AP exam question # 3 NAME_____

These questions were taken from the 2006-2009 free response sections of the AP exam. If the question requires problem solving, please show your work and express your answer with the correct number of significant figures. If the question requires you to explain something, please do so in clear concise sentences using appropriate chemical principles.

Write the formulas to show the reactants and products for each reaction. All reactants are in aqueous solution unless otherwise indicated. Represent substances in solution as ions if the substance is extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. In all cases a reaction occurs. You must balance the equations in lowest possible whole number ratios.

2008

A) Solid strontium hydroxide is added to a solution of nitric acid.

$Sr(OH)_2(s) + 2HNO_3(aq) \rightarrow 2H_2O(l) + Sr(NO_3)_2(aq)$

$Sr(OH)_2(s) + 2H^+(aq) \rightarrow 2H_2O(l) + Sr^{+2}(aq)$

B) A solution of barium chloride is added drop by drop to a solution of sodium carbonate, causing a precipitate to form.

$BaCl_2(aq) + Na_2CO_3(aq) \rightarrow BaCO_3(s) + 2NaCl(aq)$

$Ba^{+2}(aq) + CO_3^{-2}(aq) \rightarrow BaCO_3(s)$

C) Chlorine gas, an oxidizing agent, is bubbled into a solution of potassium bromide at 25°C.

$Cl_2(s) + 2KBr(aq) \rightarrow 2KCl(aq) + Br_2(l)$

$Cl_2(s) + 2Br^-(aq) \rightarrow 2Cl^-(aq) + Br_2(l)$

2006

A) Solid potassium chlorate is strongly heated.

$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)\uparrow$

C) A solution of acetic acid is added to a solution of barium hydroxide.

$2HC_2H_3O_2(aq) + Ba(OH)_2(aq) \rightarrow Ba(C_2H_3O_2)_2(aq) + 2H_2O(l)$

$2HC_2H_3O_2(aq) + 2OH^-(aq) \rightarrow 2C_2H_3O_2^-(aq) + 2H_2O(l)$

D) Zinc metal is placed in a solution of copper(II) sulfate.

$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$

$Zn(s) + Cu^{+2}(aq) \rightarrow Zn^{+2}(aq) + Cu(s)$

E) Hexane is combusted in air.

$2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$

2009

A) A barium nitrate solution and a potassium fluoride solution are combined and a precipitate forms.

$Ba(NO_3)_{2(aq)} + 2KF_{(aq)} \rightarrow 2KNO_{3(aq)} + BaF_{2(s)}$

$Ba^{+2}_{(aq)} + 2F^-_{(aq)} \rightarrow BaF_{2(s)}$

B) A piece of cadmium metal is oxidized by adding to a solution of copper(II) chloride..

$Cd_{(s)} + CuCl_{2(aq)} \rightarrow Cu_{(s)} + CdCl_{2(aq)}$

$Cd_{(s)} + Cu^{+2}_{(aq)} \rightarrow Cu_{(s)} + Cd^{+2}_{(aq)}$

C) A sample of solid ferric(iron (III)) oxide is reduced completely with solid carbon.

$2Fe_2O_{3(s)} + 3C_{(s)} \rightarrow 4Fe_{(s)} + 3CO_2\uparrow$

D) Equal volumes of equimolar solution of ammonia and hydrochloric acid are mixed.

$NH_{3(aq)} + HCl_{(aq)} \rightarrow NH_4^+{}_{(aq)} + Cl^-_{(aq)}$

$NH_{3(aq)} + H^+_{(aq)} \rightarrow NH_4^+{}_{(aq)}$

E) Solid mercury(II) oxide decomposes as it is heated in an open test tube in a fume hood

$2HgO_{(s)} \rightarrow 2Hg_{(l)} + O_{2(g)}\uparrow$

2007

A) A solution of sodium hydroxide is added to a solution of lead(II) nitrate.

$2NaOH_{(aq)} + Pb(NO_3)_{2(aq)} \rightarrow Pb(OH)_{2(s)} + 2NaNO_{3(aq)}$

$2OH^-_{(aq)} + Pb^{+2}_{(aq)} \rightarrow Pb(OH)_{2(s)}$

B) Excess nitric acid is added to solid calcium carbonate.

$2HNO_{3(aq)} + CaCO_{3(s)} \rightarrow Ca(NO_3)_{2(aq)} + CO_{2(g)}\uparrow + H_2O_{(l)}$

$2H^+_{(aq)} + CaCO_{3(s)} \rightarrow Ca^{+2}_{(aq)} + CO_{2(g)}\uparrow + H_2O_{(l)}$

C) A solution containing silver(I) ions(an oxidizing agent) is mixed with a solution containing iron(II) ions (a reducing agent)..

$Ag^{+}_{(aq)} + Fe^{+2}_{(aq)} \rightarrow Ag_{(s)} + Fe^{+3}_{(aq)}$

(reduced) (oxidized)

D) A small piece of sodium is placed in a beaker of distilled water.

$2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}\uparrow$

(HOH)

2006

A) Solid calcium carbonate is heated strongly.

$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}\uparrow$

B) A strip of magnesium metal is placed in a solution of iron(II) chloride.

$Mg_{(s)} + FeCl_{2(aq)} \rightarrow Fe_{(s)} + MgCl_{2(aq)}$

$Mg_{(s)} + Fe^{+2}_{(aq)} \rightarrow Fe_{(s)} + Mg^{+2}_{(aq)}$

C) Solid ammonium chloride is added to a solution of potassium hydroxide.

$NH_4Cl_{(s)} + KOH_{(aq)} \rightarrow NH_{3(g)}\uparrow + H_2O_{(l)} + KCl_{(aq)}$

$NH_4Cl_{(s)} + OH^{-}_{(aq)} \rightarrow NH_{3(g)}\uparrow + H_2O_{(l)} + Cl^{-}_{(aq)}$

D) Propanol is burned in air.

$2C_3H_7OH_{(g)} + 9O_{2(g)} \rightarrow 6CO_{2(g)} + 8H_2O_{(g)}$

E) A strip of aluminum foil is placed in liquid bromine.

$2Al_{(s)} + 3Br_{2(l)} \rightarrow 2AlBr_{3(s)}$

Follow-up questions:

1) 2008 letter B-If a few drops of hydrochloric acid are added to the resulting solution, what would be observed? Explain.

Bubbles - CO_2 produced and less precipitate

$2HCl + BaCO_3 \rightarrow \underline{CO_2} + H_2O + \underline{BaCl_{2(aq)}}$

2) 2006 letter A-What is the oxidation number on chlorine in the potassium chlorate molecule?

$\overset{+}{K}\overset{}{Cl}\overset{-6}{O_3}$ +5

3) 2006 letter D-What happens to the color of solution as the reaction proceeds?

Blue → Clear

4) 2006 letter E-How many moles of gaseous products are produced when **1 mole** of hexane is combusted?

13 mols (6 + 7)

5) 2009 letter B-List 2 visible changes you would see that would indicate a reaction is occurring?

solid Cu forming

solution becomes less blue as $CuCl_2$ reacts

6) 2009 letter E-After the reaction is complete, is the mass of the material in the testtube greater than, less than, or equal to the mass of the original sample? Explain.

Less, O_2 gas leaves the test tube

7) 2006 form B letter A-If the gaseous product is bubbled through lime water, what happens to the lime water?

The CO_2 will form a $CaCO_3$ precipitate

8) 2006 form B letter D-What organic functional group is found in propanol?

OH → hydroxyl