Balancing Equations - Practice Problems

Answers follow the problems.

1) Complete and/or balance the following reactions.

a) $FeS + O_2 \rightarrow Fe_3O_4 + SO_3$

b) $CO_2 + H_2O \rightarrow CH_4 + O_2$

c) $P_2O_5 + H_2O \rightarrow H_3PO_4$

d) $Cl_2 + CH_4 \rightarrow CHCl_3 + HCl$

e) $H_2SO_4 + Al(OH)_3 \rightarrow Al_2(SO_4)_3 + H_2O$

f) $NH_3 + O_2 \rightarrow NO + H_2O$

g) $H_2S + O_2 \rightarrow H_2O + SO_3$

h) $Pb(NO_3)_2 + H_3AsO_4 \rightarrow PbHAsO_4 + HNO_3$

i) $Na + H_2O \rightarrow$

j) $Li + N_2 \rightarrow$

k) $C + Cl_2 \rightarrow$

l) $CaCl_2 + (NH_4)_3PO_4 \rightarrow$

m) $C_3H_8O + O_2 \rightarrow$

n) $CaCl_2 + H_3PO_4 \rightarrow$

2) Write the formulas for the following compounds

a) Titanium(IV) Chloride
b) Tetraphosphorous decaoxide
c) Sodium Carbonate
d) Calcium Fluoride
e) Iron (III) Nitrate
f) Iodine Pentafluoride
g) Aluminum Hydroxide

3) Provide names for the following compounds

a) ZrO_2
b) $(NH_4)_3PO_4$
c) Na_2S
d) SeF_4
e) CCl_4
f) $CaCO_3$
g) Co_2O_3

4) Write the product formed and balance each reaction

a) $P + O_2$ ---->
b) $Mg + N_2$ ---->
c) $Sc + S_8$ ---->
d) $Li + N_2$ ---->
e) $N_2 + H_2$ ---->

5) Write the net ionic reaction that occurs when the following compounds are mixed.

Barium Nitrate and Ammonium Carbonate

Aluminum Nitrate and Sodium Hydroxide

Lead(II) Acetate and Potassium Iodide

Silver(I) Nitrate and Sodium Dichromate

Mercury(I) Perchlorate and Sodium Chloride

Ammonium Phosphate and Calcium Chloride

Phosphoric acid and Ammonium Hydroxide

6) Complete and balance the following reactions when the each compound is combusted with oxygen.

Fe_2S_3
NH_3
NaCN
CH_3SH
$AgCH_3CO_2$

7) When a 10.0 gram sample of an unknown organic acid is subjected to combustion analysis, 21.2 grams of CO_2 and 3.25 grams of H_2O are produced. What is the empirical formula of the oxygen-containing compound?

8) An 11.0 gram sample of a solid unknown was burned in oxygen producing 5.00 grams of water and 16.29 grams of carbon dioxide. What is the empirical formula of the oxygen-containing compound?

9) When a 15.0 gram sample of an acid is subjected to combustion analysis, 26.76 grams of carbon dioxide and 10.94 grams of water are formed. What is the empirical formula of the oxygen-containing compound?

10) A 15.25 gram sample of an organic acid was combusted in oxygen and produced 34.71 grams of carbon dioxide and 14.20 grams of water. What is the empirical formula of the oxygen-containing compound?

Balancing Equations - Practice Problems – Answers

1) Complete and/or balance the following reactions,

a) $6\ FeS + 1\ 3\ O_2 \rightarrow 2\ Fe_3O_4 + 6\ SO_3$

b) $CO_2 + 2\ H_2O \rightarrow CH_4 + 2\ O_2$

c) $P_2O_5 + 3\ H_2O \rightarrow 2\ H_3PO_4$

d) $3\ Cl_2 + CH_4 \rightarrow CHCl_3 + 3\ HCl$

e) $3\ H_2SO_4 + 2\ Al(OH)_3 \rightarrow Al_2(SO_4)_3 + 6\ H_2O$

f) $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

g) $H_2S + 2\ O_2 \rightarrow H_2O + SO_3$

h) $Pb(NO_3)_2 + H_3AsO_4 \rightarrow PbHAsO_4 + 2\ HNO_3$

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

j) $3\ Li + 2\ N_2 \rightarrow 2\ Li_3N$

k) $C + 2\ Cl_2 \rightarrow CCl_4$

l) $CaCl_2 + (NH_4)_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6\ NH_4Cl$

m) $2\ C_3H_8O + 9\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

n) $3\ CaCl_2 + 2\ H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6\ HCl$

2) Write the formulas for the following compounds

a)	Titanium(IV) Chloride	$TiCl_4$
b)	Tetraphosphorous decaoxide	P_4O_{10}
c)	Sodium Carbonate	Na_2CO_3
d)	Calcium Fluoride	CaF_2
e)	Iron(III) Nitrate	$Fe(NO_3)_3$
f)	Iodine Pentafluoride	IF_5
g)	Aluminum Hydroxide	$Al(OH)_3$

3) Provide names for the following compounds.

a)	ZrO_2	Zirconium(IV) Oxide
b)	$(NH_4)_3PO_4$	Ammonium Phosphate
c)	Na_2S	Sodium Sulfide
d)	SeF_4	Selenium Tetrafluoride
e)	CCl_4	Carbon Tetrachloride
f)	$CaCO_3$	Calcium Carbonate
g)	Co_2O_3	Cobalt(III) Oxide

4) Write the product formed and balance each reaction

a) $4\ P + 5\ O_2 \text{ ----> } 2\ P_2O_5$
b) $3\ Mg + N_2 \text{ ----> } Mg_3N_2$
c) $3\ Sc + 3/8\ S_8 \text{ ----> } Sc_2S_3$
d) $6\ Li + N_2 \text{ ----> } 2\ Li_3N$
e) $N_2 + 3\ H_2 \text{ ----> } 2\ NH_3$

5) Write the net ionic reaction that occurs when the following compounds are mixed.

Barium Nitrate and Ammonium Carbonate	$Ba^{2+} + CO_3^{2-} \text{ ----> } BaCO_3$
Aluminum Nitrate and Sodium Hydroxide	$Al^{3+} + 3\ OH^- \text{ ----> } Al(OH)_3$
Lead(II) Acetate and Potassium Iodide	$Pb^{2+} + 2\ I^- \text{ ----> } PbI_2$
Silver(I) Nitrate and Sodium Dichromate	$2\ Ag^+ + Cr_2O_7^{2-} \text{ ----> } Ag_2Cr_2O_7$
Mercury(I) Perchlorate and Sodium Chloride	$Hg_2^{2+} + 2\ Cl^- \text{ ----> } Hg_2Cl_2$
Ammonium Phosphate and Calcium Chloride	$3\ Ca^{2+} + 2\ PO_4^{3-} \text{ ----> } Ca_3(PO_4)_2$
Phosphoric acid and Ammonium Hydroxide	$H^+ + OH^- \text{ ----> } H_2O$

6) Complete and balance the following reactions when the each compound is combusted with oxygen.

$Fe_2S_3 + 6\ O_2 \text{ ----> } Fe_2O_3 + 3\ SO_3$
$2\ NH_3 + 4\ O_2 \text{ ----> } N_2O_5 + 3\ H_2O$
$2NaCN + 5\ O_2 \text{ ----> } Na_2O + 2\ CO_2 + N_2O_5$
$CH_3SH + 7/2\ O_2 \text{ ----> } CO_2 + 2\ H_2O + SO_3$
$2\ AgCH_3CO_2 + 4\ O_2 \text{ ----> } Ag_2O + 4\ CO_2 + 3\ H_2O$

7) When a 10.0 gram sample of an unknown organic acid is subjected to combustion analysis, 21.2 grams of CO_2 and 3.25 grams of H_2O are produced. What is the empirical formula of the oxygen-containing compound?

$\frac{21.2 \text{ g } CO_2}{44 \text{ g/mol}} = 0.4818 \text{ mol } CO_2 \Longrightarrow 0.4818 \text{ mol C}$

$\frac{3.25 \text{ g } H_2O}{18 \text{ g/mol}} = 0.1805 \text{ mol } H_2O \Longrightarrow 0.3610 \text{ mol H}$

$\frac{3.8574 \text{ g O}}{16 \text{ g/mol}} = 0.244 \text{ mol O}$

0.4818 mol C x 12 g/mol = 5.7816 g C

0.3610 mol H x 1 g/mol = 0.3610 g H

6.1426 g Total

10 g - 6.1426 g = 3.8574 g of oxygen

$\frac{0.4818 \text{ mol C}}{0.2440 \text{ mol O}} = \frac{2 \text{ C}}{1 \text{ O}}$ $\qquad$ $\frac{0.3610 \text{ mol H}}{0.2440 \text{ mol O}} = \frac{1.5 \text{ H}}{1 \text{ O}}$

The formula is $C_2H_{1.5}O$ but you cannot have a fraction so, $2(C_2H_{1.5}O) = C_4H_3O_2$

8) An 11.0 gram sample of a solid unknown was burned in oxygen producing 5.00 grams of water and 16.29 grams of carbon dioxide. What is the empirical formula of the oxygen-containing compound?

$\frac{16.29 \text{ g } CO_2}{44 \text{ g/mol}} = 0.3702 \text{ mol } CO_2 \Longrightarrow 0.3702 \text{ mol C}$

$\frac{5.00 \text{ g } H_2O}{18 \text{ g/mol}} = 0.2777 \text{ mol } H_2O \Longrightarrow 0.5556 \text{ mol H}$

$\frac{6.002 \text{ g O}}{16 \text{ g/mol}} = 0.3751 \text{ mol O}$

0.3702 mol C x 12 g/mol = 4.4424 g C

0.5556 mol H x 1 g/mol = 0.5556 g H

4.998 g Total

11 g - 4.998 g = 6.002 g of oxygen

$\frac{0.5556 \text{ mol H}}{0.3702 \text{ mol C}} = \frac{1.5 \text{ H}}{1 \text{ C}}$ $\qquad$ $\frac{0.3751 \text{ mol O}}{0.3702 \text{ mol C}} = \frac{1 \text{ O}}{1 \text{ C}}$

The formula is $CH_{1.5}O$ but you cannot have a fraction so, $2(CH_{1.5}O) = C_2H_3O_2$

9) When a 15.0 gram sample of an acid is subjected to combustion analysis, 26.76 grams of carbon dioxide and 10.94 grams of water are formed. What is the empirical formula of the oxygen-containing compound?

$\frac{26.76\text{ g } CO_2}{44\text{ g/mol}} = 0.6082\text{ mol } CO_2 \Longrightarrow 0.6082\text{ mol C}$

$0.6082\text{ mol C} \times 12\text{ g/mol} = 7.2984\text{ g C}$

$1.2160\text{ mol H} \times 1\text{ g/mol} = 1.2160\text{ g H}$

8.5144 g Total

$\frac{10.94\text{ g } H_2O}{18\text{ g/mol}} = 0.6080\text{ mol } H_2O \Longrightarrow 1.2160\text{ mol H}$

$15\text{ g} - 8.5144\text{ g} = 6.4856\text{ g of oxygen}$

$\frac{6.4856\text{ g O}}{16\text{ g/mol}} = 0.4050\text{ mol O}$

$\frac{0.6082\text{ mol C}}{0.4050\text{ mol O}} = \frac{1.5\text{ C}}{1\text{ O}}$ $\qquad$ $\frac{1.2160\text{ mol H}}{0.4050\text{ mol O}} = \frac{3\text{ H}}{1\text{ C}}$

The formula is $C_{1.5}H_3O$ but you cannot have a fraction so, $2(C_{1.5}H_3O) = C_3H_6O_2$

10) A 15.25 gram sample of an organic acid was combusted in oxygen and produced 34.71 grams of carbon dioxide and 14.20 grams of water. What is the empirical formula of the oxygen-containing compound?

$\frac{34.71\text{ g } CO_2}{44\text{ g/mol}} = 0.7889\text{ mol } CO_2 \Longrightarrow 0.7889\text{ mol C}$

$0.7889\text{ mol C} \times 12\text{ g/mol} = 9.4668\text{ g C}$

$1.5778\text{ mol H} \times 1\text{ g/mol} = 1.5778\text{ g H}$

11.0446 g Total

$\frac{14.20\text{ g } H_2O}{18\text{ g/mol}} = 0.7889\text{ mol } H_2O \Longrightarrow 1.5778\text{ mol H}$

$15.25\text{ g} - 11.0446\text{ g} = 4.2054\text{ g of oxygen}$

$\frac{4.2054\text{ g O}}{16\text{ g/mol}} = 0.2628\text{ mol O}$

$\frac{0.7889\text{ mol C}}{0.2628\text{ mol O}} = \frac{3\text{ C}}{1\text{ O}}$ $\qquad$ $\frac{1.5778\text{ mol H}}{0.2628\text{ mol O}} = \frac{6\text{ H}}{1\text{ C}}$

The formula is C_3H_6O.