

Unit 13 Practice Problems (with answers at end)

Don't keep your coals
in a volcano.
--Publius Syrus

Oxidation numbers and definitions

1. For each of the following, give the oxidation number of each atom:

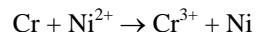
- a. KBr b. SO₂ c. P₄O₁₀ d. CO e. SO₃ f. HClO₄ g. Al₂(SO₄)₃ h. KIO₃
i. K₂HPO₄ j. Na₂S₂O₃

2. For each of the following processes, decide which substance is being oxidized, which reduced, and label the oxidizing and reducing agents.

- a. $\text{Cr} + \text{Sn}^{4+} \rightarrow \text{Cr}^{3+} + \text{Sn}^{2+}$
b. $\text{Al} + \text{H}^+ \rightarrow \text{Al}^{3+} + \text{H}_2$
c. $\text{Zn} + \text{Ag}^+ \rightarrow \text{Zn}^{2+} + \text{Ag}$
d. $\text{NO}_3^- + \text{S} \rightarrow \text{NO}_2 + \text{H}_2\text{SO}_4$
e. $\text{Br}_2 + \text{SO}_3^{2-} \rightarrow \text{Br}^- + \text{SO}_4^{2-}$
f. $\text{Fe}^{2+} + \text{MnO}_4^- \rightarrow \text{Mn}^{2+} + \text{Fe}^{3+}$
g. $\text{IO}_3^- + \text{H}_2\text{S} \rightarrow \text{I}_2 + \text{SO}_3^{2-}$

Galvanic cells

3. For the following reaction, diagram a galvanic cell and label all the parts. Calculate the net voltage.



4. For the following calculate the net voltages and state whether the reaction will be spontaneous or not. (not balanced)

- a. $\text{Al} + \text{H}^+ \rightarrow \text{Al}^{3+} + \text{H}_2$
b. $\text{Br}^- + \text{I}_2 \rightarrow \text{Br}_2 + \text{I}^-$
c. $\text{Fe}^{2+} + \text{MnO}_4^- \rightarrow \text{Fe}^{3+} + \text{Mn}^{2+}$
d. $\text{Cl}^- + \text{Sn}^{4+} \rightarrow \text{Cl}_2 + \text{Sn}^{2+}$

A man's first care should
be to avoid the reproaches
of his own heart; his next
to escape the censures of
the world.--Joseph Addison

Electrolysis of Aqueous solutions

5. What are the probable products formed at each electrode when *dilute* aqueous solutions of the following compounds are electrolyzed?

- a. CuBr₂ b. PbF₂ c. Ca(OH)₂ d. NaI e. CoCl₂

Faraday's Laws

6. If 3.0 moles of electrons are passed through a solution of FeBr₃, how many grams of Fe metal can be plated out?

7. How many grams of aluminum metal can be deposited from an aluminum nitrate solution if 31,500 C (to the nearest 100 C) of electricity pass through?

8. If 10 amps (to the nearest 1 amp) flow for 20.0 min. through a solution of copper(II) nitrate, how many moles of Cu are plated?

9. Calculate the mass of silver metal which can be deposited if a 5.12 amp current is passed through a silver nitrate solution for 2.00 hours.

10. How many amps are required to deposit 0.504 g of iron metal in 40.0 min. by passing the current through a solution of iron(II) acetate?

Answers:

1. (in order shown in each compound)

(a) +1,-1 (b) +4,-2 (c) +5,-2 (d) +2,-2 (e) +6,-2 (f) +1,+7,-2
(g) +3,+6,-2 (h) +1,+5,-2 (i) +1,+1,+5,-2 (j) +1,+2,-2

2. (a) Cr is RA, ox; Sn^{4+} is OA, red

(b) Al is RA, ox; H^+ is OA, red

(c) Zn is RA, ox; Ag^+ is OA, red

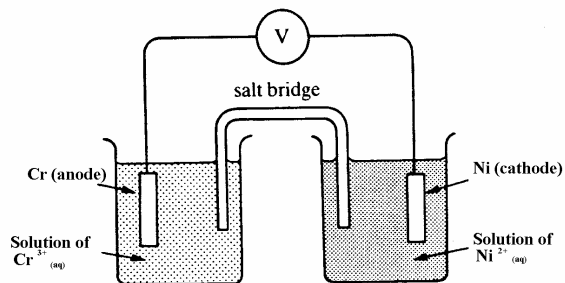
(d) NO_3^- is OA, red; S is RA, ox

(e) Br_2 is OA, red; SO_3^{2-} is RA, ox

(f) Fe^{2+} is RA, ox; MnO_4^- is OA, red

(g) IO_3^- is OA, red; H_2S is RA, ox

3.



$$E^{\circ} = +0.49 \text{ v}$$

4. (a) +1.66 v, spon

(b) -0.54 v, non-spon

(c) +0.74 v, spon

(d) -1.23 v, non-spon

5. (a) Cu at cathode, Br_2 at anode (b) Pb at cathode, O_2 at anode

(c) H_2 at cathode, O_2 at anode (d) H_2 at cathode, I_2 at anode

(e) Co at cathode, Cl_2 and O_2 at anode

6. 55.9 g Fe

7. 2.94 g

8. 0.062 mol Cu

9. 41.2 g Ag

10. 0.726 amp