Redox (no calculator)

(All of these questions may be completed without the use of a calculator. Answers given were generated without a calculator.)

1) Give the oxidation number of carbon in each of the following:

   a) CF_2Cl_2
   b) $Na_2C_2O_4$
   c) HCO_3^{-1}
   d) C_2H_6

2) Give the oxidation number of sulphur in each of the following:

   a) $SOCl_2$
   b) H_2S_2
   c) H_2SO_3
   d) Na_2S

3) Identify the oxidizing and reducing agents in each of the following:

   a) $8H^+(aq) + 6Cl^{-1}(aq) + Sn(s) + 4NO_3^{-1}(aq) \longrightarrow SnCl_6^{-2}(aq) + 4NO_2(g) + 4H_2O(l)$
   b) $2MnO_4^{-1}(aq) + 10Cl^{-1}(aq) + 16H^+(aq) \longrightarrow 5Cl_2(g) + 2Mn^{+2}(aq) + 8H_2O(l)$
   c) $8H^+(aq) + Cr_2O_7^{-2}(aq) + 3SO_3^{-2}(aq) \longrightarrow 2Cr^{+3}(aq) + 3SO_4^{-2}(aq) + 4H_2O(l)$
   d) $NO_3^{-1}(aq) + 4Zn(s) + 7OH^{-1}(aq) + 6H_2O(l) \longrightarrow 4Zn(OH)_4^{-2}(aq) + NH_3(aq)$

4) Balance the following oxidation-reduction equations. All reactions occur in acidic solutions.

   a) $Zn + NO_3^{-1} \longrightarrow Zn^{2+} + NH_4^+$
   b) $ReO_2 + Cl_2 \longrightarrow HReO_4 + Cl^{-1}$
   c) $HNO_2 + MnO_4^{-1} \longrightarrow NO_3^{-1} + Mn_2^+$
   d) $Cu + NO_3^{-1} \longrightarrow Cu^{2+} + NO$

5) Balance the following oxidation-reduction equations. All reactions occur in basic solutions.

   a) $S_2O_3^{-2} + OCl^{-1} \longrightarrow SO_4^{-2} + Cl^{-1}$
   b) $NiO_2 + Fe \longrightarrow Ni(OH)_2 + Fe(OH)_3$
   c) $SbH_3 + H_2O \longrightarrow Sb(OH)_4^{-1} + H_2$
   d) $P_4 \longrightarrow PH_3 + HPO_3^{-2}$

6) Balance the folowing oxidation-reduction equations under the specific conditions noted:

a) $Pb + PbO_2 + SO_4^{-2} \longrightarrow PbSO_4$ (acidic solution)
b) $CrI_3 + Cl_2 \longrightarrow CrO_4^{-2} + IO_4^{-1} + Cl^{-1}$ (basic solution)
c) $XO_2^{+} + YO^{+} \longrightarrow X_2O_4^{-3} + Y^{-1} + Y_3O_7^{-2}$ (basic solution)

7) Balance the following oxidation-reduction under the conditions specified:

a) $Z_2O_3 + X(CN)_6^{-3} \longrightarrow Z^{-1} + O_2 + X^{+3} + NO_2 + CO_2$ (acidic conditions)
b) $Sn^{4+} + X(CNO)_4^{-2} \longrightarrow Sn^{2+} + XO_2^{3+} + CO_3^{-2} + NO$ (basic conditions)
c) $C_7H_8 + MnO_4^{-1} \longrightarrow C_7H_6O_2 + MnO_2 + Mn^{2+}$ (basic conditions)

8) Given the following unbalanced oxidation-reduction reaction that occurs in basic solution:

$S_2O_3^{-2}(aq) + H_2O_2(aq) \longrightarrow S_3O_6^{-2}(aq) + SO_4^{-2}(aq) + H_2O(l)$

a) Balance the reaction.
b) Which substance is the oxidizing agent?

9) Stibnite (Sb_2S_3, Molar mass = 339.7 g) is the most important ore containing antimony. A 0.3397 g sample of ore was chemically treated to produce antimony(III) ions in solution. The antimony(III) was oxidized to antimony(V) by adding 25.00 mL of 0.1000 N $KMnO_4$ solution. The excess KMnO4 was titrated with 0.05000 N Fe^{2+}; 10.00 mL was required, producing $Fe^{3+}(aq)$ and $Mn^{2+}(aq)$. All reactions were carried out in acidic solutions.

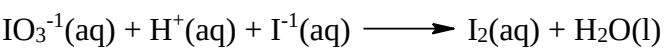
a) Calculate the % by mass Sb_2S_3 in the ore sample .**(Answer = 50.0%)**
b) What is the molarity of the $KMnO_4$ solution? **(Answer = 0.0200 M)**
c) What is the molarity of the Fe^{2+} solution? **(Answer = 0.0500 M)**

10) Iodine reacts with thiosulphate ion ($S_2O_3^{-2}$) in acidic solution to form iodide and tetrathionate ion ($S_4O_6^{-2}$). Calculate the volume in mL of 0.100 M $Na_2S_2O_3$ needed to react with 0.2538 g of I_2.
(Answer = 20.00 mL)

11) Thyroxine ($C_{15}H_{11}I_4NO_4$) is a hormone synthesized by the thyroid gland and used to control many metabolic functions in the body. A physiologist determines the mass percentage of thyroxine in a thyroid extract by igniting 0.7768 grams of extract with sodium carbonate, which converts the iodine to iodide. The iodide is dissolved in water, and bromine and hydrochloric acid are added, which converts the iodine to iodate.

a) How many moles of iodate form per mole of thyroxine?

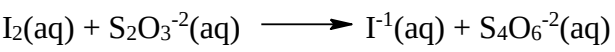
b) Excess bromine is boiled off and more iodide is added, which reacts as shown in the following *unbalanced* equation:



$$IO_3^{-1}(aq) + H^+(aq) + I^{-1}(aq) \longrightarrow I_2(aq) + H_2O(l)$$

How many moles of iodine are produced per mole of thyroxine? (*Hint:* Be sure to balance the charges as well as the atoms.) What are the oxidizing and reducing reagents in the reaction?

c) The iodine reacts completely with 24.00 mL of 0.1000 M thiosulphate as shown in the following *unbalanced* equation:



$$I_2(aq) + S_2O_3^{-2}(aq) \longrightarrow I^{-1}(aq) + S_4O_6^{-2}(aq)$$

What is the mass percent of thyroxine in the thyroid extract?

Do this part of the question by using normality, molarity and equivalents. DO NOT balance any redox equation to solve this part of the problem.
(Answer = 10.00%)