

Review for solution, electrolyte and pH test

Solutions:

1. To reduce tooth decay, some cities add fluoride to their drinking water. An employee in charge of drinking water fluoridation in a big city dissolved 48 g of fluoride in 50 000 L of water. What is the fluoride concentration of the water in ppm?

$$\frac{48 \text{ g}}{50\,000 \text{ L}} \rightarrow \frac{48 \text{ g}}{50\,000\,000 \text{ ml}} \quad \frac{48 \text{ g}}{50\,000\,000 \text{ ml}} ; \frac{x \text{ g}}{1\,000\,000 \text{ ml}} \rightarrow 0.96 \text{ g}$$

$$\boxed{0.96 \text{ ppm}}$$

2. Public pools usually contain about 7 ppm of chlorine to control bacterial growth. If your pool can hold 39 000 L of water, how much chlorine should there be in the water?

$$\frac{7 \text{ g}}{1\,000\,000 \text{ ml}} ; \frac{x \text{ g}}{39\,000\,000 \text{ ml}} \rightarrow 273 \text{ g}$$

x 1000 = 39,000,000 ml

$$\boxed{273 \text{ g}}$$

3. You test the quality of drinking water in your house by taking a 250 mL sample. You find it contains 850 mg of contaminant. What is the concentration of the contaminant in %?

$$\frac{850 \text{ (mg)} \rightarrow \text{change to grams}}{250 \text{ ml}} ; \frac{x \text{ g}}{100 \text{ ml}} \rightarrow 0.34$$

÷ 1000

$$\boxed{0.34 \%}$$

4. The lethal concentration of nitrate (NO_3^-) is 0.04 g/L and phosphate's (PO_4^{3-}) lethal concentration is 0.3 mg/L. This means that in a pond, if the concentrations of nitrate or phosphate are over the values given, certain types of aquatic organisms will die.

You test the water and get the following values:

- ① Nitrate has a concentration of 45 ppm
Phosphate has a concentration of 0.15 ppm

Determine if the pond contains any lethal doses.

nitrate

① have
45 ppm

$$\frac{45 \text{ g}}{1\,000\,000 \text{ ml}} ; \frac{x \text{ g}}{1\,000 \text{ ml}} \rightarrow 0.045$$

have $0.045 \text{ g/L} > 0.04 \text{ g/L}$ lethal

$$\boxed{\text{yes: lethal}}$$

- ② phosphate

have
 $0.15 \text{ ppm} \rightarrow = 0.15 \text{ mg/L}$

have $0.15 \text{ mg/L} < 0.3 \text{ mg/L}$ lethal

no; not lethal.

5. An antiseptic mouth wash contains a medical ingredient called thymol. A 100 mL bottle of this mouthwash contains 63 mg of thymol. What is the concentration of thymol, in ppm, in this mouthwash?

$$\frac{63 \text{ mg}}{100 \text{ ml}} ; \frac{x \text{ mg}}{1\,000 \text{ ml}} \rightarrow 630 \Rightarrow 630 \text{ mg/L} = \boxed{630 \text{ ppm}}$$

OR

$$\frac{63 \text{ mg}}{100 \text{ ml}} \xrightarrow{\div 1000} \frac{0.063 \text{ g}}{100 \text{ ml}} ; \frac{x \text{ g}}{1\,000\,000 \text{ ml}} \rightarrow 630 \Rightarrow \boxed{630 \text{ ppm}}$$

6. Measurements in atmospheric concentrations of various substances show that the amount of CO₂ and other pollutants has increased significantly in the past 260 years.

Table 1 – Changes in atmospheric pollutant concentrations

Substance	Formula	Concentration before 1750	Concentration in 2010
carbon dioxide	(CO ₂)	287 ppm	0.0389 %
nitrous oxide	(N ₂ O)	0.270 %	3.14 g/L
methane	(CH ₄)	438 ppm	720 mg/L ppm

↑ 102 ppm
↑ 440 ppm
↑ 282 ppm

Determine which of the pollutants in Table 1 has shown the greatest increase in concentration in the past 260 years. Justify your answer with the appropriate calculations.

CO₂

① $0.0389\% \rightarrow \frac{0.0389g}{100ml} ; \frac{xg}{1000000ml} \rightarrow 389g \Rightarrow 389 ppm$

② $389 - 287 = 102$ **102 ppm ↑**

N₂O

① $\frac{0.270g}{100ml} ; \frac{xg}{1000000ml} \rightarrow 2700g \Rightarrow 2700 ppm$ } year 1750

② $\frac{3.14g}{1000ml} ; \frac{xg}{1000000ml} \rightarrow 3140g \Rightarrow 3140 ppm$ } year 2010

③ $3140 - 2700 = 440 ppm$ ↑

CH₄

$720 ppm - 438 ppm = 282 ppm$

The concentration of nitrous oxide increased the most

7. Choose the answer that best explains the following concentrations.

1- 10% $\frac{10g}{100ml}$ 2- 100 g/L 3- 40 g/400 mL

A) the 100 g/L solution is the most concentrated solution

B) the 10% and the 40 g/400 mL concentrations are equal

C) the order from weakest to strongest is 10%, 40 g/400 mL and 100 g/L

D) they are all equal concentrations

$\frac{40g}{400ml} ; \frac{xg}{1000ml} \rightarrow 100g/L$

8. The concentrations of four solutions are given in the following table.

Solution	Concentration
1	20 g/L
2	0.4 g/mL
3	5 g/100 mL
4	3 g/500 mL

Which solution is the most concentrated?

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

$\frac{0.4g}{1ml} ; \frac{xg}{1000ml} \Rightarrow 400g$

$\frac{5g}{100ml} ; \frac{xg}{1000ml} \Rightarrow 50g$

$\frac{3g}{500ml} ; \frac{xg}{1000ml} \Rightarrow 6g$

9. Listed below are several different concentrations of solutions of coffee :

1. 25.0 g/250.0 ml 3. 45.0 g/675.0 ml
2. 60.0 g/800.0 ml 4. 75.0 g/825.0 ml

List the concentrations in **increasing** order.

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

25
250

0.1
0.075

$c = \frac{m}{V}$

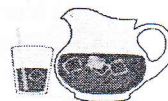
smallest → highest 3-2-4-1

$$\frac{6g}{100ml} : \frac{xg}{500ml}$$

10. A pharmacist wants to prepare 500 mL of an antibiotic solution. The concentration of the solution must be 6%. What mass of the antibiotic must she use?
 A) 1.2 g B) 3 g C) 6 g **D) 30 g**

11. A student makes a 1L pitcher of Kool-Aid and pours himself 200 mL into a glass. Which statement best explains the relationship between the concentration of Kool-Aid in the pitcher and the concentration of Kool-Aid in the glass?

- A) The Kool-Aid in the glass is more concentrated than the Kool-Aid in the pitcher.
 B) The Kool-Aid in the glass is less concentrated than the Kool-Aid in the pitcher.
 C) The Kool-Aid in the glass is more diluted than the Kool-Aid in the pitcher.
D) The Kool-Aid in the glass has the same concentration as the Kool-Aid in the pitcher.



Electrolytes:

1. The table below shows the results for four liquids when tested with Litmus paper and a conductivity meter.

Results of unknowns

	Liquid A	Liquid B	Liquid C	Liquid D
Red Litmus paper	Stays red	Stays red	Stays red	Turns blue
Blue Litmus paper	Turns red	Stays blue	Stays blue	Stays blue
Conductivity	Light turns on	Light turns on	Light stays off	Light turns on

The four liquids tested were CH₃OH, HCl, CaCl₂ and Mg(OH)₂.

Using the results from the table above, match each liquid (A, B, C and D) with the correct molecular formula (CH₃OH, HCl, CaCl₂ or Mg(OH)₂).

2. What is an electrolyte? Which substances are electrolytes?

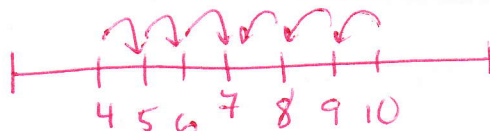
A substance that, when dissolved in water, conducts electricity.
acids, bases, salts

3. Fill in the table. Give the pH range or number.

	Ca(OH) ₂	CaCl ₂	CH ₃ COOH	CH ₃ OH	H ₂ SO ₄	HCl	NCl ₃	NaCl
Acid, base, salt or non-electrolyte	B	S	A	NE	A	A	NE	S
pH range or #	>7	7	<7	7	<7	<7	7	7
Electrolyte or Non-elect.	elec.	elec.	elec.	non-el.	elec.	elec.	non-e	elec.

4. You want to neutralize something with a pH of 4, what would you use?

- A) water B) an acid C) something with a pH of 7 **D) Mg(OH)₂**



5. Which of the following substances would you use to clean greasy dishes? → base
- A) KCl B) HCl **C) KOH** D) C₂H₅OH
6. Alice frequently uses a white cleaning powder in her home. She wants to know whether this substance is acidic, basic or neutral. In order to determine the pH of this substance, what is the first thing she must do?
- 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.

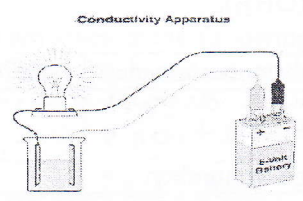
7. Some common substances are listed below.
- | | |
|--------------------|-------------------|
| 1. vinegar ✓ | 4. soft drinks ✓ |
| 2. distilled water | 5. tomato juice ✓ |
| 3. seawater | |
- Which of the substances have a pH that is less than 7?
- A) 1, 2, and 3 B) 1, 3, and 4 C) 1, 4, and 5 D) 2, 3, and 5

8. A student is testing the conductivity of a solution. She observes that the solution conducts electricity. Which of the following combinations includes ONLY substances that will cause the solution to conduct electricity?
- A) HF, LiOH, KBr** ✓ C) BeF₂, CCl₄, C₂H₅OH ✗
 B) C₂H₆, CCl₄, C₆H₁₂O₆ ✗ D) LiOH, NaCl, C₆H₁₂O₆ ✗

9. Which of the following, when dissolved in water, is an electrolyte?
- A) CO₂ **B) HNO₃** C) H₂O D) C₆H₁₂O₆

10. Which of the following, when dissolved in water, will be a non-electrolyte?
- A) KCl B) HCl C) KOH **D) C₂H₅OH**

11. The electrical conductivity of several aqueous solutions were tested in the laboratory using the apparatus below.



✓	✗	✓	✗	✗	✓
CaCl ₂	N ₂ O ₄	HBr	N ₂	H ₂ O	LiF

Which of the following lists the aqueous solutions that would allow the current to flow? acids, bases, salts

A) N₂O₄, N₂, LiF C) N₂O₄, N₂, H₂O
B) CaCl₂, HBr, LiF D) CaCl₂, HBr, H₂O

12. Which of the following molecules is a salt?
- A) KBr** B) LiOH C) HNO₃ D) SO₂

13. The incomplete table gives information on three aqueous solutions.

Information on Different Aqueous Solutions

Solution	Chemical formula of solute	pH	Electrical conductivity
1		2	
2			weak
3	C ₆ H ₁₂ O ₆		

acid.

non-elec.

Using the information in the table above, which of the following statements is true?

- A) Only solution 1 conducts an electric current. ✗
 B) Solutions 1 and 2 conduct an electric current. ✓
 C) Solutions 2 and 3 conduct an electric current.
 D) Solutions 1, 2 and 3 conduct an electric current

14. Which of the following are characteristic properties of a basic solution?

1. Conducts electricity ✓ 4. Turns litmus paper red
 2. Does not conduct electricity 5. Does not change the colour of litmus paper
 3. Turns litmus paper blue ✓

- A) 1 and 3 B) 1 and 4 C) 2 and 3 D) 2 and 5

15. To check the electrical conductivity of certain liquids, a student used a conductivity apparatus equipped with a light bulb. Using the table of information, determine which substances are electrolytes.

Substances	Observations
HCl	Bright light ✓
CH ₃ OH	No light ✗
MgCl ₂	Faint light ✓
NaOH	Bright light ✓
Ca(OH) ₂	Faint light ✓
CCl ₄	No light ✗

A) CH₃OH and CCl₄ ✗

B) HCl, MgCl₂ and CCl₄ ✗

C) CH₃OH, NaOH and Ca(OH)₂ ✗

D) HCl, MgCl₂, NaOH and Ca(OH)₂ ✓

16. The lab technician stores chemicals according to their type. Which column contains the chemicals correctly classified as acids, bases and salts.

	A ✗	B ✓	C ✗	D ✗
Acids	H ₂ SO ₄ , H ₂ O	H ₂ SO ₄ , HCl	KOH, Ca(OH) ₂	H ₂ SO ₄ , H ₂ O
Bases	KOH, Ca(OH) ₂	KOH, Ca(OH) ₂ ✓	NaCl, KClO ₃	KOH, Ca(OH) ₂
salts	NaCl, HCl	NaCl, KClO ₃ ✓	H ₂ SO ₄ , Na ₂ SO ₄	NaCl, KClO ₃

17. Which of the following procedures can be used to determine whether sugar is an electrolyte or a non-electrolyte?

- A) Check the electrical conductivity of a cube of sugar.
 B) Check the electrical conductivity of powdered sugar.
 C) Check the electrical conductivity of an aqueous sugar solution. ✓
 D) Check the electrical conductivity of a heterogeneous mixture of sugar and alcohol.

18. We wish to demonstrate that some substances conduct electricity in certain situations. What substance must we add to distilled water to demonstrate this fact?

- A) Vegetable oil **B) Lemon juice** C) Icing sugar D) Food colouring

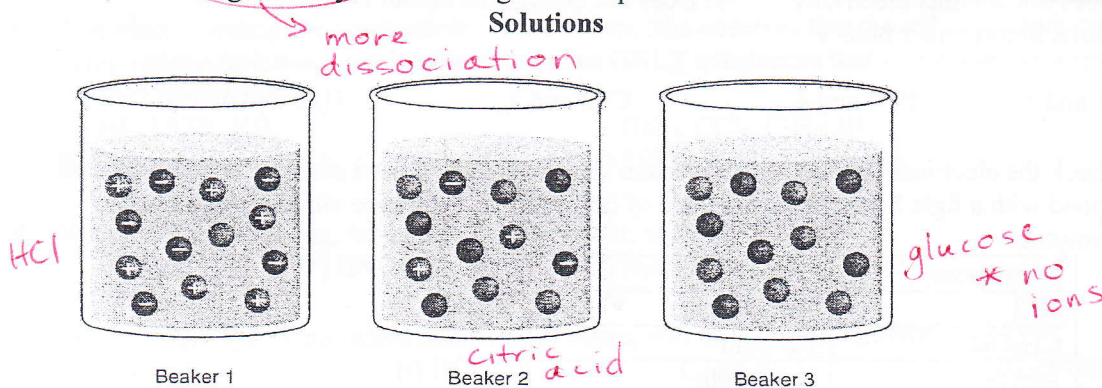
19. Four different solutions made with distilled water are described below.

Solution	Characteristic
1	Aqueous solution with a pH of 11 <i>base ✓</i>
2	Vinegar solution (HCH ₃ COO) ✓
3	Glucose solution (C ₆ H ₁₂ O ₆) ✗
4 <i>salt</i>	Ionic solution with a pH of 7 ✓

Which of these solutions can conduct an electric current?

- A) Solutions 1, 2 and 3 C) Solutions 1, 3 and 4
 B) Solutions 2, 3 and 4 **D) Solutions 1, 2 and 4**

20. Solutions can be categorized as non-electrolytes, weak electrolytes and strong electrolytes. Glucose, C₆H₁₂O₆, is a non-electrolyte when dissolved in water. Citric acid, C₆H₈O₇, the acid in orange juice, is a weak electrolyte when dissolved in water. Hydrochloric acid, HCl, sometimes known as stomach acid, is a strong electrolyte. A drawing of these particles in three different solutions is shown below.



Which of the following correctly identifies the solutions in each of the beakers?

	Beaker 1	Beaker 2	Beaker 3
A)	Glucose	Hydrochloric acid	Citric acid
B)	Hydrochloric acid	Citric acid	Glucose
C)	Citric acid	Hydrochloric acid	Glucose
D)	Glucose	Citric acid	Hydrochloric acid

pH:

1. In order to make apple juice from apple cider, the cider is filtered and then the following ingredients are added:

- 1 stick of cinnamon
- 6 whole cloves
- 4 strips of orange rind
- Enough brown sugar to have a sugar concentration of 205.71 g/L

The mixture is then heated in a pot at low temperature for 20 minutes.

A) How much sugar needs to be added to a 1.75 L pitcher of filtered cider?

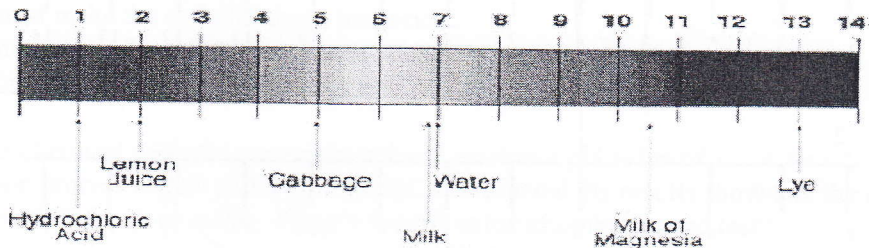
$$\frac{205.71 \text{ g}}{1000 \text{ ml}} ; \frac{x \text{ g}}{1750 \text{ ml}} \rightarrow \boxed{359.99 \text{ g}}$$

B) Often, to make apple juice less acidic, another juice is added to it. Apple juice normally has a pH of 3. Which of the following products should be mixed with the apple juice in order to obtain a liquid with a pH that is almost neutral? Justify your answer.

- Berry juice pH = 5.6
- Cranberry juice pH = 2.5
- Goji Berry juice pH = 8.4
- Lemon juice pH = 2.3

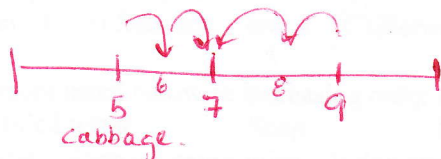
acid + base = neutral solution
(sac + water)

2. The following table shows the pH of various products. Use the table to answer the questions.



The pH Scale

- a- Which substance is the most acidic? hydrochloric acid
- b- Which substance is neutral? water
- c- You would like to neutralize 40 mL of cabbage juice. You are told the only thing available to neutralize the cabbage juice is the milk of magnesia. Explain if you would use more than 40 mL, 40 mL exactly or less than 40 mL to neutralize the cabbage juice.



* ideally, 40 ml of a pH "9" solution

→ milk of magnesia has a pH > 9
∴ it is "stronger" than what is needed, so less of it would be used

$$\boxed{< 40 \text{ ml}}$$

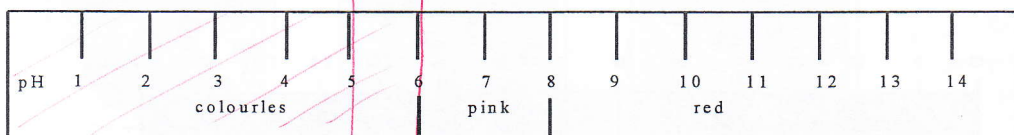
3. The following table gives the colours of four different indicators in solutions with pH values ranging from 0 to 14. Use the table to answer the following questions.

pH	1	3	5	7	9	11	13
Indicator 1	Red		Orange		Yellow		
Indicator 2	Blue		Green		Yellow		
Indicator 3	Red		Orange		Yellow		
Indicator 4	Colourless		Pink		Red		

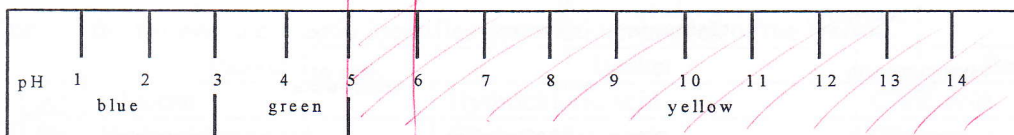
- a- What is the pH of an unknown solution if it turns yellow with indicator 1 and green with indicator 2? **8**
- b- If an unknown solution turned blue with indicator 2 and orange with indicator 3, what colour would indicator 4 become in this solution? **colourless**.

4. Terry has prepared colour charts for two indicators as shown below. Answer the questions using the chart.

Indicator 1



Indicator 2



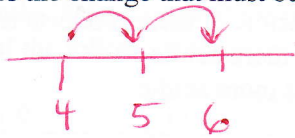
- a- Which indicator would allow you to more easily identify acids, bases and neutral solutions? **#1**
- b- What is the pH of a substance if it turned colourless when mixed with indicator 1 and yellow when mixed with indicator 2? **5**
- c- Using indicator 2, which colour gives you a result in the acidic, basic and neutral range?

yellow

5. The following table shows the colour of a universal indicator in solutions of varying pH values.

pH	Colour
0	red
1	red
2	red
3	red-orange
4	red-orange
5	orange
6	yellow
7	yellow-green
8	green
9	green-blue
10	blue
11	blue
12	blue
13	blue

- a) What colour would the indicator be in a very strong alkaline detergent? *blue*
 b) What colour would the indicator be in the weakest acidic drink? *yellow*
6. Corn grows best in soils with a pH of 6. When the soil pH is too low, the corn's growth is stunted. Alicia noticed that her corn crop is not growing well. She tests the pH of the soil and discovers that it has a pH of 4. Which of the following statements describes the change that must occur so that the corn has ideal growing conditions?
- A) Alicia must make the soil 100 times more acidic.
 B) Alicia must make the soil 100 times less acidic.
 C) Alicia must make the soil 2 times more acidic.
 D) Alicia must make the soil 2 times less acidic.
7. Following a chemical spill, the contaminated soil reaches a pH value of 12. After a few days, a neutralization process begins and a second test is conducted. Its results show that the pH of the soil has become 10 times more acidic. What is the pH value after the second test?
 A) pH= 1 B) pH= 7 C) pH= 9 D) pH= 11



8. In the laboratory, you are given two acid-base indicators and a colourless solution with an unknown pH.

pH	1	2	3	4	5	6	7	8	9	10	11	12	13
Indicator 1	Yellow		////		Green		Blue						
Indicator 2	Violet		Yellow		Red								

When you add a drop of each indicator to the colourless solution, it turns yellow.

What is the pH range of this solution?

- A) Between 1 and 4 B) Between 1 and 5 C) Between 3 and 4 D) Between 3 and 5
9. Place the substances listed below in increasing order of pH. *acid → base*
- Distilled water Soap Lemon juice Rainwater
- A) Distilled water – Soap – Lemon juice – Rainwater
 B) Lemon juice – Rainwater – Distilled water – Soap
 C) Soap – Lemon juice – Rainwater – Distilled water
 D) Lemon juice – Distilled water – Soap – Rainwater

10. Scientists discovered that a certain bacterium grew best in a slightly alkaline (basic) environment. The table below gives the pH value of each environment in which this bacteria was cultivated.

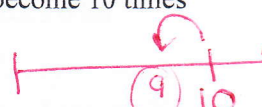
pH Values in the Environments Tested

Environment	pH
1	2.4
2	6.1
3	7.6
4	13.2

In which of these environments did this bacterium grow best?

- A) Environment 1 B) Environment 2 C) Environment 3 D) Environment 4
11. The pH of contaminated soil was 10. The soil was decontaminated using a neutralization process. After a few days, a second test is conducted. The results show that the pH of the soil has become 10 times more acidic. What is the new pH of the soil?

- A) pH= 1 B) pH= 7 C) pH= 9 D) pH= 11

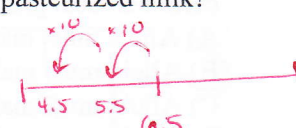


12. The most widely sold dairy products on the market are pasteurized milk, cheese and yogourt. The pH of each of these products is given below.

Dairy product	pH
Cheese	7.5
Pasteurized milk	6.5
Yogourt	4.5

The most acidic of these products is how many times more acidic than the pasteurized milk?

- A) 2 times more acidic C) 20 times more acidic
B) 10 times more acidic D) 100 times more acidic

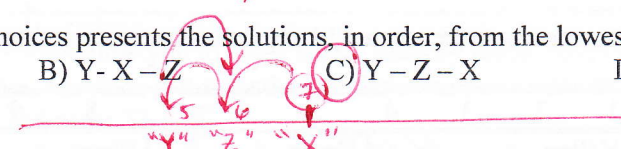


13. The table below provides information on the pH values of three solutions.

Solution X	Solution Y	Solution Z
pH 7	100 times more acidic than solution X	10 times more basic than solution Y

Which of the following choices presents the solutions, in order, from the lowest to the highest pH?

- A) X - Z - Y B) Y - X - Z C) Y - Z - X D) Z - X - Y



14. You find a bottle containing an unidentified liquid. By using universal indicator paper, you determine that the pH of this liquid is 11. 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 C) Add distilled water
B) Add a solution whose pH is 5 D) Add a solution whose pH is 8

add an acid.

15. Below is the colour chart for an indicator.

pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	violet red	clear red	orange red	orange	yellow orange	yellow	green	blue green	blue	violet blue	indigo blue	black	grey	white

Maria carries out the following experiment: she numbers four test tubes 1 to 4 and into each adds 2 mL of the following substances and two drops of the indicator.

EXPERIMENT		RESULTS
Test-tube	Substances	Colours
N° 1	2 mL of Drano solution	indigo-blue
N° 2	2 mL of vinegar	clear red
N° 3	2 mL of soft drink	orange
N° 4	2 mL of sodium bicarbonate solution	blue green

Which answer lists the order of the test tubes from least to most acidic?

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

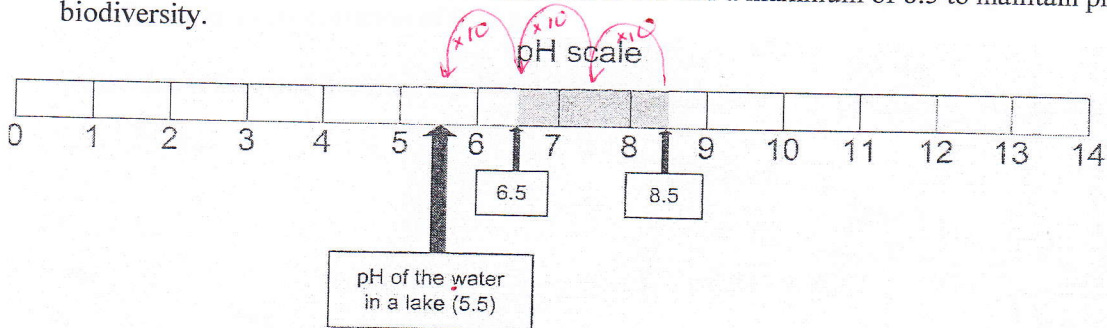
pH
 ↓
 11
 ↓
 2
 ↓
 4
 ↓
 8

16. The following table gives the colours of a universal indicator. A few drops of the indicator is added to a sample of solution. The solution turned purple. Which of the following correctly describes the solution?

pH	1	3	5	7	9	11	13
colour	red	orange	yellow	green	Turquoise	blue	Purple

- A) It is a strong basic solution
 B) It is a weak basic solution
 C) It is a strong acidic solution
 D) It is a weak acidic solution

17. The pH of lakes must be between a minimum of 6.5 and a maximum of 8.5 to maintain proper aquatic biodiversity.



Which of the statements below completes the following sentence correctly? If the pH of the water in a lake is 5.5, this pH ...

- A) Is 1000 times more acidic than the maximum acceptable pH.
 B) Is 30 times more acidic than the maximum acceptable pH.
 C) Is 3 times more acidic than the minimum acceptable pH.
 D) Is 1 time more acidic than the minimum acceptable pH.