1. Which metal will react spontaneously with HCl(aq)?

a. Au b. Ag c. Cu d. Mn

2. Given the reaction: Sn2+(aq) + Fe3+(aq) Sn+4(aq) + Fe0 (aq), the total number of moles of electrons lost by 1 mole of Sn2+ in the half-reaction is:

a. 1 b. 2 c. 3 d. 4

3. Given the redox reaction: Sn2+(aq) + Fe3+(aq) Sn+4(aq) + Fe0 (aq), the total number of moles Sn2+ needed is:

a. 1 b. 2 c. 3 d. 4

4. What is oxidation number of sulfur in H2SO4?

a. 0 b. -2 c. +6 d. +4

5. In the reaction: 4HCl + MnO2 🡪 MnCl2 + 2H2O + Cl2, the manganese is:

a. reduced and the oxidation number changes from +4 to +2

b. oxidized and the oxidation number changes from +4 to +2

c. reduced and the oxidation number changes from +2 to +4

d. oxidized and the oxidation number changes from +2 to +4

6. In the reaction: 2Na + 2H2O🡪 2Na+ + 2OH- + H2, the substance oxidized is:

a. H2 b. H+ c. Na d. Na+

7. Given the reaction: 3Cu + 8HNO3 🡪 3Cu(NO3)2 + 2NO + 4H2O, the reducing agent is:

a. Cu0 b. N+5 c. Cu+2 d. N+2

8. What is the voltage for a chemical cell that has reached equilibrium?

a. 1 b. greater than 1 c. between 0 and 1 d. 0

9. Which atom-ion pair will react spontaneously under standard conditions?

a. Mg + Li+ b. Mg + Ag+ c. Mg + Ba+2 d. Mg + Sr+2

10. During the electrolysis of fused KBr, which reaction occurs at the positive electrode?

a. Br- ions are oxidized c. K+ ions are oxidized

b. Br- ions are reduced d. K+ ions are reduced

11. Given the reaction: Sn2+(aq) + Fe3+(aq) Sn+4(aq) + Fe2+ (aq), the oxidizing agent is:

a. Sn2+ b. Fe+3 c. Sn+4 d. Fe+2

12. In a chemical cell composed of two half-cells, ions are allowed to flow from one half-cell to another by means of

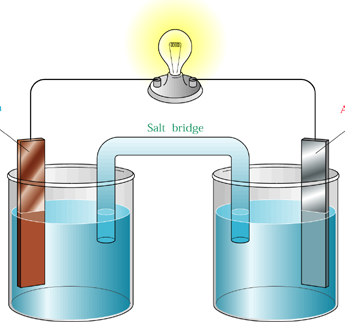
a. electrodes c. a voltmeter

b. an external conductor d. a salt bridge

13. Which will oxidize Zn(s) to Zn2+, but will not oxidize Pb(s) to Pb2+?

a. Al3+ b. Au+3 c. Co+2 d. Mg2+

Base questions 14-20 on the following diagram:



copper

aluminum

14. What type of electrochemical cell is shown?

a. voltaic b. electrolytic c. electroplating d. recharging

15. Which electrode is the anode and what sign does it have?

a. aluminum (+) b. copper (+) c. aluminum (-) d. copper (-)

16. Which direction will the electrons flow in this cell?

a. from the cathode to the light to the anode

b. from the anode to the light to the cathode

c. from the anode through the salt bridge to the cathode

d. from the cathode through the salt bridge to the anode

17. The maximum potential (E0cell) for the electrochemical cell will be

a. +1.32 volts b. +2.00 volts c. -1.32 volts d. -2.00 volts

18. What is the half reaction at the copper electrode?

a. Cu+2 + 2e- 🡪 Cu0 c. Cu0 🡪 Cu+2 + 2 e-

b. Al+3 + 3e- 🡪 Al0 d. Al0 🡪 Al+3 + 3 e-

### 19. Which statement is true of this reaction?

a. Al is the oxidizing agent c. Cu is the reducing agent

b. Al+3 is the reducing agent d. Cu+2 is the oxidizing agent

### 20. What will be attracted to the aluminum electrode?

a. cations b. Al atoms c. anions d. Cu atoms

Base questions 21-27 on the following diagram:

### 

A

B

21. What type of electrochemical cell is shown?

a. voltaic b. electrolytic c. electroplating d. recharging

22. Which electrode is the anode and what sign does it have?

a. A (+) b. B (+) c. A (-) d. B (-)

23. Where does oxidation take place in this cell?

a. anode (B) c. cathode (B)

b. anode (A) d. cathode (A)

24. What is the half reaction at the electrode A?

a. 2H+ + 2e- 🡪 H20 c. 2O-2 🡪 O20 + 4e-

b. 2H2O([*l*](https://en.wikipedia.org/wiki/Liquid)) → O2(*g*) + 4H+(*aq*) + 4e− d. H20 🡪 2H+ + 2e-

25. What is the maximum potential (E0cell) for the electrochemical cell to split water into its elements (assume water is oxidized and hydrogen is reduced).

a. +1.23 volts b. +0.40 volts c. -1.23 volts d. -2.06 volts

### 26. Which statement is true of this reaction?

a. the reaction is spontaneous c. H2 and O2 combine to form water

b. the cell powers the battery d. the reaction is nonspontaneous

### 27. How many moles of electrons are required to oxidize water 2H2O([*l*](https://en.wikipedia.org/wiki/Liquid)) → O2(*g*) + 4H+(*aq*)?

a. 2 b. 4 c. 6 d. 8

Base questions 28-32 on the following diagram:

### 

28. What type of electrochemical cell is shown?

a. voltaic b. electrolytic c. electroplating d. recharging

29. In the electrochemical cell above, the copper electrode is

a. the anode (+) where oxidation occurs c. the anode (+) that gets coated by Cu

b. the anode (-) where oxidation occurs d. the anode (-) that gets coated by Cu

30. Which metal (Me) would not work in this electrochemical cell?

a. Hg b. Ag c. Au d. Mg

31. What is the half reaction at the cathode if Ag is the metal?

a. Ag+ + e- 🡪 Ag0 c. Cu+2 + 2e- 🡪 Cu0

b. Ag0 🡪 Ag+ + e- d. Cu0 🡪 Cu+2 + 2e-

32. What voltage (E0cell) is needed for copper to coat silver in this cell?

a. 1.14 volts b. 0.46 volts c. 1.26 volts d. 1.96 volts

### 33. Electroplating is used for all of the following purposes EXCEPT:

a. prevents corrosion c. increases wear resistance

b. splits a compound into its elements d. enhances the appearance ofan object

34. To electroplate a material, such as iron with silver, the iron must be the

a. cathode and in a solution containing Ag+

b. anode and in a solution containing Ag+

c. cathode and in a solution containing Fe+2

d. anode and in a solution containing Fe+2

35. Which of the following is an oxidation-reduction reaction?

a. 4Na + O2 🡪 2Na2O c. AgNO3 + NaCl 🡪 AgCl + NaNO3

b. 3O2 🡪 2O3 d. KI 🡪 K+ + I-

36. In an electrochemical cell made up of two metals each immersed in solutions of their ions, electrons

a. leave the metal that is more easily oxidized

b. leave the metal that is more easily reduced

c. are picked up by the ion that is more easily oxidized

d. are lost by the ion that is more easily reduced

37. The process of bringing about chemical changes with an electric current is

a. internalizing b. reduction c. oxidation d. electrolysis

38. The electrochemical cell that potentially consists of reversible cell reactions that can regain their cell potential, through the work done by passing currents of electricity

a. voltaic b. electrolytic c. electroplating d. rechargeable batteries

39. Name the type of electrochemical cells from the diagram above.

a. discharging 🡪 voltaic; charging 🡪 electrolytic

b. discharging 🡪 electrolytic; charging 🡪 voltaic

c. discharging 🡪 voltaic; charging 🡪 electroplating

d. discharging 🡪 electrolysis; charging 🡪 electrolytic

40. To recharge a battery,

a. oxidation now occurs at the new cathode that now has a positive charge

b. reduction occurs at the former cathode that now has a positive charge

c. reduction occurs at the former anode that now has a negative charge

d. reduction occurs at the former anode that now has a positive charge

ANSWER KEY

1. d … the most active metal will reduce 2H+ to H20. See SRP chart.

2. b … the oxidation half reaction is: Sn2+(aq) 🡪 Sn+4(aq) + 2e-

3. c … to balance the redox reaction, 6e- are transferred. 3[Sn2+(aq) + 2e- 🡪 Sn+4(aq)]

4. c … (S+6O42-)2- … the oxidation numbers add up to the charge of the polyatomic ion

5. a … Mn+4O22- 🡪 Mn+2Cl2-

6. c … Na0 🡪 Na+ + e-

7. a … Cu0 🡪 Cu+2 + 2 e- … the reducing agent gets oxidized

8. d … equilibrium means that the redox reaction is complete or depleted

9. b … See SRP chart. E0cell = SOP + SRP is greater than 0

10. a … electrolysis splits the compound into its elements: 2K+Br- 🡪 2K0 + Br20. Oxidation occurs at the anode (the positive terminal for electrolysis).

11. b … Fe+3 + e- 🡪 Fe+2 . The oxidizing agent gets reduced.

12. d

13. c … the metal must be less active than Zn, but more active than Pb. See SRP chart.

14. a … voltaic cells are spontaneous redox reactions (lights the bulb)

15. c … Al (- terminal) is the more active metal & will reduce Cu. (See Ref Table N)

16. b … electrons flow from the anode (oxidation) to the cathode (reduction) through the load

17. b … See SRP chart. E0cell = SOP + SRP.

18. a … copper is reduced at the cathode (+)

19. d … since Cu+2 is reduced to Cu0, it is the oxidizing agent

20. c … anions are attracted to the anode in voltaic cells

21. b … note the outside power source (battery) … this is a non-spontaneous redox reaction

22. b … the anode is + for an electrolytic cell

23. a … oxidation always occurs at the anode; anode is (+) in an electrolytic cell

24. a … The negative terminal leads to the cathode (reduction) … gains electrons.

25. c … See SRP chart. E0cell = SOP + SRP. Oxid: 2H2+O-2([*l*](https://en.wikipedia.org/wiki/Liquid)) → O20(*g*) + 4H+(*aq*) + 4e−

26. d … electrolytic cells are non-spontaneous, requiring an outside power source

27. b … 2H2+O-2([*l*](https://en.wikipedia.org/wiki/Liquid)) → O20(*g*) + 4H+(*aq*) + 4e−

28. c

29. a … oxidation always occurs at the anode which is (+) in an electrolytic cell; in electroplating, the cathode is the metal that gets coated

30. d … Mg is a more active metal than copper so copper cannot coat Mg

31. a… reduction (gains e-) occurs at the cathode (the metal being plated with copper)

32. b … SOP (Cu = -0.34 V) + SRP (Ag = +0.80 V)

33. b … electrolysis splits a compound into its elements; electroplating coats a metal

34. a … the material being plated is always at the cathode (reduction) and the plating metal ions (Ag+ in this case) must be in the solution getting reduced: Ag+ + e- 🡪 Ag0

35. a … 4Na0 + O20 🡪 2Na2+O-2 … oxidation state changed

36. a … oxidation involves the release or loss of electrons to the reduced substance

37. d

38. d

39. a

40. c … the voltaic cell (on the left) has a (-) anode and (+) cathode. The electrolytic (recharging) cell has a (+) anode and a (-) cathode because the electrons flow in the opposite direction due to the outside power source. The former anode is now the cathode where reduction takes place. For electrolytic cells, the cathode is (-).