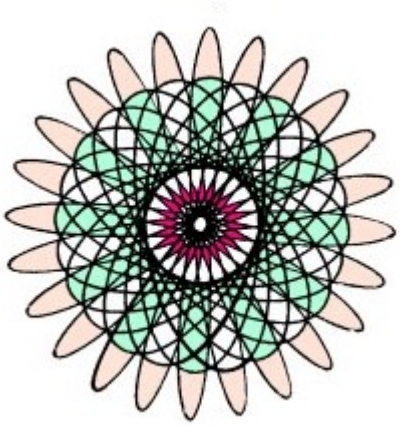

12.8 End-of-Chapter Material

ADDITIONAL EXERCISES

1. Write the balanced chemical equation between Zn metal and HCl(aq). The other product is $ZnCl_2$.

2. Write the neutralization reaction in which $ZnCl_2$, also found in Exercise 1, is the salt product.

3. Why isn't an oxide compound like CaO considered a salt? (Hint: what acid-base combination would be needed to make it if it were a salt?)

4. Metal oxides are considered basic because they react with H_2O to form OH compounds. Write the chemical equation for a reaction that forms a base when CaO is combined with H_2O.

5. Write the balanced chemical equation between aluminum hydroxide and sulfuric acid.

6. Write the balanced chemical equation between phosphoric acid and barium hydroxide.

7. Write the equation for the chemical reaction that occurs when caffeine ($C_8H_{10}N_4O_2$) acts as a Brønsted-Lowry base.

8. Citric acid ($C_6H_8O_7$) is the acid found in citrus fruits. It can lose a maximum of three H^+ions in the presence of a base. Write the chemical equations for citric acid acting stepwise as a Brønsted-Lowry acid.

9. Can an amphiprotic substance be a strong acid and a strong base at the same time? Explain your answer.

10. Can an amphiprotic substance be a weak acid and a weak base at the same time? If so, explain why and give an example.

11. Under what conditions will the equivalence point of a titration be slightly acidic?

12. Under what conditions will the equivalence point of a titration be slightly basic?

13. Write the chemical equation for the autoionization of NH_3.

14. Write the chemical equation for the autoionization of HF.

15. What is the pOH range for an acidic solution?

16. What is the pOH range for a basic solution?

17. The concentration of commercial HCl is about 12 M. What is its pH and pOH?

18. The concentration of concentrated H_2SO_4 is about 18 M. Assuming only one H^+ comes off the H_2SO_4 molecule, what is its pH and pOH? What would the pH and pOH be if the second H^+ were also ionized?

ANSWERS

1. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

3. The O^{2-} ion would come from H_2O, which is not considered a classic acid in the Arrhenius sense.

5. $2Al(OH)_3 + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6H_2O$

7. $C_8H_{10}N_4O_2 + H_2O \rightarrow C_8H_{10}N_4O_2H^+ + OH^-$; the H^+ ion attaches to one of the N atoms in the caffeine molecule.

9. As a strong acid or base, an amphiprotic substance reacts 100% as an acid or a base, so it cannot be a base or an acid at the same time.

11. if the salt produced is an acidic salt

13. $NH_3 + NH_3 \rightarrow NH_4^+ + NH_2^-$

15. pOH > 7

17. pH = −1.08; pOH = 15.08