1. Haber and Bosch succeeded in making ammonia by controlling what two variables?

2. What is a reversible reaction?

3. What does a double arrow mean?

4. A reaction has reached chemical equilibrium when what?

5. At equilibrium, there is no ______ ________ in the actual amounts of substances in the system.

6. At equilibrium, you might mistakenly think what?

7. At equilibrium, what are NOT necessarily the same?

8. What does the equilibrium position indicate?

9. Why does a catalyst speed up both the forward and reverse reactions equally?

10. Do catalysts affect the amounts of reactants and products at equilibrium?

   What DO catalysts do?

11. What does Le Chatelier’s principle state?

12. List three stresses that could upset the equilibrium of a chemical system.

13. Adding a product to an equilibrium system pushes the reaction in the direction of…

   Removing a product from an equilibrium system pushes the reaction in the direction of…

   Adding a reactant to an equilibrium system pushes the reaction in the direction of…

   Removing a reactant from an equilibrium system pushes the reaction in the direction of…

14. A change in the pressure on a system affects only gaseous equilibria that have an _______ _______ of moles of reactants and products.
15. A ratio of product-to-reactant concentrations at equilibrium is called an ___________ __________.

16. The exponents in the equilibrium-constant expression are the ___________ in the equation.

17. If \( K_{eq} > 1 \), ___________ are favored; if \( K_{eq} < 1 \), ___________ are favored.

18. Acids taste _____, will change the color of an ___________ ____________, and can be strong or weak ___________ in solution.

19. Bases taste ___________.

20. According to Arrhenius, acids yield what in aqueous solution?
    
    And bases yield what?

21. What are monoprotic acids?

22. Sulfuric acid is an example of a ___________ _____.

23. Which hydrogens are ionizable?

24. What can some very basic solutions cause if not immediately washed off the skin?

25. According to Bronsted-Lowry, bases are H\(^+\)-ion ___________ and acids are H\(^+\)-ion _________.

26. Why does ammonia act as a base in water?

27. When a base gains a hydrogen ion, a ___________ _______ is formed. When an acid has donated a hydrogen ion, a ___________ _______ is formed.

28. What is a hydronium ion?

29. What is an amphoteric substance?

30. A ___________ _______ accepts a pair of ___________, while a ___________ _______ donates a pair.

31. Write the equation for the self-ionization of water.

32. What is a neutral solution?

33. Write the equation for the ion-product constant for water (\( K_w \)).
34. How do the \([H^+]\) and \([OH^-]\) compare in an acidic solution?

35. How do the \([H^+]\) and \([OH^-]\) compare in a basic solution?

36. Basic solutions are also called __________ __________.

37. Write the equation for calculating pH.

38. Fill in the missing information.  neutral solution: \(\text{pH} = 7.0\) \([H^+]=1 \times 10^{-7} \text{M}\)

    __________ solution: \(\text{pH} = 7.0\) \([H^+] < 1 \times 10^{-7} \text{M}\)

    __________ solution: \(\text{pH} < 7.0\) \([H^+] = 1 \times 10^{-7} \text{M}\)

39. Write the equation for calculating pOH.

40. \(\text{pH} + \text{pOH} = _____

41. For pH calculations, you need to express concentrations in __________ __________.

42. Why is an indicator a valuable tool for measuring pH?

43. Using indicators, how could you get a more precise estimate of a solution’s pH?

44. Accurate, rapid pH measurements can be made using a ______ ________.

45. A pH meter’s reading is NOT affected by either the ______ or the ___________ of the solution.

   19.3

46. ________ acids ionize completely, while ________ acids ionize only slightly in aqueous solution.

47. Strong acids have ________ \(K_a\) values; weak acids have ______ \(K_a\) values.

48. Strong bases dissociate into what two things, in aqueous solution?

49. The smaller the value of \(K_b\), the ________ the base.

50. “Concentrated” and “dilute” refer to __________ of an acid or base is __________ in solution.

   “Strong” and “weak” refer to the extent of ___________ or ___________.

   19.4

51. What is a neutralization reaction?

52. What can you prepare from neutralization reactions?
53. In a salt produced from a neutralization reaction, the anion comes from the _____ and the cation comes from the _____.

54. When has the equivalence point been reached?

55. In the laboratory, what is often the preferred indicator for acid-base neutralization reactions?

56. What is a titration?

57. The solution of known concentration is also called the ___________ ___________.

58. What is the end point of the titration?

59. Why can even a slight change in blood pH be harmful?

60. Hydrolyzing salts are usually derived from what two combinations?

61. What is a buffer?

62. A buffer is a solution of what two combinations?

63. What is meant by a solution’s buffer capacity?

64. List two of the buffer systems that are crucial in maintaining the narrow range of human blood pH.