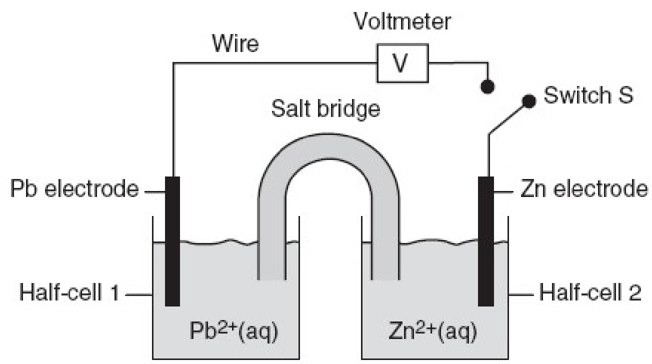
Redox/Electrochemistry Regents Unit Review. ANSWERS

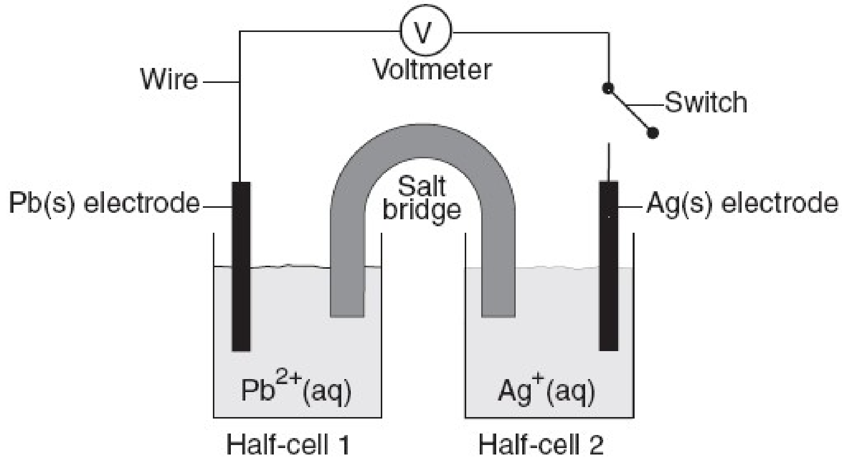
$Zn° + Cr^{3+} \rightarrow Zn^{2+} + Cr°$

1. ½ red = $Cr^{3+} + 3e^- \rightarrow Cr°$
2. ½ ox = $Zn° \rightarrow Zn^{+2} + 2e^-$
3. Balanced = $3Zn° + 2Cr^{3+} \rightarrow 3Zn^{+2} + 2Cr°$
4. Zn° loses electrons, $2Cr^{3+}$ gains electrons
5. Reduction happens at the cathode (red-cat), $2Cr^{3+} + 6e^- \rightarrow 2Cr°$
6. The number of protons in any atom, in any redox reaction, never changes. Charge or oxidation changes.
7. A. $Mg_{(S)}$
8. A. electrons
9. neutrons remain the same: C. remains the same
10. ½ ox = $4Al° \rightarrow 4Al^{+3} + 12e^-$
11. -2, it's: O^{-2}
12. reduction means to gain electrons, B. gain electrons and have a decrease in oxidation number
    example, $O_2° \rightarrow 2O^{-2}$ (a neutral element becomes —2 anion)
14. oxidation means loss of electrons, so oxidation number increases, D. increases as it loses electrons
    example: $Al° \rightarrow Al^{+3} + 3e^-$ (The neutral Al atom ® a +3 cation)
15. reduction is gain of electrons, so B. H^+ in H_2O, hydrogen is H^{+1}, while as elemental hydrogen, it's $H_2°$ It was reduced.
16. ½ red = C. $Cu^{2+} + 2e^- \rightarrow Cu$ the copper cations gain electrons to become neutral atoms
17. The GER, gain of electrons is reduction C. reduction
18. Given the reaction: $Zn_{(S)} + 2HCl_{(AQ)} \rightarrow ZnCl_{2(AQ)} + H_{2(G)}$
    A. Atoms of $Zn_{(S)}$ lose electrons and are oxidized.
    Zinc atoms are oxidized into cations, each atom loses $2e^-$, they are picked up by the $2H^{+1}$
19. ½ red = $Cl_2° + 2e^- \rightarrow 2Cl^{-1}$
20. Red-Cat, reduction is gain of electrons, C. Fe^{3+} the iron cations gain $3e^-$ each, becoming Fe°
21. Conservation of both mass + charge? D. $Ni + Pb^{2+} \rightarrow Ni^{2+} + Pb$
    The Ni loses $2e^-$, the Pb^{2+} gain $2e^-$ the number of particles is the same
22. During this reaction, the oxidation number of Zn changes from A. 0 to +2
    as an atom, Zn is neutral, as a cation it's a +2 cation
23. ½ ox = B. $Al \rightarrow Al^{3+} + 3e^-$ aluminum atoms lose e^- to become cations in the aluminum oxide
24. Balanced: $Cu_{(S)} + 2AgNO_{3(AQ)} \rightarrow Cu(NO_3)_{2(AQ)} + 2Ag_{(S)}$
25. ½ red = $2Ag^{+1} + 2e^- \rightarrow 2Ag°$
26. It's redox and it's single replacement
27. ½ red = C. $Au^{3+} + 3e^- \rightarrow Au$ Au or Au°, it's still atomic, so it's still neutral
28. B. The number of e^- lost is <u>always equal</u> to the number of e^- gained.
29. The redox is: C. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

30. oxidation would be: A. –1 to +2
31. In this redox, A. electrons transfer from Al to Cr^{3+}
32. reduction is defined as the D. gain of electrons
33. Since Cu is below H_2 on table J, it's less reactive, copper can not undergo redox with water.
34. Half-reactions can be written to represent all D. oxidation and reduction reactions
35. B. K It's the highest of the group on table J, the most reactive metal here.
36. A. Oxidation occurs at the anode, only. (reduction only can happen at the cathode, red-cat)
37. The salt bridge is D. a path for positive and negative ions flow. Salt ions relieve the charge build up in the solutions of the voltaic cell. Ions move in the salt bridge, only electrons, electricity, move through the wire.



38. In this cell, electricity will flow A. Zn to Pb Zn higher on table J than Pb, zinc oxidizes.
39. In this voltaic cell A. the zinc electrode oxidizes, it's the anode. Zinc higher on table J, it oxidizes. Oxidation happens at the anode only (red-cat).
40. The solution on the right side D, becomes positively charged so anions flow into it from the salt bridge. Zn^{+2} ions form into the solution, making it + charged. The salt ions cancel out this charge build up.
41. While this electrochemical cell runs, producing electricity, A. the zinc is the anode, it gets smaller Zinc atoms jump into solution when they oxidize electrons.
42. While this electrochemical cell runs, producing electricity, B. the lead is the cathode, it gets bigger Reduction happens on the cathode, $Pb^{+2} + 2e^{-} \rightarrow Pb^{\circ}$
43. ½ ox = $Zn^{\circ} \rightarrow Zn^{+2} + 2e^{-}$
44. ½ red = $Pb^{+2} + 2e^{-} \rightarrow Pb^{\circ}$
45. net ionic equation = $Zn^{\circ} + Pb^{+2} \rightarrow Zn^{+2} + Pb^{\circ}$
46. A. Zn is oxidized Oxidation is the loss of electrons, see #43.



47. ½ red = $Ag^{+1} + 1e^{-} \rightarrow Ag°$

48. net ionic equation: $Pb° + 2Ag^{+1} \rightarrow Ag° + Pb^{+2}$

49. Cl^{-1}

50. K^{+1}

51. The electricity flows A. Pb to Ag anode to cathode

52. The anode in this cell is A. Pb, it gets smaller (anodes get used up as they oxidize)

53. This is an electrochemical cell called C. a voltaic cell, which produces electricity

54. This cell would stop producing electricity for 3 reasons: A. running out of anode
D. running out of cathode side cations E. running out of salt ions

55. $Ni_{(S)} + CuSO_{4(AQ)} \rightarrow NiSO_{4(AQ)} + Cu_{(S)}$ This is spontaneous redox, which is NOT supposed to happen here. Rather, a forced redox, forced because the battery provides electricity to "push" in the non-spontaneous direction.

56. single replacement

57. single replacement is also redox? The proof is both Ni + Cu^{+2} change oxidation numbers

58. The anode is B. the copper electrode, which is where $Cu° \rightarrow Cu^{+2} + 2e^{-}$

59. Electrons flow from the battery B. to the key, which is the cathode

60. ½ ox = $Cu° \rightarrow Cu^{+2} + 2e^{-}$

61. ½ red = $Cu^{+2} + 2e^{-} \rightarrow Cu°$

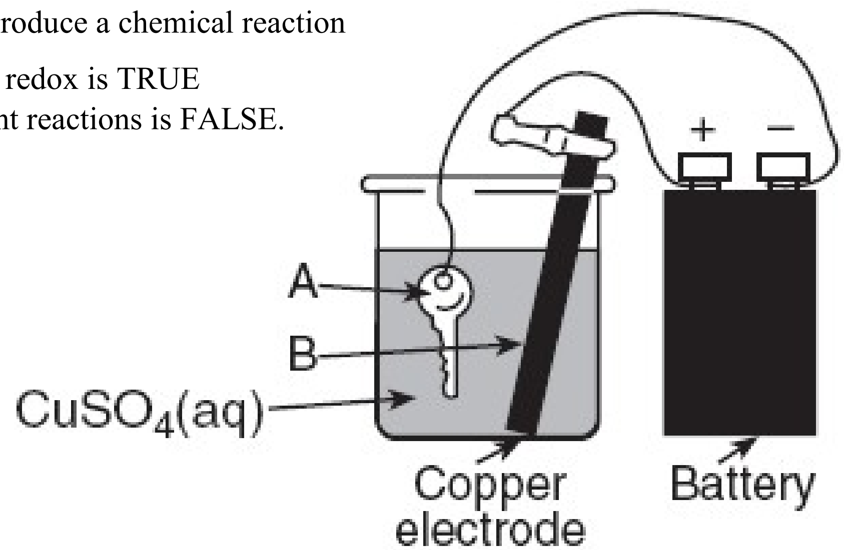
62. LEO the Lion goes GER infers that the LOSS of e^{-} is OXIDATION *and*

63. GAIN of ELECTRONS is REDUCTION

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

65. All single replacement reactions are also redox is TRUE

66. All redox reactions are single replacement reactions is FALSE. Many are synthesis, decomp, etc.



67. SYNTHESIS is also REDOX

68. Mg° are oxidized Mg^{+2}

69. $O_2°$ are reduced $2O^{-2}$

70. Mg°

71. Mg^{+2}

72. O^{-2}

73. $CaSO_4$ would be D. Ca^{+2} S^{+6} O^{-2} (1 Ca, 1 S, and 4 O, sums to zero)

74. $Al(OH)_3$ would be B. Al^{+3} O^{-2} H^{+1} (1 Al, 3 O, and 3 H, sums to zero)

75. CO_2 would be D. C^{+4} O^{-2} (1 C, and 2 O)

76. HCO_3^{-1} would be B. H^{+1} C^{+4} O^{-2} (1 H, 1 C, and 3 O, sums to -1, it's an anion!)

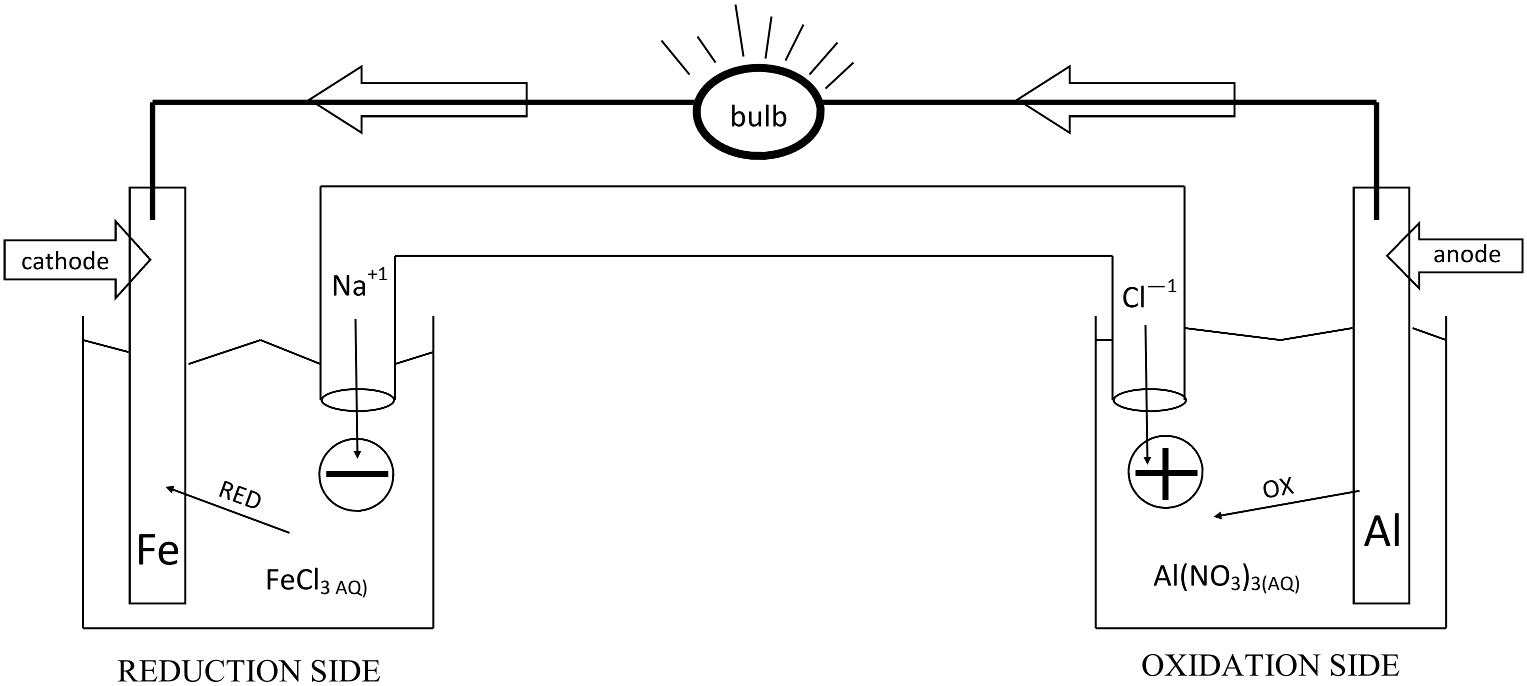
77. Ag + HCl yields nothing, silver is below H on table J, no reaction

78. $Br_2 + 2NH_4I_{(AQ)} \rightarrow 2NH_4Br_{(AQ)} + I_2$

79. Ag + HCl → X no reaction can't be redox, it's nothing

80. $Br_2 + 2NH_4I_{(AQ)} \rightarrow 2NH_4Br_{(AQ)} + I_2$ is redox, the Br and the I both change oxidation numbers

81. The spectator ion is the ammonium, the NH_4^{+1}



Al is higher than Fe on table J, it's more reactive, so, Al will oxidize into Al^{+3} cations, releasing electrons to flow through the wire, right to left. That's the electricity. The electrons force themselves onto the Fe (iron) electrode, and the Fe^{+3} cations in solution are reduced by picking these electrons up, making more iron atoms.

As the aluminum cations enter the solution on the right, and as the negative electrons leave, that solution becomes + charged. On the other side, the loss of cations as they form atoms, makes the left solution become more negative. This charge build up must be alleviated, or else electricity can't flow. The salt ions in the salt bridge flow (by charge) to offset this charge build up. Chloride anions flow to the right side solution. Sodium cation flow to the left, and both solutions remain neutral.

The anode, the Al bar, gets smaller and smaller as it oxidizes. The cathode gets larger and larger as more Fe^{+3} cations form into more Fe atoms. The salt ions keep moving.

The half reactions and net ionic equation are as follows.

½ ox = $Al^\circ \rightarrow Al^{3+} + 3e^-$

½ red = $Fe^{3+} + 3e^- \rightarrow Fe^\circ$

The net ionic equation = $Al^\circ + Fe^{3+} \rightarrow Fe^\circ + Al^{3+}$

A battery "dies" when you run out of anode (Al), run out of cathode side cations (Fe^{+3}), or run out of salt. As long as the system is fully hooked up, this is spontaneous redox, so it will go and go, making more electricity from the chemistry, until it cannot.