

Name: _____

REVIEW for Acid-Base Test

1. _____ Solution *A* has a pH of 3 and solution *Z* has a pH of 6. How many times greater is the hydronium ion concentration in solution *A* than the hydronium ion concentration in solution *Z*?

- (a) 100 (b) 2 (c) 3 (d) 1000

2. _____ An Arrhenius base yields which ion as the only negative ion in an aqueous solution?

- (a) hydride ion (b) hydroxide ion
(c) hydronium ion (d) hydrogen ion

3. _____ Which reactants form the salt $\text{CaSO}_4(\text{s})$ in a neutralization reaction?

- (a) $\text{H}_2\text{S}(\text{g})$ and $\text{Ca}(\text{ClO}_4)_2(\text{s})$
(b) $\text{H}_2\text{SO}_3(\text{aq})$ and $\text{Ca}(\text{NO}_3)_2(\text{aq})$
(c) $\text{H}_2\text{SO}_4(\text{aq})$ and $\text{Ca}(\text{OH})_2(\text{aq})$
(d) $\text{SO}_2(\text{g})$ and $\text{CaO}(\text{s})$

4. _____ A student tested a 0.1 M aqueous solution and made the following observations:

- conducts electricity
- turns blue litmus to red
- reacts with $\text{Zn}(\text{s})$ to produce gas bubbles

Which compound could be the solute in this solution?

- (a) CH_3OH (b) LiBr (c) HBr (d) LiOH

5. _____ What volume of 0.500 M $\text{HNO}_3(\text{aq})$ must completely react to neutralize 100.0 milliliters of 0.100 M $\text{KOH}(\text{aq})$?

- (a) 10.0 mL (b) 20.0 mL (c) 50.0 mL (d) 500. mL

6. _____ Which compound is an Arrhenius acid?

- (a) $\text{HC}_2\text{H}_3\text{O}_2$ (b) NaOH (c) KCl (d) NH_3

7. _____ One acid-base theory states that an acid is

- (a) an H^- donor (b) an H^+ donor
(c) an H^- acceptor (d) an H^+ acceptor

8. _____ Which of these pH numbers indicates the strongest acid?

- (a) 1 (b) 3 (c) 8 (d) 12

9. _____ What color is methyl orange in a solution that has a pH of 5?

- (a) red (b) orange (c) blue (d) yellow

10. _____ Which pH change represents a hundredfold increase in the concentration of H_3O^+ ?

- (a) pH 3 to pH 2 (b) pH 7 to pH 9
(c) pH 5 to pH 3 (d) pH 13 to pH 14

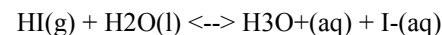
11. _____ The pH of a pond water is 9.0, after a spill of acid the pond is 1000 more acidic. What is the new pH of the pond?

- (a) 12 (b) 6 (c) 7 (d) 5

12. _____ As pH decreases

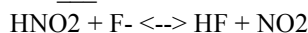
- (a) $[\text{H}^+]$ increases only (b) $[\text{H}^+]$ decreases only
(c) $[\text{OH}^-]$ increases only (d) $[\text{H}^+]$ increases and $[\text{OH}^-]$ decreases

13. _____ Which substance acts as an acid in the reverse reaction?



- (a) H_2O (b) I^- (c) H_3O^+ (d) HI

14. _____ Given the reaction below,



in the reverse reaction, HF is a/an

- (a) acid by accepting H^+ (b) base by accepting H^+
(c) base by donating H^+ (d) acid by donating H^+

15. _____ In $M_aV_a = M_bV_b$, what is M_b ?

- (a) molarity of OH^- (b) molarity of H^+
(c) molarity of H^- (d) molarity of O_2

16. _____ What is the molarity of $\text{HCl}(\text{aq})$ if 25. milliliters of 8.0M $\text{NaOH}(\text{aq})$ neutralizes exactly 20. milliliters of $\text{HCl}(\text{aq})$?

- (a) 5M (b) 10M (c) 15M (d) 20M

17. _____ When NaOH and HCl react, what will be on the product side?

- (a) only NaCl (b) only HOH
(c) NaCl and HOH (d) NaCl and Cl_2

18. _____ At a pH of 7

- (a) $[\text{H}^+]$ is greater than $[\text{OH}^-]$
(b) $[\text{OH}^-]$ is greater than $[\text{H}^+]$
(c) $[\text{H}^+]$ is equal to $[\text{OH}^-]$

19. _____ In the process of neutralization, an Arrhenius acid and an Arrhenius base react to form which of the following?

- (a) Water only
(b) Salt and Carbon dioxide
(c) Water and Carbon dioxide
(d) Water and Salt

20. _____ Which of the following can conduct an electric current?

- (a) $\text{Mg(OH)}_2(\text{s})$ (b) $\text{H}_2\text{O}(\text{s})$
(c) $\text{NaOH}(\text{aq})$ (d) $\text{NH}_4\text{Cl}(\text{s})$

Base your answers to questions 21 and 22 on the information below.

Using burettes, a student titrated a sodium hydroxide solution of unknown concentration with a standard solution of 0.10 M hydrochloric acid. The data are recorded in the table below.

Titration Data

Solution	HCl (aq)	NaOH (aq)
Initial Burette Reading (mL)	15.50	5.00
Final Burette Reading (mL)	25.00	8.80

21. Determine *both* the total volume of $\text{HCl}(\text{aq})$ and the total volume of $\text{NaOH}(\text{aq})$ used in the titration. [1]

22. Calculate the molarity of the sodium hydroxide solution. Show all work. [1]

Base your answers to questions 23 and 24 on the information below.

Three bottles of liquids labeled 1, 2, and 3 were found in a storeroom. One of the liquids is known to be drain cleaner. Drain cleaners commonly contain KOH or NaOH . The pH of each liquid at 25°C was determined with a pH meter. The table below shows the test results.

pH Test Results

Bottle	pH of liquid
1	3.8
2	7.0
3	12.8

23. Explain how the pH results in this table enable a student to correctly conclude that bottle 3 contains the drain cleaner. [1]

24. Explain, in terms of the pH values, why thymol blue is *not* a suitable indicator to distinguish between the contents of bottle 1 and bottle 2. [1]

Base your answers to questions 25 and 26 on the passage below.

Acid rain lowers the pH in ponds and lakes and over time can cause the death of some aquatic life. Acid rain is caused in large part by the burning of fossil fuels in power plants and by gasoline-powered vehicles. The acids commonly associated with acid rain are sulfurous acid, sulfuric acid, and nitric acid. In general, fish can tolerate a pH range between 5 and 9. However, even small changes in pH can significantly affect the solubility and toxicity of common pollutants. Increased concentrations of these pollutants can adversely affect the behavior and normal life processes of fish and cause deformity, lower egg production, and less egg hatching.

25. Acid rain caused the pH of a body of water to decrease. Explain this pH decrease in terms of the change in concentration of hydronium ions. [1]

26. Write the chemical formula of a *negative* polyatomic ion present in an aqueous nitric acid solution. [1]

1. d
2. b
3. c
4. c
5. b
6. a
7. b
8. a
9. d
10. c
11. b
12. d
13. c
14. d
15. a
16. b
17. c
18. c
19. d
20. c

21. $V_{\text{HCl}} = 9.5 \text{ mL}$

$$V_{\text{NaOH}} = 3.8 \text{ mL}$$

22. $M_{\text{B}} = 0.25 \text{ mol/L}$

23. Drain cleaner contains KOH or NaOH, which are bases with a pH value greater than 7.

or

A pH of 12.8 indicates a base.

or

A base has a pH above 7.

24. The liquids in bottle 1 and bottle 2 both have a pH below 8, but thymol blue does not change color until the pH value reaches at least 8.0. The pH range for the thymol blue color change is too high.

25. The pH decreases because the concentration of hydrogen ions $[\text{H}^+]$ (or hydronium ions $[\text{H}_3\text{O}^+]$) in solution increases.

26. NO_3^- or NO_3^{-1} or OH^- or OH^{-1}