Chem 30 Unit 4 EC1 Practice Test

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

___ 1. What are the oxidation numbers in the compound H₂O₂?
   a. H = +1, O = –2
   b. H = –1, O = –2
   c. H = +2, O = –2
   d. H = +1, O = –1

___ 2. What are the oxidation numbers in the ion SO₃²⁻?
   a. S = +6, O = –2
   b. S = +1, O = –1
   c. S = +4, O = –2
   d. S = 0, O = –1

___ 3. In an oxidation, atoms or ions
   a. increase their oxidation number.
   b. decrease their oxidation number.
   c. do not change their oxidation number.
   d. have a zero oxidation number after the reaction.

___ 4. How does the number of electrons lost in an oxidation compare with the number gained in the simultaneous reduction?
   a. The two numbers are always equal.
   b. The number lost is always greater than the number gained.
   c. The number lost is always less than the number gained.
   d. No relationship exists between the two numbers.

___ 5. A species whose oxidation number decreases in a reaction is
   a. oxidized.
   b. reduced.
   c. electrolyzed.
   d. autooxidized.

___ 6. In the reaction O₂ + 4e⁻ → 2O₂⁻, the species O₂ is
   a. oxidized.
   b. reduced.
   c. electrolyzed.
   d. autooxidized.

___ 7. In the reaction F₂ + Mg → 2F⁻ + Mg²⁺, which species is oxidized?
   a. F₂ only
   b. Mg only
   c. both Mg and F₂
   d. neither Mg nor F₂

___ 8. Which of the following is an oxidation-reduction reaction?
   a. H₂ → 2H
   b. 2O⁻ → O₂²⁻
   c. H₂ + Cl₂ → 2HCl
   d. HCl + NaBr → HBr + NaCl

___ 9. Which of the following substances could be produced from SO₃ only by an oxidation-reduction reaction?
   a. H₂SO₄
   b. H₂SO₃
   c. SF₆
   d. None of the above

___ 10. In a redox reaction, MnO₄⁻ is changed to MnO₄²⁻. How many electrons must be lost or gained by Mn?
    a. none lost or gained
    b. one lost
    c. one gained
    d. two gained
11. In redox reactions,
   a. the oxidizing agent is the substance reduced.
   b. the reducing agent is the substance reduced.
   c. the oxidizing agent is the substance oxidized.
   d. both oxidizing and reducing agents are reduced.

12. When hydrogen peroxide decomposes, usually the only products are
   a. hydrogen and oxygen.  
   b. hydrogen and water.  
   c. oxygen and water.  
   d. oxygen and water.

13. Which of the following reactions is an autooxidation?
   a. \(2\text{NO} \rightarrow \text{N}_2\text{O}_4\)  
   b. \(\text{N}_2\text{O}_3 \rightarrow \text{NO} + \text{NO}\)  
   c. \(2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2\)  
   d. \(\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}\)

14. If the reactants in a spontaneous energy-releasing redox reaction are in direct contact, the energy is released in the form of
   a. light.  
   b. electrical energy.  
   c. heat.  
   d. mechanical energy.

15. Where does reduction take place in an electrochemical cell?
   a. the anode  
   b. the cathode  
   c. the anode or the cathode  
   d. the half-cell

16. The voltage of a voltaic cell is determined by the \(E^0\) value(s) of the
   a. half-reaction at the anode.  
   b. half-reactions at the cathode and anode.  
   c. half-reaction at the cathode.  
   d. standard hydrogen electrode.

17. In which cell does a current drive a nonspontaneous redox reaction?
   a. electrolytic cell  
   b. dry cell  
   c. electrochemical cell  
   d. voltaic cell

18. In an electrolytic cell, oxidation occurs
   a. at the cathode.  
   b. at the anode.  
   c. at either the cathode or the anode.  
   d. between the cathode and the anode.

19. In an electrolytic cell, the cathode
   a. can be either positively or negatively charged.  
   b. is not charged.  
   c. is positively charged.  
   d. is negatively charged.

20. In an electroplating cell, the object to be plated is the
   a. external circuit.  
   b. electrolyte.  
   c. anode.  
   d. cathode.

21. In a cell used to electroplate silver onto an object, Ag\(^+\) is
   a. oxidized at the anode.  
   b. reduced at the anode.  
   c. oxidized at the cathode.  
   d. reduced at the cathode.

22. Electrical energy is provided to a rechargeable cell from an outside source when
   a. it is charging.  
   b. it is discharging.  
   c. its external circuit is not closed.  
   d. the porous barrier is in place.
## Standard Reduction Potentials

<table>
<thead>
<tr>
<th>Half-cell reaction</th>
<th>Standard electrode potential, $E^0$ (in volts)</th>
<th>Half-cell reaction</th>
<th>Standard electrode potential, $E^0$ (in volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{F}_2 + 2e^- \rightarrow \text{F}^-$</td>
<td>+2.87</td>
<td>$\text{Fe}^{3+} + 3e^- \rightarrow \text{Fe}$</td>
<td>−0.04</td>
</tr>
<tr>
<td>$\text{MnO}_4^- + 8\text{H}^+ + 5e^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$</td>
<td>+1.50</td>
<td>$\text{Pb}^{2+} + 2e^- \rightarrow \text{Pb}$</td>
<td>−0.13</td>
</tr>
<tr>
<td>$\text{Au}^{3+} + 3e^- \rightarrow \text{Au}$</td>
<td>+1.50</td>
<td>$\text{Sn}^{2+} + 2e^- \rightarrow \text{Sn}$</td>
<td>−0.14</td>
</tr>
<tr>
<td>$\text{Cl}_2 + 2e^- \rightarrow 2\text{Cl}^-$</td>
<td>+1.36</td>
<td>$\text{Ni}^{2+} + 2e^- \rightarrow \text{Ni}$</td>
<td>−0.26</td>
</tr>
<tr>
<td>$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6e^- \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$</td>
<td>+1.23</td>
<td>$\text{Co}^{2+} + 2e^- \rightarrow \text{Co}$</td>
<td>−0.28</td>
</tr>
<tr>
<td>$\text{MnO}_2 + 4\text{H}^+ + 2e^- \rightarrow \text{Mn}^{2+} + 2\text{H}_2\text{O}$</td>
<td>+1.22</td>
<td>$\text{Cd}^{2+} + 2e^- \rightarrow \text{Cd}$</td>
<td>−0.40</td>
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<tr>
<td>$\text{Br}_2 + 2e^- \rightarrow 2\text{Br}^-$</td>
<td>+1.07</td>
<td>$\text{Fe}^{2+} + 2e^- \rightarrow \text{Fe}$</td>
<td>−0.45</td>
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<tr>
<td>$\text{Hg}^{2+} + 2e^- \rightarrow \text{Hg}$</td>
<td>+0.85</td>
<td>$\text{S} + 2e^- \rightarrow \text{S}^{2-}$</td>
<td>−0.48</td>
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<tr>
<td>$\text{Ag}^+ + e^- \rightarrow \text{Ag}$</td>
<td>+0.80</td>
<td>$\text{Cr}^{3+} + 3e^- \rightarrow \text{Cr}$</td>
<td>−0.74</td>
</tr>
<tr>
<td>$\text{Hg}_2^{2+} + 2e^- \rightarrow 2\text{Hg}$</td>
<td>+0.80</td>
<td>$\text{Zn}^{2+} + 2e^- \rightarrow \text{Zn}$</td>
<td>−0.76</td>
</tr>
<tr>
<td>$\text{Fe}^{3+} + e^- \rightarrow \text{Fe}^{2+}$</td>
<td>+0.77</td>
<td>$\text{Al}^{3+} + 3e^- \rightarrow \text{Al}$</td>
<td>−1.66</td>
</tr>
<tr>
<td>$\text{MnO}_4^- + e^- \rightarrow \text{MnO}_2^{2-}$</td>
<td>+0.56</td>
<td>$\text{Mg}^{2+} + 2e^- \rightarrow \text{Mg}$</td>
<td>−2.37</td>
</tr>
<tr>
<td>$\text{I}_2 + 2e^- \rightarrow 2\text{I}^-$</td>
<td>+0.54</td>
<td>$\text{Na}^+ + e^- \rightarrow \text{Na}$</td>
<td>−2.71</td>
</tr>
<tr>
<td>$\text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}$</td>
<td>+0.34</td>
<td>$\text{Ca}^{2+} + 2e^- \rightarrow \text{Ca}$</td>
<td>−2.87</td>
</tr>
<tr>
<td>$\text{Cu}^{2+} + e^- \rightarrow \text{Cu}^+$</td>
<td>+0.15</td>
<td>$\text{Ba}^{2+} + 2e^- \rightarrow \text{Ba}$</td>
<td>−2.91</td>
</tr>
<tr>
<td>$\text{S} + 2\text{H}^+(aq) + 2e^- \rightarrow \text{H}_2\text{S}(aq)$</td>
<td>+0.14</td>
<td>$\text{K}^+ + e^- \rightarrow \text{K}$</td>
<td>−2.93</td>
</tr>
<tr>
<td>$2\text{H}^+(aq) + 2e^- \rightarrow \text{H}_2$</td>
<td>0.00</td>
<td>$\text{Li}^+ + e^- \rightarrow \text{Li}$</td>
<td>−3.04</td>
</tr>
</tbody>
</table>

23. Calculate $E^0$ for the reaction $3\text{Sn}^{2+} + 2\text{Cr} \rightarrow 3\text{Sn} + 2\text{Cr}^{3+}$. Is the reaction spontaneous?

a. $–0.88 \text{ V}$; yes       c. $+0.60 \text{ V}$; yes
b. $+0.88 \text{ V}$; no       d. $+0.60 \text{ V}$; no

24. Calculate $E^0$ for the spontaneous reaction when a Co$^{2+}$/Co half-cell is joined to a Cu$^{2+}$/Cu half-cell. Name the neutral metal produced.

a. $+0.62 \text{ V}$; Cu       c. $+0.06 \text{ V}$; Cu
b. $+0.62 \text{ V}$; Co       d. $+0.06 \text{ V}$; Co

25. In a balanced redox equation, how does the total number of reactant molecules compare with the total number of product molecules?

a. The two numbers are always equal.

b. Reactant molecules are always more numerous.

c. Product molecules are always more numerous.

d. No relationship exists between the two numbers.

26. In a balanced redox equation, how does the total charge of reactants compare with the total charge of products?

a. The two totals are always equal.

b. Total reactant charge is always greater.

c. Total product charge is always greater.

d. No relationship exists between the two totals.

27. In a zinc-copper dry cell, oxidation of

a. zinc occurs at the anode.       c. zinc occurs at the cathode.

b. copper at the anode.          d. copper occurs at the cathode.
28. Which is the most active oxidizing agent among the elements?
   a. cesium  
   b. iodine  
   c. fluorine  
   d. lithium

29. In the figure above, which ion is reduced by Zn but reduces Ag\(^+\) to Ag?
   a. Mg\(^{2+}\)  
   b. F\(^-\)  
   c. Fe\(^{2+}\)  
   d. NO\(_3^-\)

30. In the figure above, which element displaces Cu\(^{2+}\) ions from solution but is displaced by Ni metal when it is in ionic form?
   a. Al  
   b. Ag  
   c. Fe  
   d. Pb

**Short Answer: answer of paper provided (5 marks each)**

31. Balance the following redox reaction:
   \[ \text{FeCl}_2 + \text{KMnO}_4 + \text{HCl} \rightarrow \text{FeCl}_3 + \text{MnCl}_2 + \text{H}_2\text{O} + \text{KCl} \]

32. Balance the following redox reaction that takes place in acidic conditions:
   \[ \text{Cr}_2\text{O}_7^{2-} + \text{SO}_2 \rightarrow \text{Cr}^{3+} + \text{HSO}_4^- \]

33. Balance the following redox equation that takes place in basic conditions:
   \[ \text{Bi}^{3+} + \text{SnO}_2^{2-} \rightarrow \text{Bi} + \text{SnO}_3^{3-} \]
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Answer Section

MULTIPLE CHOICE

1. D
2. C
3. A
4. A
5. B
6. B
7. B
8. C
9. B
10. C
11. A
12. C
13. B
14. C
15. B
16. B
17. A
18. B
19. D
20. D
21. D
22. A
23. C
24. A
25. D
26. A
27. A
28. C
29. C
30. D

SHORT ANSWER

31. 5FeCl₂ + KMnO₄ + 8HCl → 5FeCl₃ + MnCl₂ + 4H₂O + KCl
32. 5H⁺ + Cr₂O₇²⁻ + 3SO₂ → 2Cr³⁺ + 3HSO₄⁻ + H₂O
33. 6OH⁻ + 2Bi³⁺ + 3SnO₂²⁻ → 2Bi + 3SnO₃²⁻ + 3H₂O