1. What factors determine the rate of a chemical reaction?

2. What is the role of a catalyst in a chemical reaction?

3. Sketch a simple energy diagram for an exothermic reaction?

4. Sketch a simple energy diagram for an endothermic reaction?

5. When sodium hydrogen carbonate (sodium bicarbonate) $NaHCO_3$ is heated strongly in a test tube, carbon dioxide gas, CO_2, water vapor, H_2O, are evolved from the test tube, leaving a residue of sodium carbonate, Na_2CO_3.

a) The reactant(s) for this reaction are:

b) The product(s) for this reaction are:

6. Boric acid, H_3BO_3, is produced by treating borax ($Na_2B_4O_7$) with aqueous sulfuric acid and water. Sodium sulfate is a by-product of this process.

a) The reactant(s) for this reaction are:

b) The product(s) for this reaction are:

7. When sulfuric acid is added to ordinary table sugar (sucrose), $C_{12}H_{22}0_{11}$, a long black snake of elemental carbon forms, with the release of a cloud of steam (water vapor).

a) The reactant(s) of this reaction are:

b) The product(s) of this reaction are:

8. Balance each of the following chemical equations.

a) $FeCl_3(aq) + KOH(aq) \rightarrow Fe(OH)_3(s) + KCl(aq)$

b) $Pb(C_2H_3O_2)_2(aq) + KI(aq) \rightarrow PbI_2(s) + KC_2H_3O_2(aq)$

c) $P_4O_{10}(s) + H_2O(l) \rightarrow H_3PO_4(aq)$

d) $Li_2O(s) + H_2O(l) \rightarrow LiOH(aq)$

e) $Sb(s) + Cl_2(g) \rightarrow SbCl_3(s)$

f) $CH_4(g) + H_2O(g) \rightarrow CO(g) + H_2(g)$

g) $FeS(s) + HCl(aq) \rightarrow FeCl_2(aq) + H_2S(g)$

h) $NH_3(l) + H_2O(l) \rightarrow NH_4OH(aq)$

i) $H_2SO_4(aq) + NaHCO_3(aq) \rightarrow Na_2SO_4(aq) + CO_2(g) + H_2O(l)$

j) $FeCl_3(aq) + KI(aq) \rightarrow Fe(I_3)_2(aq) + FeI_2(aq) + KCl(aq)$

9. Classify the following chemical reactions in as many ways as possible.

a) $FeCl_3(aq) + 3\ KOH(aq) \rightarrow Fe(OH)_3(s) + 3\ KCl(aq)$

b) $Pb(C_2H_3O_2)_2(aq) + 2\ KI(aq) \rightarrow PbI_2(s) + 2\ KC_2H_3O_2(aq)$

c) $P_4O_{10}(s) + 6\ H_2O(l) \rightarrow 4\ H_3PO_4(aq)$

d) $Li_2O(s) + H_2O(l) \rightarrow 2\ LiOH(aq)$

e) $MnO_2(s) + C(s) \rightarrow Mn(s) + CO_2(g)$

f) $2\ Sb(s) + 3\ Cl_2(g) \rightarrow 2\ SbCl_3(s)$

g) $HNO_3 + KOH \rightarrow KNO_3 + H_2O$

h) $FeS(s) + 2\ HCl(aq) \rightarrow FeCl_2(aq) + H_2S(g)$

i) $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

j) $2\ H_2O_2 \rightarrow 2\ H_2O + O_2$

k) $CH_4(g) + H_2O(g) \rightarrow CO(g) + 3\ H_2(g)$

l) $4\ FeCl_3(aq) + 12\ KI(aq) \rightarrow Fe(I_3)_2(aq) + 3\ FeI_2(aq) + 12\ KCl(aq)$

10. Evaluate the following aqueous double displacement reactions:

a) Aqueous solutions of ammonium hydroxide and copper (II) sulfate

i. Predict the products and their physical state (using a table of solubility)

ii. Write down the balanced chemical equation for the reaction

b) Aqueous solutions of barium chloride and copper(II) sulfate

i. Predict the products and their physical state (using a table of solubility)

ii. Write down the balanced chemical equation for the reaction

c) Aqueous solutions of silver nitrate and aluminum chloride

i. Predict the products and their physical state (using a table of solubility)

ii. Write down the balanced chemical equation for the reaction

d) Aqueous solutions of sodium hydroxide and hydrochloric acid are combined in a test tube.

i. Predict the products and their physical state (using a table of solubility)

ii. Write down the balanced chemical equation for the reaction