Redox/Electrochemistry Regents Unit Review. In chemistry we will sometimes see ions written as Zn^{+2} but sometimes as Zn^{2+}. I mixed them up here so you don't get "surprised". Sometimes Na^{+1} will be written as Na^{+}, without the "one". Cl^{-1} might be "just" Cl^{-}. It's okay, relax, you're smart.

Base your answers on the following redox reaction, which occurs spontaneously in an electrochemical cell:

$$Zn^{\circ} + Cr^{3+} \rightarrow Zn^{2+} + Cr^{\circ}$$

1. Write the half-reaction for the reduction that occurs.
2. Write the half-reaction for the oxidation that occurs.
3. Balance the equation using the smallest whole-number coefficients.
4. Which species loses electrons and which species gains electrons?
5. Which half-reaction occurs at the cathode?
6. What happens to the number of protons in a Zn atom when it changes to Zn^{2+} in the redox reaction.

Given the reaction: $Mg_{(S)} + 2H^{+}_{(AQ)} + 2Cl^{-}_{(AQ)} \rightarrow Mg^{2+}_{(AQ)} + 2Cl^{-}_{(AQ)} + H_{2(G)}$

7. Which species undergoes oxidation? A. $Mg_{(S)}$ B. $H^{+}_{(AQ)}$ C. $Cl^{-}_{(AQ)}$ D. $H_{2(G)}$
8. Which particles are gained and lost during a redox reaction?
   A. electrons B. neutrons C. protons D. positrons
9. As a Ca atom undergoes oxidation to Ca^{2+}, the number of neutrons in its nucleus
   A. increases B. decreases C. remains the same D. no one knows this, me either

Given the reaction: $4Al_{(S)} + 3O_{2(G)} \rightarrow 2Al_2O_{3(S)}$

10. Write the balanced oxidation half-reaction for this oxidation-reduction reaction.
11. What is the oxidation number of oxygen in Al_2O_3?

12. In any redox reaction, the substance that undergoes reduction will
   A. lose electrons and have a decrease in oxidation number
   B. gain 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

14. 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 gains electrons D. increases as it loses electrons

15. Given the equation: $C_{(S)} + H_2O_{(G)} \rightarrow CO_{(G)} + H_{2(G)}$ Which species undergoes reduction?
   A. $C_{(S)}$ B. H^{+} C. C^{2+} D. $H_{2(G)}$

16. Given the equation: $2Al + 3Cu^{2+} \rightarrow 2Al^{3+} + 3Cu$ The reduction half-reaction is...
   A. $Al \rightarrow Al^{3+} + 3e^{-}$ B. $Al + 3e^{-} \rightarrow A1^{3+}$ C. $Cu^{2+} + 2e^{-} \rightarrow Cu$ D. $Cu^{2+} \rightarrow Cu + 2e^{-}$

17. Which type of reaction occurs when nonmetal atoms become negative nonmetal ions?
A. oxidation B. substitution C. reduction D. condensation

18. Given the reaction: $Zn_{(S)} + 2HCl_{(AQ)} \rightarrow ZnCl_{2(AQ)} + H_{2(G)}$
Which statement correctly describes what occurs when this reaction takes place in a closed system?
A. Atoms of $Zn_{(S)}$ lose electrons and are oxidized. B. Atoms of $Zn_{(S)}$ gain electrons and are reduced.
C. There is a net loss of mass. D. There is a net gain of mass.

19. Given the reaction: $Cl_2 + 2HBr \rightarrow Br_2 + 2HCl$
Write a correctly balanced reduction half-reaction for this equation.

20. Given the reaction: $2\ Al_{(S)} + Fe_2O_{3(S)} \rightarrow Al_2O_{3(S)} + 2Fe_{(S)}$
Which species undergoes reduction? A. Al B. Al^{3+} C. Fe^{3+} D. Fe

21. Which equation shows conservation of both mass and charge?
A. $Cl_2 + Br \rightarrow Cl^- + Br_2$ B. $Cu + 2Ag^+ \rightarrow Cu^{2+} + Ag$
C. $Zn + Cr^{3+} \rightarrow Zn^{2+} + Cr$ D. $Ni + Pb^{2+} \rightarrow Ni^{2+} + Pb$

22. Given the reaction that occurs in an chemical cell: $Zn_{(S)} + CuSO_{4(AQ)} \rightarrow ZnSO_{4(AQ)} + Cu_{(S)}$
During this reaction, the oxidation number of Zn changes from
A. 0 to +2 B. 0 to -2 C. +2 to 0 D. -2 to 0

23. Given the reaction for the corrosion of aluminum: $4Al + 3O_2 \rightarrow 2Al_2O_{3(S)}$
Which half-reaction correctly represents the oxidation that occurs?
A. $Al + 3e^- \rightarrow Al^{3+}$ B. $Al \rightarrow Al^{3+} + 3e^-$ C. $O_2 + 4e^- \rightarrow 2O^{2-}$ D. $O_2 \rightarrow 2O^{2-} + 4e^-$

24. Balance this *unbalanced* redox reaction: $Cu_{(S)} + AgNO_{3(AQ)} \rightarrow Cu(NO_3)_{2(AQ)} + Ag_{(S)}$

25. Write the reduction half reaction from it now.

26. Besides redox, what kind of chemical reaction is the reaction in question 24?

27. Which half-reaction correctly represents reduction?
A. $Ag \rightarrow Ag^+ + e^-$ B. $F_2 \rightarrow 2F^- + 2e^-$ C. $Au^{3+} + 3e^- \rightarrow Au$ D. $Fe^{2+} + e^- \rightarrow Fe^{+3}$

28. 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? The number of electrons lost is

A. always greater than the number gained.
B. always equal to the number gained.
C. sometimes equal to the number gained.
D. sometimes less than the number gained.

29. Which reaction is an example of an oxidation-reduction reaction?

A. $AgNO_3 + KI \rightarrow AgI + KNO_3$
B. $2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$
C. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$
D. $Ba(OH)_2 + 2HCl \rightarrow BaCl_2 + 2H_2$

30. Which change in oxidation number indicates oxidation?

A. –1 to +2 B. –1 to –2 C. +2 to –3 D. +3 to +2

31. Given the redox reaction: $Cr^{3+} + Al \rightarrow Cr + Al^{3+}$ As the reaction takes place, there is a transfer of

A. electrons from Al to Cr^{3+}
B. protons from Al to Cr^{3+}
C. electrons from Cr^{3+} to Al
D. protons from Cr^{3+} to Al

32. In an oxidation-reduction reaction, reduction is defined as the

A. loss of protons B. gain of protons C. loss of electrons D. gain of electrons

33. Because tap water is slightly acidic, water pipes made of iron corrode over time, as shown by this balanced ionic equation: $4Fe_{(S)} + 6H_2O_{(L)} \rightarrow 2Fe_2O_{3(S)} + 3H_{2(G)}$

Explain, in terms of chemical reactivity, why copper pipes are less likely to corrode than iron pipes.

34. Half-reactions can be written to represent all

A. double-replacement reactions
B. neutralization reactions
C. fission and fusion reactions
D. oxidation and reduction reactions

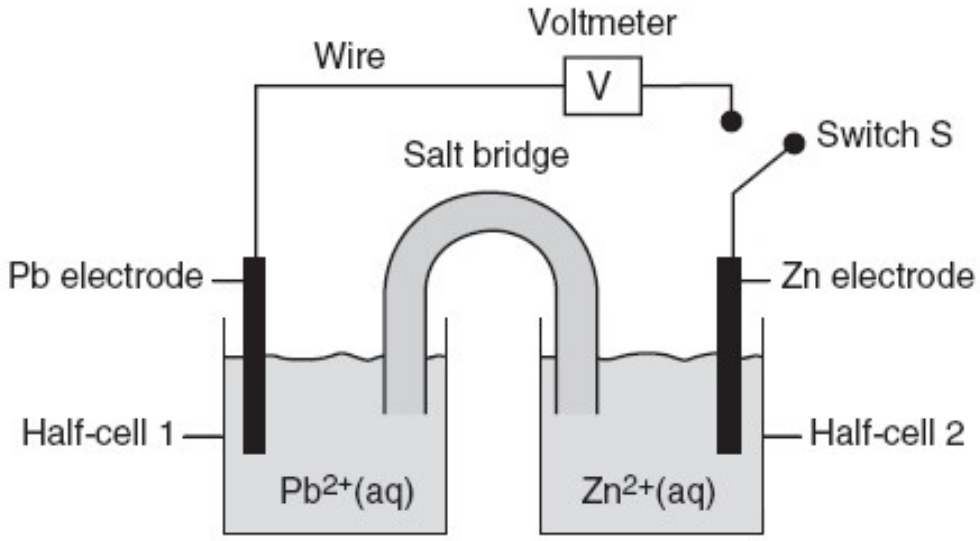
35. According to the Activity Series, which of these metals will react most readily with 1.0 M HCl to produce $H_{2(G)}$? A. Ca B. K C. Mg D. Zn

36. Which statement is true for any electrochemical cell?

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

37. What is the purpose of the salt bridge in a voltaic cell?

A. It blocks the flow of electrons.
B. It is a path for the flow of electrons.
C. It blocks the flow of positive and negative ions.
D. It is a path for positive and negative ions flow.



Use this voltaic cell set up, and your reference tables, to answer the following questions:

38. In this cell, electricity will flow A. Zn to Pb B. Pb to Zn C. Zn to Zn^{2+} D. Pb^{2+} to Pb

39. In this voltaic cell
   A. the zinc electrode oxidizes, it's the anode B. the zinc electrode oxidizes, it's the cathode
   C. the lead electrode oxidizes, it's the anode D. the lead electrode oxidizes, it's the cathode

40. When the switch is closed and the cell starts to produce electricity, the solution on the right side will
   A. become negatively charged, so anions flow into it from the salt bridge
   B. become positively charged, so cations flow into it from the salt bridge
   C. becomes negatively charged, so cations flow into it from the salt bridge
   D. becomes positively charged so anions flow into it from the salt bridge

41. While this electrochemical cell runs, producing electricity,
   A. the zinc is the anode, it gets smaller B. the zinc is the cathode, it gets bigger
   C. the lead is the anode, it gets bigger D. the lead is the cathode, it gets smaller

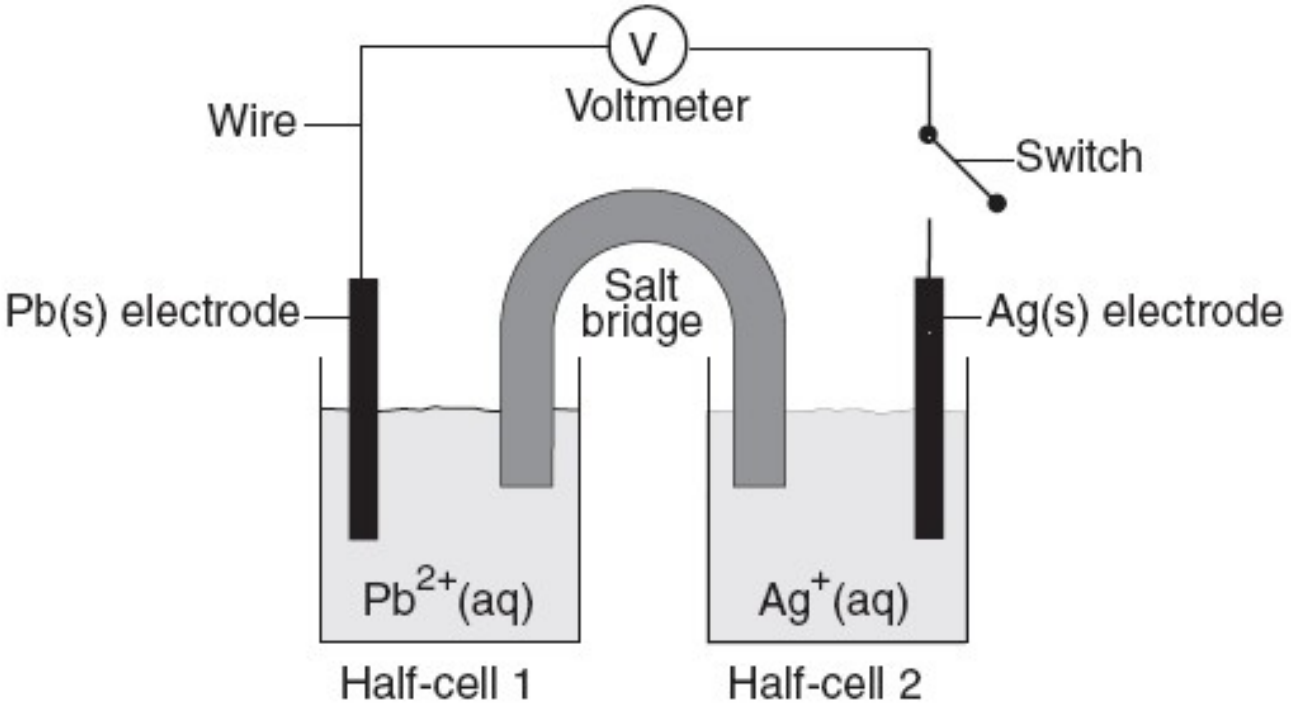
42. While this electrochemical cell runs, producing electricity,
   A. the lead is the anode, it gets bigger B. the lead is the cathode, it gets bigger
   C. the zinc is the anode, it gets bigger D. the zinc is the cathode, it gets bigger

43. Write the oxidation ½ reaction for this electrochemical cell

44. Write the reduction ½ reaction for this electrochemical cell.

45. Write the net ionic equation for this redox reaction

46. Which species is oxidized? A. Zn B. Pb C. Zn^{2+} D. Pb^{2+}



For this electrochemical cell, write the oxidation ½ reaction

47. Write the reduction ½ reaction.

48. Write the net ionic equation for this cell.

49. If the salt in the salt bridge were to be aqueous KCl, which ion would flow into the beaker on the left?

50. Which ion would flow into the beaker on the right?

51. The electricity in this cell flows from…
A. Pb to Ag B. Ag to Pb C. Pb to Ag^{+} D. Pb^{2+} to Ag^{+}

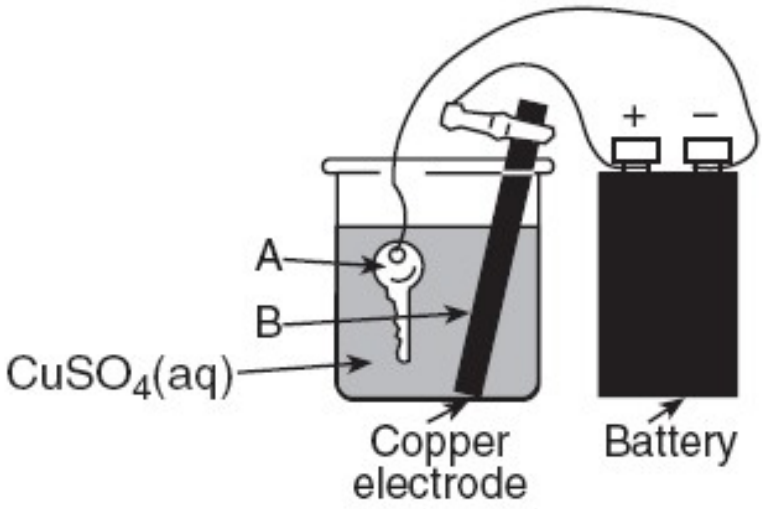
52. The anode in this cell is
A. Pb, it gets smaller B. Ag, it gets smaller C. Pb, it gets bigger D. Ag, it gets bigger

53. The diagram represents an electrochemical cell called
A. a voltaic cell, which uses electricity B. an electrolytic cell, which uses electricity
C. a voltaic cell, which produces electricity D. an electrolytic cell, which produces electricity

54. The reasons that this cell would stop producing electricity include (choose ALL the correct answers)
A. running out of anode B. running out of cathode C. running out of anode side cations
D. running out of cathode side cations E. running out of salt ions F. anode getting too big
G. opening the switch, breaking the electric connection H. time for the Sopranos
I. radioactive decay of anode resulting in radiation disrupting your brain wave pattern J. rain or snow

At right is an electrochemical cell, use the diagram and your knowledge of redox chemistry to answer the following questions.

The key, marked "A" is made of nickel metal, it's very strong.



55. If the battery were not present, the chemical reaction of putting nickel metal into $CuSO_{4(AQ)}$ would be balanced this way:

_____ → _____

56. This reaction is called a _____ _____ reaction.

57. Is that reaction also redox? _____ What proof do you have? _____

58. In this set up, the anode is
A. the key B. the copper electrode C. the copper (II) sulfate solution D. the wires

59. Electrons flow from the battery
A. to the key, which is the anode
B. to the key, which is the cathode
C. to the solution, which is neither the cathode or anode
D. to the air

60. Write the oxidation ½ reaction for this cell.

61. Write the reduction ½ reaction for this cell.

62. LEO the Lion goes GER infers that the _____ of _____ is _____ *and*

63. … that the _____ of _____ is _____

64. Which TWO of these statements are correct?
A. a voltaic cell uses electricity to produce a chemical reaction
B. a voltaic cell creates electricity from a chemical reaction
C. an electrolytic cell uses electricity to produce a chemical reaction
D. an electrolytic cell produces electricity from a chemical reaction.

65. True or False: All single replacement reactions are also redox.

66. True or False: All redox reactions are single replacement reactions.

Given this balanced reaction: $2Mg + O_2 \rightarrow 2MgO$

67. This is an example of a _____ chemical reaction that is also _____.

68. In this reaction, the _____ are oxidized into _____.

69. In this reaction, the _____ are reduced into _____.

70. The oxidation number for the magnesium atom in the reactants is: ___

71. The oxidation state for the magnesium cation in the product is: ___

72. The oxidation state for the oxide anion in the product is: ___

73. The oxidation state for each species in $CaSO_4$ would be…
A. Ca^{+2} S° O^{-2} B. Ca° S° O° C. Ca^{+2} S^{+6} O^{-8} D. Ca^{+2} S^{+6} O^{-2}

74. The oxidation state for each species in $Al(OH)_3$ would be…
A. Al^{+3} O^{-6} H^{+3} B. Al^{+3} O^{-2} H^{+1} C. Al° O° H° D. Al^{+1} O^{-2} H^{+1}

75. The oxidation state for each species in CO_2 would be…
A. C° O° B. C° O^{-2} C. C^{+2} O^{-2} D. C^{+4} O^{-2}

76. The oxidation state for each species in HCO_3^{-1} would be…
A. H^{+1} C^{+2} O^{-2} B. H^{+1} C^{+4} O^{-2} C. H^{+3} C° O^{-2} D. H° C° O°

77. When you place silver metal into hydrochloric acid, what are the products?

78. When you mix bromine into an aqueous solution of ammonium iodide, what are the products?

79. Is question 77 a redox reaction?

80. Is question 78 redox?

81. In question 78, what is the spectator ion?

One last big question on the next page.

Label this set up for a voltaic cell. Show the flow of electrons, flow of ions, which metal bar is the anode, which metal bar is the cathode, write the chemical formulas for the both ionic solutions, indicate which solution gets positively charged and which becomes negative. Write the formula for the salt in the salt bridge. The metal bars are labeled, don't change them. State exactly why the voltaic cell would stop producing electricity (there are 3 reasons, be specific). Write both of the half reactions and net ionic equation too. Go.