

## CHAPTER 9 LAB ACTIVITIES

### INVESTIGATION 9.1.1 SINGLE DISPLACEMENT REACTIONS

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#### Prediction

(a) According to the single displacement reaction generalization, the products are as follows:

- $\text{Cu}_{(s)} + 2 \text{AgNO}_{3(aq)} \rightarrow 2 \text{Ag}_{(s)} + \text{Cu}(\text{NO}_3)_2(aq)$
- $\text{Cl}_{2(aq)} + 2 \text{NaBr}_{(aq)} \rightarrow \text{Br}_{2(l)} + 2 \text{NaCl}_{(aq)}$
- $\text{Mg}_{(s)} + 2 \text{HCl}_{(aq)} \rightarrow \text{H}_{2(g)} + \text{MgCl}_{2(aq)}$
- $\text{Zn}_{(s)} + \text{CuSO}_{4(aq)} \rightarrow \text{Cu}_{(s)} + \text{ZnSO}_{4(aq)}$
- $\text{Cl}_{2(aq)} + 2 \text{KI}_{(aq)} \rightarrow \text{I}_{2(s)} + 2 \text{KCl}_{(aq)}$

#### Experimental Design

(b) For reaction 1, silver metal is identified by its silvery appearance and copper(II) nitrate is identified by its blue colour in solution. For reaction 2, bromine is identified by the orange colour in the halogen diagnostic test. For reaction 3, hydrogen gas is identified by the “pop” sound in the hydrogen diagnostic test. For reaction 4, copper metal is identified by its appearance. For reaction 5, iodine is identified by the violet colour in the halogen diagnostic test.

#### Evidence

(c)

#	Test procedure	Observations
1.	mixture observed	<ul style="list-style-type: none"><li>initially black and later silver-grey crystals on copper strip</li><li>blue-coloured solution</li></ul>
2.	mixture observed before and after adding hexane	<ul style="list-style-type: none"><li>initial yellow-brown colour of the solution</li><li>orange colour in organic layer</li></ul>
3.	gas collected and a flame inserted	<ul style="list-style-type: none"><li>a squeaky “pop” sound heard in the test tube</li></ul>
4.	mixture observed	<ul style="list-style-type: none"><li>initially, a black deposit which later appeared reddish-brown</li></ul>
5.	mixture observed before and after adding hexane	<ul style="list-style-type: none"><li>initial yellow-brown colour of the solution</li><li>violet colour in organic layer</li></ul>

#### Analysis

(d) In reaction 1, the silver-grey crystals suggest the presence of silver metal and the blue solution colour agrees with the formation of copper(II) nitrate. In reaction 2, the orange colour in the organic layer confirms the presence of bromine in the final mixture. In reaction 3, the “pop” sound when the gas was ignited confirms the presence of hydrogen. In reaction 4, the appearance of a reddish-brown precipitate suggests copper metal has formed. In reaction 5, the violet colour in the organic layer confirms the presence of iodine.

#### Evaluation

- (e) The experimental design was barely adequate to answer the problem with the materials provided. In most cases, only one product was tested and some of the tests were not very specific. The design could be improved by including additional diagnostic tests which would require additional materials. The procedure was adequate for collecting the evidence indicated in the design.
- (f) The quality of evidence was variable. Some evidence like the halogen and hydrogen tests clearly showed the presence of the predicted product. Other evidence such as the observations of a precipitate were of low quality. In all cases, more evidence is required to check for the presence of a second product.
- (g) I am only moderately confident in the answers obtained. The initial appearance of dark precipitates in reactions 1 and 4 cannot be explained, although the final appearance seemed to agree with the predicted product.
- (h) All predictions are judged to be verified because they generally agree with the results obtained and no significant contradictory evidence was obtained for any of the reactions.