11-A. Potassium ion in a 250.0 ($\pm$0.1) mL water sample was precipitated with sodium tetraphenylborate:

$$K^+ + (C_6H_5)_4B^- \rightarrow KB(C_6H_5)_4(s)$$

The precipitate was filtered, washed, dissolved in an organic solvent, and treated with excess $Hg(EDTA)^{2-}$:

$$4HgY^{2-} + (C_6H_5)_4B^- + 4H_2O \rightarrow H_3BO_3 + 4C_6H_5Hg^+ + 4HY^{3-} + OH^-$$

The liberated EDTA was titrated with 28.73 ($\pm$0.03) mL of 0.043 7 ($\pm$0.000 1) M Zn^{2+}. Find $[K^+]$ (and its absolute uncertainty) in the original sample.

11-C. Calculate pCu^{2+} (to the 0.01 decimal place) at each of the following points in the titration of 50.0 mL of 0.040 0 M EDTA with 0.080 0 M $Cu(NO_3)_2$ at pH 5.00: 0.1, 5.0, 10.0, 15.0, 20.0, 24.0, 25.0, 26.0, and 30.0 mL. Make a graph of pCu^{2+} versus volume of titrant.

11-E. Suppose that 0.010 0 M Mn^{2+} is titrated with 0.005 00 M EDTA at pH 7.00.

(a) What is the concentration of free Mn^{2+} at the equivalence point?

(b) What is the quotient $[H_3Y^-]/[H_2Y^{2-}]$ in the solution when the titration is just 63.7% of the way to the equivalence point?

13-1. Explain the difference between electric charge (q, coulombs), electric current (I, amperes), and electric potential (E, volts).

13-2. **(a)** How many electrons are in one coulomb?

(b) How many coulombs are in one mole of charge?

13-3. The basal rate of consumption of O_2 by a 70-kg human is about 16 mol of O_2 per day. This O_2 oxidizes food and is reduced to H_2O, providing energy for the organism:

$$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$$

(a) To what current (in amperes = C/s) does this respiration rate correspond? (Current is defined by the flow of electrons from food to O_2.)

(b) Compare your answer in part (**a**) with the current drawn by a refrigerator using 5.00×10^2 W at 115 V. Remember that power (in watts) = work/s = $E \cdot I$.

(c) If the electrons flow from nicotinamide adenine dinucleotide (NADH) to O_2, they experience a potential drop of 1.1 V. What is the power output (in watts) of our human friend?

13-5. Consider the redox reaction

$$I_2 + 2S_2O_3^{2-} \rightleftharpoons 2I^- + S_4O_6^{2-}$$

Thiosulfate — Tetrathionate

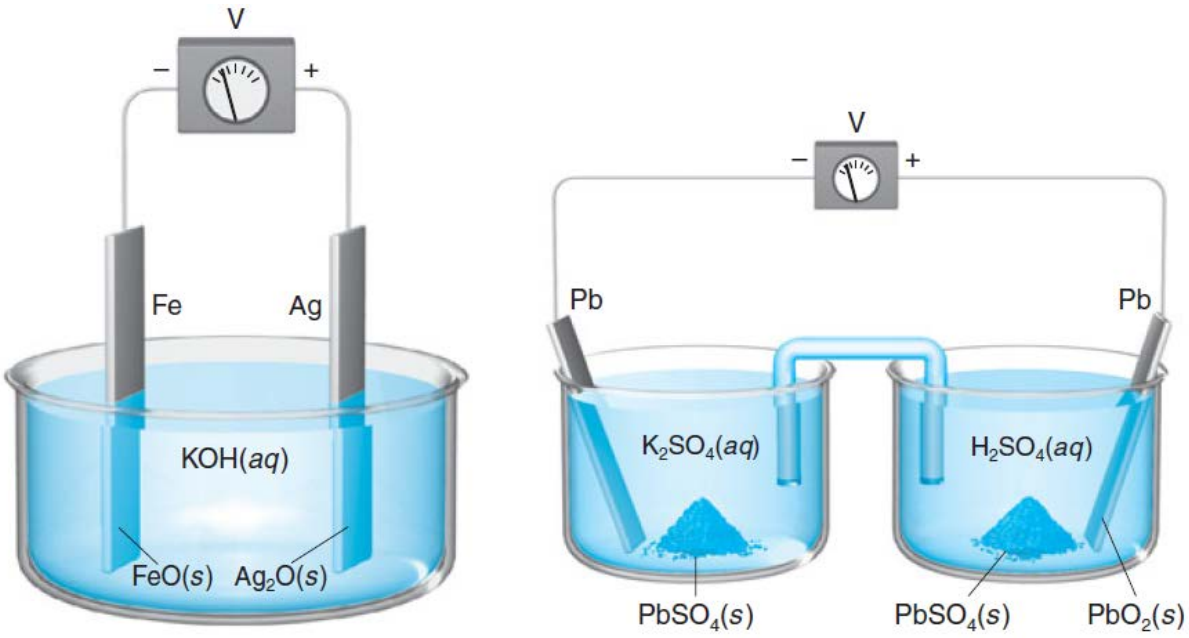
(a) Identify the oxidizing agent on the left side of the reaction and write a balanced oxidation half-reaction.

(b) Identify the reducing agent of the left side of the reaction and write a balanced reduction half-reaction.

(c) How many coulombs of charge are passed from reductant to oxidant when 1.00 g of thiosulfate reacts?

(d) If the rate of reaction is 1.00 g of thiosulfate consumed per minute, what current (in amperes) flows from reductant to oxidant?

13-8. Write a line notation and two reduction half-reactions for each cell pictured above.



Galvanic cells for Problem 13.8

13-9. Draw a picture of the following cell and write reduction half-reactions for each electrode:

$Pt(s) \mid Fe^{3+}(aq), Fe^{2+}(aq) \parallel Cr_2O_7^{2-}(aq), Cr^{3+}(aq), HA(aq) \mid Pt(s)$

13-10. Consider the rechargeable battery:

$Zn(s) \mid ZnCl_2(aq) \parallel Cl^-(aq) \mid Cl_2(l) \mid C(s)$

(a) Write reduction half-reactions for each electrode. From which electrode will electrons flow from the battery into a circuit if the electrode potentials are not too different from E° values?

(b) If the battery delivers a constant current of 1.00×10^3 A for 1.00 h, how many kilograms of Cl_2 will be consumed?

13-13. **(a)** Cyanide ion causes E° for Fe(III) to decrease:

$$\underset{\text{Ferric}}{Fe^{3+}} + e^- \rightleftharpoons \underset{\text{Ferrous}}{Fe^{2+}} \qquad E^\circ = 0.771 \text{ V}$$

$$\underset{\text{Ferricyanide}}{Fe(CN)_6^{3-}} + e^- \rightleftharpoons \underset{\text{Ferrocyanide}}{Fe(CN)_6^{4-}} \qquad E^\circ = 0.356 \text{ V}$$

Which ion, Fe(III) or Fe(II), is stabilized more by complexing with CN^-?

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