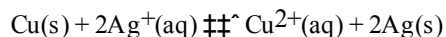
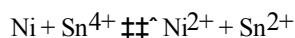


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- 1) Which of the following statements describes what occurs in the following redox reaction?



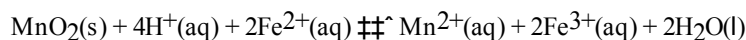
- A) Only charge is conserved. C) Both mass and charge are conserved.
B) Neither mass nor charge is conserved. D) Only mass is conserved.
- 2) A redox reaction is a reaction in which
A) reduction occurs first and then oxidation occurs C) only oxidation occurs
B) reduction and oxidation occur at the same time D) only reduction occurs
- 3) In the reaction $\text{Zn} + \text{Cu}^{2+} \rightleftharpoons \text{Zn}^{2+} + \text{Cu}$, the Cu^{2+} ions
A) gain protons B) lose protons C) gain electrons D) lose electrons
- 4) In the reaction $\text{Mg} + \text{Cl}_2 \rightleftharpoons \text{MgCl}_2$, the correct half-reaction for the oxidation that occurs is
A) $\text{Cl}_2 \rightleftharpoons 2\text{Cl}^- + 2\text{e}^-$ C) $\text{Mg} \rightleftharpoons \text{Mg}^{2+} + 2\text{e}^-$
B) $\text{Cl}_2 + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$ D) $\text{Mg} + 2\text{e}^- \rightleftharpoons \text{Mg}^{2+}$
- 5) All redox reactions involve
A) both the gain and the loss of electrons C) the loss of electrons, only
B) neither the loss nor the gain of electrons D) the gain of electrons, only
- 6) As the elements in Period 3 of the Periodic Table are considered in order of increasing atomic number, the ability of each successive element to act as a reducing agent
A) remains the same B) increases C) decreases
- 7) Which of the following statements correctly describes a redox reaction?
A) The oxidation half-reaction occurs before the reduction half-reaction.
B) The oxidation half-reaction and the reduction half-reaction occur simultaneously.
C) The oxidation half-reaction occurs spontaneously but the reduction half-reaction does not.
D) The oxidation half-reaction occurs after the reduction half-reaction.
- 8) Given the redox reaction:



Which species is oxidized?

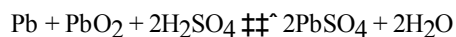
- A) Sn^{2+} B) Ni^{2+} C) Sn^{4+} D) Ni
- 9) Given the oxidation-reduction reaction:
- $$\text{Hg}^{2+} + 2\text{I}^- \rightleftharpoons \text{Hg(l)} + \text{I}_2(\text{s})$$
- Which situation correctly represents the half-reaction for the reduction that occurs?
A) $2\text{I}^- + 2\text{e}^- \rightleftharpoons \text{I}_2(\text{s})$ C) $\text{Hg}^{2+} \rightleftharpoons \text{Hg(l)} + 2\text{e}^-$
B) $\text{Hg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Hg(l)}$ D) $2\text{I}^- \rightleftharpoons \text{I}_2(\text{s}) + 2\text{e}^-$
- 10) When Fe^{3+} is reduced to Fe^{2+} , the Fe^{3+} ion
A) loses 1 proton B) gains 1 proton C) loses 1 electron D) gains 1 electron
- 11) In the reaction $2\text{Fe}^{3+} + \text{S}^{2-} \rightleftharpoons 2\text{Fe}^{2+} + \text{S}^0$, the species oxidized is
A) S^0 B) Fe^{3+} C) S^{2-} D) Fe^{2+}
- 12) The reaction $\text{CuO} + \text{CO} \rightleftharpoons \text{CO}_2 + \text{Cu}$ is an example of
A) both oxidation and reduction C) oxidation, only
B) neither oxidation nor reduction D) reduction, only

- 13) Which change occurs when an Sn^{2+} ion is oxidized?
 A) Two electrons are lost. C) Two protons are lost.
 B) Two protons are gained. D) Two electrons are gained.
- 14) Which half-reaction correctly represents reduction?
 A) $\text{Ca}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ca}$ B) $\text{Ca}^+ \rightleftharpoons \text{Ca} + 2\text{e}^-$ C) $2\text{F}^- \rightleftharpoons \text{F}_2 + 2\text{e}^-$ D) $2\text{F}^- + 2\text{e}^- \rightleftharpoons \text{F}_2$
- 15) In the reaction $\text{Zn} + \text{Cu}^{2+} \rightleftharpoons \text{Zn}^{2+} + \text{Cu}$, the oxidizing agent
 A) loses electrons B) gains protons C) is reduced D) is oxidized
- 16) Given the reaction:



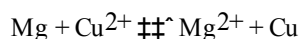
Which species is oxidized?

- A) $\text{H}_2\text{O}(\text{l})$ B) $\text{MnO}_2(\text{s})$ C) $\text{Fe}^{2+}(\text{aq})$ D) $\text{H}^+(\text{aq})$
- 17) Given the equation for the discharge of a lead-acid battery:



Which substance is oxidized?

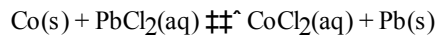
- A) PbO_2 B) PbSO_4 C) Pb D) H_2SO_4
- 18) In the reaction $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{H}_2\text{O}(\text{g})$, the oxidizing agent is
 A) O^{2-} B) H^+ C) O_2 D) H_2
- 19) In the reaction $2\text{K} + \text{Cl}_2 \rightleftharpoons 2\text{KCl}$, the species oxidized is
 A) Cl^- B) K^+ C) Cl_2 D) K
- 20) In the reaction $\text{Zn}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightleftharpoons \text{Zn}^{2+}(\text{aq}) + \text{Cu}(\text{s})$, the reducing agent is
 A) $\text{Zn}^{2+}(\text{aq})$ B) $\text{Cu}(\text{s})$ C) $\text{Zn}(\text{s})$ D) $\text{Cu}^{2+}(\text{aq})$
- 21) Given the reaction:



Which half-reaction represents the oxidation that occurs?

- A) $\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$ C) $\text{Mg}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mg}$
 B) $\text{Mg} \rightleftharpoons \text{Mg}^{2+} + 2\text{e}^-$ D) $\text{Cu} \rightleftharpoons \text{Cu}^{2+} + 2\text{e}^-$
- 22) Which of the following is a redox reaction?
 A) $2\text{KBr} + \text{F}_2 \rightleftharpoons 2\text{KF} + \text{Br}_2$ C) $2\text{NaCl} + \text{H}_2\text{SO}_4 \rightleftharpoons \text{Na}_2\text{SO}_4 + 2\text{HCl}$
 B) $\text{Ca}(\text{OH})_2 + \text{Pb}(\text{NO}_3)_2 \rightleftharpoons \text{Ca}(\text{NO}_3)_2 + \text{Pb}(\text{OH})_2$ D) $2\text{HCl} + \text{Mg}(\text{OH})_2 \rightleftharpoons 2\text{HOH} + \text{MgCl}_2$
- 23) When 1 mole of Sn^{4+} ions is reduced to 1 mole of Sn^{2+} ions, 2 moles of electrons are
 A) gained by Sn^{4+} B) gained by Sn^{2+} C) lost by Sn^{2+} D) lost by Sn^{4+}
- 24) In the reaction $\text{Zn} + \text{Fe}^{2+} \rightleftharpoons \text{Zn}^{2+} + \text{Fe}$, the reducing agent is
 A) Fe^{2+} B) Fe C) Zn D) Zn^{2+}
- 25) For a redox to occur, there must be a transfer of
 A) ions B) electrons C) protons D) neutrons
- 26) What is the oxidizing agent in the reaction $\text{Zn}^0 + 2\text{Ag}^+ \rightleftharpoons \text{Zn}^{2+} + 2\text{Ag}^0$?
 A) Zn^{2+} B) Ag^0 C) Ag^+ D) Zn^0

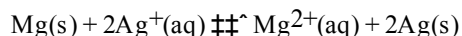
27) Given the redox reaction:



Which of the following statements correctly describes the oxidation and reduction that occur?

- A) Co(s) is reduced and $\text{Pb}^{2+}(\text{aq})$ is oxidized. C) Co(s) is oxidized and $\text{Pb}^{2+}(\text{aq})$ is reduced.
 B) Co(s) is oxidized and $\text{Cl}^-(\text{aq})$ is reduced. D) Co(s) is reduced and $\text{Cl}^-(\text{aq})$ is oxidized.

28) Which species undergoes a loss of electrons?



- A) Mg(s) B) Ag(s) C) $\text{Ag}^+(\text{aq})$ D) $\text{Mg}^{2+}(\text{aq})$

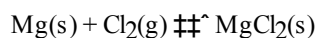
29) Which half-reaction correctly represents reduction?

- A) $\text{H}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{H}^+(\text{aq})$ C) $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Cu(s)}$
 B) $\text{I}_2(\text{s}) \rightleftharpoons 2\text{I}^-(\text{aq}) + 2\text{e}^-$ D) $\text{Al(s)} \rightleftharpoons \text{Al}^{3+}(\text{aq}) + 3\text{e}^-$

30) Which half-cell reaction correctly represents oxidation?

- A) $\text{Pb} + 2\text{e}^- \rightleftharpoons \text{Pb}^{2+}$ B) $\text{Pb}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pb}$ C) $\text{Pb}^{2+} \rightleftharpoons \text{Pb} + 2\text{e}^-$ D) $\text{Pb} \rightleftharpoons \text{Pb}^{2+} + 2\text{e}^-$

31) Given the reaction:



Which half-reaction correctly represents the reduction that occurs?

- A) $\text{Mg}^{2+} \rightleftharpoons \text{Mg(s)} + 2\text{e}^-$ C) $\text{Cl}_2(\text{g}) + 2\text{e}^- \rightleftharpoons 2\text{Cl}^-$
 B) $2\text{Cl}^- \rightleftharpoons \text{Cl}_2(\text{g}) + 2\text{e}^-$ D) $\text{Mg(s)} + 2\text{e}^- \rightleftharpoons \text{Mg}^{2+}$

32) Which of the following is an oxidation-reduction reaction?

- A) $\text{KI} \rightleftharpoons \text{K}^+ + \text{I}^-$ C) $4\text{Na} + \text{O}_2 \rightleftharpoons 2\text{Na}_2\text{O}$
 B) $\text{AgNO}_3 + \text{NaCl} \rightleftharpoons \text{AgCl} + \text{NaNO}_3$ D) $3\text{O}_2 \rightleftharpoons 2\text{O}_3$

33) Given the reaction:



In this reaction, the K^+ ions are

- A) oxidized by gaining electrons C) reduced by gaining electrons
 B) oxidized by losing electrons D) reduced by losing electrons

34) In the reaction $4\text{NH}_3 + 5\text{O}_2 \rightleftharpoons 4\text{NO} + 6\text{H}_2\text{O}$, the oxidation number of nitrogen changes from

- A) -2 to -3 B) -3 to +2 C) -2 to +3 D) -3 to -2

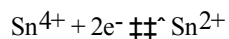
35) Given the reaction:



What is the total number of moles of Ag^+ that can be reduced to Ag by 1 mole of Zn?

- A) 1 B) 2 C) 0.5 D) 4

36) Given the reaction:

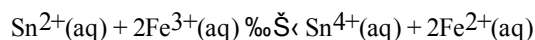


This reaction can be classified as

- A) an oxidation reaction, because there is an increase in oxidation number
 B) a reduction reaction, because there is a decrease in oxidation number
 C) a reduction reaction, because there is an increase in oxidation number
 D) an oxidation reaction, because there is a decrease in oxidation number
- 37) Which equation represents a redox reaction?
 A) $\text{H}_2\text{CO}_3 \rightleftharpoons 3\text{H}_2\text{O} + \text{CO}_2$
 B) $\text{HCl} + \text{KOH} \rightleftharpoons \text{KCl} + \text{H}_2\text{O}$
 C) $\text{NaCl} + \text{AgNO}_3 \rightleftharpoons \text{NaNO}_3 + \text{AgCl}$
 D) $2\text{KClO}_3 \rightleftharpoons 2\text{KCl} + 3\text{O}_2$
- 38) In the reaction $3\text{Cu}^0 + 2\text{NO}_3^- + 8\text{H}^+ \rightleftharpoons 3\text{Cu}^{2+} + 2\text{NO} + 4\text{H}_2\text{O}$, the substance oxidized is
 A) O^{2-}
 B) H^+
 C) N^{2+}
 D) Cu^0
- 39) Which half-reaction correctly represents a reduction reaction?
 A) $\text{Li}^0 + \text{e}^- \rightleftharpoons \text{Li}^+$
 B) $\text{Sn}^0 + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}$
 C) $\text{Br}_2^0 + 2\text{e}^- \rightleftharpoons 2\text{Br}^-$
 D) $\text{Na}^0 + \text{e}^- \rightleftharpoons \text{Na}^+$
- 40) Which species is produced when a hydrogen atom is oxidized?
 A) $\text{H}\cdot$
 B) $\text{H}:\text{H}$
 C) H^+
 D) $\text{H}:\text{H}^-$
- 41) Which oxidation number change could occur during an oxidation half-reaction?
 A) -2 to -3
 B) +1 to -1
 C) +2 to +3
 D) +3 to +1
- 42) Which of the following is a redox reaction?
 A) $\text{Mg}(\text{OH})_2 + 2\text{HCl} \rightleftharpoons \text{MgCl}_2 + 2\text{H}_2\text{O}$
 B) $\text{MgCl}_2 + 6\text{H}_2\text{O} \rightleftharpoons \text{MgCl}_2 + 6\text{H}_2\text{O}$
 C) $\text{Mg} + 2\text{HCl} \rightleftharpoons \text{MgCl}_2 + \text{H}_2$
 D) $\text{Mg}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightleftharpoons \text{Mg}(\text{OH})_2$
- 43) Given the equations *A*, *B*, *C*, and *D*:
- (A) $\text{AgNO}_3 + \text{NaCl} \rightleftharpoons \text{AgCl} + \text{NaNO}_3$
 (B) $\text{Cl}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HClO} + \text{HCl}$
 (C) $\text{CuO} + \text{CO} \rightleftharpoons \text{CO}_2 + \text{Cu}$
 (D) $\text{NaOH} + \text{HCl} \rightleftharpoons \text{NaCl} + \text{H}_2\text{O}$

Which two equations represent redox reactions?

- A) *D* and *B*
 B) *A* and *B*
 C) *B* and *C*
 D) *C* and *A*
- 44) Which half-reaction correctly represents reduction?
 A) $\text{Cr}(\text{s}) + 3\text{e}^- \rightleftharpoons \text{Cr}^{3+}$
 B) $\text{Cr}^{3+} + 3\text{e}^- \rightleftharpoons \text{Cr}(\text{s})$
 C) $\text{Cr}^{3+} \rightleftharpoons \text{Cr}(\text{s}) + 3\text{e}^-$
 D) $\text{Cr}(\text{s}) \rightleftharpoons \text{Cr}^{3+} + 3\text{e}^-$
- 45) In the reaction $\text{Cu} + 2\text{Ag}^+ \rightleftharpoons \text{Cu}^{2+} + 2\text{Ag}$, the oxidizing agent is
 A) Cu
 B) Ag^+
 C) Ag
 D) Cu^{2+}
- 46) What is the oxidizing agent in the reaction $2\text{Fe}^{2+} + \text{Cl}_2 \rightleftharpoons 2\text{Fe}^{3+} + 2\text{Cl}^-$?
 A) Cl^-
 B) Fe^{2+}
 C) Fe^{3+}
 D) Cl_2
- 47) Given the reaction:



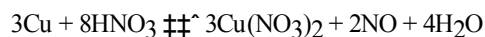
The total number of moles of electrons lost by 1 mole of Sn^{2+} is

- A) 1
 B) 2
 C) 3
 D) 4

- 48) In the reaction $\text{Ni} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{NiSO}_4$, each nickel atom
- A) gains one electron, only
B) gains two electrons
C) loses two electrons
D) loses one electron, only
- 49) What occurs in the half-reaction $\text{Na(s)} \rightarrow \text{Na}^+ + \text{e}^-$?
- A) Na^+ is oxidized.
B) Na(s) gains electrons.
C) Na(s) is oxidized.
D) Na(s) is reduced.
- 50) Given the reaction:
- $$\text{Zn(s)} + 2\text{H}^+(\text{aq}) + 2\text{Cl}^-(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq}) + \text{H}_2(\text{g})$$
- Which species is oxidized?
- A) $\text{H}^+(\text{aq})$
B) $\text{H}_2(\text{g})$
C) Zn(s)
D) $\text{Cl}^-(\text{aq})$
- 51) Which half-reaction correctly represents reduction?
- A) $2\text{I}^- \rightarrow \text{I}_2^0 + 2\text{e}^-$
B) $\text{Cr}^{3+} + 3\text{e}^- \rightarrow \text{Cr}^0$
C) $\text{Cu}^0 \rightarrow \text{Cu}^{2+} + 2\text{e}^-$
D) $\text{Zn}^0 + 2\text{e}^- \rightarrow \text{Zn}^{2+}$
- 52) Given the reaction:
- $$\text{Ca(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Ca}^{2+}(\text{aq}) + \text{Cu(s)}$$
- Which represents the correct half-reaction for the reduction that occurs?
- A) $\text{Cu(s)} \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$
B) $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu(s)}$
C) $\text{Cu(s)} + 2\text{e}^- \rightarrow \text{Cu}^{2+}(\text{aq})$
D) $\text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)} + 2\text{e}^-$
- 53) Based on the *Activity Series* chemistry reference table, which element is the *strongest* reducing agent?
- A) Fe
B) Cr
C) Sr
D) Cu
- 54) Which half-reaction correctly represents the oxidation which occurs in the reaction $\text{Cl}_2 + 2\text{Br}^-(\text{aq}) \rightarrow 2\text{Cl}^-(\text{aq}) + \text{Br}_2$?
- A) $\text{Cl}_2 \rightarrow 2\text{Cl}^- + 2\text{e}^-$
B) $2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$
C) $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$
D) $2\text{Br}^- + 2\text{e}^- \rightarrow \text{Br}_2$
- 55) In the reaction $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{Na}^+ + 2\text{OH}^- + \text{H}_2$, the substance oxidized is
- A) Na^+
B) H_2
C) Na
D) H^+
- 56) An oxide ion is oxidized to an oxygen atom by
- A) gaining protons
B) gaining electrons
C) losing electrons
D) losing protons
- 57) In the chemical cell reaction, $2\text{Al} + 3\text{Ni}^{2+} \rightarrow 2\text{Al}^{3+} + 3\text{Ni}$, which species is reduced?
- A) Ni^{2+}
B) Al
C) Ni
D) Al^{3+}
- 58) Which equation represents an oxidation-reduction reaction?
- A) $\text{H}_2\text{O} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{OH}^-$
B) $\text{H}_2\text{O} + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{OH}^-$
C) $\text{Zn(OH)}_2 + 2\text{HCl} \rightarrow \text{ZnCl}_2 + 2\text{H}_2\text{O}$
D) $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$
- 59) A redox reaction *always* involves
- A) the formation of ions
B) the transfer of protons
C) a change in oxidation number
D) a change of phase
- 60) In the reaction $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$, the oxidation number of sulfur changes from
- A) 0 to -2
B) +2 to +4
C) -2 to +4
D) -2 to +6
- 61) In the reaction $3\text{Zn}^0 + 2\text{Fe}^{3+} \rightarrow 3\text{Zn}^{2+} + 2\text{Fe}^0$, the oxidizing agent is
- A) Fe^0
B) Zn^{2+}
C) Fe^{3+}
D) Zn^0
- 62) In the reaction $2\text{KMnO}_4 + 5\text{SO}_2 + 2\text{H}_2\text{O} \rightarrow \text{K}_2\text{SO}_4 + 2\text{MnSO}_4 + 2\text{H}_2\text{SO}_4$, the oxidation number of manganese changes from
- A) +5 to +2
B) +4 to +3
C) +7 to +2
D) +6 to +3

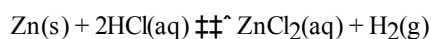
- 63) The reaction $\text{BaCO}_3 \rightarrow \text{BaO} + \text{CO}_2$ involves
- A) reduction, only
B) oxidation, only
C) neither oxidation nor reduction
D) both oxidation and reduction
- 64) In the reaction $2\text{Al} + 3\text{Ni}(\text{NO}_3)_2 \rightarrow 2\text{Al}(\text{NO}_3)_3 + 3\text{Ni}$, the aluminum is
- A) oxidized and its oxidation number decreases
B) reduced and its oxidation number decreases
C) reduced and its oxidation number increases
D) oxidized and its oxidation number increases

- 65) Given the reaction:



The reducing agent is

- A) N^{+5}
B) Cu^0
C) N^{+2}
D) Cu^{+2}
- 66) Given the reaction:

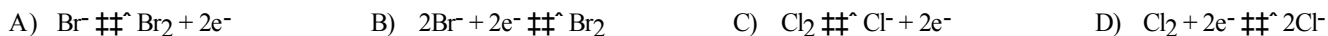


Which equation represents the correct oxidation half-reaction?

- A) $2\text{Cl}^- \rightarrow \text{Cl}_2(\text{g}) + 2\text{e}^-$
B) $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}(\text{s})$
C) $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$
D) $\text{Zn}(\text{s}) \rightarrow \text{Zn}^{2+} + 2\text{e}^-$
- 67) Which of the following is true when an Sn^{2+} ion is reduced?
- A) It acts as a reducing agent.
B) Its mass decreases.
C) Its oxidation number increases.
D) It gains electrons.
- 68) In the reaction $4\text{Zn} + 10\text{HNO}_3 \rightarrow 4\text{Zn}(\text{NO}_3)_2 + \text{NH}_4\text{NO}_3 + 3\text{H}_2\text{O}$, the zinc is
- A) oxidized and the oxidation number changes from +2 to 0
B) reduced and the oxidation number changes from 0 to +2
C) oxidized and the oxidation number changes from 0 to +2
D) reduced and the oxidation number changes from +2 to 0

- 69) In the reaction $\text{Pb} + 2\text{Ag}^+ \rightarrow \text{Pb}^{2+} + 2\text{Ag}$, the Ag^+ is
- A) reduced, and the oxidation number changes from +2 to 0
B) oxidized, and the oxidation number changes from +1 to 0
C) reduced, and the oxidation number changes from +1 to 0
D) oxidized, and the oxidation number changes from 0 to +1

- 70) Which half-reaction shows both the conservation of mass and the conservation of charge?



- 71) Which half-reaction correctly represents reduction?



- 72) In the reaction, $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$, the oxidation number of the manganese



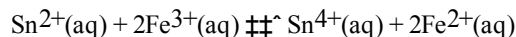
- 73) Which equation represents a redox reaction?



- 74) Which half-reaction correctly represents reduction?



75) Given the reaction:



The oxidizing agent in this reaction is

- A) Fe^{3+} B) Fe^{2+} C) Sn^{2+} D) Sn^{4+}

76) When a substance is oxidized, it

- A) acts as an oxidizing agent C) acts as a reducing agent
 B) loses protons D) gains protons

77) Which half-reaction correctly represents reduction?

- A) $\text{Sn}^{2+} \rightleftharpoons \text{Sn}^{4+} + 2\text{e}^-$ C) $\text{Sn}^{4+} + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}$
 B) $\text{Sn} + 2\text{e}^- \rightleftharpoons \text{Sn}^{2+}$ D) $\text{Sn} \rightleftharpoons \text{Sn}^{2+} + 2\text{e}^-$

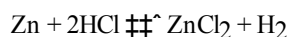
78) In the redox reaction



there is conservation of

- A) mass, only C) neither mass nor charge
 B) both mass and charge D) charge, only

79) Given the reaction:



Which of the following statements *best* describes what happens to the zinc?

- A) The oxidation number changes from +2 to 0, and the zinc is reduced.
 B) The oxidation number changes from +2 to 0, and the zinc is oxidized.
 C) The oxidation number changes from 0 to +2, and the zinc is oxidized.
 D) The oxidation number changes from 0 to +2, and the zinc is reduced.

80) Given the redox reaction:



What occurs during this reaction?

- A) The I^- ion is reduced, and its oxidation number decreases.
 B) The I^- ion is reduced, and its oxidation number increases.
 C) The I^- ion is oxidized, and its oxidation number decreases.
 D) The I^- ion is oxidized, and its oxidation number increases.

81) What is the reducing agent in the reaction $\text{Pb} + 2\text{AgNO}_3 \rightleftharpoons \text{Pb}(\text{NO}_3)_2 + 2\text{Ag}$?

- A) Pb B) Ag C) NO_3^- D) Ag^+

82) In the reaction $2\text{Al}(\text{s}) + 3\text{Cu}^{2+}(\text{aq}) \rightleftharpoons 2\text{Al}^{3+}(\text{aq}) + 3\text{Cu}(\text{s})$, the Al(s)

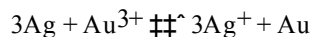
- A) gains electrons B) loses protons C) loses electrons D) gains protons

83) In the reaction $4\text{HCl} + \text{MnO}_2 \rightleftharpoons \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$, the manganese is

- A) oxidized and the oxidation number changes from +4 to +2
 B) oxidized and the oxidation number changes from +2 to +4
 C) reduced and the oxidation number changes from +4 to +2
 D) reduced and the oxidation number changes from +2 to +4

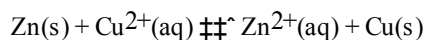
- 84) In any oxidation-reduction reaction, the total number of electrons gained is
- A) unrelated to the total number of electrons lost
 B) less than the total number of electrons lost
 C) greater than the total number of electrons lost
 D) equal to the total number of electrons lost

- 85) Given the reaction:



Which equation correctly represents the oxidation half-reaction?

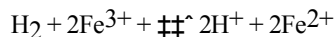
- A) $\text{Au}^{3+} \rightleftharpoons \text{Au} + 3\text{e}^-$
 B) $3\text{Ag} + 3\text{e}^- \rightleftharpoons 3\text{Ag}^+$
 C) $3\text{Ag} \rightleftharpoons 3\text{Ag}^+ + 3\text{e}^-$
 D) $\text{Au}^{3+} + 3\text{e}^- \rightleftharpoons \text{Au}$
- 86) According to the *Activity Series* chemistry reference table, which ion is the *strongest* oxidizing agent?
- A) Al^{3+}
 B) Mg^{2+}
 C) Au^{3+}
 D) Ni^{2+}
- 87) Given the reaction:



What particles must be transferred from one reactant to the other reactant?

- A) electrons
 B) protons
 C) neutrons
 D) ions
- 88) In the reaction $\text{Cl}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HClO} + \text{HCl}$, the hydrogen is
- A) both oxidized and reduced
 B) oxidized, only
 C) neither oxidized nor reduced
 D) reduced, only
- 89) In the reaction $3\text{Cl}_2 + 6\text{NaOH} \rightleftharpoons 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$, Cl_2 undergoes
- A) both oxidation and reduction
 B) neither oxidation nor reduction
 C) oxidation, only
 D) reduction, only
- 90) In the reaction $\text{Zn}^0 + \text{Cu}^{2+} \rightleftharpoons \text{Zn}^{2+} + \text{Cu}^0$, which species is oxidized?
- A) Cu^0
 B) Cu^{2+}
 C) Zn^0
 D) Zn^{2+}
- 91) In the reaction $\text{Pb} + \text{Cu}^{2+} \rightleftharpoons \text{Pb}^{2+} + \text{Cu}$, the Cu^{2+} ions
- A) loses protons
 B) loses electrons
 C) gains electrons
 D) gains protons
- 92) As an S^{2-} ion is oxidized to an S^0 atom, the number of protons in its nucleus
- A) increases
 B) decreases
 C) remains the same
- 93) Which of the following is *not* an oxidation and reduction reaction?
- A) $\text{KOH} + \text{HCl} \rightleftharpoons \text{KCl} + \text{H}_2\text{O}$
 B) $2\text{K} + 2\text{H}_2\text{O} \rightleftharpoons 2\text{KOH} + \text{H}_2$
 C) $2\text{KClO}_3 \rightleftharpoons 2\text{KCl} + 3\text{O}_2$
 D) $2\text{K} + \text{Cl}_2 \rightleftharpoons 2\text{KCl}$
- 94) Which equation represents a redox reaction?
- A) $\text{O}_2 + 2\text{H}_2 \rightleftharpoons 2\text{H}_2\text{O}$
 B) $\text{SO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{SO}_3$
 C) $\text{OH}^- + \text{H}^+ \rightleftharpoons \text{H}_2\text{O}$
 D) $\text{SO}_3^{2-} + 2\text{H}^+ \rightleftharpoons \text{H}_2\text{SO}_3$
- 95) In the reaction $\text{Al} + \text{Cr}^{3+} \rightleftharpoons \text{Al}^{3+} + \text{Cr}$, the reducing agent is
- A) Cr
 B) Cr^{3+}
 C) Al^{3+}
 D) Al
- 96) In the reaction $\text{Zn} + \text{Cu}^{2+} \rightleftharpoons \text{Zn}^{2+} + \text{Cu}$, the reducing agent
- A) loses electrons
 B) gains electrons
 C) gains protons
 D) loses protons

97) Given the oxidation-reduction reaction:



Which species undergoes reduction?

- A) Fe^{3+} B) H_2 C) Fe^{2+} D) H^+

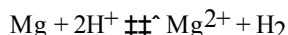
98) Which ion can be *both* an oxidizing agent and a reducing agent?

- A) Sn^{2+} B) Fe^{3+} C) Al^{3+} D) Cu^{2+}

99) In the reaction $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$, which species is reduced?

- A) H^+ B) Cl^- C) Mn^{4+} D) O^{2-}

100) Given the reaction:



The reducing agent is

- A) H_2 B) Mg C) Mg^{2+} D) H^+

101) Which occurs in the half-reaction $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$?

- A) Cu loses electrons. C) Cu^{2+} is reduced.
 B) Cu gains electrons. D) Cu^{2+} is oxidized.

102) Which half-reaction correctly represents reduction?

- A) $\text{Ni}^{4+} + 3\text{e}^- \rightarrow \text{Ni}^+$ C) $\text{Mn}^{7+} \rightarrow \text{Mn}^{4+} + 3\text{e}^-$
 B) $\text{S}^{2-} + 2\text{e}^- \rightarrow \text{S}^0$ D) $\text{S}^{2-} \rightarrow \text{S}^0 + 2\text{e}^-$

103) Which element is the *poorest* reducing agent?

- A) Zn B) Ba C) Al D) H_2

104) What happens to reducing agents in chemical reactions?

- A) Reducing agents are oxidized. C) Reducing agents are reduced.
 B) Reducing agents gain electrons. D) Reducing agents gain protons.

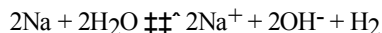
105) What occurs when an atom is oxidized in a chemical reaction?

- A) a loss of electrons and a decrease in oxidation number
 B) a gain in electrons and an increase in oxidation number
 C) a loss of electrons and an increase in oxidation number
 D) a gain in electrons and a decrease in oxidation number

106) In the equation $\text{Cu}(s) + 2\text{Ag}^+(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{Ag}(s)$, the oxidizing agent is

- A) Ag^0 B) Ag^+ C) Cu^{2+} D) Cu^0

107) Given the reaction:



Which substance is oxidized?

- A) Na^+ B) H^+ C) Na D) H

108) In the reaction $2\text{H}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{SO}_2 + 2\text{H}_2\text{O}$, the oxidizing agent is

- A) water B) hydrogen sulfide C) oxygen D) sulfur dioxide

109) Compared to the amount of mass and total charge at the beginning of a redox reaction, the amount of mass and total charge upon completion of the reaction is

- A) greater B) less C) the same

- 110) Which of the following is a redox reaction?
- A) $2\text{NH}_4\text{Cl} + \text{Ca}(\text{OH})_2 \rightarrow 2\text{NH}_3 + 2\text{H}_2\text{O} + \text{CaCl}_2$ C) $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
B) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ D) $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- 111) Oxidation-reduction reactions occur because of the competition between particles for
- A) protons B) positrons C) electrons D) neutrons
- 112) In the reaction $\text{Cu} + 2\text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + 2\text{H}_2\text{O} + \text{SO}_2$, copper is
- A) oxidized and is the reducing agent C) reduced and is the oxidizing agent
B) oxidized and is the oxidizing agent D) reduced and is the reducing agent
- 113) Which quantities are conserved in *all* oxidation-reduction reactions?
- A) both charge and mass C) neither charge nor mass
B) charge, only D) mass, only
- 114) In the reaction $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$, the magnesium
- A) loses electrons and is reduced C) loses electrons and is oxidized
B) gains electrons and is oxidized D) gains electrons and is reduced