g/mol

$\frac{92.02}{46} = 2$

N_2O_4

⑩ C_2H_3O 43 g/mol

$\frac{172}{43} = 4$

$C_8H_{12}O_4$

⑪ C_7H_9O 109 g/mol

$\frac{215}{109} = 2$

$C_{14}H_{18}O_2$

⑫ C: $\frac{74.1\text{ g}}{12\text{ g/mol}} = \frac{6.175}{1.236} = 5$

H: $\frac{8.6\text{ g}}{1.0\text{ g/mol}} = \frac{8.6}{1.236} = 7$

N: $\frac{17.3\text{ g}}{14\text{ g/mol}} = \frac{1.236}{1.236} = 1$

empirical C_5H_7N 81 g/mol

$\frac{160}{81} = 2$

$C_{10}H_{14}N_2$

(13) C: $\frac{59\ g}{12\ g/mol} = \frac{4.92}{0.55} = 9$

H: $\frac{7.1\ g}{1.0\ g/mol} = \frac{7.1}{0.55} = 13$

O: $\frac{26.2\ g}{16.0\ g/mol} = \frac{1.64}{0.55} = 3$

N: $\frac{7.7\ g}{14\ g/mol} = \frac{0.55}{0.55} = 1$

empirical $C_9H_{13}O_3N$ 183 g/mol

$\frac{180}{183} = 1$

molecular $C_9H_{13}O_3N$

E (14) Yes. see #13

(15) $H = 3C$ $C = 20$

so if O is 1, then C is 2 and H is 6

H_6C_2O