These problems are intended to ***supplement*** the problems in the textbook, not ***replace*** them.

Questions

What is the oxidation number of each atom in the following formulas?

1. $KMnO_4$
2. NH_4^+
3. SbF_5
4. $SrCr_2O_7$
5. Mn_2O_3
6. $Cr_2(SO_4)_3$
7. Na_2CrO_4
8. $HC_2H_3O_2$
9. CO_3^{2-}
10. $H_4As_2O_7$

Use oxidation numbers to identify what is oxidized and what is reduced in the following reactions:

11. $2\ Fe_2O_3\,(l) + 3\ C(s) \rightarrow 4\ Fe(l) + 3\ CO_2\,(g)$
12. $5\ Fe^{2+}\,(aq) + MnO_4^-\,(aq) + 8\ H^+\,(aq) \rightarrow 5\ Fe^{3+}\,(aq) + Mn^{2+}\,(aq) + 4\ H_2O(l)$
13. $HgO(s) + Zn(s) \rightarrow Hg(l) + ZnO(s)$
14. $2\ K_2Cr_2O_7\,(aq) + 3\ C_2H_5OH(aq) + 8\ H_2SO_4\,(aq) \rightarrow 2\ Cr_2(SO_4)_3\,(aq) + 2\ K_2SO_4\,(aq) + 3\ HC_2H_3O_2\,(aq) + 11\ H_2O(l)$
15. $2\ NH_4^+\,(aq) + 2\ MnO_2\,(s) + Zn(s) \rightarrow Mn_2O_3\,(s) + 2\ NH_3\,(aq) + H_2O(l) + Zn^{2+}\,(aq)$
16. $2\ Cr_2O_3\,(s) + 3\ Si(s) \rightarrow 4\ Cr(s) + 3\ SiO_2\,(s)$
17. $6\ H^+\,(aq) + 5\ H_2C_2O_4\,(aq) + 2\ MnO_4^-\,(aq) \rightarrow 10\ CO_2\,(g) + 2\ Mn^{2+}\,(aq) + 8\ H_2O(l)$
18. $PbO_2\,(s) + 4\ Cl^-\,(aq) + 4\ H^+\,(aq) \rightarrow PbCl_2\,(s) + 2\ H_2O(l) + Cl_2\,(g)$

Write the molecular, complete ionic, and net ionic equations for each of the following oxidation-reduction reactions. Also, use the Activity Series to predict whether each reaction will occur or not.

19. zinc + hydrobromic acid
20. tin + mercury(II) nitrate
21. barium iodide + iron
22. cobalt(II) sulfate + magnesium
23. hydrogen + copper(II) acetate
24. aluminum chloride + silver
25. potassium + phosphoric acid
26. lead + chromium(III) nitrate
27. gold(III) sulfate + calcium
28. manganese + lithium acetate

Answers

If you cannot figure out how to get the correct answer, go to your instructor, the Science Tutoring Center, SI, etc.

1. K is +1, O is –2, Mn is +7
2. H is +1, N is –3
3. F is –1, Sb is +5
4. Sr is +2, O is –2, Cr is +6
5. O is –2, Mn is +3
6. Cr is +3, O is –2, S is +6
7. Na is +1, O is –2, Cr is +6
8. H is +1, O is –2, C is 0
9. O is –2, C is +4
10. H is +1, O is –2, As is +5

11. C is oxidized and Fe is reduced
12. Fe is oxidized and Mn is reduced
13. Zn is oxidized and Hg is reduced
14. C is oxidized and Cr is reduced
15. Zn is oxidized and Mn is reduced
16. Si is oxidized and Cr is reduced
17. C is oxidized and Mn is reduced
18. Cl is oxidized and Pb is reduced

19. molecular: $Zn(s) + 2\ HBr(aq) \rightarrow ZnBr_2(aq) + H_2(g)$
ionic: $Zn(s) + 2\ H^{1+}(aq) + 2\ Br^{1-}(aq) \rightarrow Zn^{2+}(aq) + 2\ Br^{1-}(aq) + H_2(g)$
net: $Zn(s) + 2\ H^{1+}(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$
Zinc is above hydrogen in the Activity Series, so YES, this reaction should occur.

20. molecular: $Sn(s) + Hg(NO_3)_2(aq) \rightarrow Sn(NO_3)_2(aq) + Hg(l)$
ionic: $Sn(s) + Hg^{2+}(aq) + 2\ NO_3^{1-}(aq) \rightarrow Sn^{2+}(aq) + 2\ NO_3^{1-}(aq) + Hg(l)$
net: $Sn(s) + Hg^{2+}(aq) \rightarrow Sn^{2+}(aq) + Hg(l)$
Tin is above mercury in the Activity Series, so YES, this reaction should occur.

21. molecular: $BaI_2(aq) + Fe(s) \rightarrow Ba(s) + FeI_2(aq)$
ionic: $Ba^{2+}(aq) + 2\ I^{1-}(aq) + Fe(s) \rightarrow Ba(s) + Fe^{2+}(aq) + 2\ I^{1-}(aq)$
net: $Ba^{2+}(aq) + Fe(s) \rightarrow Ba(s) + Fe^{2+}(aq)$
Iron is below barium in the Activity Series, so NO, this reaction should not occur.

22. molecular: $CoSO_4(aq) + Mg(s) \rightarrow Co(s) + MgSO_4(aq)$
ionic: $Co^{2+}(aq) + SO_4^{2-}(aq) + Mg(s) \rightarrow Co(s) + Mg^{2+}(aq) + SO_4^{2-}(aq)$
net: $Co^{2+}(aq) + Mg(s) \rightarrow Co(s) + Mg^{2+}(aq)$
Magnesium is above cobalt in the Activity Series, so yes, this reaction should occur.

23. molecular: $H_2(g) + Cu(C_2H_3O_2)_2(aq) \rightarrow 2\ HC_2H_3O_2(aq) + Cu(s)$
ionic: $H_2(g) + Cu^{2+}(aq) + 2\ C_2H_3O_2^{1-}(aq) \rightarrow 2\ HC_2H_3O_2(aq) + Cu(s)$
net: $H_2(g) + Cu^{2+}(aq) \rightarrow 2\ H^{1+}(aq) + Cu(s)$
Hydrogen is above copper in the Activity Series, so yes, this reaction should occur.

24. molecular: $AlCl_3(aq) + 3\ Ag(s) \rightarrow Al(s) + 3\ AgCl(s)$
ionic: $Al^{3+}(aq) + 3\ Cl^{1-}(aq) + 2\ Ag(s) \rightarrow Al(s) + 3\ AgCl(s)$
net: $Al^{3+}(aq) + 3\ Cl^{1-}(aq) + 2\ Ag(s) \rightarrow Al(s) + 3\ AgCl(s)$
Silver is below aluminum in the Activity Series, so NO, this reaction should not occur.

25. molecular: $6\ K(s) + 2\ H_3PO_4(aq) \rightarrow 2\ K_3PO_4(aq) + 3\ H_2(g)$
ionic: $6\ K(s) + 2\ H_3PO_4(aq) \rightarrow 6\ K^{1+}(aq) + 2\ PO_4^{3-}(aq) + 3\ H_2(g)$
net: $6\ K(s) + 2\ H_3PO_4(aq) \rightarrow 6\ K^{1+}(aq) + 2\ PO_4^{3-}(aq) + 3\ H_2(g)$
Potassium is above hydrogen in the Activity Series, so yes, this reaction should occur.

26. molecular: $3\ Pb(s) + 2\ Cr(NO_3)_3(aq) \rightarrow 3\ Pb(NO_3)_2(aq) + 2\ Cr(s)$
ionic: $3\ Pb(s) + 2\ Cr^{3+}(aq) + 6\ NO_3^{1-}(aq) \rightarrow 3\ Pb^{2+}(aq) + 6\ NO_3^{1-}(aq) + 2\ Cr(s)$
net: $3\ Pb(s) + 2\ Cr^{3+}(aq) \rightarrow 3\ Pb^{2+}(aq) + 2\ Cr(s)$
Lead is below chromium in the Activity Series, so NO, this reaction should not occur.

27. molecular: $Au_2(SO_4)_3(aq) + 3\ Ca(s) \rightarrow 2\ Au(s) + 3\ CaSO_4(aq)$
ionic: $2\ Au^{3+}(aq) + 3\ SO_4^{2-}(aq) + 3\ Ca(s) \rightarrow 2\ Au(s) + 3\ Ca^{2+}(aq) + 3\ SO_4^{2-}(aq)$
net: $2\ Au^{3+}(aq) + 3\ Ca(s) \rightarrow 2\ Au(s) + 3\ Ca^{2+}(aq)$
Calcium is above gold in the Activity Series, so yes, this reaction should occur.

28. molecular: $Mn(s) + 2\ LiC_2H_3O_2(aq) \rightarrow Mn(C_2H_3O_2)_2(aq) + 2\ Li(s)$
ionic: $Mn(s) + 2\ Li^{1+}(aq) + 2\ C_2H_3O_2^{1-}(aq) \rightarrow Mn^{2+}(aq) + 2\ C_2H_3O_2^{1-}(aq) + 2\ Li(s)$
net: $Mn(s) + 2\ Li^{1+}(aq) \rightarrow Mn^{2+}(aq) + 2\ Li(s)$
Manganese is below lithium in the Activity Series, so NO, this reaction should not occur.