Acid Base Short Answer Review

1. Base your answer to the following question on the information below.

   In a laboratory activity, 0.500 mole of NaOH(s) is completely dissolved in distilled water to form 400. milliliters of NaOH(aq). This solution is then used to titrate a solution of HNO_3(aq).

   If 300ml of acid is used in this titration, what is the molarity of the acid? Show all work.

   Complete the equation representing the titration reaction by writing the formulas of the products.

   $$NaOH(aq) + HNO_3(aq) \rightarrow \_\_\_\_\_ + \_\_\_\_\_$$

2. Identify *two* indicators from Reference Table *M* that are yellow in solutions with a pH of 5.5.

3. Base your answer to the following question 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

   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.

4. Base your answer to the following question on the information below.

   Using burets, 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 Buret Reading (mL)	15.50	5.00
Final Buret Reading (mL)	25.00	8.80

   Show a correct numerical setup for calculating the molarity of the sodium hydroxide solution.

5. Base your answer to the following question 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.

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.

6. Base your answer to the following question on the information and equation below.

Antacids can be used to neutralize excess stomach acid. Brand Antacid contains the acid-neutralizing agent magnesium hydroxide, $Mg(OH)_2$. It reacts with HCl(aq) in the stomach, according to the following balanced equation:

$$2\ HCl(aq) + Mg(OH)_2(s) \rightarrow MgCl_2(aq) + 2\ H_2O(\ell)$$

If a person produces 0.050 mole of excess HCl in the stomach, how many moles of $Mg(OH)_2$ are needed to neutralize this excess hydrochloric acid?

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7. Base your answer to the following question on the article below.

Fizzies — A Splash from the Past

They're baaack . . . a splash from the past! Fizzies instant sparkling drink tablets, popular in the 1950s and 1960s, are now back on the market. What sets them apart from other powdered drinks is that they bubble and fizz when placed in water, forming an instant carbonated beverage.

The fizz in Fizzies is caused by bubbles of carbon dioxide (CO_2) gas that are released when the tablet is dropped into water. Careful observation reveals that these bubbles rise to the surface because CO_2 gas is much less dense than water. However, not all of the CO_2 gas rises to the surface; some of it dissolves in the water. The dissolved CO_2 can react with water to form carbonic acid, H_2CO_3.

$H_2O(\ell) + CO_2(aq) \leftrightarrow H_2CO_3(aq)$

The pH of the Fizzies drink registers between 5 and 6, showing that the resulting solution is clearly acidic. Carbonic acid is found in other carbonated beverages as well. One of the ingredients on any soft drink label is carbonated water, which is another name for carbonic acid. However, in the production of soft drinks, the CO_2 is pumped into the solution under high pressure at the bottling plant.

— Brian Rohrig

Excerpted from "Fizzies—A Splash from the Past,"

Chem Matters, February 1998

What is the only positive ion in an aqueous solution of carbonic acid?

Base your answers to questions **8** through **10** 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.

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

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

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

11. A student recorded the following buret readings during a titration of a base with an acid:

	Standard 0.100 M HCl	Unknown KOH
Initial reading	9.08 mL	0.55 mL
Final reading	19.09 mL	5.56 mL

a Calculate the molarity of the KOH. Show all work.

b Record your answer to the correct number of significant figures.

Answer Key
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1. *Examples:* – $NaOH(aq) + HNO_3(aq) \rightarrow NaNO_3(aq) + H_20(\ell)$ –$NaOH(aq) + HNO_3(aq) \rightarrow HOH + NaNO_3$
2. *Examples:* —methyl orange —bromthymol blue —thymol blue
3. Examples: – 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.
4. Examples: $(0.10\ M)(9.50\ mL) = M_B\ (3.80\ mL)$ *or* $(0.1)(9.5)/3.8$
5. Examples: – the pH goes down because there are more hydronium ions in solution. – $[H_3O^+]\uparrow$
6. 0.025
7. H_3O^+ or H^+ or hydronium or hydrogen.
8. yellow
9. 5
10. H^+ or hydrogen or H_3O^+ or hydronium or NO_3^- or nitrate.
11. *a* Example: V = Final - Initial Reading $M_AV_A = M_BV_B$
    b 0.200