

Name \_\_\_\_\_

Topic 8 Questions - Reduction and Oxidation

- \_\_\_\_\_ 1. What is the oxidation number of sulfur in  $\text{H}_2\text{SO}_4$ ?  
1) -2      2) 0      3) +6      4) +4
- \_\_\_\_\_ 2. What is the oxidation number of chlorine in  $\text{KClO}_4$ ?  
1) +7      2) -7      3) +1      4) -1
- \_\_\_\_\_ 3. The oxidation number of hydrogen in sodium hydride ( $\text{NaH}$ ) is  
1) +1      2) -1      3) -2      4) +2
- \_\_\_\_\_ 4. If the element X forms oxides  $\text{XO}$  and  $\text{X}_2\text{O}_3$ , the oxidation numbers of element X are  
1) +2 and +4      2) +1 and +3  
3) +1 and +2      4) +2 and +3
- \_\_\_\_\_ 5. In the reaction  
 $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HClO} + \text{HCl}$ ,  
the oxidation number of chlorine  
1) both decreases and increases  
2) decreases, only  
3) neither decreases nor increases  
4) increases, only
- \_\_\_\_\_ 6. The oxidation number of nitrogen is *highest* in  
1)  $\text{N}_2\text{O}$       2)  $\text{NH}_3$   
3)  $\text{NO}_2$       4)  $\text{N}_2$

- \_\_\_\_\_ 7. In any oxidation-reduction reaction, the total number of electrons gained is  
1) greater than the total number of electrons lost  
2) less than the total number of electrons lost  
3) unrelated to the total number of electrons lost  
4) equal to the total number of electrons lost
- \_\_\_\_\_ 8. Given the reaction:  
 $\text{Zn}_{(s)} + \text{Cu}^{+2}_{(aq)} \rightarrow \text{Zn}^{+2}_{(aq)} + \text{Cu}_{(s)}$   
What particles must be transferred from one reaction to the other reactant?  
1) electrons      2) ions  
3) neutrons      4) protons
- \_\_\_\_\_ 9. Which of the following statements correctly described a redox reaction?  
1) The oxidation half-reaction and the reduction half-reaction happens simultaneously  
2) The oxidation half-reaction occurs after the reduction half-reaction  
3) The oxidation half-reaction occurs before the reduction half-reaction  
4) The oxidation half-reaction happens spontaneously but the reduction half-reaction does not
- \_\_\_\_\_ 10. Which equation represents a redox reaction?  
1)  $\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$   
2)  $\text{OH}^- + \text{H}^+ \rightarrow \text{H}_2\text{O}$   
3)  $\text{O}_2 + 2\text{H}_2 \rightarrow 2\text{H}_2\text{O}$   
4)  $\text{SO}_3^{-2} + 2\text{H}_2 \rightarrow \text{H}_2\text{SO}_3$

- \_\_\_\_\_ 11. Which of the following is a redox reaction?  
1)  $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$   
2)  $2\text{NH}_4\text{Cl} + \text{Ca}(\text{OH})_2 \rightarrow 2\text{NH}_3 + 2\text{H}_2\text{O} + \text{CaCl}_2$   
3)  $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$   
4)  $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- \_\_\_\_\_ 12. Which of the following is *not* an oxidation and reduction reaction?  
1)  $\text{KOH} + \text{HCl} \rightarrow \text{KCl} + \text{H}_2\text{O}$   
2)  $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$   
3)  $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$   
4)  $2\text{K} + \text{Cl}_2 \rightarrow 2\text{KCl}$
- \_\_\_\_\_ 13. The reaction:  
 $\text{BaCO}_3 \rightarrow \text{BaO} + \text{CO}_2$   
involves  
1) neither oxidation nor reduction  
2) oxidation, only  
3) both oxidation and reduction  
4) reduction, only
- \_\_\_\_\_ 14. Given the redox reaction:  
 $\text{Co}_{(s)} + \text{PbCl}_{2(aq)} \rightarrow \text{CoCl}_{2(aq)} + \text{Pb}_{(s)}$   
Which of the following statements correctly describes the oxidation and reduction that occur?  
1)  $\text{Co}_{(s)}$  is oxidized and  $\text{Pb}^{+2}_{(aq)}$  is reduced  
2)  $\text{Co}_{(s)}$  is oxidized and  $\text{Cl}^-_{(aq)}$  is reduced  
3)  $\text{Co}_{(s)}$  is reduced and  $\text{Pb}^{+2}_{(aq)}$  is oxidized  
4)  $\text{Co}_{(s)}$  is reduced and  $\text{Cl}^-_{(aq)}$  is oxidized

\_\_\_\_\_ 15. Which half-reaction shows both the conservation of mass and the conservation of charge?

- 1)  $2\text{Br}^- + 2\text{e}^- \rightarrow \text{Br}_2$
- 2)  $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$
- 3)  $\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$
- 4)  $\text{Cl}_2 \rightarrow \text{Cl}^- + 2\text{e}^-$

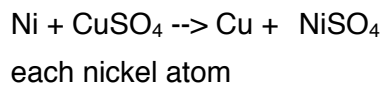
\_\_\_\_\_ 16. An oxide ion is oxidized to an oxygen atom by

- 1) losing protons
- 2) gaining electrons
- 3) gaining protons
- 4) losing electrons

\_\_\_\_\_ 17. Which change occurs when an  $\text{Sn}^{2+}$  ion is oxidized

- 1) Two electrons are lost
- 2) Two protons are lost
- 3) Two electrons are gained
- 4) Two protons are gained

\_\_\_\_\_ 18. In the reaction

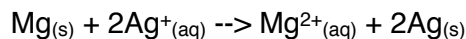


- 1) gains one electron, only
- 2) loses two electrons
- 3) gains two electrons
- 4) loses one electron, only

\_\_\_\_\_ 19. As an  $\text{S}^{2-}$  ion is oxidized to an  $\text{S}^0$  atom, the number of protons in its nucleus

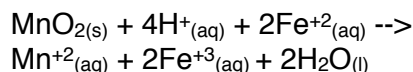
- 1) increases
- 2) decreases
- 3) remains the same

\_\_\_\_\_ 20. Which species undergoes a loss of electrons?



- 1)  $\text{Ag}^+_{(aq)}$
- 2)  $\text{Mg}_{(s)}$
- 3)  $\text{Mg}^{2+}_{(aq)}$
- 4)  $\text{Ag}_{(s)}$

\_\_\_\_\_ 21. Given the reaction:



Which species is oxidized?

- 1)  $\text{H}^+_{(aq)}$
- 2)  $\text{H}_2\text{O}_{(l)}$
- 3)  $\text{Fe}^{2+}_{(aq)}$
- 4)  $\text{MnO}_{2(s)}$

\_\_\_\_\_ 22. What occurs in the half-reaction



- 1)  $\text{Na}_{(s)}$  gains electrons
- 2)  $\text{Na}_{(s)}$  is reduced
- 3)  $\text{Na}_{(s)}$  is oxidized
- 4)  $\text{Na}^+$  is oxidized

\_\_\_\_\_ 23. In the reaction:  $\text{Mg} + \text{Cl}_2 \rightarrow \text{MgCl}_2$ , the correct half-reaction for the oxidation that occurs is

- 1)  $\text{Mg} + 2\text{e}^- \rightarrow \text{Mg}^{+2}$
- 2)  $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$
- 3)  $\text{Mg} \rightarrow \text{Mg}^{+2} + 2\text{e}^-$
- 4)  $\text{Cl}_2 \rightarrow 2\text{Cl}^- + 2\text{e}^-$

\_\_\_\_\_ 24. In the reaction:



the  $\text{Cu}^{2+}$  ions

- 1) gain protons
- 2) lose electrons
- 3) lose protons
- 4) gain electrons

\_\_\_\_\_ 25. When  $\text{Fe}^{+3}$  is reduced to  $\text{Fe}^{+2}$ , the  $\text{Fe}^{+3}$  ion

- 1) gains 1 electrons
- 2) loses 1 electron
- 3) gains 1 proton
- 4) loses 1 proton

\_\_\_\_\_ 26. In the reaction



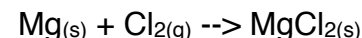
which species is reduced?

- 1)  $\text{Mn}^{+4}$
- 2)  $\text{Cl}^-$
- 3)  $\text{O}^{2-}$
- 4)  $\text{H}^+$

\_\_\_\_\_ 27. Which half-reaction correctly represents reduction?

- 1)  $\text{Sn} \rightarrow \text{Sn}^{+2} + 2\text{e}^-$
- 2)  $\text{Sn} + 2\text{e}^- \rightarrow \text{Sn}^{+2}$
- 3)  $\text{Sn}^{4+} + 2\text{e}^- \rightarrow \text{Sn}^{2+}$
- 4)  $\text{Sn}^{2+} \rightarrow \text{Sn}^{4+} + 2\text{e}^-$

\_\_\_\_\_ 28. Given the reaction:



Which half-reaction correctly represents the reduction that occurs?

- 1)  $\text{Mg}^{+2} \rightarrow \text{Mg}_{(s)} + 2\text{e}^-$
- 2)  $2\text{Cl}^- \rightarrow \text{Cl}_{2(g)} + 2\text{e}^-$
- 3)  $\text{Mg}_{(s)} + 2\text{e}^- \rightarrow \text{Mg}^{2+}$
- 4)  $\text{Cl}_{2(g)} + 2\text{e}^- \rightarrow 2\text{Cl}^-$

\_\_\_\_\_ 29. Which oxidation number change could occur during an oxidation half-reaction?

- 1) -2 to -3
- 2) +1 to -1
- 3) +3 to +1
- 4) +2 to +3

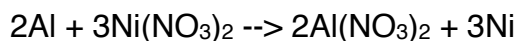
\_\_\_\_\_ 30. Which occurs in the half reaction  $\text{Cu}^{+2} + 2\text{e}^- \rightarrow \text{Cu}$ ?

- 1)  $\text{Cu}^{+2}$  is reduced
- 2) Cu loses electrons
- 3) Cu gains electrons
- 4)  $\text{Cu}^{+2}$  is oxidized

\_\_\_\_\_ 31. What occurs when an atom is oxidized in a chemical reaction?

- 1) a loss of electrons and an increase in oxidation number
- 2) a loss of electrons and a decrease in oxidation number
- 3) a gain of electrons and an increase in oxidation number
- 4) a gain of electrons and a decrease in oxidation number

\_\_\_\_\_ 32. In the reaction



the aluminium is

- 1) reduced and its oxidation number increases
- 2) oxidized and its oxidation number increases
- 3) reduced and its oxidation number decreases
- 4) oxidized and its oxidation number decreases

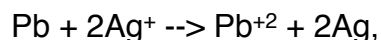
\_\_\_\_\_ 33. Given the reaction:



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 an increase in oxidation number
- 4) an oxidation reaction, because there is a decrease in oxidation number

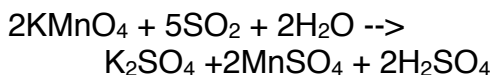
\_\_\_\_\_ 34. In the reaction



the  $\text{Ag}^+$  is

- 1) oxidized, and the oxidation number changes from +1 to 0
- 2) reduced, and the oxidation number changes from +2 to 0
- 3) reduced and the oxidation number changes from +1 to 0
- 4) oxidized, and the oxidation number changes from 0 to +1

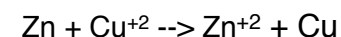
\_\_\_\_\_ 35. In the reaction



The oxidation number of manganese changes from

- 1) +5 to +2
- 2) +7 to +2
- 3) +6 to +3
- 4) +4 to +3

\_\_\_\_\_ 36. In the reaction



the oxidizing agent

- 1) is oxidized
- 2) gains protons
- 3) loses electrons
- 4) is reduced

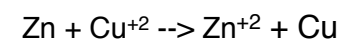
\_\_\_\_\_ 37. When a substance is oxidized, it

- 1) acts as an oxidizing agent
- 2) acts as a reducing agent
- 3) loses protons
- 4) gains protons

\_\_\_\_\_ 38. Which metal is more active than  $\text{H}_2$ ?

- 1) Ag
- 2) Au
- 3) Cu
- 4) Pb

\_\_\_\_\_ 39. Given the balanced ionic equation representing the reaction in an operating voltaic cell:



The flow of electrons through the external circuit in this cell is from the

- 1) Cu anode to the Zn cathode
- 2) Cu cathode to the Zn anode
- 3) Zn anode to the Cu cathode
- 4) Zn cathode to the Cu anode

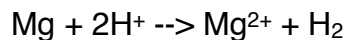
\_\_\_\_\_ 40. Which half-reaction equation represents the reduction of an iron(II) ion?

- 1)  $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + e^-$
- 2)  $\text{Fe}^{3+} + e^- \rightarrow \text{Fe}^{2+}$
- 3)  $\text{Fe}^{2+} + 2e^- \rightarrow \text{Fe}$
- 4)  $\text{Fe} \rightarrow \text{Fe}^{2+} + 2e^-$

\_\_\_\_\_ 41. 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

- 1) oxidized and is the reducing agent
- 2) oxidized and is the oxidizing agent
- 3) reduced and is the oxidizing agent
- 4) reduced and is the reducing agent

\_\_\_\_\_ 42. Given the reaction:



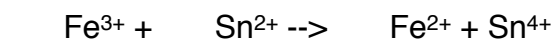
The reducing agent is

- 1) Mg
- 2)  $\text{H}^+$
- 3)  $\text{Mg}^{2+}$
- 4)  $\text{H}_2$

\_\_\_\_\_ 43. Which element is the most likely to undergo reduction?

- 1)  $\text{H}_2$
- 2) Ba
- 3) Al
- 4) Zn

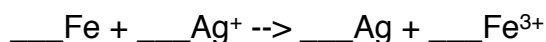
\_\_\_\_\_ 44. Given the reaction:



When the reaction is completely balanced using the *smallest* whole numbers, the coefficient of  $\text{Fe}^{3+}$  will be

- 1) 1
- 2) 2
- 3) 3
- 4) 4

\_\_\_\_\_ 45. Given the unbalanced equation:



When the equation is correctly balanced using *smallest* whole numbers, the coefficient of  $\text{Ag}^+$  is

- 1) 5
- 2) 2
- 3) 3
- 4) 4

\_\_\_\_\_ 46. The type of reaction in a voltaic cell is *best* described as a

- 1) spontaneous oxidation-reduction reaction
- 2) nonspontaneous oxidation-reduction reaction
- 3) nonspontaneous oxidation reaction, only
- 4) nonspontaneous reduction reaction, only

\_\_\_\_\_ 47. In a voltaic cell composed of two half-cells, ions are allowed to flow from one half cell to another by means of

- 1) a salt bridge
- 2) electrodes
- 3) an external conductor
- 4) a voltmeter

\_\_\_\_\_ 48. A discharging lead-acid battery is best described as a(n)

- 1) voltaic cell that uses an electric current
- 2) voltaic cell that produces an electric current
- 3) electrolytic cell that produces an electric current
- 4) electrolytic cell that uses an electric current

\_\_\_\_\_ 49. In an electrolytic cell, to which electrode will a positive ion migrate and undergo reduction?

- 1) the anode, which is positively charged
- 2) the cathode, which is negatively charged
- 3) the cathode, which is positively charged
- 4) the anode, which is negatively charged

\_\_\_\_\_ 50. In an electrolytic cell, a  $\text{Cl}^-$  ion would be attracted to the

- 1) positive electrode and oxidized
- 2) negative electrode and reduced
- 3) negative electrode and oxidized
- 4) positive electrode and reduced

\_\_\_\_\_51. In the electrolytic process used to plate copper onto a material, the material is the

- 1) anode which is positive
- 2) cathode which is positive
- 3) anode which is negative
- 4) cathode which is negative

\_\_\_\_\_52. Given the reaction :



In which type of cell would this reaction *most* likely occur

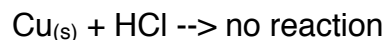
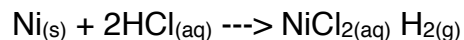
- 1) an electrolytic cell, because it is exothermic
- 2) an electrolytic cell, because it is endothermic
- 3) a voltaic cell, because it is endothermic
- 4) a voltaic cell, because it is exothermic

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### Constructed Response

1. When a nickel coin is dropped into hydrochloric acid, a reaction occurs in which nickel (II) chloride is formed and hydrogen gas is released. When a copper penny is dropped into hydrochloric acid, no visible reaction occurs.

These reactions are summarized by the chemical equations below:



Using Table J in the Chemistry Reference Tables, and your knowledge of redox reactions, explain the difference in reactivity of nickel and copper with hydrochloric acid.

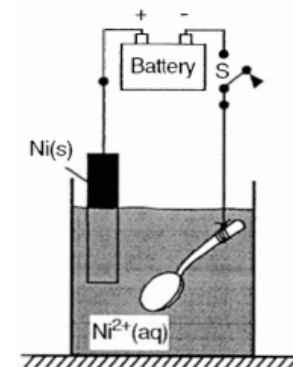
2. An electrochemical cell can be either voltaic or electrolytic.
  - a. State *one* similarity between a voltaic and an electrolytic cell

- b. State *one* difference between a voltaic and an electrolytic cell.

Questions 3 and 4 refer to the following:

The diagram below shows a spoon that will be electroplated with nickel metal.

3. Does the chemical cell diagram below represent a voltaic or an electrolytic cell? [Give *one* reason to support your answer.]



4. Write the correct half reaction for the deposition of Ni<sub>(s)</sub> on the surface of the spoon.

Questions 5 through 10 refer to the following:

The diagram below shows a chemical cell. The reaction occurs at 1 atmosphere and 298 K.

5. According to Table J on the Chemistry Reference Tables, which electrode is the anode?  
[*Explain why.*]

6. According to Table J, which electrode is the cathode? [*Explain why.*]

7. Write the correct half-reaction for the reduction which occurs.

8. What is the function of the salt bridge?

9. Is this chemical cell a voltaic or an electrolytic cell? [*Give evidence to support your answer.*]

10. On the chemical cell diagram, draw an arrow above the voltmeter to indicate the direction of electron flow.

