Real AP Past Papers with Multiple-Choice Questions

1. $2Mg(s) + 2CuSO_4(aq) + H_2O(l) \rightarrow 2MgSO_4(aq) + Cu_2O(s) + H_2(g)$

(a) If 1.46 grams of Mg(s) are added to 500 milliliters of a 0.200-molar solution of $CuSO_4$, what is the maximum molar yield of $H_2(g)$?

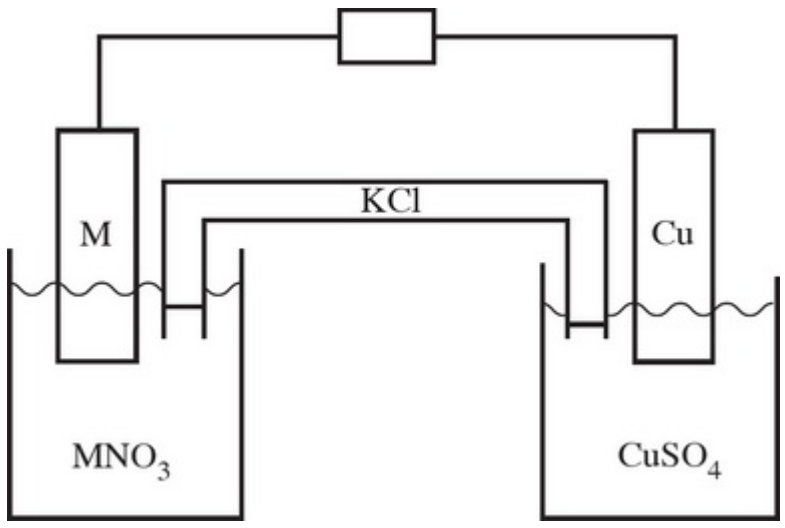
(b) When all of the limiting reagent has been consumed in (a), how many moles of the other reactant (not water) remain?

(c) What is the mass of the Cu_2O produced in (a)?

(d) What is the value of $[Mg^{2+}]$ in the solution at the end of the experiment? (Assume that the volume of the solution remains unchanged.)

Show Answer

2. A student performs an experiment in which a bar of unknown metal M is placed in a solution with the formula MNO_3. The metal is then hooked up to a copper bar in a solution of $CuSO_4$ as shown below. A salt bridge that contains aqueous KCl links the cell together.



The cell potential is found to be +0.74 V. Separately, when a bar of metal M is placed in the copper sulfate solution, solid copper starts to form on the bar. When a bar of copper is placed in the MNO_3 solution, no visible reaction occurs.

The following gives some reduction potentials for copper:

Half-reaction	*E*
$Cu^{2+} + 2e^- \rightarrow Cu(s)$	0.34 V
$Cu^{2+} + e^- \rightarrow Cu^+$	0.15 V
$Cu^+ + e^- \rightarrow Cu(s)$	0.52 V

(a) Write the net ionic equation that takes place in the Cu/M cell.

(b) What is the standard reduction potential for metal M?

(c) Which metal acted as the anode and which as the cathode? Justify your answer.

(d) On the diagram of the cell, indicate which way the electrons are flowing in the wire. Additionally, indicate any ionic movement occurring in the salt bridge.

(e) What would happen to the voltage of the reaction in the Cu/M cell if the concentration of the $CuSO_4$ increased while the concentration of the MNO_3 remained constant? Justify your answer.

Show Answer

3. Two electrodes are inserted into a solution of nickel (II) fluoride and a current of 2.20 A is run through them. A list of standard reduction potentials is as follows:

Half-reaction	E
$O_2\ (g) + 4\ H^+\ (aq) + 4e^- \rightarrow H_2O(l)$	1.23 V
$F_2(g) + 2e^- \rightarrow 2F^-(aq)$	2.87 V
$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2\ OH^-(aq)$	-0.83 V
$Ni^{2+} + 2e^- \rightarrow Ni(s)$	-0.25 V

(a) Write the net ionic equation that takes place during this reaction.

(b) Qualitatively describe what an observer would see taking place at each electrode.

(c) Will the solution become acidic, basic, or remain neutral as the reaction progresses?

(d) How long would it take to create 1.2 g of Ni(s) at the cathode?

Show Answer