Name: _____

1) In which compound does chlorine have the *highest* oxidation number?
   A) $NaClO_3$
   B) NaClO
   C) $NaClO_4$
   D) $NaClO_2$

2) In which substance does chlorine have an oxidation number of +1?
   A) HClO
   B) Cl_2
   C) HCl
   D) $HClO_2$

3) What is the oxidation number of chromium in $K_2Cr_2O_7$?
   A) +12
   B) +2
   C) +6
   D) +7

4) What is the oxidation number of chromium in $K_2Cr_2O_7$?
   A) +12
   B) +2
   C) +3
   D) +6

5) The transfer of which particle is required for a redox reaction to occur?
   A) electron
   B) ion
   C) proton
   D) neutron

6) Which particles are gained and lost during a redox reaction?
   A) protons
   B) electrons
   C) positrons
   D) neutrons

7) As a Ca atom undergoes oxidation to Ca^{2+}, the number of neutrons in its nucleus
   A) decreases
   B) increases
   C) remains the same

8) Given the reaction:

$$Mg + CuSO_4 \longrightarrow MgSO_4 + Cu$$

Which equation represents the oxidation that takes place?
   A) $Cu \longrightarrow Cu^{2+} + 2e^-$
   B) $Mg^{2+} + 2e^- \longrightarrow Mg$
   C) $Mg \longrightarrow Mg^{2+} + 2e^-$
   D) $Cu^{2+} + 2e^- \longrightarrow Cu$

9) Given the reaction:

$$Mg(s) + 2H^+(aq) + 2Cl^-(aq) \longrightarrow Mg^{2+}(aq) + 2Cl^-(aq) + H_2(g)$$

Which species undergoes oxidation?
   A) $H_2(g)$
   B) Mg(s)
   C) $H^+(aq)$
   D) $Cl^-(aq)$

10) In any redox reaction, the substance that undergoes reduction will
   A) gain electrons and have a decrease in oxidation number
   B) lose electrons and have a decrease in oxidation number
   C) lose electrons and have an increase in oxidation number
   D) gain electrons and have an increase in oxidation number

11) Given the equation:

$$C(s) + H_2O(g) \longrightarrow CO(g) + H_2(g)$$

Which species undergoes reduction?
   A) $H_2(g)$
   B) C(s)
   C) H^+
   D) C^{2+}

12) Given the equation:

$$2Al + 3Cu^{2+} \longrightarrow 2Al^{3+} + 3Cu$$

What is the reduction half-reaction?
   A) $Cu^{2+} + 2e^- \longrightarrow Cu$
   B) $Al \longrightarrow Al^{3+} + 3e^-$
   C) $Cu^{2+} \longrightarrow Cu + 2e^-$
   D) $Al + 3e^- \longrightarrow Al^{3+}$

13) When a neutral atom undergoes oxidation, the atom's oxidation state
   A) decreases as it gains electrons
   B) decreases as it loses electrons
   C) increases as it loses electrons
   D) increases as it gains electrons

14) A catalyst is added to a system at equilibrium. If the temperature remains constant, the activation energy of the forward reaction

A) remains the same
B) increases
C) decreases

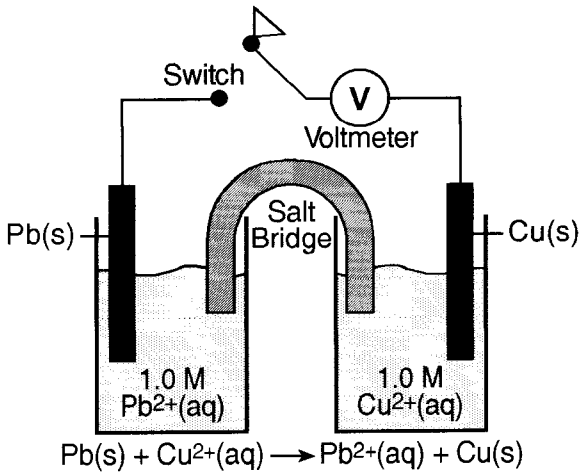
15) Which equation shows conservation of charge?

A) $Fe + 2e^- \longrightarrow Fe^{2+}$
B) $Fe \longrightarrow Fe^{2+} + e^-$
C) $Fe \longrightarrow Fe^{2+} + 2e^-$
D) $Fe + 2e^- \longrightarrow Fe^{3+}$

16) Which statement is true for any electrochemical cell?

A) Reduction occurs at the anode, only.
B) Oxidation occurs at both the anode and the cathode.
C) Reduction occurs at both the anode and the cathode.
D) Oxidation occurs at the anode, only.

17) A diagram of a chemical cell and an equation are shown below.



When the switch is closed, electrons will flow from

A) the $Pb^{2+}(aq)$ to the Pb(s)
B) the Cu(s) to the Pb(s)
C) the $Cu^{2+}(aq)$ to the Cu(s)
D) the Pb(s) to the Cu(s)

18) According to the *Activity Series* chemistry reference table, which of these metals will react most readily with 1.0 M HCl to produce $H_2(g)$?

A) Mg
B) K
C) Ca
D) Zn

19) Which process requires an external power source?

A) fermentation
B) electrolysis
C) synthesis
D) neutralization

20) Given the reaction: $4Al(s) + 3O_2(g) \longrightarrow 2Al_2O_3(s)$

(a) Write the balanced oxidation half-reaction for this oxidation-reduction reaction.

(b) What is the oxidation number of oxygen in Al_2O_3?

21) State *one* difference between voltaic cells and electrolytic cells. [*Include information about both types of cells in your answer.*]

Questions 22 and 23 refer to the following:

Two chemistry students each combine a different metal with hydrochloric acid. Student *A* uses zinc, and hydrogen gas is readily produced. Student *B* uses copper, and no hydrogen gas is produced.

22) State *one* chemical reason for the different results of students *A* and *B*.

23) Using *Activity Series* chemistry reference table, identify another metal that will react with hydrochloric acid to yield hydrogen gas.

Questions 24 through 29 refer to the following:

The redox reaction below occurs spontaneously in an electrochemical cell.

$$Zn + Cr^{3+} \longrightarrow Zn^{2+} + Cr$$

24) Write the half-reaction for the reduction that occurs.

25) Write the half-reaction for the oxidation that occurs.

26) In the equation below, balance the equation using the *smallest* whole-number coefficients.

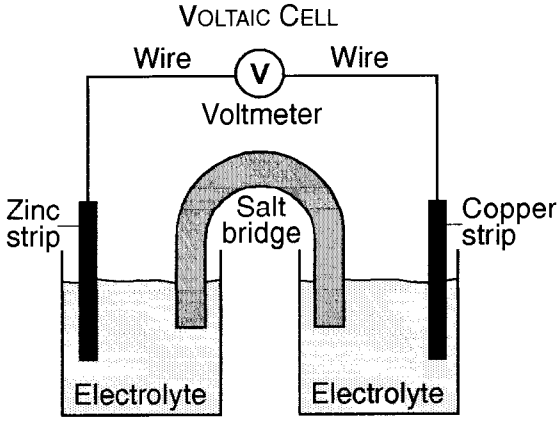
$$\_\_Zn + \_\_Cr^{3+} \longrightarrow \_\_Zn^{2+} + \_\_Cr$$

27) Which species loses electrons and which species gains electrons?

28) Which half-reaction occurs at the cathode?

29) State what happens to the number of protons in a Zn atom when it changes to Zn^{2+} as the redox reaction occurs.

Questions 30 through 32 refer to the following:



30) On the given diagram, indicate with one or more arrows the direction of electron flow through the wire.

31) Write an equation for the half-reaction that occurs at the zinc electrode in the given diagram.

32) Explain the function of the salt bridge in the given diagram.

26) In the equation below, balance the equation using the *smallest* whole-number coefficients.

$$\_\_Zn + \_\_Cr^{3+} \longrightarrow \_\_Zn^{2+} + \_\_Cr$$

27) Which species loses electrons and which species gains electrons?

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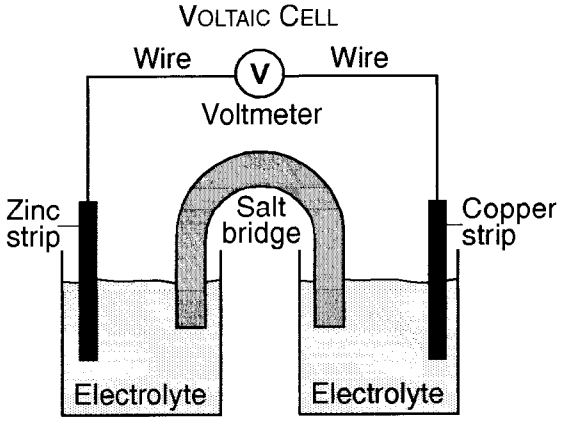
Questions 30 through 32 refer to the following:



30) On the given diagram, indicate with one or more arrows the direction of electron flow through the wire.

31) Write an equation for the half-reaction that occurs at the zinc electrode in the given diagram.

32) Explain the function of the salt bridge in the given diagram.