Synthesis Rxs (Redox reactions)

ANSWERS

1. Formation of Metal Oxides *(also fits into the combustion category)*

I. Magnesium reacts with oxygen

a. Observations:
Bright white flame, with white smoke and white powdery product.

b. Reaction (net ionic is the same):
$2\ Mg_{(s)} + O_{2(g)} \rightarrow 2\ MgO_{(s)}$ This is a redox reaction.

c. Which element is oxidized and which element is reduced?
Need a mnemonic device to help remember? LEO (the Lion) say GER (Lose Electrons Oxidized, Gain Electrons Reduction) or OIL RIG (Oxidation Is Losing, Reduction is Gaining)
Magnesium becomes a positive ion, so it must have lost electrons and is therefore oxidized.
Oxygen becomes a negative ion so it must gain electrons and is therefore reduced.

d. Why is the flame required to start this reaction?
The flame heats both the Mg and the oxygen as they react and causes more of the collisions to be productive, hard enough to allow break bonds (then new bonds form) and allow the reaction to occur.

e. What is the "smoke" that formed?
The smoke is tiny MgO particles that "fly up" into the air with the hot rising air currents.

II. Iron reacts in air

a. Observations:
Iron in air burns slowly.

Iron reacts in pure oxygen

Observations:
Iron in pure oxygen reacts very quickly.

b. Reaction [Assume the formation of iron(III)] (net ionic is the same):
$4\ Fe_{(s)} + 3\ O_{2(g)} \rightarrow 2\ Fe_2O_{3(s)}$ This is a redox reaction.

c. Why does the iron react more quickly and completely in pure oxygen than in just "air"?
It is a "slow" burn in air because there is a lot of nitrogen in the way of the oxygens trying to get with the iron.
Iron in pure oxygen reacts very quickly because there are no nitrogen molecules in the way allowing the combustion to occur very quickly.

d. Which element is oxidized and which element is reduced?
Iron becomes a positive ion, so it must have lost electrons and is therefore oxidized.
Oxygen becomes a negative ion so it must gain electrons and is therefore reduced.

2. Hydrogen Balloons

a. Observations: (Compare and contrast the boom, the fireball and the candle after the reaction.)

Balloon with just air	Balloon with helium	Balloon with pure oxygen
Small pop, no flame, candle blows out	small pop, no flame, candle blows out	about the same pop, no flame, candle stays lit
The air and helium rushes out of the balloon and blows out candle		the oxygen rushes out but helps the candle burn and thus doesn't blow out the candle.

Balloon with carbon dioxide	Balloon with pure hydrogen	Balloon with hydrogen and oxygen
Small pop, no flame, candle blows out	large boom	huge boom
the CO_2 blows out the candle	big, long lasting flame candle stays lit	tight, quick flame candle stays lit

b. Reaction for all of the balloons with hydrogen:
(Formation of water from its gaseous elements. This also fits into the combustion category.)
$2H_2 + O_2 \rightarrow 2H_2O$ (No reaction occurring in the other balloons)

c. Why was there a longer flame with the pure hydrogen balloon?
When there is no oxygen in the balloon to react with the hydrogen, the H_2 must go searching through the air, with all the nitrogen in the way on a search for oxygen causing the reaction to take longer giving us a larger fireball.

d. Why was there a shorter flame yet a louder boom with the hydrogen and oxygen balloon?
The flame is short acting because it can occur as soon as the flame is introduced, and the hydrogen does not need to leave the balloon to go and search for oxygen. The boom is louder because the burn occurs so quickly, the gases heat up more quickly and create a more sudden, larger sound wave.

3. (Electrolysis of Water) then Synthesis of Water

a. Observations:

Bubbles form at each electrode, with more bubbles at one than the other. The bubbles collect at the top of the jar then together blow out of the tube and into soap bubbles in the 2:1 hydrogen to oxygen ratio. When lit, the bubbles give a loud crack (a higher pitched noise than the boom of the larger hydrogen balloons.) There is a short flash of flame.

b. Write the reaction for the decomposition of water.

$2H_2O \rightarrow 2H_2 + O_2$

c. Write the reaction for the synthesis of water.

$2H_2 + O_2 \rightarrow 2H_2O$

d. What do you notice about these two reactions?

these two reactions are the reverse of each other. Energy was added in the form of electricity to decompose the water, and then that energy was released during the synthesis of the water (combustion of hydrogen) in the form of flame.

e. Why do you suppose the pitch of the pop of this reaction was more of a bang compared to the hydrogen oxygen balloon as a boom? (Lets compare and contrast the popping noise made by large bubble wrap and small bubble wrap.)

The pitch may be higher because the bubbles are smaller − just like small bubble wrap gives higher pitched snaps than large bubble wrap. Just like a piccolo is higher pitched than a flute, or the strings on a guitar or violin play a higher pitched note when the sting is shorter.