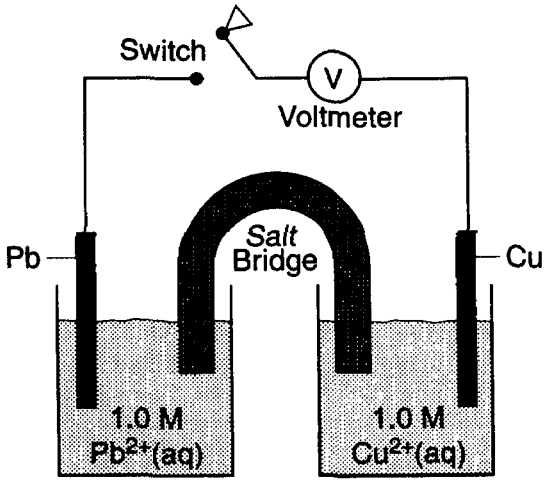
1. In any redox reaction, a reactant can undergo a decrease in oxidation number by
   1) losing electrons, only
   2) gaining electrons, only
   3) losing protons, only
   4) gaining protons, only
2. In the reaction
   $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$,
   which species is reduced?
   1) Mn^{4+}
   2) O^{2-}
   3) H^+
   4) Cl^-
3. Given the reaction:
   $3Ag + Au^{3+} \rightarrow 3Ag^+ + Au$
   Which equation correctly represents the oxidation half-reaction?
   1) $3Ag + 3e^- \rightarrow 3Ag^+$
   2) $3Ag \rightarrow 3Ag^+ + 3e^-$
   3) $Au^{3+} + 3e^- \rightarrow Au$
   4) $Au^{3+} \rightarrow Au + 3e^-$
4. Which half-reaction correctly represents reduction?
   1) $S^{2-} + 2e^- \rightarrow S^0$
   2) $S^{2-} \rightarrow S^0 + 2e^-$
   3) $Mn^{7+} + 3e^- \rightarrow Mn^{4+}$
   4) $Mn^{7+} \rightarrow Mn^{4+} + 3e^-$
5. As an atom of nitrogen gains electrons, its oxidation number
   1) decreases
   2) increases
   3) remains the same
6. Which half-reaction correctly represents oxidation?
   1) $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$
   2) $Fe^{2+}(aq) \rightarrow Fe(s) + 2e^-$
   3) $Fe(s) + 2e^- \rightarrow Fe^{2+}(aq)$
   4) $Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$
7. In the reaction
   $Cl_2 + H_2O \rightarrow HClO + HCl$,
   the Cl_2 is
   1) oxidized, only
   2) reduced, only
   3) both oxidized and reduced
   4) neither oxidized nor reduced
8. Which equation correctly represents reduction?
   1) $Na^+ + 1e^- \rightarrow Na^0$
   2) $Na^+ \rightarrow Na^0 + 1e^-$
   3) $Cl^- + 1e^- \rightarrow Cl^0$
   4) $Cl^- \rightarrow Cl^0 + 1e^-$
9. As a sodium atom is oxidized, the number of protons in its nucleus
   1) decreases
   2) increases
   3) remains the same
10. Given the reaction:
    $2Fe^{3+} + Sn^{2+} \rightarrow 2Fe^{2+} + Sn^{4+}$
    Which species is reduced?
    1) Fe^{3+}
    2) Sn^{2+}
    3) Fe^{2+}
    4) Sn^{4+}
11. Which half-reaction correctly represents oxidation?
    1) $Sn^{2+} + 2e^- \rightarrow Sn^0$
    2) $Sn^{4+} + 2e^- \rightarrow Sn^{2+}$
    3) $Sn^{2+} \rightarrow Sn^0 + 2e^-$
    4) $Sn^{2+} \rightarrow Sn^{4+} + 2e^-$
12. In the reaction
    $Al^0 + Cr^{3+} \rightarrow Al^{3+} + Cr^0$,
    the species oxidized is
    1) Al^0
    2) Cr^{3+}
    3) Al^{3+}
    4) Cr^0
13. A redox reaction always involves
    1) a change in oxidation number
    2) a change of phase
    3) the transfer of protons
    4) the formation of ions
14. Given the reaction:
    $Fe(s) + Sn^{4+}(aq) \rightarrow Fe^{2+}(aq) + Sn^{2+}(aq)$ The specie reduced is
    1) Fe(s)
    2) $Sn^{4+}(aq)$
    3) $Fe^{2+}(aq)$
    4) $Sn^{2+}(aq)$
15. A redox reaction is a reaction in which
    1) only reduction occurs
    2) only oxidation occurs
    3) reduction and oxidation occur at the same time
    4) reduction occurs first and then oxidation occurs
16. In a redox reaction, how does the total number of electrons lost by the oxidized substance compare to the total number of electrons gained by the reduced substance?
    1) The number lost is always greater than the number gained.
    2) The number lost is always equal to the number gained.
    3) The number lost is sometimes equal to the number gained.
    4) The number lost is sometimes less than the number gained.
17. Which change in oxidation number represents reduction?
    1) –1 to +1
    2) –1 to –2
    3) –1 to +2
    4) –1 to 0
18. In the chemical cell reaction
    $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$,
    which species is oxidized?
    1) Zn(s)
    2) $Cu^{2+}(aq)$
    3) Cu(s)
    4) $Zn^{2+}(aq)$
19. Given the reaction:
    $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
    Which substance is oxidized?
    1) Zn(s)
    2) HCl(aq)
    3) $Cl^-(aq)$
    4) $H^+(aq)$
20. Which particles are gained and lost during a redox reaction?
    1) electrons
    2) protons
    3) neutrons
    4) positrons
21. Which oxidation number change could occur during an oxidation of an element?
    1) +1 to –1
    2) –2 to –3
    3) +3 to + 1
    4) +2 to +3

22. Which half-reaction correctly represents reduction?
    1) $Cr^{3+} + 3e^- \rightarrow Cr(s)$
    2) $Cr^{3+} \rightarrow Cr(s) + 3e^-$
    3) $Cr(s) \rightarrow Cr^{3+} + 3e^-$
    4) $Cr(s) + 3e^- \rightarrow Cr^{3+}$
23. Given the redox reaction:
    $2I^-(aq) + Br_2(\ell) \rightarrow 2Br^-(aq) + I_2(s)$
    What occurs during this reaction?
    1) The I^- ion is oxidized, and its oxidation number increases.
    2) The I^- ion is oxidized, and its oxidation number decreases.
    3) The I^- ion is reduced, and its oxidation number increases.
    4) The I^- ion is reduced, and its oxidation number decreases.
24. Which occurs in the half-reaction
    $Na(s) \rightarrow Na^+ + e^-$?
    1) Na(s) is reduced.
    2) Na(s) is oxidized.
    3) Na(s) gains electrons.
    4) Na^+ is oxidized.
25. In the reaction
    $2Al + 3Ni(NO_3)_2 \rightarrow 2Al(NO_3)_3 + 3Ni$,
    the aluminum is
    1) reduced and its oxidation number increases
    2) reduced and its oxidation number decreases
    3) oxidized and its oxidation number increases
    4) oxidized and its oxidation number decreases
26. Given the reaction:
    $Sn^{2+}(aq) + 2Fe^{3+}(aq) \rightarrow Sn^{4+}(aq) + 2Fe^{2+}(aq)$
    The species reduced in this reaction is
    1) Sn^{2+}
    2) Fe^{3+}
    3) Sn^{4+}
    4) Fe^{2+}
27. Given the redox reaction:

    $$2Cr(s) + 3Sn^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Sn(s)$$

    Which species serves as the reducing agent?
    1) Cr
    2) Sn^{2+}
    3) Cr^{3+}
    4) Sn
28. In the reaction
    $Ca + NiCl_2 \rightarrow CaCl_2 + Ni$,
    the oxidation number of the chlorine
    1) decreases
    2) increases
    3) remains the same
29. In a redox reaction, there is a conservation of
    1) mass, only
    2) charge, only
    3) both mass and charge
    4) neither mass nor charge
30. In the reaction
    $2Al(s) + 3Fe^{2+}(aq) \rightarrow 2Al^{3+}(aq) + 3Fe^0(s)$,
    the species oxidized is
    1) Al(s)
    2) $Al^{3+}(aq)$
    3) Fe(s)
    4) $Fe^{2+}(aq)$
31. Which half-reaction correctly represents oxidation?
    1) $Mg + 2e^- \rightarrow Mg^{2+}$
    2) $Mg^{2+} + 2e^- \rightarrow Mg$
    3) $Mg^{2+} \rightarrow Mg + 2e^-$
    4) $Mg \rightarrow Mg^{2+} + 2e^-$
32. Base your answer to the following question on the diagram of a chemical cell and the equation below. The reaction occurs at 1 atmosphere and 298 K.



$Pb(s) + Cu^{2+}(aq) \longrightarrow Pb^{2+}(aq) + Cu(s)$

    Which change occurs when the switch is closed?
    1) Pb is oxidized, and electrons flow to the Cu electrode.
    2) Pb is reduced, and electrons flow to the Cu electrode.
    3) Cu is oxidized, and electrons flow to the Pb electrode.
    4) Cu is reduced, and electrons flow to the Pb electrode.
33. In a chemical reaction, as a species is oxidized, its oxidation number
    1) decreases
    2) increases
    3) remains the same
34. Which change occurs when an Sn^{2+} ion is oxidized?
    1) Two electrons are lost.
    2) Two electrons are gained.
    3) Two protons are lost.
    4) Two protons are gained.
35. As a Ca atom undergoes oxidation to Ca^{2+}, the number of neutrons in its nucleus
    1) decreases
    2) increases
    3) remains the same
36. In the half-reaction
    $Pb^0 \rightarrow Pb^{2+} + 2e^-$, the Pb^0
    1) gains protons
    2) loses protons
    3) is oxidized
    4) is reduced
37. In the reaction
    $Mg + 2HCl \rightarrow MgCl_2 + H_2$,
    the magnesium
    1) gains electrons and is reduced
    2) gains electrons and is oxidized
    3) loses electrons and is reduced
    4) loses electrons and is oxidized

38. All redox reactions involve
    1) the gain of electrons, only
    2) the loss of electrons, only
    3) both the gain and the loss of electrons
    4) neither the gain nor the loss of electrons
39. Which half-reaction correctly represents reduction?
    1) $Sn \rightarrow Sn^{2+} + 2e^-$
    2) $Sn^{2+} \rightarrow Sn^{4+} + 2e^-$
    3) $Sn + 2e^- \rightarrow Sn^{2+}$
    4) $Sn^{4+} + 2e^- \rightarrow Sn^{2+}$
40. In the half-cell reaction, $Ba^0 \rightarrow Ba^{2+} + 2e^-$, which is true of the barium atom?
    1) It gains protons.
    2) It loses protons.
    3) It gains electrons.
    4) It loses electrons.
41. In the equation:
    $Cu(s) + 2Ag^+(aq) \leftrightarrow Cu^{2+}(aq) + 2Ag(s)$
    the oxidizing agent is
    1) Cu^0
    2) Ag^+
    3) Cu^{2+}
    4) Ag^0
42. Given the cell reaction:
    $Ca(s) + Mg^{2+}(aq) \rightarrow Ca^{2+}(aq) + Mg(s)$
    Which substance was oxidized?
    1) Ca(s)
    2) $Mg^{2+}(aq)$
    3) $Ca^{2+}(aq)$
    4) Mg(s)
43. For a redox reaction to occur, there must be a transfer of
    1) protons
    2) neutrons
    3) electrons
    4) ions
44. Given the reaction:
    $Sn^{4+} + 2e^- \rightarrow Sn^{2+}$
    This reaction can be classified as
    1) a reduction reaction, because there is a decrease in oxidation number
    2) a reduction reaction, because there is an increase in oxidation number
    3) an oxidation reaction, because there is a decrease in oxidation number
    4) an oxidation reaction, because there is an increase in oxidation number
45. Which half-reaction represents reduction?
    1) $Ca^0 \rightarrow Ca^{2+} + 2e^-$
    2) $Cl_2^0 - 2e \rightarrow 2Cl^+$
    3) $Ca^{2+} + 2e \rightarrow Ca^0$
    4) $2Cl^- \rightarrow Cl_2^0 + 2e^-$
46. In the reaction:
    $2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$
    What is reduced?
    1) $Fe^{2+}(aq)$
    2) $Fe^{3+}(aq)$
    3) $I^-(aq)$
    4) $I_2(s)$
47. Given the reaction:

    $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

    The oxidation number of Zn(*s*) increases because it
    1) loses electrons
    2) gains electrons
    3) loses protons
    4) gains protons
48. Which is true when an Sn^{2+} ion is reduced?
    1) Its oxidation number increases.
    2) It gains electrons.
    3) Its mass decreases.
    4) It acts as a reducing agent.
49. Given the reaction:
    $2Li(s) + Cl_2(g) \rightarrow 2LiCl(s)$
    As the reaction takes place, the $Cl_2(g)$ will
    1) gain electrons
    2) lose electrons
    3) gain protons
    4) lose protons
50. Which half-reaction correctly represents a reduction reaction?
    1) $Sn^0 + 2e^- \rightarrow Sn^{2+}$
    2) $Na^0 + e^- \rightarrow Na^+$
    3) $Li^0 + e^- \rightarrow Li^+$
    4) $Br_2^0 + 2e^- \rightarrow 2Br^-$

Answer Key

1. 2
2. 1
3. 2
4. 3
5. 1
6. 1
7. 3
8. 1
9. 3
10. 1
11. 4
12. 1
13. 1
14. 2
15. 3
16. 2
17. 2
18. 1
19. 1
20. 1
21. 4
22. 1
23. 1
24. 2
25. 3
26. 2
27. 1
28. 3
29. 3
30. 1
31. 4
32. 1
33. 2
34. 1
35. 3
36. 3
37. 4
38. 3
39. 4
40. 4
41. 2
42. 1
43. 3
44. 1
45. 3
46. 2
47. 1
48. 2
49. 1
50. 4