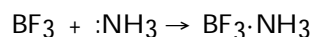


Acids and bases practice problems

1) According to Bronsted and Lowry, what is the definition of a base? 1) _____

2) According to Lewis, what is the definition of an acid? 2) _____

3) In the following reaction: 3) _____



Boron trifluoride acts as:

- A) a Lewis base
- B) a Brønsted-Lowry acid
- C) an Arrhenius acid
- D) a Lewis base
- E) a Lewis acid

4) What is meant by the statement that water is amphoteric? 4) _____

5) In a solution of pure water, what are the relative concentrations of the hydronium ion and the hydroxide ion? 5) _____

6) The ion-product constant of water is defined as 6) _____

7) Which of the following is the strongest acid? 7) _____

- A) NH_4^+
- B) $\text{H}_2\text{C}_2\text{O}_4$
- C) $\text{C}_6\text{H}_5\text{COOH}$ (benzoic acid)
- D) HClO_4
- E) HCN

8) Which of the following is a STRONG base? 8) _____

- A) Cl^- B) NH_3 C) NO_3^- D) CH_3OH E) KOH

9) For which of the following polyprotic acids is the first ionization step approximately 100%? 9) _____

- A) H_3PO_4 B) H_2S C) H_2CO_3 D) H_2SO_3 E) H_2SO_4

10) Which of the following is a WEAK base? 10) _____
A) $(C_2H_5)_2NH$
B) CH_2CH_2
C) $NaOH$
D) NH_2^-
E) None of the above are weak bases.

11) Which of the following acids is the STRONGEST? The acid is followed by its K_a value. 11) _____
A) $HClO_2$ 1.1×10^{-2}
B) $HCHO_2$ 1.8×10^{-4}
C) HCN 4.9×10^{-10}
D) HF 3.5×10^{-4}
E) HNO_2 4.6×10^{-4}

12) Which of the following bases is the WEAKEST? The base is followed by its K_b value. 12) _____
A) $(CH_3CH_2)_3N$ 5.2×10^{-4}
B) $HOCH_2CH_2NH_2$ 3.2×10^{-5}
C) NH_3 1.76×10^{-5}
D) C_5H_5N 1.7×10^{-9}
E) Since these are all weak bases, they have approximately the same strength - weak.

13) Which of the following equations do not hold true at all temperatures? 13) _____
A) $pH = -\log[H^+]$
B) $14.00 = pH + pOH$
C) $pK_a = pH + pOH$
D) $K_w = [H^+][OH^-]$

14) What molecules are bases in the following reaction: 14) _____
$$CH_3CO_2H + H_2O \rightleftharpoons H_3O^+ + CH_3CO_2^-$$

15) Identify the conjugate acid-base pairs in the following reaction 15) _____
$$NH_3(aq) + CH_3CO_2H(aq) \rightleftharpoons NH_4^+(aq) + CH_3CO_2^-(aq)$$

16) The dissociation of hydrocyanic acid occurs by the following reaction. What is the acid ionization constant (K_a) expression? 16) _____
$$HCN(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + CN^-(aq)$$

17) What is the conjugate base of H_2PO_4^- ? 17) _____

18) Which of the following acids will have the strongest conjugate base?
A) HCl B) HNO_3 C) HI D) HClO_4 E) HCN 18) _____

19) Which of the following ions is the strongest base?
A) F^- B) Cl^- C) Br^- D) I^- 19) _____

20) Why do you think it is more difficult for a polyprotic acid to lose its second proton than the first proton (for example H_2SO_4)? 20) _____

21) What is the $[\text{H}^+]$ in an aqueous solution where $[\text{OH}^-] = 1.9 \times 10^{-12} \text{ M}$? 21) _____

22) What is the pH of a solution with $[\text{H}^+] = 5.9 \times 10^{-9} \text{ M}$? 22) _____

23) What is the pH of a solution with $[\text{OH}^-] = 7.6 \times 10^{-4} \text{ M}$? 23) _____

24) Calculate the H^+ concentration in a sample of acid rain with a pH of 4.20. 24) _____

25) What is the pOH of an aqueous solution with a pH of 3.7? 25) _____

26) The pH of a 0.050 M solution of potassium hydroxide is _____. 26) _____

27) The pH of a 0.0543 M solution of strontium hydroxide is _____. 27) _____

28) What mass of barium hydroxide should be dissolved in 500.0 mL to yield a solution that has a pH of 11.109? 28) _____

29) What will the pH be if 100.0 mL of 0.105 M HNO₃, is mixed with 250.0 mL of 0.0132 M Ba(OH)₂? 29) _____

30) The ion product constant for water at 50 °C is 5.47×10^{-14} . What is the pH of pure water at this temp? 30) _____

31) What is the pH at 50 °C, if the [H⁺] is 2.9×10^{-6} M? 31) _____

32) What is the [OH⁻] at 50 °C, if the pH is 4.524? 32) _____

33) What is the pH of a 0.198 M solution of hydrocyanic acid? ($K_a = 6.2 \times 10^{-10}$)

33) _____

34) What is the pH of a 0.010 M solution of nitrous acid? What is the percent dissociation at this concentration and how would it change if we doubled the concentration? Nitrous acid has a pK_a of 3.35.

34) _____

35) What is the pH of a 0.0876 M solution of sulfuric acid? ($K_a = 0.0120$)

35) _____

36) What is the strongest acid and base possible in pure liquid methanol?

36) _____

37) Which of the following is a weak electrolyte?

A) CH_2O

B) NH_3

C) NaOH

D) HNO_3

E) $\text{C}_2\text{H}_5\text{OH}$

37) _____

38) Which would have the greatest electrical conductivity if 0.1 M solutions of the following substances were prepared?

38) _____

A) $\text{Ca}(\text{OH})_2$

B) HCl

C) CH_3COOH

D) CH_3NH_2

E) NH_4Br

39) Which one of the following substances would you expect to be a nonelectrolyte in aqueous solution?

39) _____

A) $\text{CH}_3\text{CH}_2\text{OH}$

B) HBr

C) CH_3COOH

D) KI

E) NH_3

40) Why is HF a weak acid, while the other three hydrohalic acids are strong acids?

40) _____

- 41) Why is trifluoroacetic acid (CF_3COOH) a stronger acid than acetic acid (CH_3COOH)? 41) _____
- A) The fluoroacetate ion is a stronger base than the acetate ion.
 - B) The fluorine atoms have more electrons to donate to the acid.
 - C) The carbon-fluorine bond is stronger than the carbon-hydrogen bond.
 - D) Fluorine is electron withdrawing, making the OH bond more polar and stabilizing the conjugate base.
- 42) Place the following in order of increasing acid strength. 42) _____
- HBrO_2 HBrO_3 HBrO HBrO_4
- 43) Sodium chloride dissolved in water will yield a solution that is _____. 43) _____
- A) neutral
 - B) acidic
 - C) basic
 - D) good to drink if you are dehydrated
- 44) Would the pH of solid ammonium chloride dissolved in water be acidic, basic, or neutral? 44) _____
- A) not enough information
 - B) acidic
 - C) basic
 - D) neutral
- 45) Which one of the following will form a basic solution in water? 45) _____
- A) LiI
 - B) KNO_3
 - C) NH_4Cl
 - D) NaF
 - E) None of the above solutions will be basic.
- 46) Would the pH of sodium bisulfate dissolved in water be acidic, basic, or neutral? 46) _____
- A) neutral
 - B) acidic
 - C) basic
 - D) not enough information
- 47) Which of the following will form a basic solution in water? 47) _____
- A) KClO_2
 - B) LiBrO
 - C) LiCN
 - D) $\text{NaC}_2\text{H}_3\text{O}_2$
 - E) All of the above will form basic solutions.
- 48) Which of the following will form acidic solutions if dissolved in water? 48) _____
- A) $\text{SO}_3(\text{g})$
 - B) Na_2O
 - C) MgO
 - D) $\text{CO}_2(\text{g})$
 - E) $\text{NO}_2(\text{g})$