1 M Al(NO$_3$)$_3$        1 M Pb(NO$_3$)$_2$

**Voltaic Cells**:  Answer the following questions regarding the diagram above and using Table J

1. Which is more easily oxidized, aluminum or lead? _____

2. Write the balanced equation that represents the spontaneous reaction that occurs.

   _____

3. What direction do electrons flow in the wire? _____

4. What direction do positive ions flow in the salt bridge? _____

5. Which electrode is increasing in size? _____

6. Which electrode is decreasing in size? _____

7. What is happening to the concentration of aluminum ions? _____

8. What is happening to the concentration of lead(II) ions? _____

9. Which metal forms the anode? _____

10. Which metal forms the cathode? _____

11. Which metal forms the positive electrode? _____

12. Which metal forms the negative electrode? _____

*Directions* (1-10): For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2011 Edition Reference Tables for Physical Setting/Chemistry*.

1 Which half-reaction correctly represents reduction?

(1) $Fe^{2+} + 2\,e^- \rightarrow Fe$
(2) $Fe^{2+} + e^- \rightarrow Fe^{3+}$
(3) $Fe + 2\,e^- \rightarrow Fe^{2+}$
(4) $Fe + e^- \rightarrow Fe^{3+}$

2 Given the equation representing a reaction

$Hg^{2+} + 2\,I^- \rightarrow Hg + I_2$
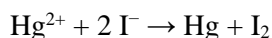
Which equation correctly represents the half-reaction for the oxidation that occurs?

(1) $Hg^{2+} \rightarrow Hg + 2\,e^-$
(2) $Hg^{2+} + 2\,e^- \rightarrow Hg$
(3) $2\,I^- \rightarrow I_2 + 2\,e^-$
(4) $2\,I^- + 2\,e^- \rightarrow I_2$

3 Which statement describes what occurs in the following redox reaction?

$Cu_{(s)} + 2\,Ag^+_{(aq)} \rightarrow Cu^{2+}_{(aq)} + Ag_{(s)}$
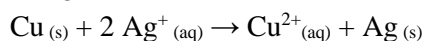
(1) Only mass is conserved.
(2) Only charge is conserved.
(3) Both mass and charge are conserved.
(4) Neither mass nor charge is conserved.

4 An electrochemical cell is made up of two half-cells connected by a salt bridge and an external conductor. What is the function of the salt bridge?

(1) to permit the migration of ions
(2) to prevent the migration of ions
(3) to permit the mixing of solutions
(4) to prevent the flow of electrons

5 Which equation is correctly balanced?

(1) $Mg + Cr^{3+} \rightarrow Mg^{2+} + Cr$
(2) $K + Al^{3+} \rightarrow Al + K^+$
(3) $H_2 + Sn^{4+} \rightarrow Sn + 2\,H^+$
(4) $Hg + Br_2 \rightarrow Hg^{2+} + 2\,Br^-$

6 Compared to the total mass and total charge at the beginning of a redox reaction, the total mass and charge upon completion of the reaction is

(1) less
(2) greater
(3) the same

7 The type of reaction in a voltaic cell is best described as

(1) spontaneous oxidation reaction only
(2) nonspontaneous oxidation reaction only
(3) spontaneous oxidation-reduction reaction
(4) nonspontaneous oxidation-reduction reaction

8 Which equation is correctly balanced?

(1) $2\,Ni + Fe^{3+} \rightarrow Fe^{2+} + Ni^{2+}$
(2) $Ni + 2\,Fe^{3+} \rightarrow 2\,Fe^{2+} + Ni^{2+}$
(3) $Ni + Fe^{3+} \rightarrow Fe^{2+} + Ni^{2+}$
(4) $2\,Ni + 2\,Fe^{3+} \rightarrow 2\,Fe^{2+} + 2\,Ni^{2+}$

9 The diagram below shows an electrochemical cell.



$Cu^{2+}(aq) + Zn(s) \longrightarrow Cu(s) + Zn^{2+}(aq)$
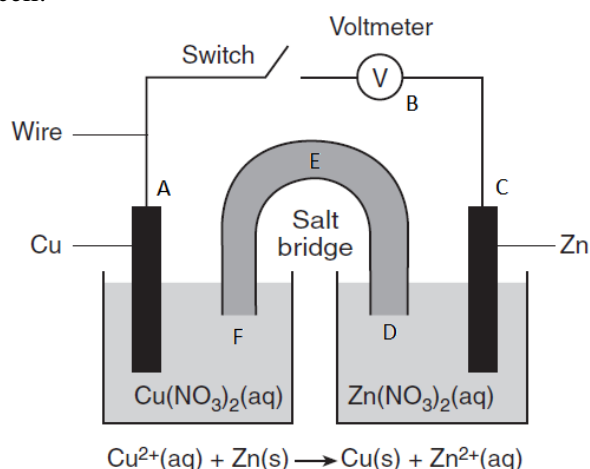
Which series of letters shows the path and direction of electron flow?

(1) ABC          (3) DEF
(2) CBA          (4) FED

10 Consider the following equation

$2\,H_2O + electricity \rightarrow 2\,H_2 + O_2$
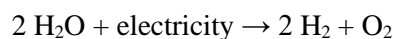
In which type of cell would this reaction most likely occur?

(1) a voltaic cell, because it releases energy
(2) an electrolytic cell, because it releases energy
(3) a voltaic cell, because it absorbs energy
(4) an electrolytic cell, because it absorbs energy