Assignment: Chemical Reactions in Aqueous Solution

Instructions

As you work these problems, consider and explain:

A. What type of question is it?
B. How do you know what type of question it is?
C. What information are you looking for?
D. What information do they give?
E. How will you go about solving this?
F. Show how to solve the problem.
G. Be able to answer for a different reaction, number, set of conditions, etc.

Questions

1. Consider two organic molecules, ethanol and benzene. One dissolves in water and the other does not. Why?
    a. They have different molar masses.
    b. One is ionic, the other is not.
    c. One is an electrolyte, the other is not.
    d. Ethanol contains a polar O–H bond, and benzene does not.
    e. Two of these are correct.
2. Which of the following is a strong acid?
    a. HF
    b. KOH
    c. $HClO_4$
    d. HClO
    e. HBrO
3. Which of the following is not a strong base?
    a. $Ca(OH)_2$

b. KOH
c. NH_3
d. LiOH
e. $Sr(OH)_2$

4. 1.00 mL of a 2.90×10^{-4}M solution of oleic acid is diluted with 9.00 mL of petroleum ether, forming solution A. Then 2.00 mL of solution A is diluted with 8.00 mL of petroleum ether, forming solution B. What is the concentration of solution B?
   a. 2.90×10^{-6}M
   b. 8.06×10^{-6}M
   c. 5.80×10^{-5}M
   d. 6.44×10^{-5}M
   e. 5.80×10^{-6}M
5. How many grams of NaCl are contained in 350. mL of a 0.196 M solution of sodium chloride?
   a. 11.5 g
   b. 4.01 g
   c. 8.02 g
   d. 68.6 g
   e. none of these
6. What volume of 18 M sulfuric acid must be used to prepare 2.00 L of 0.140 M H_2SO_4
   a. 16 mL
   b. 0.28 mL
   c. 1.3 × 103 mL
   d. 2.8 mL
   e. 5.0 mL
7. What are the following reactions examples of?

   $Pb^{2+} + 2I– \rightarrow PbI_2$

   $2Ce^{4+} + 2I^- \rightarrow I_2 + 2Ce^{3+}$

   $HOAc + NH_3 \rightarrow NH_4^+ + OAc^-$

a. acid-base reactions
b. unbalanced reactions
c. precipitation, acid-base, and redox reactions, respectively
d. redox, acid-base, and precipitation reactions, respectively
e. precipitation, redox, and acid-base reactions, respectively

8. You have exposed electrodes of a light bulb in a solution of H_2SO_4 such that the light bulb is on. You add a dilute solution and the bulb grows dim. Which of the following could be in the solution?
    a. $Ba(OH)_2$
    b. $NaNO_3$
    c. K_2SO_4
    d. $Cu(NO_3)_2$
    e. none of these
9. Aqueous solutions of potassium sulfate and ammonium nitrate are mixed together. Which statement is correct?
    a. Both KNO_3 and NH_4SO_4 precipitate from solution.
    b. A gas is released.
    c. NH_4SO_4 will precipitate from solution.
    d. KNO_3 will precipitate from solution.
    e. No reaction will occur.
10. How many of the following salts are expected to be insoluble in water?
        - sodium sulfide
        - barium nitrate
        - ammonium sulfate
        - potassium phosphate
    a. none
    b. 1
    c. 2
    d. 3
    e. 4
11. Which of the following ions is most likely to form an insoluble sulfate?

a. K^+
b. Li^+
c. Ca^{2+}
d. S^{2-}
e. Cl^-

Use the following to answer questions 12–13: Aqueous solutions of barium chloride and silver nitrate are mixed to form solid silver chloride and aqueous barium nitrate.

12. The balanced molecular equation contains which one of the following terms?
    a. AgCl (s)
    b. 2AgCl (s)
    c. $2Ba(NO_3)2$ (aq)
    d. $BaNO_3$ (aq)
    e. 3AgCl (aq)
13. The net ionic equation contains which of the following terms?
    a. Ag^+(aq)
    b. Ba^{2+}(aq)
    c. NO_3^- (aq)
    d. H^+ (aq)
    e. AgCl (aq)
14. The net ionic equation for the reaction of calcium bromide and sodium phosphate contains which of the following species?
    a. $2Br^-$ (aq)
    b. PO_4^{3-} (aq)
    c. $2Ca_3(PO_4)_2$(s)
    d. 6NaBr (aq)
    e. $3Ca^{2+}$ (aq)
15. The net ionic equation for the reaction of aluminum sulfate and sodium hydroxide contains which of the following species?
    a. $3Al^{3+}$(aq)
    b. OH^- (aq)
    c. $3OH^-$ (aq)
    d. $2Al^{3+}$(aq)
    e. $2Al(OH)^3$(s)

16. You mix 265.0 mL of 1.20 M lead(II) nitrate with 300.0 mL of 1.55 M potassium iodide. The lead(II) iodide is insoluble. Which of the following is false?
    a. The final concentration of Pb^{2+} ions is 0.151 M.
    b. You form 107 g of lead(II) iodide.
    c. The final concentration of K+ is 0.823 M.
    d. The final concentration of NO_3^- is 0.823 M.
    e. All are true.
17. When solutions of formic acid and sodium hydroxide react, which of the following are NOT present in the net ionic equation?
    I. hydrogen ion
    II. formate ion
    III. sodium ion
    IV. hydroxide ion
    a. I and II
    b. I, II, and III
    c. I and IV
    d. I and III
    e. II and III
18. When solutions of acetic acid and copper(II) react, which of the following are spectator ions?
    a. hydrogen ion
    b. acetate ion
    c. copper(II) ion
    d. hydroxide ion
    e. none of these
19. A 0.307-g sample of an unknown triprotic acid is titrated to the third equivalence point using 35.2 mL of 0.106 M NaOH. Calculate the molar mass of the acid.
    a. 247 g/mol
    b. 171 g/mol
    c. 165 g/mol
    d. 151 g/mol
    e. 82.7 g/mol

20. You have separate solutions of HCl and H_2SO_4 with the same concentrations in terms of molarity. You wish to neutralize a solution of NaOH. Which acid solution would require more volume (in mL) to neutralize the base?
    a. The HCl solution.
    b. The H_2SO_4 solution.
    c. You need to know the acid concentrations to answer this question.
    d. You need to know the volume and concentration of the NaOH solution to answer this question.
    e. C and D
21. With what volume of 5.00 M HF will 5.41 g of calcium hydroxide react completely, according to the following reaction?
    $2\ HF + Ca(OH)_2 \rightarrow CaF_2 + 2H_2O$
    a. 14.6 mL
    b. 146 mL
    c. 730 mL
    d. 29.2 mL
    e. 34.2 mL
22. A student weighs out 0.557 g of KHP (molar mass = 204.22 g/mol) and titrates to the equivalence point with 36.78 mL of a stock NaOH solution. What is the concentration of the stock NaOH solution? KHP is an acid with one acidic proton.
    a. 0.00273 M
    b. 0.100 M
    c. 0.0151 M
    d. 0.0742 M
    e. none of these
23. In which of the following does nitrogen have an oxidation state of +4?
    a. HNO_3
    b. NO_2
    c. N_2O
    d. NH_4Cl
    e. $NaNO_2$
24. What is the oxidation state of chlorine in ClO^-?

a. 0
b. +1
c. –1
d. +3
e. –7

25. In the reaction 2Ca(s) + O2(g) → 2CaO(s), which species is oxidized?
    a. O_2
    b. O^{2-}
    c. Ca
    d. Ca^{2+}
    e. none of these
26. In the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, N_2 is
    a. oxidized
    b. reduced
    c. the electron donor
    d. the reducing agent
    e. two of these
27. Which of the following are oxidation-reduction reactions?
    I. $PCl_3 + Cl_2 \rightarrow PCl_5$
    II. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$
    III. $CO_2 + 2LiOH \rightarrow Li_2CO_3 + H_2O$
    IV. $FeCl_2 + 2NaOH \rightarrow Fe(OH)_2 + 2NaCl$
    a. III
    b. IV
    c. I and II
    d. I, II, and III
    e. I, II, III, and IV
28. In the reaction $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$, which, if any, element is oxidized?
    a. zinc
    b. hydrogen
    c. sulfur
    d. oxygen
    e. none of these

29. Balance the following oxidation-reduction reaction using the oxidation number method: $Fe_{3+} + I^{-} \rightarrow Fe_{2+} + I_2$

    In the balanced equation, the coefficient of $Fe^{2+} + I_2$

    a. 1
    b. 2
    c. 3
    d. 4
    e. none of these

30. Given the reaction $2MnO_{4-} + 5H_2O_2 + 6H^{+}\ \ 2Mn^{2+} + 8H_2O + 5O_2$ determine the number of electrons involved in this reaction.

    a. 10
    b. 8
    c. 6
    d. 4
    e. 2