# Redox practice worksheet

**Name:** __________________________  **Date:** __________________________

1. In which substance is the oxidation number of nitrogen zero?
   - A. NH₃  
   - B. N₂  
   - C. NO₂  
   - D. N₂O

2. What is the oxidation number of carbon in NaHCO₃?
   - A. +6  
   - B. +2  
   - C. −4  
   - D. +4

3. In the reaction Al⁺⁺⁺ + Cr³⁺ → Al³⁺ + Cr⁰, the reducing agent is
   - A. Al⁺⁺⁺  
   - B. Cr³⁺  
   - C. Al³⁺  
   - D. Cr⁰

4. In the reaction 2K + Cl₂ → 2KCl, the species oxidized is
   - A. Cl₂  
   - B. Cl⁻  
   - C. K  
   - D. K⁺

5. As an S²⁻ ion is oxidized to an S⁰ atom, the number of protons in its nucleus
   - A. decreases  
   - B. increases  
   - C. remains the same

6. Given the probable reaction for the nickel-cadmium battery:
   \[ 2\text{Ni(OH)}_3 + \text{Cd} \rightleftharpoons 2\text{Ni(OH)}_2 + \text{Cd(OH)}_2 \]
   Which species is oxidized during the discharge of the battery?
   - A. Ni³⁺  
   - B. Ni²⁺  
   - C. Cd⁰  
   - D. Cd²⁺

7. If element X forms the oxides XO and X₂O₃, the oxidation numbers of element X are
   - A. +1 and +2  
   - B. +2 and +3  
   - C. +1 and +3  
   - D. +2 and +4

8. Oxygen has a positive oxidation number in the compound
   - A. H₂O  
   - B. H₂O₂  
   - C. OF₂  
   - D. IO₂

9. What is the oxidation number of sulfur in H₂SO₄?
   - A. 0  
   - B. −2  
   - C. +6  
   - D. +4

10. In the equation Cu(s) + 2Ag⁺(aq) → Cu²⁺(aq) + 2Ag(s), the oxidizing agent is
    - A. Cu⁰  
    - B. Ag⁺  
    - C. Cu²⁺  
    - D. Ag⁰

11. In the reaction Al + Cr³⁺ → Al³⁺ + Cr, the reducing agent is
    - A. Al  
    - B. Cr³⁺  
    - C. Al³⁺  
    - D. Cr

12. In the compound Na₂HPO₄, which element has a negative oxidation number?
    - A. H  
    - B. O  
    - C. P  
    - D. Na
13. Which species undergoes a loss of electrons?

\[ \text{Mg(s) + 2Ag}^+(aq) \rightarrow \text{Mg}^{2+}(aq) + 2\text{Ag(s)} \]

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

14. Given the reaction:

\[ 2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{Na}^{+} + 2\text{OH}^- + \text{H}_2 \]

Which substance is oxidized?

A. H\(_2\)  B. H\(^{+}\)  C. Na  D. Na\(^{+}\)

15. Which change occurs when an Sn\(^{2+}\) ion is oxidized?

A. Two electrons are lost.
B. Two electrons are gained.
C. Two protons are lost.
D. Two protons are gained.

16. A redox reaction always involves

A. a change in oxidation number
B. a change in phase
C. the transfer of protons
D. the formation of ions

17. In the reaction \( \text{Cl}_2 + 2\text{Br}^-(aq) \rightarrow 2\text{Cl}^-(aq) + \text{Br}_2 \), which half-reaction correctly represents oxidation?

A. \( 2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^- \)  B. \( \text{Cl}_2 \rightarrow 2\text{Cl}^- + 2\text{e}^- \)
C. \( 2\text{Br}^- + 2\text{e}^- \rightarrow \text{Br}_2 \)  D. \( \text{Cl}_2 + 2\text{e}^- \rightarrow \text{Cl}^- \)

18. Which half-reaction correctly represents reduction?

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

19. A solution contains 90 grams of a salt dissolved in 100 grams of water at 40°C. The solution could be an unsaturated solution of

A. KCl  B. KNO\(_3\)
C. NaCl  D. NaNO\(_3\)

20. Which is an oxidation-reduction reaction?

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

21. Which is a redox reaction?

A. \( \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2 \)
B. \( \text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} \)
C. \( 2\text{NH}_4\text{Cl} + \text{Ca(OH)}_2 \rightarrow 2\text{NH}_3 + 2\text{H}_2\text{O} + \text{CaCl}_2 \)
D. \( 2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2 \)
22. In the reaction
\[ 3\text{Cl}_2 + 6\text{NaOH} \rightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}, \]
\( \text{Cl}_2 \) undergoes
A. oxidation, only
B. reduction, only
C. both oxidation and reduction
D. neither oxidation nor reduction

23. In the reaction
\[ \text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{AgCl}(\text{s}), \]
the reactants
A. gain electrons, only
B. lose electrons, only
C. both gain and lose electrons
D. neither gain nor lose electrons

24. In the reaction \( \text{Mg} + \text{Cl}_2 \rightarrow \text{MgCl}_2 \), the correct half-reaction for the oxidation that occurs is
A. \( \text{Mg} + 2\text{e}^- \rightarrow \text{Mg}^{2+} \)
B. \( \text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^- \)
C. \( \text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^- \)
D. \( \text{Cl}_2 \rightarrow 2\text{Cl}^- + 2\text{e}^- \)

25. The reaction that takes place in a chemical cell is best classified as
A. fusion
B. redox
C. transmutation
D. cracking

26. Which equation represents the half-reaction that takes place at the fork?

\[ \text{Ag}^+ + \text{NO}_3^- \rightarrow \text{AgNO}_3 \]
A. \( \text{Ag}^+ + \text{NO}_3^- \rightarrow \text{AgNO}_3 \)
B. \( \text{AgNO}_3 \rightarrow \text{Ag}^+ + \text{NO}_3^- \)
C. \( \text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}(\text{s}) \)
D. \( \text{Ag}(\text{s}) \rightarrow \text{Ag}^+ + \text{e}^- \)

27. Which half-reaction correctly represents a reduction reaction?
A. \( \text{Sn}^0 + 2\text{e}^- \rightarrow \text{Sn}^{2+} \)
B. \( \text{Na}^0 + \text{e}^- \rightarrow \text{Na}^+ \)
C. \( \text{Li}^0 + \text{e}^- \rightarrow \text{Li}^+ \)
D. \( \text{Br}_2^0 + 2\text{e}^- \rightarrow 2\text{Br}^- \)

28. Which half-cell reaction correctly represents oxidation?
A. \( \text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb} \)
B. \( \text{Pb} + 2\text{e}^- \rightarrow \text{Pb}^{2+} \)
C. \( \text{Pb}^{2+} \rightarrow \text{Pb} + 2\text{e}^- \)
D. \( \text{Pb} \rightarrow \text{Pb}^{2+} + 2\text{e}^- \)

29. Which represents the positive electrode of a nickel-cadmium battery?
A. \( \text{Ni(OH)}_3 \)
B. \( \text{Cd} \)
C. \( \text{Ni} \)
D. \( \text{Cd(OH)}_2 \)

30. The diagram shown represents an electroplating arrangement. In the setup shown, an object to be plated with metal would be the
A. anode at \( A \)
B. anode at \( B \)
C. cathode at \( A \)
D. cathode at \( B \)
31. In this electrolytic cell, electrode A is designated as the
   A. anode and is positive
   B. anode and is negative
   C. cathode and is positive
   D. cathode and is negative

32. The diagram shown represents a chemical cell at 298 K and 1 atmosphere.

Which species represents the cathode?
   A. Zn     B. Zn²⁺    C. Cu     D. Cu²⁺

33. Which part of the electroplating system is provided by the fork?
   A. the anode, which is the negative electrode
   B. the cathode, which is the negative electrode
   C. the anode, which is the positive electrode
   D. the cathode, which is the positive electrode

34. Based on Reference Table N, what is the standard electrode potential (E⁰) for the oxidation of Cu(s) to Cu²⁺(aq)?
   A. +0.52 V     B. +0.34 V
   C. −0.52 V     D. −0.34 V

35. Which statement best describes the key?
   A. It acts as the cathode and is negative.
   B. It acts as the cathode and is positive.
   C. It acts as the anode and is negative.
   D. It acts as the anode and is positive.
36. The diagram below shows a key being plated with copper in an electrolytic cell.

![Diagram of electroplating](image)

Given the reduction reaction for this cell:

\[
\text{Cu}^{2+}(aq) + 2e^- \rightarrow \text{Cu}(s)
\]

This reduction occurs at

A. A, which is the anode
B. A, which is the cathode
C. B, which is the anode
D. B, which is the cathode

37. Base your answer(s) to the following question(s) on the diagram below, which represents a voltaic cell at 298 K and 1 atm.

![Diagram of voltaic cell](image)

Describe the direction of electron flow between the electrodes when switch S is closed.

38. Where does oxidation occur in an electrochemical cell?

A. at the cathode in both an electrolytic cell and a voltaic cell
B. at the cathode in an electrolytic cell and at the anode in a voltaic cell
C. at the anode in both an electrolytic cell and a voltaic cell
D. at the anode in an electrolytic cell and at the cathode in a voltaic cell

39. Base your answer(s) to the following question(s) on the diagram and balanced equation below, which represent the electrolysis of molten NaCl.

![Diagram of electrolysis](image)

\[2\text{NaCl} \rightarrow \text{Cl}_2 + 2\text{Na}\]

When the switch is closed, which electrode will attract the sodium ions?

40. Base your answer(s) to the following question(s) on the information and diagram below.

The apparatus shown in the diagram consists of two inert platinum electrodes immersed in water. A small amount of an electrolyte, H$_2$SO$_4$, must be added to the water for the reaction to take place. The electrodes are connected to a source that supplies electricity.

![Diagram of electrolysis of water](image)

What particles are provided by the electrolyte that allow an electric current to flow?
41. Base your answer(s) to the following question(s) on the diagram below. The diagram shows a voltaic cell with copper and aluminum electrodes immediately after the external circuit is completed.

As this voltaic cell operates, the mass of the Al(s) electrode decreases. Explain, in terms of particles, why this decrease in mass occurs.

42. Base your answer(s) to the following question(s) on the information below.

A flashlight can be powered by a rechargeable nickel-cadmium battery. In the battery, the anode is Cd(s) and the cathode is NiO\(_2\)(s). The unbalanced equation below represents the reaction that occurs as the battery produces electricity. When a nickel-cadmium battery is recharged, the reverse reaction occurs.

\[
\text{Cd(s)} + \text{NiO}_2(s) + \text{H}_2\text{O}(l) \rightarrow \text{Cd(OH)}_2(s) + \text{Ni(OH)}_2(s)
\]

Determine the change in oxidation number for the element that makes up the anode in the reaction that produces electricity.

43. Base your answer(s) to the following question(s) on the information below.

Underground iron pipes in contact with moist soil are likely to corrode. This corrosion can be prevented by applying the principles of electrochemistry. Connecting an iron pipe to a magnesium block with a wire creates an electrochemical cell. The magnesium block acts as the anode and the iron pipe acts as the cathode. A diagram of this system is shown below.

State the direction of the flow of electrons between the electrodes in this cell.

44. Base your answer(s) to the following question(s) on the information below.

A voltaic cell with magnesium and copper electrodes is shown in the diagram below. The copper electrode has a mass of 15.0 grams.

\[
\text{Mg(s)} + \text{Cu}^{2+}(aq) \rightarrow \text{Mg}^{2+}(aq) + \text{Cu(s)}
\]

When the switch is closed, the reaction in the cell begins. The balanced ionic equation for the reaction in the cell is shown below the cell diagram. After several hours, the copper electrode is removed, rinsed with water, and dried. At this time, the mass of the copper electrode is greater than 15.0 grams.

State the direction of electron flow through the wire between the electrodes when the switch is closed.
45. Explain, in terms of copper ions and copper atoms, why the mass of the copper electrode increases as the cell operates. Your response must include information about both copper ions and copper atoms.

46. Base your answers to the following question(s) on the information below.

The diagram below represents an operating electrolytic cell used to plate silver onto a nickel key. As the cell operates, oxidation occurs at the silver electrode and the mass of the silver electrode decreases.

Identify the cathode in the cell.

47. When the redox equation \( \text{Cr}^{3+}(aq) + 3\text{Mn}(s) \rightarrow \text{Mn}^{2+}(aq) + \text{Cr}(s) \) is completely balanced, the coefficient of \( \text{Cr}^{3+}(aq) \) will be

A. 1  B. 2  C. 3  D. 4

48. When the redox equation \( \quad \text{Cr}^{3+}(aq) + 3\text{Mn}(s) \rightarrow 
\quad \text{Mn}^{2+}(aq) + \quad \text{Cr}(s) \) is completely balanced, the coefficient of \( \text{Cr}^{3+}(aq) \) will be

A. 1  B. 2  C. 3  D. 4

49. Which redox equation is correctly balanced?

A. \( \text{Cr}^{3+} + \text{Mg} \rightarrow \text{Cr} + \text{Mg}^{2+} \)
B. \( \text{Al}^{3+} + \text{K} \rightarrow \text{Al} + \text{K}^+ \)
C. \( \text{Sn}^{4+} + \text{H}_2 \rightarrow \text{Sn} + 2\text{H}^+ \)
D. \( \text{Br}_2 + \text{Hg} \rightarrow \text{Hg}^{2+} + 2\text{Br}^- \)

50. Given the reaction:

\( 2\text{Al}^0(s) + 3\text{Ni}^{2+}(aq) \rightarrow 2\text{Al}^{3+}(aq) + 3\text{Ni}^0(s) \)

What is the total number of moles of electrons lost by 2 moles of \( \text{Al}^0(s) \)?

A. 6  B. 2  C. 3  D. 8
Redox practice worksheet 05/09/2013

1. Answer: B
2. Answer: D
3. Answer: A
4. Answer: C
5. Answer: C
6. Answer: C
7. Answer: B
8. Answer: C
9. Answer: C
10. Answer: B
11. Answer: A
12. Answer: B
13. Answer: A
14. Answer: D
15. Answer: A
16. Answer: A
17. Answer: A
18. Answer: C
19. Answer: D
20. Answer: A
21. Answer: D
22. Answer: C
23. Answer: D
24. Answer: C
25. Answer: B
26. Answer: B
27. Answer: D
28. Answer: D
29. Answer: A
30. Answer: D
31. Answer: A
32. Answer: C
33. Answer: C
34. Answer: D
35. Answer: A
36. Answer: B
37. Answer: From the anode to cathode or half-cell 2 to half-cell 1.
38. Answer: C
39. Answer: negative electrode, cathode, or one on the right

40. Answer: ions, charged particles, \( \text{H}_3\text{O}^+ \), \( \text{SO}_4^{2-} \)

41. Answer: Aluminum atoms are losing electrons and becoming aluminum ions that are entering the solution.

42. Answer: from 0 to +2

43. Answer: Acceptable answers but not limited to: Electrons flow from the magnesium block to the iron pipe. Electrons flow from the Mg to the Fe through the wire. Electrons flow from the anode to the cathode in a voltaic cell. from the block to the pipe.

44. Answer: The electrons flow from the Mg electrode to the Cu electrode. from anode to cathode

45. Answer: Copper ions from the solution are reduced to copper atoms at the electrode, increasing the mass of the electrode. Copper ions become copper atoms. The number of copper ions decreases, and the number of copper atoms increases.

46. Answer: Ni(s) key

47. Answer: B

48. Answer: B

49. Answer: D

50. Answer: A