Analysis

(d) The evidence obtained is consistent with spontaneous, single displacement reactions for only the combinations of:

- copper metal and silver ions;
- lead metal and copper(II) ions;
- lead metal and silver ions; and
- zinc metal and each of copper(II), silver, and lead(II) ions.

Evaluation

(e) The experimental design was adequate to answer the problem since only evidence for a reaction (not the identity of the product) was required. The materials and procedure were adequate, although the short observation time did create a little uncertainty for those combinations that did not appear to react.

(f) Two aspects of this experiment could be improved. The combinations that did not appear to react could be left longer in case there was a slow reaction. Some diagnostic tests could be done to determine the identity of any products produced.

(g) Overall, the prediction is judged to be falsified since six out of the twelve predicted spontaneous reactions did not give any evidence of a chemical change. The mixture of a metal and a solution of its own ion was predicted to be nonspontaneous and this was verified with the possible exception of the copper system, which would require further testing.

(h) The assumption of spontaneous reactions is judged to be unacceptable since the prediction was clearly falsified. The assumption will need to be restricted, revised, or discarded.

LAB EXERCISE 9.3.1 BUILDING A REDOX TABLE

(Page 717)

Analysis

(a) SOA $Br_{2(aq)} + 2\,e^- \rightleftharpoons 2\,Br^-_{(aq)}$

$Ag^+_{(aq)} + e^- \rightleftharpoons Ag_{(s)}$

$I_{2(aq)} + 2\,e^- \rightleftharpoons 2\,I^-_{(aq)}$

$Cu^{2+}_{(aq)} + 2\,e^- \rightleftharpoons Cu_{(s)}$ SRA

Synthesis

(b) SOA $Cl_{2(aq)} + 2\,e^- \rightleftharpoons 2\,Cl^-_{(aq)}$

$Br_{2(aq)} + 2\,e^- \rightleftharpoons 2\,Br^-_{(aq)}$

$Ag^+_{(aq)} + e^- \rightleftharpoons Ag_{(s)}$

$I_{2(aq)} + 2\,e^- \rightleftharpoons 2\,I^-_{(aq)}$

$Cu^{2+}_{(aq)} + 2\,e^- \rightleftharpoons Cu_{(s)}$

$Pb^{2+}_{(aq)} + 2\,e^- \rightleftharpoons Pb_{(s)}$

$Zn^{2+}_{(aq)} + 2\,e^- \rightleftharpoons Zn_{(s)}$ SRA

INVESTIGATION 9.3.2 THE REACTION OF SODIUM WITH WATER

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Prediction

(a) According to the method for predicting redox reactions, the products of the reaction are hydrogen gas and aqueous sodium hydroxide as shown below.

	SOA
$Na_{(s)}$	$H_2O_{(l)}$
SRA	RA

$$2\,H_2O_{(l)} + 2\,e^- \rightarrow H_{2(g)} + 2\,OH^-_{(aq)}$$

$$2\,[Na_{(s)} \rightarrow Na^+_{(aq)} + e^-]$$

$$2\,H_2O_{(l)} + 2\,Na_{(s)} \xrightarrow{\text{spont.}} H_{2(g)} + 2\,OH^-_{(aq)} + 2\,Na^+_{(aq)}$$

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