Name _____ Date _____ Section _____

Solving Problems in Chemistry (SPIC) Chapter 9: Chemical Reactions (Tan Edition)

Chapter 9 Review Problems

Balance the following reactions. Use the Activity Series to determine if the single replacement reactions will indeed occur.

1. $HgO\ (cr) \rightarrow Hg\ (l) + O_2\ (g)$
2. $H_2O\ (l) \rightarrow H_2\ (g) + O_2\ (g)$
3. $Al\ (cr) + Pb(NO_3)_2\ (aq) \rightarrow Al(NO_3)_3\ (aq) + Pb\ (cr)$
4. $Cu\ (cr) + AgNO_3\ (aq) \rightarrow Cu(NO_3)_2\ (aq) + Ag\ (cr)$
5. $K\ (cr) + H_2O\ (l) \rightarrow KOH\ (aq) + H_2\ (g)$
6. $MnO_2\ (cr) + HCl\ (aq) \rightarrow MnCl_2\ (aq) + Cl_2\ (g) + H_2O\ (l)$
7. $Cl_2\ (g) + LiI\ (aq) \rightarrow LiCl\ (aq) + I_2\ (g)$
8. $F_2\ (g) + H_2O\ (l) \rightarrow HF\ (aq) + O_3\ (g)$
9. $AgNO_3\ (aq) + K_2SO_4\ (aq) \rightarrow Ag_2SO_4\ (aq) + KNO_3\ (aq)$
10. $NH_3\ (g) + O_2\ (g) \rightarrow N_2O_4\ (g) + H_2O\ (g)$

Write a balanced equation and indicate the reaction type (single SD or double displacement DD, decomposition DEC, synthesis SYN, or combustion CB) for each of the following reactions.

___ 11. aluminum nitrate (aq) + sodium hydroxide (aq) → aluminum hydroxide (cr) + sodium nitrate (aq)
___ 12. sulfur trioxide (g) → sulfur dioxide (g) + oxygen (g)
___ 13. phosphoric acid (aq) + magnesium hydroxide (aq) → magnesium phosphate (cr) + water
___ 14. ammonium nitrite (cr) → nitrogen (g) + water (l)
___ 15. ammonia (g) + oxygen (g) → nitrogen (II) oxide (g) + water (g)
___ 16. barium chloride (aq) + sodium sulfate (aq) → sodium chloride (aq) + barium sulfate (cr)
___ 17. iron (III) oxide (cr) + carbon monoxide (g) → iron (cr) + carbon dioxide (g)
___ 18. magnesium hydroxide (aq) + ammonium phosphate (aq) → magnesium phosphate (cr) + ammonia (g) + water (l)
___ 19. aluminum (cr) + copper (II) chloride (aq) → aluminum chloride (aq) + copper (cr)
___ 20. iron (cr) + silver acetate (aq) → iron (II) acetate (aq) + silver (cr)

Balance each of the following reactions after predicting the products. Use the Activity Series to determine if the single replacement reactions will indeed occur.

21. magnesium hydroxide (aq) + phosphoric acid (aq) →
22. iron (II) sulfide (cr) + hydrochloric acid (aq) →
23. ammonium sulfide (aq) + iron (II) nitrate (aq) →
24. sulfuric acid (aq) + potassium hydroxide →
25. aluminum sulfate (aq) + calcium phosphate (cr) →
26. barium carbonate (cr) + hydrochloric acid (aq) →
27. silver acetate (aq) + potassium chromate (aq) →

Activity of Metals

Li, Rb, K, Ca, Ba, Sr, Ca, Na	react with cold H_2O and acids, replacing hydrogen; react with oxygen, forming oxides
Mg, Al, Mn, Zn, Cr, Fe, Cd	react with steam (but not cold water) and acids; replacing hydrogen; react with oxygen, forming oxides
Co, Ni, Sn, Pb	do not react with water; react with acids, replacing hydrogen; react with oxygen, forming oxides
H_2, Sb, Bi, Cu, Hg	react with oxygen, forming oxides
Ag, Pt, Au	fairly unreactive, forming oxides only indirectly

Activity of Halogens

F_2
Cl_2
Br_2
I_2

28. ammonium phosphate (aq) + barium hydroxide (aq) →
29. chromium (III) sulfite (aq) + sulfuric acid (aq) →
30. calcium hydroxide (aq) + nitric acid (aq) →

31. In a series of steps in an experiment, copper metal is converted into various compounds and then back to copper metal by treating the original copper stepwise with nitric acid, sodium hydroxide, heat, sulfuric acid, and zinc metal. Write the five equations representing these chemical changes if the overall experiment can be represented as:
$Cu \rightarrow Cu(NO_3)_2 \rightarrow Cu(OH)_2 \rightarrow CuO \rightarrow CuSO_4 \rightarrow Cu$

32. One type of fire extinguisher contains concentrated sulfuric acid that reacts with a solution to produce carbon dioxide. What solution, a sodium hydrogen carbonate or sodium carbonate, would give the greater amount of carbon dioxide in a reaction with the same amount of acid?

33. If iron pyrite, FeS, is not removed from coal, oxygen from the air will combine with both the iron and the sulfur as the coal burns. Write a balanced chemical equation illustrating the formation of iron (III) oxide and sulfur dioxide.

34. Sodium sulfite, Na_2SO_3, can be used for the removal of SO_2 produced as a by-product in manufacturing operations. The SO_2 reacts with a sodium sulfite solution to form sodium hydrogen sulfite. The $NaHSO_3$ solution is heated to regenerate the original sodium sulfite for reuse. Write the equation for this reaction.

TABLE A-12 SOLUBILITY CHART

	acetate	bromide	carbonate	chlorate	chloride	chromate	hydroxide	iodine	nitrate	oxide	phosphate	silicate	sulfate	sulfide
aluminum	S	S	—	S	S	—	A	S	S	a	A	I	S	d
ammonium	S	S	S	S	S	S	S	S	S	—	S	—	S	S
barium	S	S	P	S	S	A	S	S	S	S	A	S	a	d
calcium	S	S	P	S	S	S	S	S	S	P	P	P	S	S
copper(II)	S	S	—	S	S	—	A	—	S	A	A	A	S	A
hydrogen	S	S	—	S	S	—	—	S	S	S	S	I	S	S
iron(II)	—	S	P	S	S	—	A	S	S	A	A	—	S	A
iron(III)	—	S	—	S	S	A	A	S	S	A	P	—	P	d
lead(II)	S	S	A	S	S	A	P	P	S	P	A	A	P	A
magnesium	S	S	P	S	S	S	A	S	S	A	P	A	S	d
manganese(II)	S	S	P	S	S	—	A	S	S	A	P	I	S	A
mercury(I)	P	A	A	S	a	P	—	A	S	A	A	—	P	I
mercury(II)	S	S	—	S	S	P	A	P	S	P	A	—	d	I
potassium	S	S	S	S	S	S	S	S	S	S	S	S	S	S
silver	P	a	A	S	a	P	—	I	S	P	A	—	P	A
sodium	S	S	S	S	S	S	S	S	S	d	S	S	S	S
strontium	S	S	P	S	S	P	S	S	S	S	A	A	P	S
tin(II)	d	S	—	S	S	A	A	S	d	A	A	—	S	A
tin(IV)	S	S	—	—	S	S	P	d	—	A	—	—	S	A
zinc	S	S	P	S	S	P	A	S	S	P	A	A	S	A

S = soluble in water. A = soluble in acids, insoluble in water. P = partially soluble in water, soluble in dilute acids.
I = insoluble in dilute acids and in water. a = slightly soluble in acids, insoluble in water. d = decomposes in water.

Holt: Modern Chemistry 2009 Appendix A p. 860.