

Name \_\_\_\_\_

A student is given two beakers, each containing an equal amount of clear, odorless liquid. One solution is acidic and the other is basic.

- State *two* safe methods of distinguishing the acid solution from the base solution.
- For *each* method, state the results of both the testing of the acid solution and the testing of the base solution.

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1/03

1. Which of these 1 M solutions will have the highest pH? (1) NaOH (2) CH<sub>3</sub>OH (3) HCl (4) NaCl

2. Given the following solutions:

Solution A: pH of 10

Solution B: pH of 7

Solution C: pH of 5

Which list has the solutions placed in order of increasing H<sup>+</sup> concentration?

(1) A, B, C (2) B, A, C (3) C, A, B (4) C, B, A

3. A compound whose water solution conducts electricity and turns phenolphthalein pink is

(1) HCl (2) HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> (3) NaOH (4) CH<sub>3</sub>OH

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48. A student was given four unknown solutions. Each solution was checked for conductivity and tested with phenolphthalein. The results are shown in the data table below.

Solution	Conductivity	Color with Phenolphthalein
A	Good	Colorless
B	Poor	Colorless
C	Good	Pink
D	Poor	Pink

Based on the data table, which unknown solution could be 0.1 M NaOH? (1) A (2) B (3) C (4) D

Base your answers to questions 77 through 79 on the information below.

A truck carrying concentrated nitric acid overturns and spills its contents. The acid drains into a nearby pond. The pH of the pond water was 8.0 before the spill. After the spill, the pond water is 1,000 times more acidic.

77. Name an ion in the pond water that has increased in concentration due to this spill.

78. What is the new pH of the pond water after the spill?

79. What color would bromthymol blue be at this new pH?

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25 Which of these pH numbers indicates the highest level of acidity? (1) 5 (2) 8 (3) 10 (4) 12

35 Which solution when mixed with a drop of bromthymol blue will cause the indicator to change from blue to yellow?

(1) 0.1 M HCl (2) 0.1 M NH<sub>3</sub> (3) 0.1 M CH<sub>3</sub>OH (4) 0.1 M NaOH

Base your answers to questions 80 and 81 on the information below.

Calcium hydroxide is commonly known as agricultural lime and is used to adjust the soil pH. Before the lime was added to a field, the soil pH was 5. After the lime was added, the soil underwent a 100-fold decrease in hydronium ion concentration.

80 What is the new pH of the soil in the field?

81 According to Reference Table F, calcium hydroxide is soluble in water. Identify another hydroxide compound that contains a Group 2 element and is also soluble in water.

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45 Which pH indicates a basic solution? (1) 1 (2) 7 (3) 5 (4) 12

Base your answers to questions 56 through 58 on the information below.

A student titrates 60.0 mL of  $\text{HNO}_3$  (aq) with 0.30 M  $\text{NaOH}$ (aq). Phenolphthalein is used as the indicator. After adding 42.2 mL of  $\text{NaOH}$ (aq), a color change remains for 25 seconds, and the student stops the titration.

56 What color change does phenolphthalein undergo during this titration?

57 Show a correct numerical setup for calculating the molarity of the  $\text{HNO}_3$  (aq).

58 According to the data, how many significant figures should be present in the calculated molarity of the  $\text{HNO}_3$  (aq)?

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30 Which pH change represents a hundredfold increase in the concentration of  $\text{H}_3\text{O}^+$ ?

- (1) pH 5 to pH 7 (2) pH 13 to pH 14 (3) pH 3 to pH 1 (4) pH 4 to pH 3

48 Which statement correctly describes a solution with a pH of 9?

- 1) It has a higher concentration of  $\text{H}_3\text{O}^+$  than  $\text{OH}^-$  and causes litmus to turn blue.
  - 2) It has a higher concentration of  $\text{OH}^-$  than  $\text{H}_3\text{O}^+$  and causes litmus to turn blue.
  - 3) It has a higher concentration of  $\text{H}_3\text{O}^+$  than  $\text{OH}^-$  and causes methyl orange to turn yellow.
  - 4) It has a higher concentration of  $\text{OH}^-$  than  $\text{H}_3\text{O}^+$  and causes methyl orange to turn red.
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1/05

26 According to Reference Table M, what is the color of the indicator methyl orange in a solution that has a pH of 2?

- (1) blue (2) yellow (3) orange (4) red

6/05

50 In which solution will thymol blue indicator appear blue? (1) 0.1 M  $\text{CH}_3\text{COOH}$  (2) 0.1 M  $\text{KOH}$  (3) 0.1 M  $\text{HCl}$  (4) 0.1 M  $\text{H}_2\text{SO}_4$

Base your answers to questions 75 through 76 on the passage below.

Acid rain is a problem in industrialized countries around the world. Oxides of sulfur and nitrogen are formed when various fuels are burned. These oxides dissolve in atmospheric water droplets that fall to earth as acid rain or acid snow. While normal rain has a pH between 5.0 and 6.0 due to the presence of dissolved carbon dioxide, acid rain often has a pH of 4.0 or lower. This level of acidity can damage trees and plants, leach minerals from the soil, and cause the death of aquatic animals and plants. If the pH of the soil is too low, then quicklime,  $\text{CaO}$ , can be added to the soil to increase the pH. Quicklime produces calcium hydroxide when it dissolves in water.

75 A sample of wet soil has a pH of 4.0. After the addition of quicklime, the  $\text{H}^+$  ion concentration of the soil is 1,000 less of the original  $\text{H}^+$  ion concentration of the soil. What is the new pH of the soil sample?

76 Samples of acid rain are brought to a laboratory for analysis. Several titrations are performed and it is determined that a 20.0-milliliter sample of acid rain is neutralized with 6.50 milliliters of 0.010 M  $\text{NaOH}$ . What is the molarity of the  $\text{H}^+$  ions in the acid rain?

1/06

47 Which indicator is yellow in a solution with a pH of 9.8?

(1) methyl orange (2) bromthymol blue (3) bromcresol green (4) thymol blue

Base your answers to questions 71 through 74 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.

71 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.

72 Write the chemical formula of a *negative* polyatomic ion present in an aqueous nitric acid solution.

73 Using information in the passage, describe *one* effect of acid rain on future generations of fish species in ponds and lakes.

74 Sulfur dioxide,  $\text{SO}_2$ , is one of the gases that reacts with water to produce acid rain. According to Reference Table G, describe how the solubility of sulfur dioxide in water is affected by an increase in water temperature.

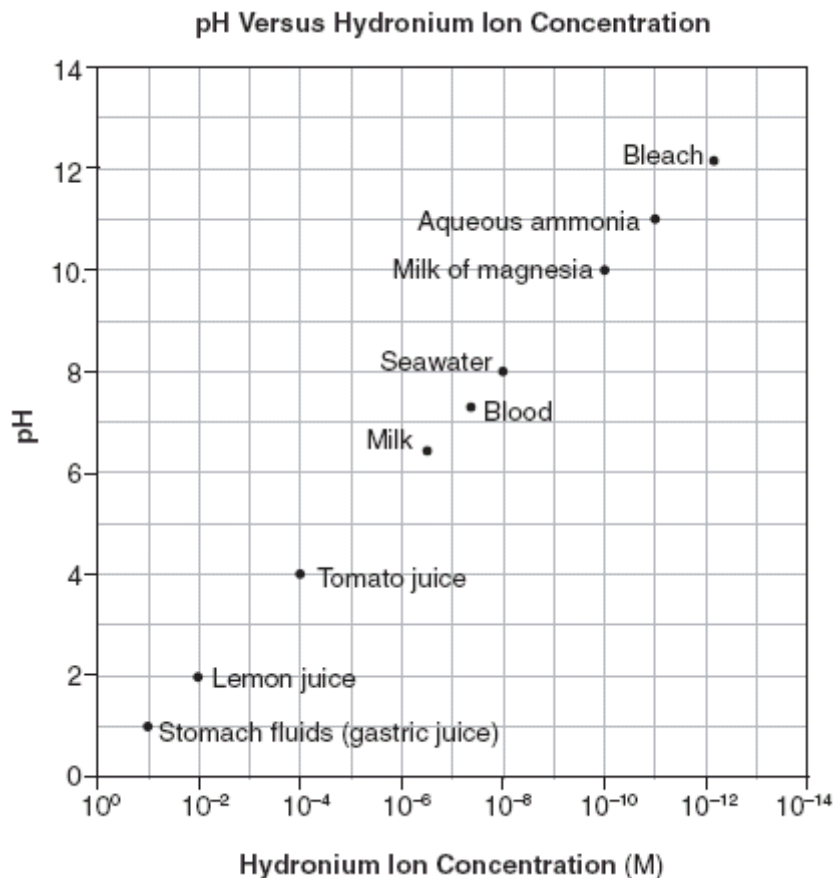
6/06

48 A student tested a 0.1 M aqueous solution and made the following observations:

- conducts electricity
- turns blue litmus to red
- reacts with Zn(s) to produce gas bubbles

Which compound could be the solute in this solution? (1) CH<sub>3</sub>OH (2) LiBr (3) HBr (4) LiOH

Base your answers to questions 73 through 75 on the graph below. The graph shows the relationship between pH value and hydronium ion concentration for common aqueous solutions and mixtures.



73 What is the hydronium ion concentration of tomato juice?

74 What color is thymol blue when added to milk of magnesia?

75 According to this graph, which mixture is approximately 100 times more acidic than milk of magnesia?

8/06

50 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? (1) 100 (2) 2 (3) 3 (4) 1000