

## Unit VII Answers

### Pg 266

1. A chemical reaction is process where one or more substances are changed into something new, something that has different chemical properties.
5.  $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$
6.  $C_3H_8(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$
7. The reaction uses manganese as a catalyst.
8. The + sign is used to represent "reacts with".
9. silicon tetrachloride + magnesium  $\rightarrow$  silicon + magnesium chloride;  $SiCl_4(g) + Mg(s) \rightarrow Si(s) + MgCl_2(s)$
10. magnesium + oxygen  $\rightarrow$  magnesium oxide;  $Mg(s) + O_2(g) \rightarrow MgO(s)$
17. a) Solid zinc reacts with a solution of hydrogen chloride to produce a solution of zinc chloride and hydrogen gas.  
b) Calcium chloride and sodium carbonate, both in water solution, react to form solid calcium carbonate and a solution of sodium chloride.  
c) A solution of sodium hydroxide reacts with a solution of hydrogen chloride to produce a solution containing sodium chloride and water.  
d) Heating solid calcium carbonate produces solid calcium oxide and carbon dioxide gas.

### Pg 274

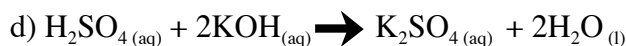
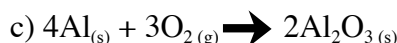
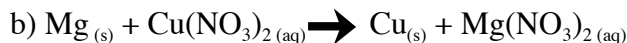
4. a) potassium chlorate  $\rightarrow$  potassium chloride and oxygen  $KClO_3 \rightarrow KCl + O_2$   $2KClO_3 \rightarrow 2KCl + 3O_2$   
b) silver and sulfur  $\rightarrow$  silver sulfide  $Ag + S_8 \rightarrow Ag_2S$   $16Ag + S_8 \rightarrow 8Ag_2S$   
c) sodium hydrogen carbonate  $\rightarrow$  sodium carbonate + carbon dioxide + water  
 $NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$   $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$
5. a)  $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$  b)  $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$   
c)  $3AgNO_3 + AlCl_3 \rightarrow 3AgCl + Al(NO_3)_3$  d)  $Ni(ClO_3)_2 \rightarrow NiCl_2 + 3O_2$
6. a)  $(NH_4)_2Cr_2O_7 \rightarrow Cr_2O_3 + N_2 + 4H_2O$  b)  $2NH_3 + 3CuO \rightarrow N_2 + 3Cu + 3H_2O$   
c)  $Na_2SiF_6 + 4Na \rightarrow Si + 6NaF$  d)  $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$
9.  $2H_2 + O_2 \rightarrow 2H_2O$  (2 mole)(2.02 g/mole) + 1 mole (31.998 g/mole) = 2 mole (18.02 g/mole)
10. The correct formula for chlorine is  $Cl_2$  not  $Cl_3$ .  $2Fe(s) + 3Cl_2(g) \rightarrow 2FeCl_3(s)$

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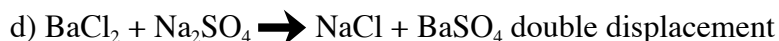
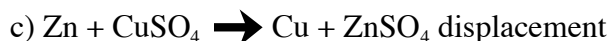
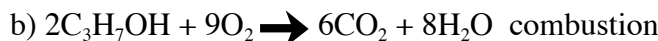
8. a)  $Cl_2(g) + 2NaBr(aq) \rightarrow 2NaCl(aq) + Br_2(l)$  displacement

- b)  $\text{CaO}_{(s)} + \text{H}_2\text{O}_{(l)} \rightarrow \text{Ca(OH)}_{2(aq)}$  synthesis
- c)  $\text{Ca(ClO}_3)_2_{(s)} \rightarrow \text{CaCl}_2_{(s)} + 3\text{O}_2_{(g)}$  decomposition
- d)  $2\text{AgNO}_3_{(aq)} + \text{K}_2\text{SO}_4_{(aq)} \rightarrow \text{Ag}_2\text{SO}_4_{(s)} + 2\text{KNO}_3_{(aq)}$  double displacement
- e)  $\text{Zn}_{(s)} + \text{CuBr}_2_{(aq)} \rightarrow \text{ZnBr}_2_{(aq)} + \text{Cu}_{(s)}$  displacement
- f)  $2\text{C}_8\text{H}_{18(l)} + 25\text{O}_2_{(g)} \rightarrow 16\text{CO}_2_{(g)} + 18\text{H}_2\text{O}_{(g)}$  combustion

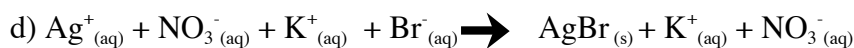
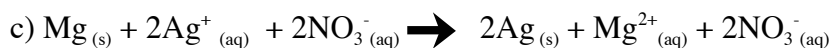
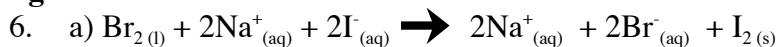
9. a) no reaction



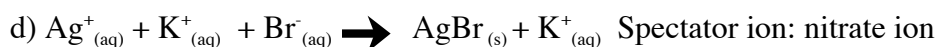
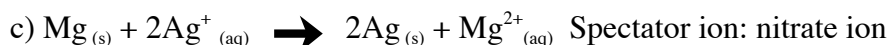
10. a)  $2\text{HgO} \rightarrow 2\text{Hg} + \text{O}_2$  decomposition



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7. a)  $\text{Br}_2_{(l)} + 2\text{I}^-_{(aq)} \rightarrow 2\text{Br}^-_{(aq)} + \text{I}_2_{(s)}$  Spectator ion: sodium ion



- e)  $\text{Ni}_{(s)} + \text{Pb}^{2+}_{(aq)} \rightarrow \text{Ni}^{2+}_{(aq)} + \text{Pb}_{(s)}$  Spectator ion: nitrate ion
- f)  $\text{Ca}_{(s)} + 2\text{H}_2\text{O}_{(l)} \rightarrow \text{Ca}^{2+} + 2\text{OH}^{-}_{(aq)} + \text{H}_{2(g)}$  Spectator ion: none
8. a)  $\text{Au}^{+3}_{(aq)} + 3\text{Cl}^{-}_{(aq)} + 3\text{Ag}_{(s)} \rightarrow \text{Au}_{(s)} + 3\text{AgCl}_{(s)}$
- b)  $2\text{Ag}^{+}_{(aq)} + 2\text{NO}_3^{-}_{(aq)} + \text{Ca}^{2+}_{(aq)} + 2\text{Cl}^{-}_{(aq)} \rightarrow 2\text{AgCl}_{(s)} + \text{Ca}^{2+}_{(aq)} + 2\text{NO}_3^{-}_{(aq)}$
- c)  $2\text{Al}_{(s)} + 3\text{Ni}^{2+}_{(aq)} + 3\text{SO}_4^{2-}_{(aq)} \rightarrow 3\text{Ni}_{(s)} + 2\text{Al}^{3+}_{(aq)} + 3\text{SO}_4^{2-}_{(aq)}$
- d)  $2\text{Na}_{(s)} + 2\text{H}_2\text{O}_{(l)} \rightarrow 2\text{Na}^{+}_{(aq)} + 2\text{OH}^{-}_{(aq)} + \text{H}_{2(g)}$
- e)  $\text{Ag}^{+}_{(aq)} + \text{NO}_3^{-}_{(aq)} + \text{Na}^{+}_{(aq)} + \text{Cl}^{-}_{(aq)} \rightarrow \text{AgCl}_{(s)} + \text{Na}^{+}_{(aq)} + \text{NO}_3^{-}_{(aq)}$
9. a)  $\text{Au}^{+3}_{(aq)} + 3\text{Cl}^{-}_{(aq)} + 3\text{Ag}_{(s)} \rightarrow \text{Au}_{(s)} + 3\text{AgCl}_{(s)}$  Spectator ion: none
- b)  $\text{Ag}^{+}_{(aq)} + \text{Cl}^{-}_{(aq)} \rightarrow \text{AgCl}_{(s)}$  Spectator ion: nitrate and calcium ions
- c)  $2\text{Al}_{(s)} + 3\text{Ni}^{2+}_{(aq)} \rightarrow 3\text{Ni}_{(s)} + 2\text{Al}^{3+}_{(aq)}$  Spectator ion: sulfate ion
- d)  $2\text{Na}_{(s)} + 2\text{H}_2\text{O}_{(l)} \rightarrow 2\text{Na}^{+}_{(aq)} + 2\text{OH}^{-}_{(aq)} + \text{H}_{2(g)}$  Spectator ion: none
- e)  $\text{Ag}^{+}_{(aq)} + \text{Cl}^{-}_{(aq)} \rightarrow \text{AgCl}_{(s)}$  Spectator ion: nitrate and sodium ions
10. a)  $2\text{Ag}^{+}_{(aq)} + 2\text{NO}_3^{-}_{(aq)} + 2\text{Na}^{+}_{(aq)} + \text{SO}_4^{2-}_{(aq)} \rightarrow 2\text{Na}^{+}_{(aq)} + 2\text{NO}_3^{-}_{(aq)} + \text{Ag}_2\text{SO}_4_{(s)}$
- b)  $2\text{Al}_{(s)} + 3\text{Ni}^{2+}_{(aq)} + 6\text{I}^{-}_{(aq)} \rightarrow 3\text{Ni}_{(s)} + 2\text{Al}^{3+}_{(aq)} + 6\text{I}^{-}_{(aq)}$
- c)  $2\text{K}^{+}_{(aq)} + \text{SO}_4^{2-}_{(aq)} + \text{Ca}^{2+}_{(aq)} + 2\text{Cl}^{-}_{(aq)} \rightarrow \text{CaSO}_4_{(s)} + 2\text{K}^{+}_{(aq)} + 2\text{Cl}^{-}_{(aq)}$
- d)  $\text{Mg}_{(s)} + \text{Cu}^{2+}_{(aq)} + 2\text{Br}^{-}_{(aq)} \rightarrow \text{Cu}_{(s)} + \text{Mg}^{2+}_{(aq)} + 2\text{Br}^{-}_{(aq)}$
- e)  $\text{Pb}^{2+}_{(aq)} + 2\text{NO}_3^{-}_{(aq)} + 2\text{Na}^{+}_{(aq)} + 2\text{Cl}^{-}_{(aq)} \rightarrow \text{PbCl}_2_{(s)} + 2\text{Na}^{+}_{(aq)} + 2\text{NO}_3^{-}_{(aq)}$
11. a)  $2\text{Ag}^{+}_{(aq)} + \text{SO}_4^{2-}_{(aq)} \rightarrow \text{Ag}_2\text{SO}_4_{(s)}$  Spectator ion: nitrate and sodium ions
- b)  $2\text{Al}_{(s)} + 3\text{Ni}^{2+}_{(aq)} \rightarrow 3\text{Ni}_{(s)} + 2\text{Al}^{3+}_{(aq)}$  Spectator ion: iodide ion
- c)  $\text{SO}_4^{2-}_{(aq)} + \text{Ca}^{2+}_{(aq)} \rightarrow \text{CaSO}_4_{(s)}$  Spectator ion: potassium and chloride ions
- d)  $\text{Mg}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow \text{Cu}_{(s)} + \text{Mg}^{2+}_{(aq)}$  Spectator ion: bromide ion
- e)  $\text{Pb}^{2+}_{(aq)} + 2\text{Cl}^{-}_{(aq)} \rightarrow \text{PbCl}_2_{(s)}$  Spectator ion: nitrate and sodium ions

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31. a)  $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$
- b)  $2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3$
- c)  $\text{Ba}(\text{ClO}_3)_2 \rightarrow \text{BaCl}_2 + 3\text{O}_2$
- d)  $3\text{Cu} + 8\text{HNO}_3 \rightarrow 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$
32. a)  $\text{Fe}_2\text{O}_3 + 3\text{Mg} \rightarrow 3\text{MgO} + 2\text{Fe}$
- b)  $3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$

- c)  $\text{SiCl}_4 + 2\text{H}_2\text{O} \rightarrow \text{SO}_2 + 4\text{HCl}$
33. a)  $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$
- c)  $2\text{C}_8\text{H}_{18} + 25\text{O}_2 \rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O}$
34. a)  $2\text{C}_3\text{H}_7\text{OH} + 9\text{O}_2 \rightarrow 6\text{CO}_2 + 8\text{H}_2\text{O}$
- c)  $2\text{Fe}(\text{OH})_3 \rightarrow 2\text{Fe}_2\text{O}_3 + 3\text{H}_2\text{O}$
35. a)  $\text{Zn} + \text{Pb}(\text{NO}_3)_2 \rightarrow \text{Pb} + \text{Zn}(\text{NO}_3)_2$
- c)  $\text{H}_2\text{C}_2\text{O}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{C}_2\text{O}_4 + 2\text{HOH}$
36. a)  $\text{CuSO}_4 + (\text{NH}_4)_2\text{S} \rightarrow \text{CuS} + (\text{NH}_4)_2\text{SO}_4$
- c)  $\text{Fe}(\text{NO}_3)_3 + 3\text{LiOH} \rightarrow 3\text{LiNO}_3 + \text{Fe}(\text{OH})_3$
37. a)  $2\text{Zn} + \text{O}_2 \rightarrow 2\text{ZnO}$
- c)  $\text{Cl}_2 + 2\text{K} \rightarrow 2\text{KCl}$
38. a)  $2\text{HgO} \rightarrow 2\text{Hg} + \text{O}_2$
- c)  $2\text{AgCl} \rightarrow 2\text{Ag} + \text{Cl}_2$
39. a)  $2\text{C}_3\text{H}_6 + 9\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$
- c)  $2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$
40. a)  $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$  combustion
- c)  $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$  synthesis
- e)  $\text{Ba}(\text{OH})_2 \rightarrow \text{BaO} + \text{H}_2\text{O}$  decomposition
46. a)  $\text{H}^+_{(\text{aq})} + \text{Cl}^-_{(\text{aq})} + \text{Na}^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})} \rightarrow \text{Na}^+_{(\text{aq})} + \text{Cl}^-_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})}$   
 $\text{H}^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})} \rightarrow \text{H}_2\text{O}_{(\text{l})}$
- b)  $\text{Mg}_{(\text{s})} + 2\text{H}^+_{(\text{aq})} + 2\text{Cl}^-_{(\text{aq})} \rightarrow \text{Mg}^{2+}_{(\text{aq})} + 2\text{Cl}^- + \text{H}_{2(\text{g})}$   
 $\text{Mg}_{(\text{s})} + 2\text{H}^+_{(\text{aq})} \rightarrow \text{Mg}^{2+}_{(\text{aq})} + \text{H}_{2(\text{g})}$
- c)  $\text{Cd}^{2+}_{(\text{aq})} + 2\text{Cl}^-_{(\text{aq})} + 2\text{Na}^+_{(\text{aq})} + \text{CO}_3^{2-}_{(\text{aq})} \rightarrow \text{CdCO}_{3(\text{s})} + 2\text{Na}^+_{(\text{aq})} + 2\text{Cl}^-_{(\text{aq})}$   
 $\text{Cd}^{2+}_{(\text{aq})} + \text{CO}_3^{2-}_{(\text{aq})} \rightarrow \text{CdCO}_{3(\text{s})}$
- d)  $\text{Mg}_{(\text{s})} + \text{Zn}^{2+}_{(\text{aq})} + 2\text{NO}_3^-_{(\text{aq})} \rightarrow \text{Zn}_{(\text{s})} + \text{Mg}^{2+}_{(\text{aq})} + 2\text{NO}_3^-_{(\text{aq})}$   
 $\text{Mg}_{(\text{s})} + \text{Zn}^{2+}_{(\text{aq})} \rightarrow \text{Zn}_{(\text{s})} + \text{Mg}^{2+}_{(\text{aq})}$
47. a) sodium and chloride ions      b) chloride ion      c) sodium and chloride ions      d) nitrate ion
- d)  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \rightarrow \text{N}_2 + \text{Cr}_2\text{O}_3 + 4\text{H}_2\text{O}$
- b)  $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
- d)  $2\text{Al} + 3\text{F}_2 \rightarrow 2\text{AlF}_3$
- b)  $2\text{Al} + 3\text{Fe}(\text{NO}_3)_2 \rightarrow 2\text{Al}(\text{NO}_3)_3 + 3\text{Fe}$
- d)  $2\text{PbO}_2 \rightarrow 2\text{PbO} + \text{O}_2$
- b)  $\text{NH}_4\text{CH}_3\text{COO} + \text{AgNO}_3 \rightarrow \text{NH}_4\text{NO}_3 + \text{AgCH}_3\text{COO}$
- d)  $2\text{Al} + 3\text{CuSO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + 3\text{Cu}$
- b)  $2\text{HNO}_3 + \text{Ba}(\text{OH})_2 \rightarrow \text{Ba}(\text{NO}_3)_2 + 2\text{HOH}$
- d)  $3\text{BaCl}_2 + 3\text{H}_3\text{PO}_4 \rightarrow \text{Ba}_3(\text{PO}_4)_2 + 6\text{HCl}$
- b)  $\text{F}_2 + \text{Mg} \rightarrow \text{MgF}_2$
- d)  $\text{H}_2 + \text{I}_2 \rightarrow 2\text{HI}$
- b)  $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
- d)  $2\text{KOH} \rightarrow \text{K}_2\text{O} + \text{H}_2\text{O}$
- b)  $\text{C}_5\text{H}_{12} + 8\text{O}_2 \rightarrow 5\text{CO}_2 + 6\text{H}_2\text{O}$
- d)  $\text{C}_{12}\text{H}_{22}\text{O}_{11} + 12\text{O}_2 \rightarrow 12\text{CO}_2 + 11\text{H}_2\text{O}$
- b)  $\text{CuCl}_2 \rightarrow \text{Cu} + \text{Cl}_2$  decomposition
- d)  $\text{Na}_2\text{CO}_3 \rightarrow \text{Na}_2\text{O} + \text{CO}_2$  decomposition
- f)  $\text{C}_2\text{H}_5 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$  combustion

48. a)  $\text{CO}_3^{2-}(\text{aq}) + \text{Ca}^{2+}(\text{aq}) \rightarrow \text{CaCO}_3(\text{s})$       b)  $\text{SO}_4^{2-}(\text{aq}) + 2\text{Ag}^+(\text{aq}) \rightarrow \text{Ag}_2\text{SO}_4(\text{s})$   
 c)  $\text{Cl}^-(\text{aq}) + \text{Ag}^+(\text{aq}) \rightarrow \text{AgCl}(\text{s})$       d) No Reaction
51. a)  $\text{CaH}_2(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq}) + 2\text{H}_2(\text{g})$       b)  $\text{CH}_3\text{CH}_2\text{CCH}(\text{g}) + 2\text{Br}_2(\text{l}) \rightarrow \text{CH}_3\text{CH}_2\text{CHBr}_2(\text{l})$   
 c)  $\text{Pb}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Pb}(\text{OH})_2(\text{s})$       d)  $3\text{NO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2\text{HNO}_3(\text{aq}) + \text{NO}(\text{g})$
52. a)  $\text{H}_2 + \text{I}_2 \rightarrow 2\text{HI}$  synthesis      b)  $2\text{Li} + 2\text{HOH} \rightarrow 2\text{LiOH} + \text{H}_2$  displacement  
 c)  $2\text{HgO} \rightarrow 2\text{Hg} + \text{O}_2$  decomposition      d)  $\text{Cu} + \text{Cl}_2 \rightarrow \text{CuCl}_2$  synthesis
53. a)  $\text{H}_2\text{O}(\text{g}) + \text{C}(\text{s}) \rightarrow \text{CO}(\text{g}) + \text{H}_2(\text{g})$       b)  $\text{NH}_4\text{NO}_3(\text{aq}) \rightarrow \text{N}_2\text{O}(\text{g}) + 2\text{H}_2\text{O}(\text{l})$   
 c)  $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
54. a)  $\text{CO}(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{CH}_3\text{OH}(\text{l})$       b)  $2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$
55. a) not possible, nickel is below magnesium in the activity series  
 b) possible, magnesium is above aluminum in the activity series  
 c) not possible, lead does not react with water
56. The correct equation is “b”. In “a” the formula for chlorine is incorrect and in “c” the formula for iron (III) chloride is incorrect.
57. a)  $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$       b)  $\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$   
 c)  $\text{Pt} + 2\text{F}_2 \rightarrow \text{PtF}_4$       d)  $\text{Zn} + \text{Pb}(\text{NO}_3)_2 \rightarrow \text{Pb} + \text{Zn}(\text{NO}_3)_2$
58. a)  $\text{Li}_2\text{CO}_3(\text{aq}) + \text{BaBr}_2(\text{aq}) \rightarrow \text{BaCO}_3(\text{s}) + 2\text{LiBr}(\text{aq})$   
 $2\text{Li}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) + \text{Ba}^{2+}(\text{aq}) + 2\text{Br}^-(\text{aq}) \rightarrow \text{BaCO}_3(\text{s}) + 2\text{Li}^+(\text{aq}) + 2\text{Br}^-(\text{aq})$   
 $\text{CO}_3^{2-}(\text{aq}) + \text{Ba}^{2+}(\text{aq}) \rightarrow \text{BaCO}_3(\text{s})$   
 b)  $\text{Na}_2\text{SO}_4(\text{aq}) + \text{Sr}(\text{NO}_3)_2(\text{aq}) \rightarrow \text{SrSO}_4(\text{s}) + 2\text{NaNO}_3(\text{aq})$   
 $2\text{Na}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) + \text{Sr}^{2+}(\text{aq}) + 2\text{NO}_3^-(\text{aq}) \rightarrow \text{SrSO}_4(\text{s}) + 2\text{Na}^+(\text{aq}) + 2\text{NO}_3^-(\text{aq})$   
 $\text{SO}_4^{2-}(\text{aq}) + \text{Sr}^{2+}(\text{aq}) \rightarrow \text{SrSO}_4(\text{s})$   
 c)  $2\text{Al}(\text{s}) + 3\text{NiCl}_2(\text{aq}) \rightarrow 3\text{Ni}(\text{s}) + 2\text{AlCl}_3(\text{aq})$   
 $2\text{Al}(\text{s}) + 3\text{Ni}^{2+}(\text{aq}) + 6\text{Cl}^-(\text{aq}) \rightarrow 3\text{Ni}(\text{s}) + 2\text{Al}^{3+}(\text{aq}) + 6\text{Cl}^-(\text{aq})$   
 $2\text{Al}(\text{s}) + 3\text{Ni}^{2+}(\text{aq}) \rightarrow 3\text{Ni}(\text{s}) + 2\text{Al}^{3+}(\text{aq})$   
 d)  $3\text{K}_2\text{CO}_3(\text{aq}) + 2\text{FeCl}_3(\text{aq}) \rightarrow 6\text{KCl}(\text{aq}) + \text{Fe}_2(\text{CO}_3)_3(\text{s})$   
 $6\text{K}^+(\text{aq}) + 3\text{CO}_3^{2-}(\text{aq}) + 2\text{Fe}^{3+}(\text{aq}) + 6\text{Cl}^-(\text{aq}) \rightarrow 6\text{K}^+(\text{aq}) + 6\text{Cl}^-(\text{aq}) + \text{Fe}_2(\text{CO}_3)_3(\text{s})$   
 $3\text{CO}_3^{2-}(\text{aq}) + 2\text{Fe}^{3+}(\text{aq}) \rightarrow \text{Fe}_2(\text{CO}_3)_3(\text{s})$
59. a)  $\text{Li}^+$  and  $\text{Br}^-$       b)  $\text{Na}^+$  and  $\text{NO}_3^-$       c)  $\text{Cl}^-$       d)  $\text{K}^+$  and  $\text{Cl}^-$

60. a) The formula of the product is incorrect:  $4\text{Li} + \text{O}_2 \rightarrow 2\text{Li}_2\text{O}$
- b) A ternary compound does not break into its elements. Carbonates decompose to form carbon dioxide  
 $\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$
- c) Chlorine atoms are not balanced and iodine is diatomic.  $2\text{NaI} + \text{Cl}_2 \rightarrow 2\text{NaCl} + \text{I}_2$
- d) The formulas for the products are incorrect.  $2\text{AgNO}_3 + \text{CaCl}_2 \rightarrow 2\text{AgCl} + \text{Ca}(\text{NO}_3)_2$
- e) Magnesium should take the place of iron in the compound  $3\text{Mg} + 2\text{FeBr}_3 \rightarrow 2\text{Fe} + 3\text{MgBr}_2$
73. fluorine            74. 20 pm
75. The bond length of a single bond with hydrogen increases down the halogen group.
76. The size of a halogen atom increases down the group. Fluorine is the smallest atom and iodine the largest of the four.

**Pg 311**

4. a) 5.48 mole BrCl            b) 780.0 g BrCl            c) 18.3 ml Br<sub>2</sub> d)  $1.20 \times 10^4$  g Br<sub>2</sub>
5. a) 1.42 mole CO<sub>2</sub>            b) 47.2 ml CO<sub>2</sub>

**Pg 319**

7. a)  $\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_4$             b) 138.1 g H<sub>3</sub>PO<sub>4</sub>            c) 91.4%
8. TiCl<sub>4</sub> is limiting; 3.5 mole TiO<sub>2</sub> and 7.0 mole Cl<sub>2</sub> are produced; 1.0 mole O<sub>2</sub> is left over
9. 3.70 g Cu            10. 93.8%
11. a)  $\text{Mg} + 2\text{HOH} \rightarrow \text{Mg}(\text{OH})_2 + \text{H}_2$             b) 86.8%            c) 55 g Mg(OH)<sub>2</sub>
12. a) CuO is limiting            b) 94.3%            c) 15.0 g Cu

**Pgs 329-334**

6. The balanced chemical equation relates the relative amounts of the reactants and products in moles. To determine the amounts of substances one needs to use the coefficients of the balanced equation.
7. The mole ratio indicated by the coefficients in the balanced equation.
8. The purpose is to change the formula, the kind of substance.
9. The coefficients give the mole ratio of the balanced equation. This ratio is needed to determine the amount of one substance that will react or produce the required amount of another substance.
27. a) 6.6 mole H<sub>2</sub>            b) 3.36 mole O<sub>2</sub>            c) 8.12 mole H<sub>2</sub>
28. a)  $1.63 \times 10^3$  mole H<sub>2</sub>O            b)  $2.90 \times 10^3$  mole N<sub>2</sub>H<sub>4</sub>            c)  $6.39 \times 10^3$  mole N<sub>2</sub>
29. a) 1.08 mole O<sub>2</sub>            b) 2.62 mole Al<sub>2</sub>O<sub>3</sub>            c) 1.99 mole Al<sub>2</sub>O<sub>3</sub>

30. a) 273 g H<sub>2</sub>O                      b) 58.1 g CaC<sub>2</sub>                      c) 269 g H<sub>2</sub>O
31. a) 49.0 g O<sub>2</sub>                      b) 748 g KClO<sub>3</sub>                      c) 12.7 g KCl
32. 73.3 g Al<sub>2</sub>O<sub>3</sub>                      33. 107 g O<sub>2</sub>
34. a) 1.68 L O<sub>2</sub>                      b) 0.153 g KClO<sub>3</sub>                      c) 1.51 x 10<sup>4</sup> mL O<sub>2</sub>
35. a) 113 L O<sub>2</sub>                      b) 25 L O<sub>2</sub>                      c) 7.41 L O<sub>2</sub>
36. a) 1.34 x 10<sup>24</sup> molecules NO<sub>2</sub>    b) 9.67 x 10<sup>23</sup> molecules NO                      c) 1.88 x 10<sup>23</sup> molecules O<sub>2</sub>
37. a) 4.61 x 10<sup>23</sup> molecules H<sub>2</sub>    b) 4.31 x 10<sup>23</sup> atoms Na                      c) 3.30 x 10<sup>23</sup> molecules H<sub>2</sub>
38. a) excess, O<sub>2</sub>; limiting NO                      b) 4.0 mole NO<sub>2</sub>
39. a) excess, H<sub>2</sub>O; limiting CaC<sub>2</sub>    b) 26 g C<sub>2</sub>H<sub>2</sub>                      c) 74 g Ca(OH)<sub>2</sub>
40. a) excess, H<sub>2</sub>; limiting N<sub>2</sub>                      b) 34 g NH<sub>3</sub>                      c) 22 g H<sub>2</sub>
41. 75.6%
54. a) 1.2 x 10<sup>2</sup> g CO<sub>2</sub>                      b) 9.70 mL H<sub>2</sub>O                      c) 4.49 x 10<sup>22</sup> molecules H<sub>2</sub>O
55. a)  $\frac{2 \text{ mole NaN}_3}{2 \text{ mole Na}}$                        $\frac{2 \text{ mole NaN}_3}{3 \text{ mole N}_2}$                        $\frac{2 \text{ mole Na}}{2 \text{ mole NaN}_3}$      $\frac{2 \text{ mole Na}}{3 \text{ mole N}_2}$      $\frac{3 \text{ mole N}_2}{2 \text{ mole NaN}_3}$      $\frac{3 \text{ mole N}_2}{2 \text{ mole Na}}$
- b) 4.0 mole N<sub>2</sub>                      c) 11.0 g Na                      d) 4.86 x 10<sup>23</sup> molecules N<sub>2</sub>
56. a) NO                      b) 84 g NO<sub>2</sub>                      c) 37%
57. 1.44 L N<sub>2</sub>                      58. 8.6 x 10<sup>3</sup> g HNO<sub>3</sub>                      59. 1.74 x 10<sup>3</sup> g CO<sub>2</sub>

### Pg 611

- Oxidation is the loss of electrons, reduction is the gain of electrons LEO the lion says GER.
  - If the oxidation number of an element changes it is a redox reaction.
  - The half reactions show the electron change. To balance an equation the number of electrons lost must equal the number of electrons gained. Writing half reactions helps to determine the electron transfer.
  - The number of electrons lost must be equal to the number gained.
  - An oxidizing agent is something that takes electrons away from another substance, in the process it is reduced. A reducing agent is something that gives electrons to another substance, in the process it is oxidized.
6. a) H=+1, S=+4, O=-2    b) Cl=0                      c) S=+6, F=-1                      d) N=+5, O=-2
7. a) C=-4, H=+1                      b) H=+1, S=+4, O=-2    c) Na=+1, H=+1, O=-2                      d) Na=+1, Bi=+5, O=-2

8.  $\text{CrO}_3 +6$ ,  $\text{CrO} +2$ ,  $\text{Cr}_{(s)} 0$ ,  $\text{CrO}_2 +4$ ,  $\text{Cr}_2\text{O}_3 +3$ ,  $\text{Cr}_2\text{O}_7^{2-} +6$ ,  $\text{CrO}_4^{2-} +6$
9. a) not redox  
 b) O is oxidized (from  $-2$  to  $0$ ),  $\text{NO}_3^-$  is the reducing agent, N is reduced (from  $+5$  to  $+3$ )  $\text{NO}_3^-$  is the oxidizing agent  
 c) H is oxidized (from  $0$  to  $+1$ )  $\text{H}_2$  is the reducing agent, Cu is reduced (from  $+2$  to  $0$ )  $\text{Cu}^{2+}$  is the oxidizing agent  
 d) not redox  
 e) H is oxidized (from  $0$  to  $+1$ )  $\text{H}_2$  is the reducing agent, Cl is reduced (from  $0$  to  $-1$ )  $\text{Cl}_2$  is the oxidizing agent  
 f) not redox
10. a)  $6\text{Cl}^-_{(aq)} + \text{Cr}_2\text{O}_7^{2-}_{(aq)} + 14\text{H}_3\text{O}^+_{(aq)} \rightarrow 3\text{Cl}_{2(g)} + 2\text{Cr}^{3+}_{(aq)} + 21\text{H}_2\text{O}_{(l)}$   
 b)  $\text{Cu}_{(s)} + 2\text{Ag}^+_{(aq)} \rightarrow \text{Cu}^{2+}_{(aq)} + 2\text{Ag}_{(s)}$   
 c)  $\text{Br}_{2(l)} + 2\text{I}^-_{(aq)} \rightarrow 2\text{Br}^-_{(aq)} + \text{I}_{2(s)}$   
 d)  $2\text{I}^-_{(aq)} + 2\text{NO}_2^-_{(aq)} + 4\text{H}_3\text{O}^+_{(aq)} \rightarrow \text{I}_{2(s)} + 2\text{NO}_{(g)} + 6\text{H}_2\text{O}_{(l)}$
11. a) Cl is oxidized,  $\text{Cl}^-$  is the reducing agent. Cr is reduced,  $\text{Cr}_2\text{O}_7^{2-}$  is the oxidizing agent.  
 b) Cu is oxidized, Cu is the reducing agent. Ag is reduced,  $\text{Ag}^+$  is the oxidizing agent  
 c) I is oxidized, I is the reducing agent. Br is reduced,  $\text{Br}_2$  is the oxidizing agent.  
 d) I is oxidized, I is the reducing agent. N is reduced,  $\text{NO}_2^-$  is the oxidizing agent.

### Pg 615

- The potential difference or electromotive force is measured in volts.
- A voltage is needed for electrons to move from one place to another.
- Anode – attracts anions, where oxidation occurs; Cathode – attracts cations, where reduction occurs; wires are the path for electrons; the electrolyte is the path for the ions; salt bridge to keep electrolytes from mixing.
- See #3
- No light, the electrons would be pushed against each other.
- The flashlight would probably work (if it is not an LED flashlight), the path of the electrons would be reversed.

### Pg 624

- Zinc will corrode the easiest because it has the most negative electrode potential
- +1.136 volts                      6. +0.066 volts



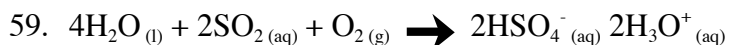
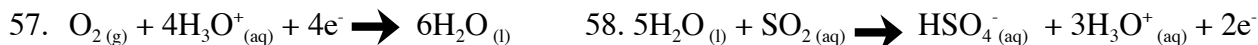
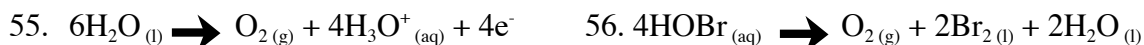
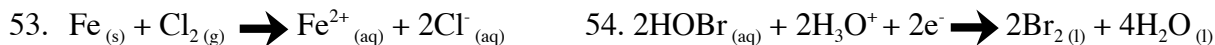
7.  $\text{Pb}_{(s)} + \text{PbO}_{2(s)} + 2\text{H}_3\text{O}^+_{(aq)} + 2\text{HSO}_4^-_{(aq)} \rightarrow 2\text{PbSO}_{4(s)} + 4\text{H}_2\text{O}_{(l)}$  Sulfuric acid is consumed and water is produced so the sulfuric acid concentration decreases as the battery is discharged. As the concentration of sulfuric acid decreases so does the density so the charge level is indicated by the density of the solution.

**Pgs 634-638**

39. C=+4, O=-2      40. Co=+2, O=-2      41. Ba=+2, Cl=-1      42. K=+1, S=+6, O=-2      43. S=-2

44. La=+3      45. C=-4, H=+1      46. N=-3, H=+1      47. Ca=+2, C=+4, O=-2

48. Pt=+4, Cl=-1      49. C=+4, O=-2, Cl=-1      50. P=+5, O=-2



61. +0.85 volts      63. 0.222 volts      64. +1.174 volts      65. 1.229 volts