DO NOT DO {12, 10, 31, 32}

Name KEY

Class _____ Date _____

Chapter 19 Test

Acids and Bases

Part I

Select the response that best completes each statement or answers each question. Write the letter of each answer in the space provided on the left.

B 1. Which of these tests would NOT distinguish an acid from a base?
   a. sample releases H_2 gas in combination with certain metals
   b. sample conducts electric current
   c. sample changes indicator's color
   d. sample registers on a pH meter

B 2. Brønsted's definition of acids and bases is based on _____.
   a. acid acceptance of a proton
   b. acid donation of a proton
   c. base donation of a proton
   d. base donation of an electron

C 3. Water can act as _____.
   a. an acid
   b. a proton acceptor
   c. both a and b
   d. neither a nor b

D 4. In the equation $NH_3 + HNO_3 \rightarrow NH_4^+ + NO_3^-$, NH_3 is _____.
   a. an Arrhenius acid
   b. a Brønsted acid
   c. an Arrhenius base
   d. a Brønsted base

A 5. A strong acid _____.
   a. ionizes almost completely
   b. conducts poorly
   c. is a concentrated solution
   d. both a and c

B 6. Identify the conjugate acid–base pair.
   a. HCl and NaOH
   b. NH_4^+ and NH_3
   c. $HC_2H_3O_2$ and OH^-
   d. HF and H_2O

Critical Thinking

A 7. When you test an unknown solution with litmus and with phenolphthalein and observe that the litmus turns red while the phenolphthalein turns colorless, what can you infer about the solution?
   a. The solution is acidic.
   b. The solution is basic.
   c. The solution is neutral.
   d. No inferences can be made since the observation made with litmus contradicts the observation made with phenolphthalein.

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Part II

Select the response that best completes each statement. Write the letter of each answer in the space provided on the left.

D 8. The term polyprotic means that a substance _____.
- a. can be neutralized by many acids
- b. can be neutralized by many bases
- c. has more than one proton
- d. can donate more than one proton

C 9. The complete neutralization of an acid by a base requires _____.
- a. equal concentrations of acid and base
- b. a stronger base than acid
- c. all the acidic protons to leave the acid
- d. a 1:1 ratio of acid and base

C 10. The equation acid + base → salt + water illustrates a(n) _____.
- a. endothermic reaction
- b. titration reaction
- c. neutralization reaction
- d. equivalence reaction

B 11. The process of determining the concentration of an acid by adding a base is called _____.
- a. endothermy
- b. titration
- c. neutralization
- d. equivalence

X 12. You must have _____ to reach the equivalence point in the reaction between hydrochloric acid and magnesium hydroxide.
- a. 1 mol HCl and 1 mol $Mg(OH)_2$
- b. 2 mol HCl and 1 mol $Mg(OH)_2$
- c. 2 mol HCl and 2 mol $Mg(OH)_2$
- d. 1 mol HCl and 2 mol $Mg(OH)_2$

Write the correct answer in the space provided.

13. Name the acid, base, and salt in this reaction: $Ca(OH)_2\ (aq) + HC_2H_3O_2\ (aq) \rightarrow Ca(C_2H_3O_2)_2 + 2H_2O$
- a. acid acetic acid
- b. base calcium hydroxide
- c. salt calcium acetate

Critical Thinking

Refer to a periodic table and use a calculator to answer question 14. Show your work.

14. Titrating a solution of 25 mL sodium hydroxide requires 42.5 mL of a 0.225*M* HCl solution. What is the molarity of the basic solution? The reaction is $NaOH + HCl \rightarrow NaCl + H_20$.

$$42.5\text{ mL HCl} \left|\frac{1\text{ L}}{1000\text{ mL}}\right| \frac{0.225\text{ mol HCl}}{1\text{ L}} \left|\frac{1\text{ mol NaOH}}{1\text{ mol HCl}}\right| = 0.0095625\text{ mol NaOH}$$

$$\frac{0.0095625\text{ mol}}{0.025\text{ L}} = \boxed{0.3825\text{ M}}$$

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Part III

Select the response that best completes each statement or answers each question. Write the letter of each answer in the space provided on the left.

A 15. Dill pickles with a H_3O^+ concentration of 1×10^{-3} are _____.

a. acidic
b. basic
c. neutral
d. Question cannot be answered from the data given.

C 16. Water with a H_3O^+ concentration of 1×10^{-7} has a pH of _____.

a. 1
b. –7
c. 7
d. Question cannot be answered from the data given.

B 17. Milk of magnesia with a H_3O^+ concentration of 1×10^{-10} is _____.

a. acidic
b. basic
c. neutral
d. Question cannot be answered from the data given.

_____ 18. In the equilibrium reaction $H_2O(l) + H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$, there are _____.

a. more reactants than products
b. more products than reactants
c. equal numbers of products and reactants
d. Question cannot be answered from the data given.

B 19. Which of the following describes the relationship of pH to $[H_3O^+]$?

a. As pH decreases, $[H_3O^+]$ decreases.
b. As pH decreases, $[H_3O^+]$ increases.
c. As pH increases, $[H_3O^+]$ increases.
d. a and c

C 20. Which of the following describes the relationship of K_a to an acid's ability to donate a proton?

a. As K_a decreases, proton donation increases.
b. As K_a increases, proton donation decreases.
c. As K_a increases, proton donation increases.
d. K_a applies to water only.

C 21. Given the reaction: $HClO + H_2O \rightleftharpoons H_3O^+ + ClO^-$, K_a would be represented by the following:

a. $\dfrac{[H_3O^+]\,[ClO^-]}{[H_2O]}$
b. $\dfrac{[H_2O]}{[H_3O^+]\,[ClO^-]}$
c. $\dfrac{[H_3O^+]\,[ClO^-]}{[HClO]}$
d. $\dfrac{[HClO]}{[H_3O^+]\,[ClO^-]}$

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Refer to the table below to answer question 22.

K_a at 25°C	
formic acid	1.8×10^{-4}
acetic acid	1.8×10^{-5}
hydrogen carbonate ion	4.7×10^{-11}
phosphoric acid	7.1×10^{-3}

C 22. Order these acids from weakest to strongest.

a. formic, acetic, hydrogen carbonate, phosphoric
b. hydrogen carbonate, phosphoric, acetic, formic
c. hydrogen carbonate, acetic, formic, phosphoric
d. phosphoric, formic, acetic, hydrogen carbonate

B 23. To prepare a buffer, you need _____.

a. a strong acid and its salt
b. a weak acid and its conjugate base
c. any conjugate acid-base pair
d. a weak acid and a strong base

Write the correct answer in the space provided. Show all of your work and circle your answer. Use a calculator with a log/antilog function for questions 24–27.

24. Calculate the $[H_3O^+]$ in a solution with a pH of 6.

$6 = -\log[H^+]$ $[H^+] = 0.000001\ M$

25. Calculate the pH of a solution with a $[H_3O^+]$ of 3.2×10^{-6}.

$pH = -\log[3.2E-6]$ $pH = 5.49$

26. Acid rain can have a pH of 3.5. What is the $[H_3O^+]$?

$3.5 = -\log[H^+]$ $[H^+] = 0.00032\ M$

27. Tomato juice has a $[H_3O^+]$ of 2.5×10^{-6}. What is its pH?

$pH = -\log[2.5E-6]$ $pH = 5.60$

28. Complete the following table.

$[H_3O^+]$	$[OH^-]$	pH	pOH
a. 1.0×10^{-3}	1E-11	3	11
b. 1.0*M*	1E-14	0	14
c. 1.0×10^{-10}	1E-4	10	4
d. 1.0×10^{-14}	1.0M	14	0

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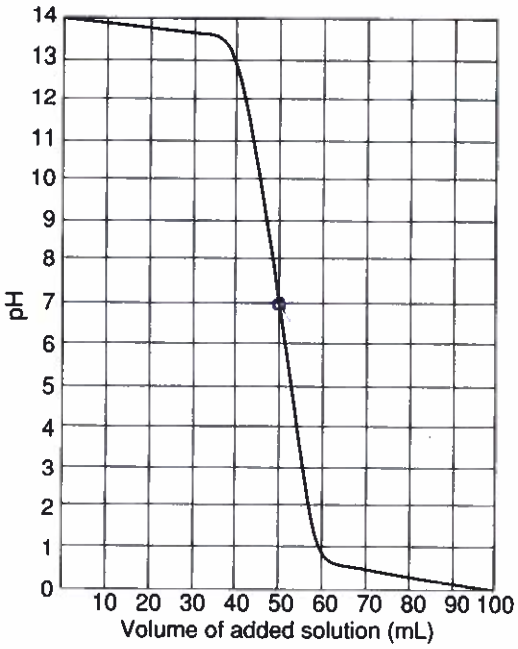
Refer to the figure below to answer questions 29–30. The titration curve plots pH versus the volume of added solution.



29. Is the original solution acidic or basic? basic

30. The equivalence point is reached at pH 7 and 50 ml of volume added.

31. Write separate equations to show how H_2CO_3 and its conjugate base can buffer $[H_3O^+]$ and $[OH^-]$ in your body.

Critical Thinking

32. Explain how Le Châtelier's principle applies to the equations in the previous question.

Laboratory Investigation

Refer to the table below to answer question 33.

Indicator	pH range	color below lower pH	color above higher pH
methyl orange	3.1–4.4	red	yellow
bromthymol blue	6.0–7.6	yellow	blue
litmus	4.5–8.3	red	blue
phenolphthalein	8.3–10.0	colorless	red

33. Predict the pH range of the unknown solutions.

a. Unknown A turns litmus blue and phenolphthalein red.

over 10

b. Unknown B turns phenolphthalein colorless and methyl orange yellow.

4.4 and 8.3

c. Unknown C turns bromthymol blue yellow and litmus red.

less than 4.5

d. Unknown D turns bromthymol blue yellow and methyl orange yellow.

4.4–6.0

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