**Acids and Bases Test**

**60 Practice Problems**

Organic Chemistry Tutor

1. Which of the following is a strong acid?

A. NH3

B. HC2H3O2

C. NaOH

D. HClO4

E. HF

2. The [H3O+] concentration is 4.7 x 10-3 M. Calculate the pH of the solution.

A) 1.46

B) 2.33

C) 3.72

D) 5.21

E) 6.84

3. The pH of the solution is 5.4. What is the pOH of the solution?

A) 4.1

B) 6.5

C) 8.6

D) 9.7

E) 11.9

4. Which of the following is the Bronsted Lowry base in the reaction shown below?

HF(aq) + H2O(l) ↔ H3O+(aq) + F-(aq)

A. HF

B. H2O

C. F-

D. H3O+

E. None of the above

5. The [OH-] concentration is 3.7 x 10-4 M. Calculate the [H3O+] concentration.

A) 4.6 x 10-5 M

B) 7.3 x 10-7 M

C) 5.4 x 10-9 M

D) 2.7 x 10-11 M

E) 6.3 x 10-2 M

6. The pH of the solution is 4.2. Calculate the [H3O+] concentration.

A) 3.1 x 10-2 M

B) 4.6 x 10-3 M

C) 1.8 x 10-4 M

D) 6.3 x 10-5 M

E) 2.5 x 10-6 M

7. The pH of the solution is 9.5 at 25o C. Is the solution acidic, basic, or neutral?

A. Acidic B. Basic

C. Neutral D. None of the above

8. The [OH-] concentration is 2.6 x 10-9 M. Calculate the pH of the solution.

A) 3.7

B) 5.4

C) 7.6

D) 8.6

E) 10.5

9. The concentration of [H3O+] is 2.7 x 10-4 M in a solution. Is the solution acidic, basic, or neutral?

A. Acidic B. Basic

C. Neutral D. None of the above

10. Which acid is stronger? HF or HCN? (The Ka values for HF and HCN are 7.2 x 10-4 and 6.2 x 10-10 respectively)

A. HF is the stronger acid because it has a higher Ka value.

B. HCN is the stronger acid because it has a higher Ka value.

C. HF is the stronger acid because it has a lower Ka value.

D. HCN is the stronger acid because it has a lower Ka value.

E. None of the above

11. What is the pH of a 0.025 M HCl solution?

A) 1.6

B) 2.3

C) 2.9

D) 3.6

E) 4.5

12. Calculate the pH of a 0.75 M HOCl solution. The Ka of HOCl is 3.5 x 10-8.

A) 2.4

B) 2.8

C) 3.2

D) 3.8

E) 4.6

13. Which acid is stronger? HCl or HBr?

A. HCl is the stronger acid because Chlorine has a higher electronegativity value than Bromine.

B. HBr is the stronger acid because Bromine has a lower electronegativity value than Chlorine.

C. HCl is the stronger acid because the Chloride ion is smaller than the Bromide ion.

D. HBr is the stronger acid because the Bromide ion is larger than the Chloride ion.

E. None of the above.

14. What is the pH of a 3.0 M NH3 solution. The Kb of NH3 is 1.8 x 10-5.

A) 9.25

B) 10.6

C) 11.2

D) 11.9

E) 12.7

15. What is the pH of a 1.0 M NaF solution. The Ka of HF is 7.2 x 10-4.

A) 7.92

B) 8.57

C) 9.34

D) 9.96

E) 10.5

16. Which of the following substances is not amphoteric?

A. H2O

B. H2PO4-

C. HCO3-

D. SO42-

E. None of the above

17. Which acid is stronger? HClO3 or HClO2?

18. The pH of a 0.40 M HX solution is 3.5. What is the Ka value of HX?

A) 4.5 x 10-4

B) 6.1 x 10-5

C) 9.3 x 10-6

D) 2.5 x 10-7

E) 1.4 x 10-9

19. The pH of a 0.25 M weak base solution is 9.75. What is the Kb value of the weak base?

A) 4.9 x 10-4

B) 2.3 x 10-6

C) 1.27 x 10-8

D) 7.5 x 10-9

E) 3.6 x 10-11

20. Which base is stronger? NH3 or CH3NH2?

(The Kb value for NH3 and CH3NH2 are 1.8 x 10-5 and 4.4 x 10-4 respectively)

21. The pKa values of four acids HA, HB, HC, and HD are 4.6, 2.5, 7.3, and 6.4. Which of these acids is the strongest acid?

A. HA

B. HB

C. HC

D. HD

E. None of the above

22. Which of the following salts will product a basic solution (pH > 7)?

A. NaCl

B. NH4Cl

C. AlCl3

D. NaI

E. NaNO2

23. Calculate the pH of a 0.50 M NH4Cl solution. The Kb for NH3 is 1.8 x 10-5.

A) 3.6

B) 4.8

C) 5.4

D) 5.9

E) 6.4

24. Calculate the % dissociation of a 2 M HC2H3O2 solution. The Ka for Acetic Acid is 1.8 x 10-5.

A) 0.15%

B) 0.30%

C) 0.75%

D) 1.4%

E) 2.1%

25. The % dissociation of a 0.25 M HX solution is 0.13%. Calculate the Ka value of HX.

A) 7.4 x 10-3

B) 8.1 x 10-4

C) 5.6 x 10-5

D) 2.7 x 10-6

E) 4.2 x 10-7

26. Which acid is stronger? HOCl or HOBr?

27. Which of the following statements is not true?

A. An Arrhenius acid is a substance that generates hydronium ions in solution.

B. A Bronsted-Lowry acid is a proton donor.

C. The percent dissociation of an acid decreases with increasing acid concentration.

D. A Lewis acid is an electron pair donor.

E. The conjugate base of a strong acid will produce a neutral solution.

28. The auto-ionization constant Kw for water is 2.92 x 10-14 at 40o C. What is the pH of water at

40o C?

A) 6.43

B) 6.77

C) 7.00

D) 7.21

E) 7.45

29. As the temperature increases, Kw for water increases. Based on this information, would you expect the reaction shown below to be endothermic or exothermic?

H2O(l) + H2O(l) ↔ H3O+(aq) + OH-(aq)

30. (a) What is the pH of a 0.05 M HCl solution? (b) What is the pH of a 4 x 10-7 M HCl solution?

31. Calculate the pH of a 0.035 M NaOH solution.

A) 4.65

B) 7.24

C) 9.87

D) 11.4

E) 12.5

32. Calculate the pH of a 0.0045 M Ba(OH)2 solution.

A) 2.05

B) 4.93

C) 9.15

D) 12.0

E) 13.6

33. What is the pH of a 4.0 M H2SO4 solution? The Ka for HSO4- is 1.2 x 10-2.

A) -0.603

B) 0.603

C) 1.25

D) 1.86

E) 2.41

34. What is the pH of A 0.03 M H2SO4 solution? The Ka value for HSO4- is 1.2 x 10-2.

A) 0.475

B) 0.726

C) 1.22

D) 1.43

E) 1.86

35. Calculate the [PO43-] concentration in a 4 M H3PO4 solution. The Ka values for H3PO4 are 7.5 x 10-3, 6.2 x 10-8, and 4.8 x 10-13.

A) 4.5 x 10-4 M

B) 6.2 x 10-8 M

C) 7.5 x 10-12 M

D) 3.5 x 10-16 M

E) 1.8 x 10-19 M

36. What mass of NaF should be dissolved to make a 5.00 L solution with a pH of 8.9? The Ka value for HF is 7.2 x 10-4.

A) 275 g

B) 425 g

C) 678 g

D) 814 g

E) 954 g

37. 80 mL of a 0.05 M HCl solution was mixed with 120 mL of a 0.04 M HNO3 solution. What is the pH of the mixture?

A) 0.748

B) 1.36

C) 1.76

D) 2.05

E) 2.49

38. Calculate the pH of a solution composed of 4.00 M HF and 5.00 M HCN. (The Ka values for HF and HCN are 7.2 x 10-4 and 6.2 x 10-10)

A) 0.825

B) 1.27

C) 1.68

D) 1.94

E) 2.31

39. Which base is stronger? CN- or OCl-? (The Ka values for HCN and HOCl are 6.2 x 10-10 and 3.5 x 10-8)

40. Which of the following substances will produce a basic solution when mixed with water?

A. CO2

B. SO3

C. CaO

D. NaH

E. C and D

41. What is the pH of a solution consisting of 0.5 M HC2H3O2 and 0.75 M NaC2H3O2? (The Ka for HC2H3O2 is 1.8 x 10-5)

A) 4.26

B) 4.57

C) 4.74

D) 4.92

E) 5.12

42. What is the pH of a solution consisting of 0.400 M NH3 and 0.500 M NH4Cl? The Kb value for NH3 is 1.8 x 10-5.

A) 8.99

B) 9.16

C) 9.26

D) 9.35

E) 9.67

43. How many grams of NaNO2 should be dissolved in a 0.25 M HNO2 solution to create a 2.0L buffered solution at a pH of 3.6? The Ka value for HNO2 is 4 x 10-4. (Assume constant volume)

A) 17 g

B) 26 g

C) 38 g

D) 44 g

E) 55 g

44. Which of the following represents a buffer solution?

A) 0.5 M HCl and 0.5 M NaCl solution

B) 1.0 M NaOH and 1.0 M NH3 solution

C) 0.75 M HF and 0.75 M NaF solution

D) 0.25 M HNO2 and 0.25 M NaCN solution

E) 0.10 M HCN and 0.10 M HI solution.

45. A solution contains H3PO4, H2PO4-, HPO42-, and PO43-. What is the predominant species at a pH of 9? (The pKa values for H3PO4 are 2.12, 7.21, and 12.32)

A. H3PO4 B. H2PO4-

C. HPO42- D. PO43-

46. What is the pH of a solution consisting of 0.5 M NaH2PO4 and 0.5 M Na2HPO4? (The pKa values for H3PO4 are 2.12, 7.21, and 12.32)

A) 2.12

B) 4.67

C) 7.21

D) 9.77

E) 12.32

47. What is the pH of a solution consisting of 0.75 M Na2HPO4 and 0.75 M Na3PO4? (The pKa values for H3PO4 are 2.12, 7.21, and 12.32)

A) 2.12

B) 4.67

C) 7.21

D) 9.77

E) 12.32

48. What is the pH of a solution consisting of 1.0 M NaH2PO4? (The pKa values for H3PO4 are 2.12, 7.21, and 12.32)

A) 2.12

B) 4.67

C) 7.21

D) 9.77

E) 12.32

49. What is the pH of a solution consisting of 1.0 M NaH2PO4 and 0.1 M Na2HPO4? (The pKa values for H3PO4 are 2.12, 7.21, and 12.32)

A) 5.21

B) 6.21

C) 7.21

D) 8.21

E) 9.21

50. Which of the following statements is not true?

A. The pH of the equivalence point of a strong acid – strong base titration is 7.

B. The pH at the equivalence point of a weak acid – strong base titration is greater than 7.

C. The pH at the equivalence point of a weak base – strong acid titration is less than 7.

D. The end point occurs at the same volume as the equivalence point of a titration.

E. None of the above.

51. 20 mL of a 0.75 M NaOH solution is added to 50 mL of a 0.45 M HCl solution. What is the pH of the resulting solution?

A) 0.97

B) 2.5

C) 6.9

D) 9.4

E) 12.8

52. A 50 mL solution of 0.5 M HF is titrated with 0.20 M NaOH. What volume of the 0.25 M NaOH solution must be added to reach the equivalence point?

A. 25 mL

B. 50 mL

C. 75 mL

D. 100 mL

E. 200 mL

53. A 50 mL solution of 0.5 M HF is titrated with 0.25 M NaOH. What is the pH of the solution before any NaOH is added? (The Ka for HF is 7.2 x 10-4)

A) 1.2

B) 1.7

C) 2.3

D) 2.9

E) 3.7

54. A 50 mL solution of 0.5 M HF is titrated with 0.25 M NaOH. What is the pH of the solution after 40 mL of NaOH has been added to it? (The Ka for HF is 7.2 x 10-4)

A) 2.74

B) 2.97

C) 3.14

D) 3.29

E) 3.45

55. A 50 mL solution of 0.5 M HF is titrated with 0.25 M NaOH. What is the pH of the solution after 100 mL of NaOH has been added to it? (The Ka for HF is 7.2 x 10-4)

A) 4.74

B) 5.82

C) 7.00

D) 8.18

E) 9.26

56. A 50 mL solution of 0.5 M HF is titrated with 0.25 M NaOH. What is the pH of the solution after 120 mL of NaOH has been added to it? (The Ka for HF is 7.2 x 10-4)

A) 7.65

B) 9.25

C) 10.9

D) 12.5

E) 13.7

57. Which of the following graphs represent a weak base – strong acid titration?



58. The table below shows the volume of NaOH that is added to a monoprotic weak acid (HX) solution as well as the pH of the solution. If the equivalence point is reached at a volume of 20 mL, what is the Ka value for HX?

|  |  |
| --- | --- |
| **Volume** | **pH** |
| 0 mL | 2.39 |
| 5 mL | 3.41 |
| 10 mL | 5.52 |
| 15 mL | 7.46 |
| 18 mL | 8.92 |
| 19 mL | 9.31 |
| 20 mL | 9.76 |
| 21 mL | 11.9 |

A) 2 x 10-4

B) 4 x 10-5

C) 3 x 10-6

D) 7 x 10-8

E) 5 x 10-9

59. A student wishes to prepare a buffer with a pH of 9.00. Which acid should the student choose from?

|  |  |
| --- | --- |
| **Acid** | **Ka** |
| HF | 7.2 x 10-4 |
| HOCl | 3.5 x 10-8 |
| HCN | 6.2 x 10-10 |
| H2CO3 | 4.3 x 10-7 |
| HC2H3O2 | 1.8 x 10-5 |

A. HF

B. HOCl

C. HCN

D. H2CO3

E. HC2H3O2

60. Bromthymol blue is an indicator with a Ka value of 1 x 10-7. The acidic form (HIn) is yellow and the basic form (In-) is blue. For a weak base – strong acid titration, at what pH will the first color change be visible?

A. pH = 5

B. pH = 6

C. pH = 7

D. pH = 8

E. pH = 9

**Answers:**

1. D

2. B

3. C

4. B

5. D

6. D

7. B

8. B

9. A

10. A

11. A

12. D

13. D

14. D

15. B

16. D

17. HClO3

18. D

19. C

20. CH3NH2

21. B

22. D

23. B

24. B

25. E

26. HOCl

27. D

28. B

29. Endothermic

30a. 1.3

30b. 6.37

31. E

32. D

33. A

34. D

35. E

36. E

37. B

38. B

39. CN-

40. E

41. D

42. B

43. E

44. C

45. C

46. C

47. E

48. B

49. B

50. D

51. A

52. D

53. B

54. B

55. D

56. D

57. D

58. C

59. C

60. D