Acid and Base

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1 Introduction

Unfortunately, as I write this on the 2nd of February, 2025, tomorrow is the chemistry test. Additionally, I was completely exhausted from doing the WS. Hence, I am creating this so others won't also be unprepared. Please note, I am not a professional, nor am I skilled in chemistry **take this with a grain of salt.**

2 Table of Contents

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3 Multiple Choice

3.1 No. 1 "Electrolyte Test Device"

01. From the testing of the solution with the electrolyte test device, the following data was obtained.

Solution	Lamp		Electrode
	on	off	
1	√	-	there are gas bubbles
2	√	-	there are gas bubbles
3	-	√	there are gas bubbles
4	-	√	no change

The strong electrolyte is....

a. Solution 1 and 2
b. Solution 2 and 3
c. Solution 2
d. Solution 3
e. Solution 4

Electrolytes are compounds that separate into ions, creating an electrically conductive solution. For example, when a light bulb

is placed in a sports drink, the charges (from electrolyte ions) in the drink allow for an electric current to flow from an external energy source to make the light bulb glow

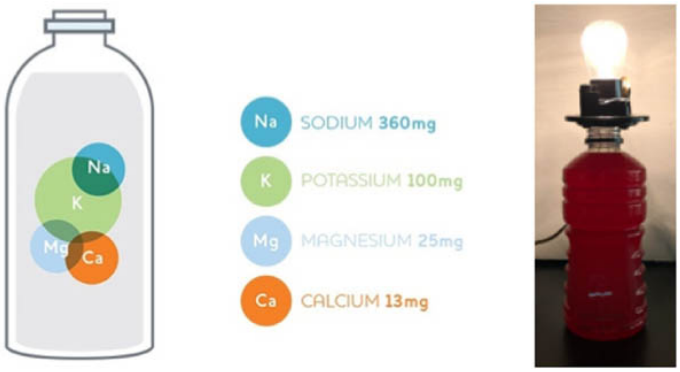


Figure 1: Example

Lamp on indicates that the solution is conductive, suggesting the presence of ions. Electrode off suggests that the solution is either non-conductive or weakly conductive. Solution 1 and 2, the lamp is on, indicating they are conductive and likely strong electrolytes. While, solution 3 and 4 the electrode is on, but the lamp is off, suggesting they are either non-conductive or weak electrolytes.

The explanation towards this phenomenon is that strong electrolytes completely dissociate into ions in solution, allowing them to conduct electricity effectively. This is why the lamp is on for solutions 1 and 2. While, weak electrolytes only partially dissociate, resulting in fewer ions and lower conductivity. This is why the lamp is off for solutions 3 and 4.

Hence the answer is **A**.

3.2 No. 2 "Litmus Test"

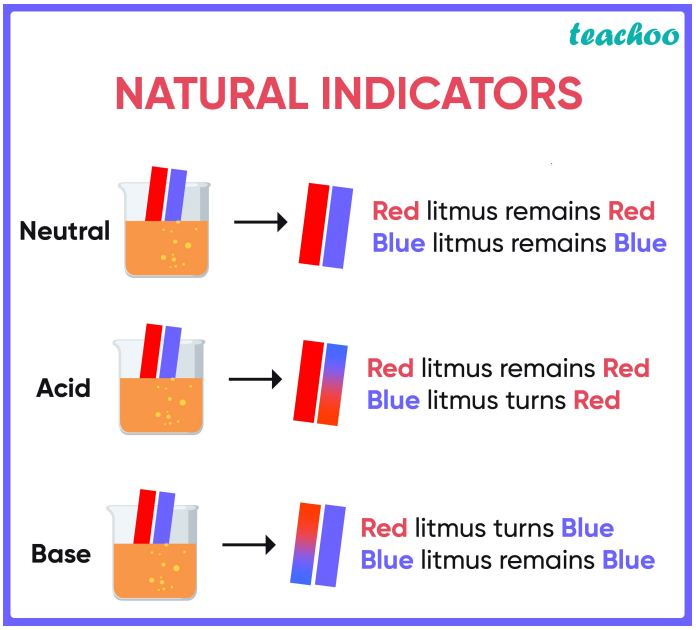
02. Several solutions were tested with litmus paper, and the results were as follows.

Solution	Red Litmus	Blue Litmus
1	Red	Red
2	Blue	Blue
3	Red	Red
4	Blue	Blue
5	Red	Blue

Based on the data above, the solution that is acidic is....

a. 1 and 2
b. 1 and 3
c. 2 and 3
d. 2 and 4
e. 4 and 5

Well, this is just memorization, really nothing else, just remember this table.



Hence the answer is **B**.

3.3 No. 3 "Combination"

03. Data from testing with an electrolyte test device and litmus paper on several solutions.

Solution	Lamp		Around electrode	Testing with litmus	
	On	Off		Red	Blue
1	√	-	there are gas bubbles	Red	Red
2	√	-	there are gas bubbles	Blue	Blue
3	-	√	there are gas bubbles	Red	Red
4	-	√	No change	Red	Blue
5	-	√	there are gas bubbles	Blue	Blue

Based on the data above, the solution that is a weak acid and a strong base in sequence is the solution....

a. 1 and 2
b. 1 and 4
c. 2 and 5
d. 3 and 1
e. 3 and 2

Well, it is the same as the last 2 questions, since weak acids' electrolytes are too weak to dissociate, meaning less conductivity that can conduct electricity, making the lamp not on but still produce gas bubbles. Using the litmus test, blue flips red, meaning it is an acid, particularly a weak acid.

For the base, it is practically the same as the weak acids, except in the litmus test, where the red litmuses flip blue, identifying it as a base.

Hence the answer is **E**.

3.4 No. 4 "Brønsted–Lowry Acid-Base Theory"

04. The pair that constitutes the acid- conjugate base pair in the following reaction is....
$HCl + H_2O_4 \rightarrow H_3O^+ + Cl^-$

a. HCl and H_2O
b. H_3O^+ and Cl^-
c. HCl and Cl^-
d. HCl and H_3O^+
e. H_2O and Cl^-

According to the Brønsted–Lowry Acid-Base Theory. Any compound that can transfer a proton to any other compound is an acid, and the compound that accepts the proton is a base.

According to the Brønsted-Lowry scheme a substance can function as an acid only in the presence of a base; similarly, a substance can function as a base only in the presence of an acid. Furthermore, when an acidic substance loses a proton, it forms a base, called the conjugate base of an acid, and when a basic substance gains a proton, it forms an acid called the conjugate acid of a base. In this case,

$$HCl + H_2O_4 \rightarrow H_3O^+ + Cl^-$$

According to the Brønsted–Lowry Acid-Base Theory. since HCl gives its only H to H_2O_4, HCl acts as the acid, and H_2O_4 acts as the base. In the right hand side, since H_3O^+ receives the H from HCl, it acts as the acid conjugate, and Cl^- acts as the base conjugate, because its the remnants of the acid.

Hence the answer is **C**.

3.5 No. 5 "Find pH"

05. As much as 100 mL of 0.1 M H_2SO_4 solution has a pH of....

- a. 1
- b. 1 + log 2
- c. 1 - log 2
- d. 2
- e. 2 - log 2

Don't be fooled, the volume 100 ml is not used in this question. Other than that, the general equation for finding pH is,

$$pH = -\log H^+$$

Since H_2SO_4 has 2 valence electrons for H, hence the molarity is multiplied by 2, hence it becomes $2 * 10^{-1}$

$$\text{pH} = -\log 2 * 10^{-1}$$

Using the laws of logs, it becomes

$$\text{pH} = -\log 10^{-1} - \log 2$$

$$\text{pH} = 1 - \log 2$$

Hence the answer is **C**.

3.6 No. 6 "Find the Base"

06. The reaction that shows $HClO_4$ is basic solution is....

a. $HClO_4 + NH_2^- \rightarrow ClO_4^- + NH_3$
b. $HClO_4 + NH_3 \rightarrow ClO_4^- + NH_4^+$
c. $HClO_4 + H_2O \rightarrow ClO_4^- + H_3O^+$
d. $HClO_4 + OH^- \rightarrow ClO_4^- + H_2O$
e. $HClO_4 + N_2H_5^+ \rightarrow H_2ClO_4^+ + N_2H_4$

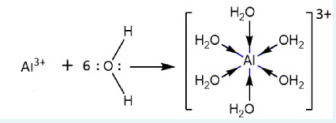
I don't want to review every number, you do it yourself, I will just explain why E is correct. The equation is,

$$HClO_4 + N_2H_5^+ \rightarrow H_2ClO_4^+ + N_2H_4$$

In this case the H_2ClO_4 receives the H from $N_2H_5^+$ making H_2ClO_4, and according to the Brønsted–Lowry Acid-Base Theory, the receiver is a base, and the giver is the acid.
Hence the answer is **E**.

3.7 No. 7 "Lewis Shenanigans"

07. Aluminum ions in the solution will bind six water molecules with the following reaction. In the following reaction, the substance that acts as an acid is....



- a. Ion Al^{3+}
- b. Molecule H_2O
- c. Atom O
- d. Group -OH
- e. Atom H

According to the definition of an acid according to the lewis definition, an acid is a species that can accept an electron pair. Has an empty orbital and can accept electron pairs from water molecules, making it a Lewis acid. In simple terms, A Lewis acid is a species that can accept an electron pair. And a Lewis base is a species that can donate an electron pair.

In this case, since Al^{3+} accepts pairs of electrons (i.e.: H_2O), it is the acid of this reaction.

Hence the answer is **A**.

3.8 No. 8 "Find Ka"

08. A 0.01M H_2SO_4 solution will give the same color as a 0.1M HA solution when both are treated with the same indicator. The ionization constant (Ka) of HA is....

- a. $1x10^{-3}$
- b. $4x10^{-3}$
- c. $4x10^{-4}$
- d. $4x10^{-2}$
- e. $4x10^{-5}$

In this case, since the colour is the same, I can assume that the pH of the substances are the same. Since the H_2SO_4 did not give any Ka, I can also assume that it is a strong acid, while the HA, since it's given that it has a Ka, it's a weak acid. The general formula for weak acids are,

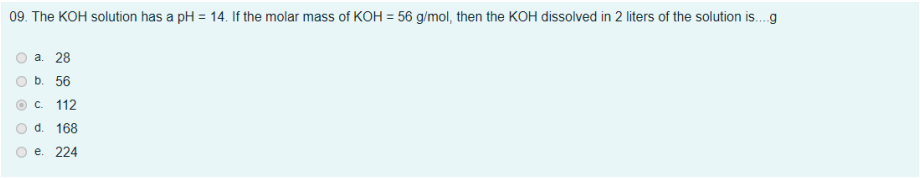
$$H^+ = \sqrt{Ka * Ma}$$

And since the H^+ of the H_2SO_4 is 0.01 M (multiplied by 2 because 2 valence), all that is needed to be found is the HA. Because it has the same pH, I can safely assume that,

$$0.02 = \sqrt{\mathrm{Ka} * \mathrm{Ma}}$$
$$(0.02)^2 = \mathrm{Ka} \cdot 0.1$$
$$\mathrm{Ka} = \frac{0.0004}{0.1}$$
$$\mathrm{Ka} = 0.004$$

Or $4 * 10^{-3}$, hence the answer is **B**.

3.9 No. 9 "pOH Finds the Mass"



In this case, it is pH but it's a base, so to find the pOH, minus the pH with 14, making the pOH 0, hence it makes the molarity 1, this is because

$0 = -\log 1$

Since the OH^- is 1, we can use the basic formulas of stochiometry to find the mass of the substance.

$$\mathrm{M} = \frac{\mathrm{n}}{\mathrm{V}}$$
$$1 = \frac{\mathrm{n}}{2}$$

Hence the n is equal to 2 moles, then using the formula to find mole, the mass can be found.

$$\mathrm{n} = \frac{\mathrm{m}}{\mathrm{Mr}}$$
$$2 = \frac{\mathrm{m}}{56}$$
$$\mathrm{m} = 112$$

Hence the mass is 112 grams, and the answer is **C**.

3.10 No. 10 "Neutralization"

10. To neutralize 100mL of 0.1M KOH solution, 0.1M H_2SO_4 solution is needed in the amount of....mL

- a. 10
- b. 50
- c. 100
- d. 150
- e. 200

To neutralize a reaction, you need to make the amount of moles the same for both the base and acid to neutralize. In this case, since H_2SO_4 have 2 valences, the molarity will be multiplied by 2

$$100 * 0.1 = V * 0.1 * 2$$
$$10 = 0.2V$$
$$V = 50$$

Hence the volume is 50 ml, do note that the moles here are milimoles, the answer is **B**.

4 Essay

Figure 2: God (is) with us, common heraldic phrase in Prussia.

4.1 No. 1 "Find pH"

4.1.1 A. 100 ml dissolved in H_2SO_4 0.05 M

It is given that the molarity, in this case the volume isn't needed, and since there is 2 valences, the M is multiplied by 2

$$\text{pH} = -\log \text{H}^+$$
$$\text{pH} = -\log 10^{-1}$$

Using the laws of logarithms, **the pH is equal to 1.**

4.1.2 B. 0.6 grams of CH_3COOH is dissolved in water to form a 500 ml solution. Ka = 2×10^{-4}

In this question the Mr of CH_3COOH is needed but it isn't given. Hence I will give the Mr, where (C = 12, H = 1, O = 16). First find the moles, make it into molarity and then find the H^+.

$$n = \frac{0.6}{60}$$
$$n = 0.01$$

Using the formula to find Molarity,

$$M = \frac{0.01}{0.5}$$
$$M = 0.02$$

Then using the formula to find the H^+ of weak acids,

$$\text{H}^+ = \sqrt{(2 \times 10^{-4})(0.02)}$$
$$\text{H}^+ = \sqrt{4 \times 10^{-6}}$$
$$\text{H}^+ = 2 \times 10^{-3}$$

Now finding the pH

$$\text{pH} = -\log 2 \times 10^{-3}$$
$$\text{pH} = 3 - \log 2$$

Hence the answer is equivalent to $3 - \log 2$.

4.1.3 C. 2 grams of NaOH in 100 ml of solution (AR Na = 23, O = 16)

For this one, ms gave the AR, so just find the moles, then find the molarity, then solve, remember 14 to minus the result to give the pH.

$$n = \frac{2}{40}$$
$$n = 0.05$$

Finding the molarity

$$M = \frac{0.05}{0.1}$$
$$M = 0.5$$

Finding the pOH

$$\text{pOH} = -\log 5 \times 10^{-1}$$
$$\text{pOH} = 1 - \log 5$$

Finding the pH

$$\text{pH} = 14 - (1 - \log 5)$$
$$\text{pH} = 13 - \log 5$$

Hence the answer to this question is $13 - \log 5$

4.1.4 D. 3.4 Grams of NH3 is dissolved in water to form a 2 litre solution, Kb = 1.8×10^{-5}, AR N = 14

Basically the same as the last question but you have to find the OH^- using the Kb because it's a weak acid.

$$n = \frac{3.4}{17}$$
$$n = 0.2$$

Finding the M,

$$M = \frac{0.2}{2}$$

$$M = 0.1$$

Finding the OH^-,

$$OH^- = \sqrt{1.8 \times 10^{-5} * 0.1}$$
$$OH^- = \sqrt{1.8 \times 10^{-6}}$$
$$OH^- \approx 1.34 \times 10^{-3}$$

Finding the pOH

$$pOH = -\log 1.34 \times 10^{-3}$$
$$pOH = 3 - \log 1.34$$

Finding the pH

$$pH = 14 - (3 - \log 1.34)$$
$$pH = 11 + \log 1.34$$

Hence the pH of this question is $11 + \log 1.34$

4.2 No. 2 How many mL of 0.1M $Ba(OH)_2$ is needed to neutralize:

4.2.1 A. 20 ml of 0.5M HCl

The equation is (unbalanced),

$$Ba(OH)_2 + HCl \rightarrow BaCl_2 + H_2O$$

Balancing the equation, it becomes

$$Ba(OH)_2 + 2\,HCl \rightarrow BaCl_2 + H_2O$$

$$0.1 * 2 * V = 0.5 * 1 * 20$$
$$10 = 0.2V$$
$$V = 50$$

Hence the volume is **50 ml**

4.2.2 B. 10 ml of 0.05M H_2SO_4

The following equation is also unbalanced,

$$Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O$$

Balancing the equation, it becomes

$$Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + 2\,H_2O$$

$$0.1 * 2 * V = 0.05 * 2 * 10$$
$$0.2V = 1$$
$$V = 5$$

Hence the answer is **5 ml**

4.3 No. 3 "pH Test Data"

Indikator	**Trayek pH**	**Perubahan warna**	**Air limbah**	
			1	**2**
Metil merah	4.2 – 6	Merah – kuning	Merah	Kuning
Bromtimol biru	6 – 7.6	Kuning – biru	Kuning	Biru
fenolftalein	8.3 – 10	Tak berwarna – merah	Tak berwarna	merah

Table 1: pH test data of the two types of waste

4.3.1 A. pH of wastewater 1

Using the number line, the answer can be determined, don't overthink this question as it's very logical. Using the number line the answer determined is **¡4.2**

4.3.2 B. pH of wastewater 2

Using the number line, the answer can be determined, don't overthink this question as it's very logical. Using the number line the answer determined is **¿10**

5 Credits

I am grateful to DeepSeek, Mistral AI, Britannica, and Wikipedia for their assistance in clarifying these topics. I also appreciate Felicia's help in addressing some of my own questions. I hope this review will assist you in finding answers to yours as well.

Figure 3: Plane. (Convair 990)