

Name: Answer Key

Alice frequently uses a white cleaning powder in her home. She wants to know whether this substance is acidic, basic or neutral.

solid! cannot test a solid!

In order to determine the pH of this substance, what is the first thing she must do?

must be dissolved in water!

- A) Put a piece of blue litmus paper on the solid.
- B) Put a piece of red litmus paper on the solid.
- C) Verify whether the solid conducts electricity.
- D) Dissolve a small amount of the solid in water.

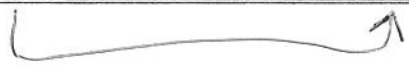
2

A student wishes to determine the turning point of an indicator, experimentally.

pH range over which an indicator changes from 1 colour into another

The table shows the results obtained using methyl orange.

Colour	red	red	red orange	orange	yellow	yellow	yellow	yellow	yellow
pH	1	2	3	4	5	6	7	8	9



What is the turning point of methyl orange?

red - yell three orange

- A) ~~pH 1 to pH 2~~
- B) ~~pH 2 to pH 3~~
- C) pH 3 to pH 4
- D) ~~pH 4 to pH 5~~

3

Which statement correctly defines an electrolyte?

ABS in water produces ions & therefore conducts electricity!

- A) A substance that conducts an electric current
- B) A substance that does not conduct an electric current
- C) A substance that conducts an electric current when dissolved in aqueous solution
- D) A substance that does not dissolve in water

M-NM = salt!

4

In the course of an experiment, you note that on dissolving $Al_2(SO_4)_3$ in pure water, you obtain a solution with the following properties :

- 1. It conducts electricity. ✓ *ABS*
- 2. It turns ^{*blue*} litmus paper red. ✓ *A*
- 3. It neutralizes a base. ✓ *A*
- 4. It produces hydrogen in the presence of a piece of zinc. ✓ *= A*



After the experiment you conclude that the $Al_2(SO_4)_3$ was:

which is a salt is an acidic salt

- A) an acid.
- B) a base.
- C) a non-neutral salt.
- D) a salt.

5

Four chemical substances are given below.

- 1. H_2SO_4 = *A*
H-NM
- 2. $Ca(OH)_2$ = *B*
M-OH
- 3. $MgCl_2$ = *S*
M-NM
- 4. C_2H_5OH
alcohol = C_xH_yOH

Which of these substances is a base?

- A) Substance 1
- B) Substance 2
- C) Substance 3
- D) Substance 4

6 The following four tests are to be carried out to determine if an aqueous solution is acidic.

1. Dip a piece of cobalt dichloride paper into the solution. = H_2O test "stupid"!
2. Dip a piece of red and a piece of blue litmus paper into the solution. \checkmark AB or NS
3. Check the electrical conductivity of the solution. ABS
4. Dip a piece of magnesium ribbon into the solution. $A + M = H_2$

Which two of these tests will definitely confirm that the solution is acidic?

- A) 1 and 2
- B) 2 and 3
- C) 2 and 4
- D) 3 and 4

7 You find a bottle containing an unidentified liquid. By using universal indicator paper, you determine that the pH of this liquid is 11. Therefore you have to neutralize it before disposing of it.

Which of the following methods can be used to neutralize the liquid?

- ~~A)~~ Add a solution of NaOH. $B+B=B!$ pH 11 = basic / alkaline
- ~~B)~~ Add distilled water. *dilutes* neutralization = $A+B \rightarrow S+W$
- C) Add a solution whose pH is 5. = A \checkmark $A + pH 11 = neut.$
- ~~D)~~ Add a solution whose pH is 8. = B X $B+B=B$

8 Which of the following substances is a salt?

- A) KCl \checkmark $M-NM$
- ~~B)~~ $HNO_3 = A = H-NM$
- ~~C)~~ $LiOH = M-$
- ~~D)~~ $SO_2 = covalent = NM-NM$

- 9 The following table gives the colours of the indicator phenol red in solutions whose pH values vary from 0 to 14.

pH	1	3	5	7	9	11	13
Colour	Yellow			Orange	Red		

Handwritten notes: A (0-3), SA (0-1), WA (4-7), WB (7-10), B (10-14), SB (13-14)

A few drops of this indicator are added to a basic solution.

$pH > 7$

What colour does the phenol red become?

- A) Orange or red
- B) Yellow or orange
- C) Yellow only
- D) Red only

- 10 The following table gives the colours of the indicators methyl orange and bromothymol blue in solutions whose pH values vary from 0 to 14.

Methyl Orange	Colour	Red	Orange	Yellow				
	pH	1	3	5	7	9	11	13
Bromothymol Blue	Colour	Yellow			Green	Blue		

$pH > 4.3$ ish

A solution turns yellow when methyl orange is added; it also turns yellow when bromothymol blue is added.

What could the pH of this solution be?

$pH < 6$ ish

- A) 4
- B) 5
- C) 7
- D) 9

$4.3 < pH < 6$

= no effect on pH

11 Which of the following describes a neutral salt solution?

conducts elec = electrolyte

- A) A solution that does not conduct electricity and that does not change the colour of litmus paper
- B) A solution that conducts electricity and that does not change the colour of litmus paper
- C) A solution that conducts electricity and that turns litmus paper red
- D) A solution that conducts electricity and that turns litmus paper blue

12 The following table gives the colours of the indicators bromthymol blue and alizarin yellow in solutions with different pH values.

pH Scale	1	3	5	7	9	11	13
Bromothymol Blue	Yellow			Green		Blue	
Alizarin Yellow	Yellow					Orange	Red

pH > 11.5 ish

A student was asked to determine the pH of a colourless solution.

After adding a few drops of each indicator to this solution, she noticed that it turned purple. = red + blue

Which of the following could be the pH value of this colourless solution?

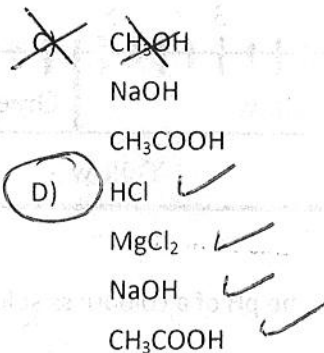
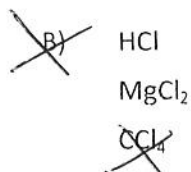
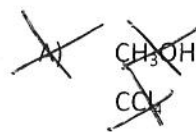
- A) 13
- B) 9
- C) 7
- D) 5

- 13 To check the electrical conductivity of certain substances, a student used a conductivity apparatus equipped with a light bulb.

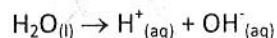
Her observations are listed in the following table.

Substances	Observations
HCl = A	Bright light ✓
CH ₃ OH = alc	No light ✓
MgCl ₂ = S	Faint light ✓
NaOH = B	Bright light ✓
CH ₃ COOH = A	Faint light ✓
CCl ₄ = \emptyset cov.	No light ✓

Which one of the following groups of substances contains only electrolytes?



- 14 In the course of an experiment, you find that the pH of pure water is 7. Given that the equation for the ionization of water is:



Determine the molar concentrations of the H⁺_(aq) ion and the OH⁻_(aq) ion in pure water.

- | | [H ⁺] | [OH ⁻] |
|----|-------------------------------|-----------------------------------|
| A) | 1.0 × 10 ⁻⁸ mol/l | and 1.0 × 10 ⁻⁶ mol/l |
| B) | 1.0 × 10 ⁻¹¹ mol/l | and 1.0 × 10 ⁻³ mol/l |
| C) | 1.0 × 10 ⁻¹ mol/l | and 1.0 × 10 ⁻¹³ mol/l |
| D) | 1.0 × 10 ⁻⁷ mol/l | and 1.0 × 10 ⁻⁷ mol/l |

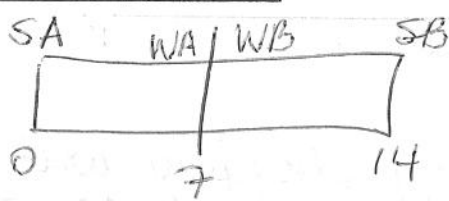
The following table gives the pH value of four liquids.

Liquid	pH
Tap water	6.8
Lemon juice	2.3
Human blood	7.3
Liquid bleach	11

A but stronger
WB stronger B

always sketch!

Which one of these liquids is weakly acidic?



A) Tap water

C) Human blood

B) Lemon juice

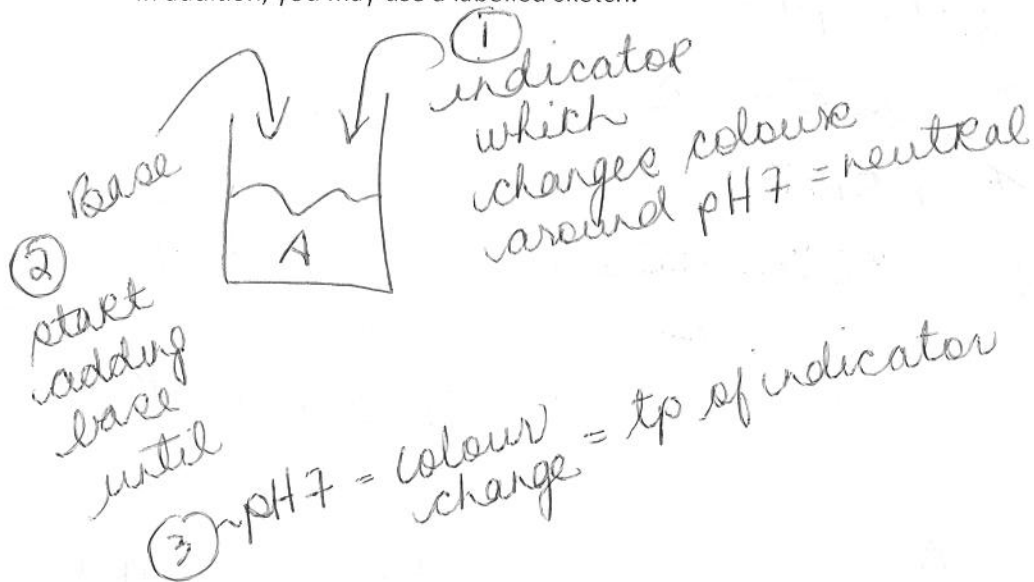
D) Liquid bleach

Part 2: Show all work, units and especially math! (4 marks each)

In the laboratory, you are to neutralize an acid solution before disposing of it.

Explain how you would neutralize this solution.

In addition, you may use a labelled sketch.

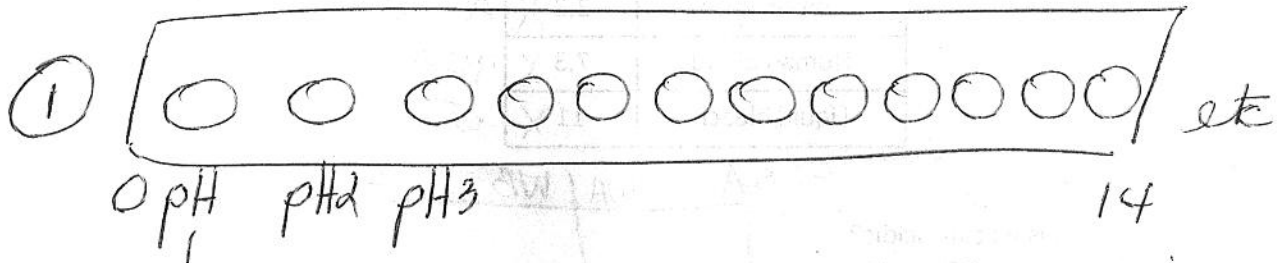


2

During an experiment, you are given an unknown solution, a bottle of universal indicator equipped with an eye-dropper, a series of buffer solutions from pH 2 to pH 12 and a chemplate with wells.

Describe a procedure that will allow you to determine the pH of the solution. You may label a sketch, in addition.

buffers of known pH

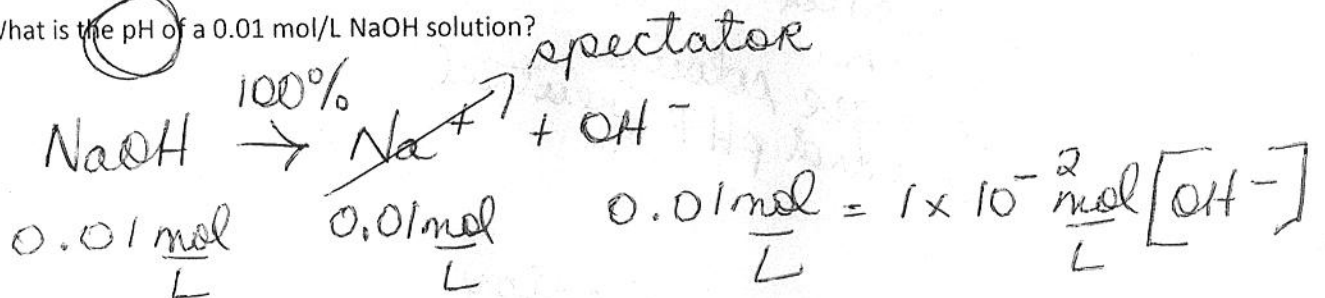


add diff buffers with different pHs in order from left to right in a chem plate
pH 1 - 12 ish

- ② add 2 or 3 drops of indicator to each well
- ③ make note of the colour the diff pHs turn
- ④ add indicator to unknown soln & compare to colour of the pHs.

3

What is the pH of a 0.01 mol/L NaOH solution?



Base
pH > 7 !!

$$\text{①} \therefore [\text{H}^+] = \frac{1 \times 10^{-14}}{1 \times 10^{-2}}$$

or ② if $[\text{OH}^-] = 1 \times 10^{-2} \text{ M}$
then pOH 2
then $14 - \text{pOH} = \text{pH } 12$!

$$[\text{H}^+] = 1 \times 10^{-12} \frac{\text{mol}}{\text{L}}$$

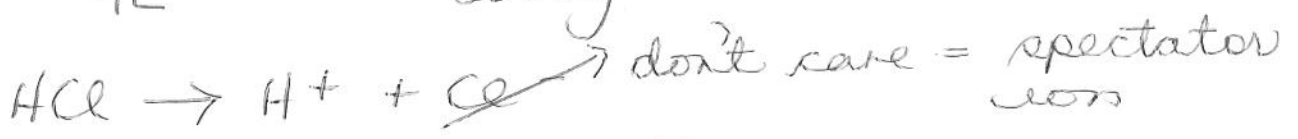
so pH 12 !

acidic

4

What is the $[OH^-]$ in a solution that contains 0.0365 g of HCl in one liter of solution?

$$\frac{0.0365 \text{ g HCl}}{1 \text{ L}} \times \frac{1 \text{ mol HCl}}{36.5 \text{ g}} = 0.001 \frac{\text{mol}}{\text{L}} \text{ HCl}$$



$$\begin{array}{ccc} 0.001 \text{ M} & 0.001 \text{ M} & 0.001 \text{ M} \\ 1 \times 10^{-3} \text{ M} & 1 \times 10^{-3} \text{ M} & \end{array}$$

Acid

$\therefore \text{pH} < 7$
but asking for $[OH^-]$

\hookrightarrow (1) if $[H^+] = 1 \times 10^{-3} \text{ M}$
 then $\text{pH} = 3$
 then $14 - 3 = 11 = \text{pOH}$
 then $[OH^-] = 1 \times 10^{-11} \frac{\text{mol}}{\text{L}}$

or (2) $[H^+][OH^-] = 1 \times 10^{-14}$
 $\frac{[H^+]}{[H^+]} \frac{[OH^-]}{[H^+]} = 1 \times 10^{-14}$
 $[OH^-] = 1 \times 10^{-11} \text{ mol/L}$

5

What is the concentration of NaOH if 12.00 mL of 0.25 mol/L HCl are required to neutralize 10.00 mL of NaOH?



$$\begin{array}{ll} C_A 0.025 \text{ M} & V_B 10.00 \text{ mL} \\ V_A 12.00 \text{ mL} & \end{array}$$

$$\frac{C_A V_A}{V_B} = \frac{C_B V_B}{V_B}$$

$$(0.025 \text{ mol/L})(12.00 \text{ mL}) = C_B = 0.03 \frac{\text{mol}}{\text{L}} \text{ NaOH}$$

6

A student was given 4 clear and colourless solutions labeled W, X, Y and Z. One of them was an acidic solution, one a basic solution, one a salt solution and one was distilled water. The student filled in the following table after performing a number of tests.

Indicate the tests she would perform and the results she would obtain to prove that W, X, Y and Z were the Acid, Base, Salt and dH_2O , respectively.

	Test 1	Test 2	Test 3	Test 4	Test 5	SC
	Red Lit	Blue Lit	Cond.	Rxn w M	Rxn w CO_3^{2-}	
W = Acid(aq)	—	Red	+	+	+	+
X = Base(aq)	Blue	—	+	—	—	+
Y = Salt (aq) neutral	—	—	+	—	—	+
Z = $\text{dH}_2\text{O}(l)$	—	—	—	—	—	+