Redox Review

1. Define oxidation and reduction.

2. Explain what a redox reaction is.

3. Cu^{2+} reacts spontaneously with Al to produce Cu and Al^{3+}. Write the oxidation half reaction, the reduction half reaction, and the net ionic redox reaction. Label the oxidizing agent and reducing agent.

4. Using your table, write the half reactions and complete redox reaction when acidified BrO_3^- reacts with H_2S gas. Label the oxidizing agent and reducing agent. Is this reaction spontaneous?

5. Give the oxidation numbers for each of the following substances:
   a) MnO_4^- b) H_2SO_3 c) Fe_3O_4 d) $BaCr_2O_7$ e) C_3H_8 f) $HClO_4$ g) P_4

6. Are the following reactions redox? State why or why not.
   a) $BaCl_2 + Na_2SO_4 \Rightarrow BaSO_4 + 2NaCl$
   b) $2Na + MgBr_2 \Rightarrow Mg + 2NaBr$

7. What metal can be oxidized by acidified MnO_4^- but not by acidified BrO_3^-?

8. Which is the stronger reducing agent: H_2O_2 or Ni? How do you know?

9. Which substance can be reduced by I^- but not by Fe^{2+}?
   (or substances)

10. If the following reactants are mixed, will the reaction be spontaneous, non spontaneous, or will there be no reaction at all? If spontaneous, write a balanced redox equation.
    a) Cu^{2+} and Ag_2S b) K^+ and Sn^{2+} c) $AuCl_4^-$ and Al

11. Balance the following and calculate the $E°_{cell}$:
    $Mn^{2+} + ClO_4^- \Rightarrow MnO_4^- + Cl^-$ (acidic)

12. Balance the following half reaction:
    $H_2BO_3^- \Rightarrow BH_4^-$ (basic)

13. Write an oxidation half reaction, reduction half reaction, and overall redox equation for the skeleton redox reaction in basic solution:

$$Ag^{+} + C_6H_4(OH)_2 \Rightarrow Ag + C_6H_4O_2$$

14. In an unusual compound, IPO_4, iodine exists as iodine (III). The compound decomposes as in the following skeleton redox reaction:

$$IPO_4 \Rightarrow I_2 + IO_3^{-} + PO_4^{3-} \quad \text{(acidic)}$$

Balance this redox equation.

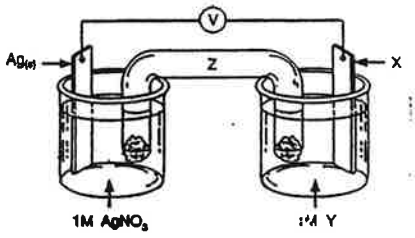
15. In a titration, 28.55mL of acidified 0.0500M $KMnO_4$ is required to oxidize a 10.00mL sample of Cr^{3+}. Write the balanced redox reaction and calculate $[Cr^{3+}]$.

16. In a redox titration, 0.300g of $Na_2C_2O_4$ is placed into a 250mL flask and acidified. The resulting solution requires 23.42mL of $KMnO_4$ to reach the endpoint. The reaction is

$$5C_2O_4^{2-} + 2MnO_4^{-} + 16H^{+} \Rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$$

Using the above data, calculate $[KMnO_4]$.

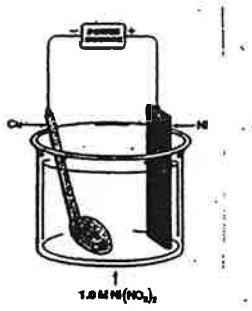
17. The electrochemical cell below produces an initial voltage of 0.93V.



a) Identify X.
b) Identify a suitable electrolyte Y
c) Identify a suitable electrolyte Z
d) Indicate on the diagram the direction of electron flow.

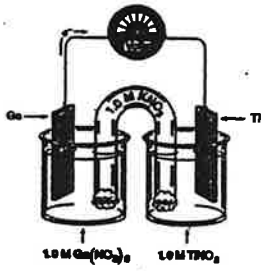
18. Draw and label a diagram of a cell capable of producing Br_2 from molten NaBr. Label the anode and cathode, then indicate at which electrode Br_2 is produced.

19. Consider the electrolytic cell:



a) Write the equation for the half reaction occurring at the anode and the cathode.
b) What is the minimum theoretical voltage necessary to plate nickel onto a copper spoon?

20. Consider the following electrochemical cell:



a) The E° for the cell is +0.22V and the reduction potential for Ga^{3+} is -0.56V. What is the reduction potential for Tl^{+}?
b) Identify the oxidizing agent in the electrochemical cell.

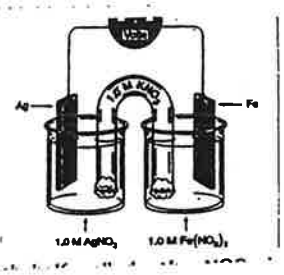
21. Draw a diagram of a simple apparatus that could be used in a lab to demonstrate the electroplating of an iron nail with zinc. Indicate a suitable electrolyte, label the anode and calculate the E° for the reaction.

22. Identify two conditions that are necessary for the corrosion of an iron nail. Give the anode and cathode half reactions for corrosion.

23. Suggest three methods to prevent corrosion of an iron boat and discuss the advantages and disadvantages of each.

24. Explain why Ag will dissolve in 1M HNO_3 but not in 1M H_2SO_4. Show reactions to support your explanation.

25. Consider the electrochemical cell:



a) Toward which half cell does NO_3^- in the salt bridge originally move?
b) Write the equation for the half reaction occurring at the silver electrode.
c) Identify the anode.
d) What is the initial cell voltage?

26. The metals In, Tl, and Fe were separately placed in 1M solutions of In^{3+}, Tl^{3+}, and Fe^{2+}. The observations are summarized in the table below.

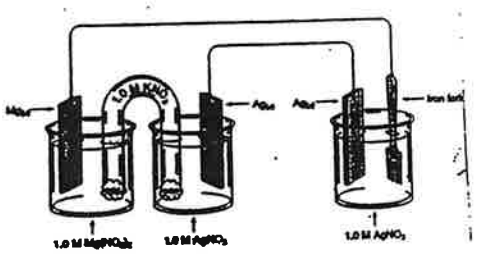
Metal \ Ion	In^{3+}	Tl^{3+}	Fe^{2+}
In		reaction	reaction
Tl			
Fe			

a) Complete the table above and indicate whether reactions do or do not occur.
b) Write the three reduction half reactions starting with the half reaction that has the highest reduction potential.

27. In separate electrolysis experiments, 1M NaCl, 1M KNO_3, 1M Li_2SO_4, and 1M Cs_3PO_4 all produced the same gas at their cathodes. Write the half reaction for the formation of this gas and explain why the same half reaction occurs in all four cases.

28. Draw a diagram of a standard electrochemical cell that could make use of the reaction $Zn_{(s)} + Cl_{2(g)} \Rightarrow Zn^{2+}_{(aq)} + 2Cl^-_{(aq)}$. Identify all of the chemical substances in the cell.

29. Consider the following apparatus:



a) On the diagram above, clearly indicate the direction of electron flow.
b) Write two oxidation half reactions that occur.
c) Write the half reaction that occurs at the iron fork.

30. Using silver as one of the electrodes, design an electrochemical cell that has a theoretical voltage greater than 3.00V. Draw a labeled diagram and identify all the components of your electrochemical cell.