

## 90934 Demonstrate understanding of aspects of chemical reactions

### Collated questions on Decomposition 2011-2013

#### Question One

Two calcium compounds were heated over a Bunsen burner in a school laboratory. In the first experiment calcium carbonate was heated.

In the second experiment, calcium hydroxide was heated.

Compare and contrast the reaction that occurs when solid calcium carbonate is strongly heated, with the reaction that occurs when solid calcium hydroxide is strongly heated.

In your answer:

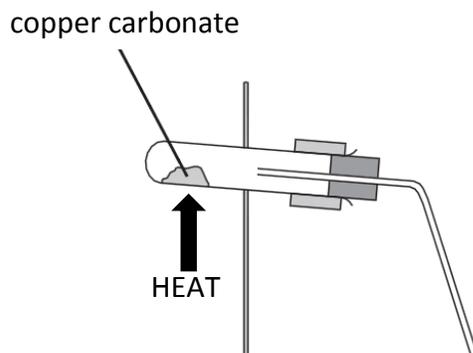
- identify the type of reaction that occurs when each substance is strongly heated, and justify your choice
- describe any observations that would be made in each reaction, and link these observations to the reactants and products involved
- explain how the gas formed in each reaction could be identified
- write a balanced symbol equation for each reaction.

#### Question Two

A boiling tube with copper carbonate powder is heated over a Bunsen burner flame.

Analyse this reaction.

- Identify the type of reaction that occurs: Give a reason for your choice:
- Describe any observations that would be made of this reaction, and link these to the substances involved in the reaction. Outline a test that could be used to confirm the presence of the product formed.
- Write a balanced symbol equation for this reaction.



#### Question Three

Two test tubes were set up in a school laboratory. Both test tubes were half-filled with identical solutions of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ).

It was observed that a few small bubbles of a colourless gas formed on the sides of each test tube.

Some solid manganese dioxide ( $\text{MnO}_2$ ) was added to test tube B.

- Describe the observations you would make after manganese dioxide ( $\text{MnO}_2$ ) was added to test tube B.
- Explain the chemistry of this reaction.

In your answer you should:

- identify the type of reaction that happens in test tube B
- justify your choice of the type of reaction
- link the observations made for the reaction in test tube B to the substances involved in the reaction
- write a balanced symbol equation for the reaction involving hydrogen peroxide.

#### Question Four

Students in a laboratory are asked to identify three powders by using a thermal decomposition reaction. The powders are copper hydroxide,  $\text{Cu}(\text{OH})_2$ , sodium carbonate,  $\text{Na}_2\text{CO}_3$ , and sodium hydrogen carbonate,  $\text{NaHCO}_3$ .

Explain how you could identify each of these powders by heating them.

Your answer should include:

- any observations that would be made
- any tests that would be carried out on products formed to confirm their presence
- balanced symbol equations for any reactions occurring.

## Answers

### Question One

When white calcium carbonate solid,  $\text{CaCO}_3$ , is strongly heated it releases a colourless gas, carbon dioxide,  $\text{CO}_2$ , and forms another white solid calcium oxide,  $\text{CaO}$ .



When white calcium hydroxide solid,  $\text{Ca}(\text{OH})_2$ , is strongly heated it releases a colourless gas, water,  $\text{H}_2\text{O}$ , and also forms the white solid calcium oxide,  $\text{CaO}$ .



### Comparisons:

Both calcium carbonate and calcium hydroxide are undergoing thermal decomposition since a solid is decomposing to form more than one substance when heated.

Both are white solids and when strongly heated, they both form another white solid, calcium oxide.

During heating, both of the solids break up because gas escapes from them.

### Contrast:

The difference in these reactions is in the gases released.

Calcium carbonate releases carbon dioxide, which will turn lime water cloudy when bubbled through it.

Calcium hydroxide releases steam or water as a gas / vapour. This will condense on the cooler upper parts of the test tube. A piece of cobalt chloride paper held in this water vapour / water droplets will turn from blue to pink.

### Question Two

This is an example of a thermal decomposition reaction where the copper carbonate is heated and it decomposes to form more than one substance / two simpler substances.

The green  $\text{CuCO}_3$  powder would heat and change colour to form a black powder of  $\text{CuO}$ . There would possibly be some 'jumping' of the powder as a colourless gas  $\text{CO}_2$  forms and then escapes the tube.

The  $\text{CO}_2$  can be collected and bubbled into limewater which would go milky and confirm that  $\text{CO}_2$  is produced.

Adding sulfuric acid to the black  $\text{CuO}$  powder will cause a blue solution ( $\text{CuSO}_4$ ) to form to show  $\text{Cu}^{2+}(\text{aq})$  is present.

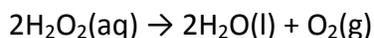


### Question Three

On its own, hydrogen peroxide decomposes / breaks down very slowly to form  $\text{H}_2\text{O}$  and  $\text{O}_2$  gas. After  $\text{MnO}_2$  (black / dark brown solid) is added to the colourless  $\text{H}_2\text{O}_2$  solution, bubbles of colourless gas are rapidly formed. The solution remains colourless and the black / dark brown solid remains in it.

This is a catalytic decomposition reaction where hydrogen peroxide decomposes / breaks down to form  $\text{H}_2\text{O}$  and  $\text{O}_2$  gas (two smaller products). Manganese dioxide ( $\text{MnO}_2$ ) is used as a catalyst to speed up the rate of the reaction.

The  $\text{MnO}_2$  causes the colourless  $\text{H}_2\text{O}_2$  solution to decompose more rapidly to form colourless  $\text{O}_2$  gas / bubbles of  $\text{O}_2$  gas and colourless  $\text{H}_2\text{O}$ .



### Question Four

$\text{Cu}(\text{OH})_2(\text{s}) \rightarrow \text{CuO}(\text{s}) + \text{H}_2\text{O}(\text{g})$  This goes from blue to a black powder, and condensation (a colourless liquid) may form. The condensation can be tested with cobalt chloride paper which will turn from blue to pink.

$\text{Na}_2\text{CO}_3$  does not decompose so no colour change will be observed and no gases will be formed.

$2\text{NaHCO}_3(\text{s}) \rightarrow \text{Na}_2\text{CO}_3(\text{s}) + \text{H}_2\text{O}(\text{g}) + \text{CO}_2(\text{g})$   $\text{NaHCO}_3$  is a white powder that will decompose to form a white powder. Two gases will form. (Or condensation (a colourless liquid) may form.) One will turn limewater milky / extinguish burning splint / turn damp blue litmus red, and the other would turn cobalt chloride paper from blue to pink.